Zowe Version 3.2 Documentation

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- Certificate configuration questionnaire
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    - Configuring your project
        - Gradle build automation system
        - Maven build automation system
    - Configuring your service
        - Service identification
        - Administrative endpoints
        - API info
        - API routing information
        - API Catalog information
        - Authentication parameters
        - API Security
        - SAF Keyring configuration
        - Eureka Discovery Service
        - Custom Metadata
    - Registering your service with API ML
    - Validating the discoverability of your API service by the Discovery Service

    - Troubleshooting
        - Log messages during registration problems
- API Mediation Layer onboarding configuration
    - Introduction
    - Configuring a REST service for API ML onboarding
    - Plain Java Enabler service onboarding API
        - Automatic initialization of the onboarding configuration by a single method call
    - Validating successful onboarding with API Mediation Layer
    - Loading YAML configuration files
        - Loading a single YAML configuration file
        - Loading and merging two YAML configuration files
- Onboarding a Spring Boot based REST API Service
    - Outline of onboarding a REST service using Spring Boot
    - Configuring your project
        - Gradle build automation system
        - Maven build automation system
    - Configuring your Spring Boot based service to onboard with API ML
        - Sample API ML Onboarding Configuration
        - Authentication properties
        - API ML Onboarding Configuration Sample
        - SAF Keyring configuration
        - Custom Metadata
    - Registering and unregistering your service with API ML
        - Unregistering your service with API ML
        - Basic routing
    - Adding API documentation
    - Validating the discoverability of your API service by the Discovery Service
    - Troubleshooting
        - Log messages during registration problems
- Onboarding a Micronaut based REST API service
    - Set up your build automation system
    - Configure the Micronaut application
        - Add API ML configuration
        - Add Micronaut configuration
        - (Optional) Set up logging configuration
    - Validate successful registration
- Onboarding a Node.js based REST API service
    - Introduction
    - Onboarding your Node.js service with API ML
    - Prerequisites
    - Installing the npm dependency
    - Configuring your service
    - Registering your service with API ML
    - Validating the discoverability of your API service by the Discovery Service
- Onboarding a Python based REST API service
    - Introduction
    - Prerequisites
    - Installing the Python dependency

    - Configuring your service
    - Registering your service with API ML
    - Validating the discoverability of your API service by the Discovery Service
- Onboarding a REST or GraphQL API without code changes required
    - Identify the APIs that you want to expose
    - Define your service and API in YAML format
    - Route your API
    - Customize configuration parameters
    - Add and validate the definition in the API Mediation Layer running on your machine
    - Add a definition in the API Mediation Layer in the Zowe runtime
    - (Optional) Check the log of the API Mediation Layer
    - (Optional) Reload the services definition after the update when the API Mediation Layer is already started
- Optional features to use with onboarded APIs
- Using API Mediation Layer Message Service
    - Message Definition
    - Creating a message
    - Mapping a message
        - API ML Logger
- Customizing Metadata (optional)
- API ML Routing Overview
    - Basic Routing
    - Deployments
        - Making a GET call to a service through single instance of API ML
            - A GET call to a service with a single version on a single instance
            - A GET call to a service with multiple versions on a single instance
            - GET calls to multiple instances of a service
        - A GET call to a service through multiple API Mediation Layer Instances
            - Same LPAR Multiple API Mediation Layer Instances
            - Different LPAR Multiple API Mediation Layer Instances
    - Advanced Configuration
- Understanding service routing through the Gateway
    - Routing with versioning
    - Routing without versioning
- Routing Websocket based APIs
    - Configure the service for Websockets
- Creating an Extension for API ML
    - Call the REST endpoint for validation
- Implementing a new SAF IDT provider
    - How to create a SAF IDT provider
    - How to integrate your extension with API ML
    - How to use the SAF IDT provider
    - How to use an existing SAF IDT provider
- Single Sign On Integration for Extenders
    - Accepting JWT
    - Accepting SAF IDT
    - Accepting PassTickets
    - Bypassing authentication for the service
    - Accepting client certificates via x509 scheme

- Accepting z/OSMF LTPA token
- Forwarding x509 client certificate
  - API ML Gateway Requirements
  - Downstream service requirements
- ZAAS Client
  - Pre-requisites
  - API Documentation
    - Obtain a JWT token (login)
    - Validate and get details from the token (query)
    - Validate the OIDC token (validateOidc)
    - Invalidate a JWT token (logout)
    - Obtain a PassTicket (passTicket)
  - Getting Started (Step by Step Instructions)
- Advanced Server Configuration
  - Configuration file
  - Environment variables (app-server only)
  - Parameter details
    - Configuration directories
      - Directories example
    - App configuration
      - Plug-ins directory example
    - Logging configuration
    - ZSS Configuration
      - Connecting ZSS to App Server
- Zowe Application Framework overview
  - How Zowe Application Framework works
  - Tutorials
  - Samples
    - Sample Iframe App
    - Sample Angular App
    - Sample React App
    - User Browser Workshop Starter App
- Plug-ins definition and structure
  - pluginDefinition.json
  - Application Plugin filesystem structure
    - Root files and directories
    - Dev and source content
      - nodeServer
      - webClient
    - Runtime content
      - lib
      - web
      - Packaging applications as compressed files
    - Default user configuration
    - App-to-App Communication
    - Documentation
  - Location of Plugin files
    - pluginsDir directory

- Application Dataservices
- Application Configuration Data
- Building plugin apps
  - Building web content
  - Building app server content
  - Building zss server content
  - Tagging plugin files on z/OS
  - Building Javascript content (*.js files)
  - Installing
  - Packaging
- Installing Plugins
  - By filesystem
    - Adding/Installing
    - Removing
    - Upgrading
    - Modifying without server restart (Exercise to the reader)
  - By REST API
    - Plugin management during development
      - Installing
      - Removing
- Embedding plugins
  - How to interact with embedded plugin
  - How to destroy embedded plugin
  - How to style a container for the embedded plugin
  - Applications that use embedding
- Dataservices
  - Defining dataservices
  - Schema
  - Defining Java dataservices
    - Prerequisites
    - Defining Java dataservices
    - Defining Java Application Server libraries
    - Java dataservice logging
    - Java dataservice limitations
  - Using dataservices with RBAC
  - Dataservice APIs
    - Router-based dataservices
      - HTTP/REST Router dataservices
      - WebSocket Router dataservices
      - Router dataservice context
      - Router storage API
    - ZSS based dataservices
      - HTTP/REST ZSS dataservices
      - ZSS dataservice context and structs
      - ZSS storage API
  - Documenting dataservices
- Authentication API
  - Handlers

        - Handler installation
        - Handler configuration
        - Handler context
        - Handler capabilities
        - Examples
        - High availability (HA)
    - REST API
        - Check status
    - Authenticate
    - User not authenticated or not authorized
        - Not authenticated
        - Not authorized
        - Refresh status
        - Logout
        - Password changes
- Internationalizing applications
    - Internationalizing Angular applications
    - Internationalizing React applications
    - Internationalizing application desktop titles
- Zowe Desktop and window management
    - Loading and presenting application plug-ins
    - Plug-in management
    - Application management
    - Windows and Viewports
    - Viewport Manager
    - Injection Manager
        - Plug-in definition
        - Logger
        - Launch Metadata
        - Viewport Events
        - Window Events
        - Window Actions
    - Framework API examples
- Configuration Dataservice
    - Resource Scope
    - REST API
        - REST query parameters
        - REST HTTP methods
            - GET
            - PUT
            - DELETE
        - Administrative access and group
    - Application API
    - Internal and bootstrapping
    - Packaging Defaults
    - Plug-in definition
    - Aggregation policies
    - Examples

- URI Broker
  - Accessing the URI Broker
    - Natively:
    - In an iframe:
  - Functions
    - Accessing an application plug-in's dataservices
      - HTTP Dataservice URI
      - Websocket Dataservice URI
    - Accessing application plug-in's configuration resources
      - Standard configuration access
      - Scoped configuration access
    - Accessing static content
    - Accessing the application plug-in's root
    - Server queries
      - Accessing a list of plug-ins
- Application-to-application communication
  - Why use application-to-application communication?
  - Actions
    - Action target modes
    - Action types
    - Loading actions
    - App2App via URL
      - Samples
    - Dynamically
    - Saved on system
  - Recognizers
    - Recognition clauses
    - Loading Recognizers at runtime
      - Dynamically
      - Saved on system
    - Recognizer example
  - Dispatcher
  - Registry
  - Pulling it all together in an example
- Configuring IFrame communication
- Error reporting UI
  - ZluxPopupManagerService
  - ZluxErrorSeverity
  - ErrorReportStruct
  - Implementation
    - Declaration
    - Usage
    - HTML
- Logging utility
  - Logging objects
  - Logger IDs
  - Accessing logger objects
    - Logger

        - App Server
        - Web
    - Component logger
        - App Server
- Logger API
- Component Logger API
- Log Levels
- Logging verbosity
    - Configuring logging verbosity
        - Server startup logging configuration
- Using log message IDs
    - Message ID logging examples
- Developing for Zowe CLI
    - How to contribute
    - Getting started
        - Contribution guidelines
        - Plug-in development overview
            - Imperative CLI Framework documentation
- Tutorials
- Setting up your development environment
    - Prerequisites
    - Initial setup
        - Clone and build your project
        - Optional step: Run automated tests
    - Next steps
- Installing the sample plug-in
    - Installing the sample plug-in to Zowe CLI
    - Viewing the installed plug-in
    - Using the installed plug-in
    - Testing the installed plug-in
    - Next steps
- Extending a plug-in
    - Overview
        - Creating a Typescript interface for the Typicode response data
        - Creating a programmatic API
            - Exporting the interface and programmatic API for other Node.js applications
        - Verify that you can build the programmatic API
        - Creating a command definition
            - Defining the syntax of your command
            - Adding a command to a command group
        - Creating a command handler
        - Verify that you can build your plug-in
    - Using the installed plug-in
    - Summary
    - Next steps
- Developing a new Zowe CLI plug-in
    - Overview
    - Setting up the new sample plug-in project

- Updating package.json
- Adjusting Imperative CLI Framework configuration
- Adding third-party packages
- Creating a Node.js client-side API
- Building your plug-in source
- Creating a Zowe CLI command
- Trying your command
- Bringing together new tools
- Next steps

- Implementing profiles in a plug-in
  - Editing the plug-in definition file
- Authentication mechanisms
- Creating plug-in lifecycle actions
  - Implementing lifecyle actions
- Extending Zowe Explorer
- Information roadmap for Zowe Client SDKs
  - Troubleshooting and support
  - Community resources
- Developing for Zowe SDKs
  - Contributing to Zowe Client SDKs
  - Community resources
- Troubleshooting Zowe
  - How to start troubleshooting
  - Known problems and solutions
    - Troubleshooting Zowe server-side components
    - Troubleshooting Zowe client-side components
  - Verifying a Zowe release's integrity
  - Understanding the Zowe release
- Understanding Zowe release versions
  - Zowe releases
    - Major release
      - Conformance programs
      - SMP/E builds
    - Minor release
    - Patch
- Checking your Zowe version release number
  - Server side
    - Using other commands
    - Using the manifest file
  - Client side
    - Zowe CLI
    - Zowe CLI plug-ins
    - Zowe Explorer for Visual Studio Code
    - Zowe Explorer for Visual Studio Code Extensions
    - Zowe Explorer plug-in for IntelliJ IDEA
- Gathering Information for Support or Troubleshooting
  - Describe your environment
    - Tips on gathering this information

        - z/OS release level
        - Zowe version
    - Describe your issue
    - Provide the logs
        - Enabling debugging and tracing
    - Screenshots
- Verify Zowe runtime directory
- Troubleshooting Kubernetes environments
    - ISSUE: Deployment and ReplicaSet failed to create pod
    - ISSUE: Failed to create services
- Diagnosing Return Codes
- Troubleshooting certificate configuration
    - PKCS12 server keystore generation fails in Java 8 SR7FP15, SR7 FP16, and SR7 FP20
    - Eureka request failed when using entrusted signed z/OSMF certificate
    - Zowe startup fails with empty password field in the keyring setup
    - Certificate error when using both an external certificate and Single Sign-On to deploy Zowe
    - Browser unable to connect due to a CIPHER error
    - API Components unable to handshake
    - Java z/OS components of Zowe unable to read certificates from keyring
    - Java z/OS components of Zowe cannot load the certificate private key pair from the keyring
    - Exception thrown when reading SAF keyring {ZWED0148E}
    - ZWEAM400E Error initializing SSL Context when using Java 11
    - Failed to load JCERACFKS keyring when using Java 11
- Troubleshooting startup of Zowe z/OS components
    - How to check if ZWESLSTC startup is successful
        - Check the startup of API Mediation Layer
        - Check the startup of Zowe Desktop
        - Check the startup of Zowe System Services
- Troubleshooting Zowe API Mediation Layer
    - Install API ML without Certificate Setup
    - Enable API ML Debug Mode
    - Change the Log Level of Individual Code Components
    - Gather atypical debug information
    - Services that are not running appear to be running
    - Debug and Fix Common Problems with SSL/TLS Setup
    - SDSF Job search fails
    - Known Issues with API ML
        - API ML stops accepting connections after z/OS TCP/IP stack is recycled
        - API ML throws I/O error on GET request and cannot connect to other services
        - SEC0002 error when logging in to API Catalog
            - Connection refused
            - Configure z/OSMF
            - Missing z/OSMF host name in subject alternative names
            - Secure fix
            - Insecure fix
            - Invalid z/OSMF host name in subject alternative names
            - Request a new certificate
            - Re-create the Zowe keystore

- Error Message Codes
  - API mediation utility messages
    - ZWEAM000I
    - ZWEAM001I
  - API mediation common messages
    - ZWEAO102E
    - ZWEAO104W
    - ZWEAO105W
    - ZWEAO106W
    - ZWEAO400E
    - ZWEAO401E
    - ZWEAO402E
    - ZWEAO404E
    - ZWEAO405E
    - ZWEAO415E
    - ZWEAO500E
    - ZWEAO503E
  - Common service core messages
    - ZWEAM100E
    - ZWEAM101E
    - ZWEAM102E
    - ZWEAM103E
    - ZWEAM104E
    - ZWEAG120E
    - ZWEAG140E
    - ZWEAG141E
    - ZWEAM400E
    - ZWEAM500W
    - ZWEAM501W
    - ZWEAM502E
    - ZWEAM503E
    - ZWEAM504E
    - ZWEAM505E
    - ZWEAM506E
    - ZWEAM507E
    - ZWEAM508E
    - ZWEAM509E
    - ZWEAM510E
    - ZWEAM511E
    - ZWEAM600W
    - ZWEAM700E
    - ZWEAM701E
  - Security common messages
    - ZWEAT100E
    - ZWEAT103E
    - ZWEAT403E
    - ZWEAT409E
    - ZWEAT410E

- ZWEAT411E
- ZWEAT412E
- ZWEAT413E
- ZWEAT414E
- ZWEAT415E
- ZWEAT416E
- ZWEAT500E
- ZWEAT501E
- ZWEAT502E
- ZWEAT503E
- ZWEAT504E
- ZWEAT601E
- ZWEAT602E
- ZWEAT603E
- ZWEAT604E
- ZWEAT605E
- ZWEAT606E
- ZWEAT608E
- ZWEAT609W
- ZWEAT610E

- Security client messages
  - ZWEAS100E
  - ZWEAS101E
  - ZWEAS103E
  - ZWEAS104E
  - ZWEAS105E
  - ZWEAS120E
  - ZWEAS121E
  - ZWEAS123E
  - ZWEAS130E
  - ZWEAS131E
- ZAAS client messages
  - ZWEAS100E
  - ZWEAS120E
  - ZWEAS121E
  - ZWEAS122E
  - ZWEAS170E
  - ZWEAS400E
  - ZWEAS401E
  - ZWEAS404E
  - ZWEAS417E
  - ZWEAS130E
  - ZWEAS500E
  - ZWEAS501E
  - ZWEAS502E
  - ZWEAS503E
  - ZWEAS504E
- Discovery service messages

    - ZWEAD400E
    - ZWEAD401E
    - ZWEAD700W
    - ZWEAD701E
    - ZWEAD702W
    - ZWEAD703E
    - ZWEAD704E
  - Gateway service messages
    - ZWEAG111E
    - ZWEAG501E
    - ZWEAG701E
    - ZWEAG702E
    - ZWEAG717E
    - ZWEAG718E
    - ZWEAG719I
    - ZWEAG101E
    - ZWEAG105E
    - ZWEAG167E
    - ZWEAM400E
    - ZWEAT403E
    - ZWEAG510E
    - ZWESG100W
    - ZWESG101E
    - ZWESG429E
  - API Catalog messages
    - ZWEAC100W
    - ZWEAC101E
    - ZWEAC102E
    - ZWEAC103E
    - ZWEAC104E
    - ZWEAC105W
    - ZWEAC106E
    - ZWEAC700E
    - ZWEAC701W
    - ZWEAC702E
    - ZWEAC703E
    - ZWEAC704E
    - ZWEAC705W
    - ZWEAC706E
    - ZWEAC707E
    - ZWEAC708E
    - ZWEAC709E
- Troubleshooting Zowe Application Framework
  - Desktop apps fail to load
  - NODEJSAPP disables immediately
  - Cannot log in to the Zowe Desktop
    - ZSS server unable to communicate with ZIS
    - Application Framework unable to communicate with zssServer

    - Slow performance of the VT terminal on SSH
    - Application Framework unable to communicate with API Mediation Layer
  - Server startup problem ret=1115
  - Server error EACCESS on z/os
  - Application plug-in not in Zowe Desktop
  - Error: You must specify MVD_DESKTOP_DIR in your environment
  - Error: Exception thrown when reading SAF keyring {ZWED0148E}
  - Warning: Problem making eureka request { Error: connect ECONNREFUSED }
  - Warning: Zowe extensions access to ZSS security endpoints fail
  - Fail when launching MVS, USS, and JES Explorers
- Gathering information to troubleshoot Zowe Application Framework
  - Basic information
  - Javascript console output
- Raising a Zowe Application Framework issue on GitHub
- Enabling tracing
  - Basic debugging
  - Advanced debugging for App Server
  - Advanced debugging for ZSS
- App-server Return Codes
- App-server Error Message Codes
  - App-server informational messages
    - ZWED0020I
    - ZWED0021I
    - ZWED0022I
    - ZWED0023I
    - ZWED0024I
    - ZWED0025I
    - ZWED0026I
    - ZWED0027I
    - ZWED0028I
    - ZWED0029I
    - ZWED0031I
    - ZWED0033I
    - ZWED0036I
    - ZWED0037I
    - ZWED0038I
    - ZWED0039I
    - ZWED0040I
    - ZWED0041I
    - ZWED0042I
    - ZWED0043I
    - ZWED0044I
    - ZWED0045I
    - ZWED0046I
    - ZWED0047I
    - ZWED0048I
    - ZWED0049I
    - ZWED0050I

- ZWED0052I
- ZWED0053I
- ZWED0054I
- ZWED0055I
- ZWED0056I
- ZWED0059I
- ZWED0062I
- ZWED0064I
- ZWED0066I
- ZWED0067I
- ZWED0070I
- ZWED0072I
- ZWED0086I
- ZWED0087I
- ZWED0090I
- ZWED0091I
- ZWED0092I
- ZWED0093I
- ZWED0094I
- ZWED0095I
- ZWED0096I
- ZWED0109I
- ZWED0110I
- ZWED0111I
- ZWED0112I
- ZWED0114I
- ZWED0115I
- ZWED0116I
- ZWED0117I
- ZWED0118I
- ZWED0119I
- ZWED0120I
- ZWED0124I
- ZWED0125I
- ZWED0129I
- ZWED0130I
- ZWED0154I
- ZWED0158I
- ZWED0159E
- ZWED0160I
- ZWED0205I
- ZWED0211I
- ZWED0212I
- ZWED0213I
- ZWED0214I
- ZWED0287I
- ZWED0290I
- ZWED0292I

- ZWED0294I
- ZWED0295I
- ZWED0299I
- ZWED0300I
- ZWED0301I
- ZWED0302I

- App-server warning messages
  - ZWED0004W
  - ZWED0006W
  - ZWED0007W
  - ZWED0008W
  - ZWED0013W
  - ZWED0014W
  - ZWED0015W
  - ZWED0016W
  - ZWED0017W
  - ZWED0018W
  - ZWED0019W
  - ZWED0020W
  - ZWED0021W
  - ZWED0027W
  - ZWED0028W
  - ZWED0029W
  - ZWED0030W
  - ZWED0032W
  - ZWED0033W
  - ZWED0034W
  - ZWED0035W
  - ZWED0036W
  - ZWED0037W
  - ZWED0038W
  - ZWED0039W
  - ZWED0040W
  - ZWED0041W
  - ZWED0042W
  - ZWED0043W
  - ZWED0044W
  - ZWED0045W
  - ZWED0046W
  - ZWED0048W
  - ZWED0049W"
  - ZWED0051W
  - ZWED0052W
  - ZWED0053W
  - ZWED0054W
  - ZWED0055W
  - ZWED0056W
  - ZWED0057W

- ZWED0058W
- ZWED0059W
- ZWED0060W
- ZWED0061W
- ZWED0062W
- ZWED0063W
- ZWED0064W
- ZWED0065W
- ZWED0066W
- ZWED0068W
- ZWED0069W
- ZWED0070W
- ZWED0071W
- ZWED0072W
- ZWED0073W
- ZWED0074W
- ZWED0075W
- ZWED0076W
- ZWED0077W
- ZWED0078W
- ZWED0079W
- ZWED0080W
- ZWED0081W
- ZWED0082W
- ZWED0083W
- ZWED0084W
- ZWED0085W
- ZWED0086W
- ZWED0087W
- ZWED0146W
- ZWED0148W
- ZWED0149W
- ZWED0150W
- ZWED0151W
- ZWED0152W
- ZWED0153W
- ZWED0154W
- ZWED0155W
- ZWED0156W
- ZWED0157W
- ZWED0158W
- ZWED0159W
- ZWED0166W
- ZWED0167W
- ZWED0168W
- ZWED0169W
- ZWED0170W
- ZWED0171W

- ZWED0172W
- ZWED0173W
- ZWED0174W
- ZWED0175W
- ZWED0177W
- ZWED0178W
- ZWED0179W
- App-server error messages
  - ZWED0001E
  - ZWED0002E
  - ZWED0003E
  - ZWED0004E
  - ZWED0005E
  - ZWED0006E
  - ZWED0007E
  - ZWED0008E
  - ZWED0009E
  - ZWED0010E
  - ZWED0011E
  - ZWED0012E
  - ZWED0013E
  - ZWED0014E
  - ZWED0015E
  - ZWED0016E
  - ZWED0017E
  - ZWED0018E
  - ZWED0019E
  - ZWED0020E
  - ZWED0021E
  - ZWED0022E
  - ZWED0023E
  - ZWED0024E
  - ZWED0025E
  - ZWED0026E
  - ZWED0027E
  - ZWED0028E
  - ZWED0038E
  - ZWED0039E
  - ZWED0040E
  - ZWED0041E
  - ZWED0042E
  - ZWED0043E
  - ZWED0044E
  - ZWED0045E
  - ZWED0046E
  - ZWED0047E
  - ZWED0049E
  - ZWED0050E

        - ZWED0051E
        - ZWED0052E
        - ZWED0053E
        - ZWED0111E
        - ZWED0112E
        - ZWED0113E
        - ZWED0114E
        - ZWED0115E
        - ZWED0145E
        - ZWED0146E
        - ZWED0147E
        - ZWED0148E
        - ZWED0149E
        - ZWED0150E
        - ZWED0151E
        - ZWED0152E
        - ZWED0153E
        - ZWED0154E
        - ZWED0155E
        - ZWED0156E
        - ZWED0157E
        - ZWED0158E
- ZSS Error Message Codes
    - ZSS informational messages
        - ZWES1007I
        - ZWES1008I
        - ZWES1010I
        - ZWES1013I
        - ZWES1014I
        - ZWES1035I
        - ZWES1038I
        - ZWES1039I
        - ZWES1061I
        - ZWES1063I
        - ZWES1064I
        - ZWES1100I
        - ZWES1101I
        - ZWES1102I
        - ZWES1600I
        - ZWES1601I
    - ZSS error messages
        - ZWES1001E
        - ZWES1002E
        - ZWES1006E
        - ZWES1011E
        - ZWES1016E
        - ZWES1017E
        - ZWES1020E

    - ZWES1021E
    - ZWES1022E
    - ZWES1034E
    - ZWES1036E
    - ZWES1037E
    - ZWES1065E
    - ZWES1500E
  - ZSS warning messages
    - ZWES1000W
    - ZWES1004W
    - ZWES1005W
    - ZWES1009W
    - ZWES1012W
    - ZWES1060W
    - ZWES1103W
    - ZWES1200W
    - ZWES1201W
    - ZWES1202W
    - ZWES1103W
    - ZWES1200W
    - ZWES1202W
    - ZWES1400W
    - ZWES1401W
    - ZWES1402W
    - ZWES1403W
    - ZWES1404W
    - ZWES1406W
    - ZWES1407W
    - ZWES1408W
    - ZWES1409W
    - ZWES1410W
    - ZWES1411W
    - ZWES1412W
    - ZWES1413W
    - ZWES1414W
    - ZWES1415W
    - ZWES1416W
    - ZWES1417W
    - ZWES1418W
    - ZWES1419W
    - ZWES1602W
    - ZWES1603W
    - ZWES1604W
    - ZWES1605W
    - ZWES1606W
    - ZWES0054E
- ZIS Error Message Codes
  - ZIS cross-memory server messages

- ZWES0001I
- ZWES0002I
- ZWES0003I
- ZWES0004I
- ZWES0005E
- ZWES0006E
- ZWES0007E
- ZWES0008E
- ZWES0009E
- ZWES0010E
- ZWES0011E
- ZWES0012I
- ZWES0013E
- ZWES0014E
- ZWES0015E
- ZWES0016I
- ZWES0017W
- ZWES0018W
- ZWES0019W
- ZWES0020E
- ZWES0021E
- ZWES0098I
- ZWES0099I
- ZIS Auxiliary Server messages
  - ZWES0050I
  - ZWES0051I
  - ZWES0052I
  - ZWES0053E
  - ZWES0054E
  - ZWES0055E
  - ZWES0056E
  - ZWES0057E
  - ZWES0058E
  - ZWES0059E
  - ZWES0060E
  - ZWES0061E
  - ZWES0062E
  - ZWES0063E
  - ZWES0064W
  - ZWES0065W
  - ZWES0066E
  - ZWES0067E
  - ZWES0068W
  - ZWES0069W
  - ZWES0070I
  - ZWES0071I
  - ZWES0072I
  - ZWES0073I

- ZWES0074W
- ZWES0075W
- ZWES0076W
- ZWES0077W
- ZWES0078I
- ZWES0079I
- ZWES0080I
- ZWES0081E
- ZWES0082W
- Core cross-memory server messages
  - ZWES0100I
  - ZWES0101I
  - ZWES0102E
  - ZWES0103I
  - ZWES0104I
  - ZWES0105I
  - ZWES0106E
  - ZWES0107I
  - ZWES0108W
  - ZWES0109I
  - ZWES0110E
  - ZWES0111I
  - ZWES0112E
  - ZWES0113I
  - ZWES0114I
  - ZWES0115E
  - ZWES0116E
  - ZWES0117E
  - ZWES0118E
  - ZWES0200I
  - ZWES0201E
  - ZWES0202E
  - ZWES0203E
  - ZWES0204E
  - ZWES0205E
  - ZWES0206E
  - ZWES0207E
  - ZWES0208E
  - ZWES0209E
  - ZWES0210W
  - ZWES0211E
  - ZWES0212E
  - ZWES0213E
  - ZWES0214E
  - ZWES0215E
  - ZWES0216E
  - ZWES0217E
  - ZWES0218E

- ZWES0219E
- ZWES0220I
- ZWES0221I
- ZWES0222I
- ZWES0223I
- ZWES0224W
- ZWES0225W
- ZWES0226W
- ZWES0227W
- ZWES0228W
- ZWES0229W
- ZWES0230W
- ZWES0231E
- ZWES0232E
- ZWES0233E
- ZWES0234E
- ZWES0235E
- ZWES0236E
- ZWES0237E
- ZWES0238E
- ZWES0239E
- ZWES0240W
- ZWES0241E
- ZWES0242W
- ZWES0243W
- ZWES0244E
- ZWES0245E
- ZWES0246E
- ZWES0247W
- ZWES0248W
- ZWES0249E
- ZWES0250E
- ZWES0251I
- ZWES0252I
- ZWES0253I
- ZWES0254W
- ZWES0255E
- ZWES0256I
- ZWES0257W

- ZIS Dynamic Linkage Base plug-in messages
  - ZWES0700I
  - ZWES0701I
  - ZWES0702E
  - ZWES0703E
  - ZWES0704I
  - ZWES0705I
  - ZWES0706E
  - ZWES0707I

    - ZWES0708I
    - ZWES0710I
    - ZWES0711I
    - ZWES0712W
    - ZWES0713W
    - ZWES0714E
- Troubleshooting Zowe Launcher
    - Enable Zowe Launcher Debug Mode
- Error Message Codes
    - Zowe Launcher informational messages
        - ZWEL0001I
        - ZWEL0002I
        - ZWEL0003I
        - ZWEL0004I
        - ZWEL0005I
        - ZWEL0006I
        - ZWEL0007I
        - ZWEL0008I
        - ZWEL0009I
        - ZWEL0010I
        - ZWEL0011I
        - ZWEL0012I
        - ZWEL0013I
        - ZWEL0014I
        - ZWEL0015I
        - ZWEL0016I
        - ZWEL0017I
        - ZWEL0018I
        - ZWEL0019I
        - ZWEL0021I
        - ZWEL0022I
        - ZWEL0023I
        - ZWEL0024I
        - ZWEL0025I
        - ZWEL0058I
        - ZWEL0069I
    - Zowe Launcher error messages
        - ZWEL0026E
        - ZWEL0027E
        - ZWEL0028E
        - ZWEL0029E
        - ZWEL0030E
        - ZWEL0031E
        - ZWEL0032E
        - ZWEL0033E
        - ZWEL0034E
        - ZWEL0035E
        - ZWEL0036E

        - ZWEL0037E
        - ZWEL0038E
        - ZWEL0039E
        - ZWEL0040E
        - ZWEL0041E
        - ZWEL0042E
        - ZWEL0043E
        - ZWEL0044E
        - ZWEL0045E
        - ZWEL0046E
        - ZWEL0047E
        - ZWEL0048E
        - ZWEL0049E
        - ZWEL0050E
        - ZWEL0055E
        - ZWEL0056E
        - ZWEL0057E
        - ZWEL0059E
        - ZWEL0060E
        - ZWEL0061E
        - ZWEL0062E
        - ZWEL0064E
        - ZWEL0065E
        - ZWEL0067E
        - ZWEL0068E
        - ZWEL0070E
        - ZWEL0071E
        - ZWEL0072E
        - ZWEL0073E
        - ZWEL0074E
    - Zowe Launcher warning messages
        - ZWEL0051W
        - ZWEL0052W
        - ZWEL0053W
        - ZWEL0054W
        - ZWEL0063W
        - ZWEL0066W
- Troubleshooting Zowe CLI
    - When there is a problem
        - Applicable environments
        - Reaching out for support
        - Resolving the problem
- Gathering information to troubleshoot Zowe CLI
    - Generating a working environment report
    - Finding configuration file properties and locations
    - Finding configuration file locations
    - Finding property values used by a Zowe command
- Using individual commands for Zowe CLI troubleshooting

- Identify the currently installed CLI version
- Identify the currently installed versions of plug-ins
- Environment variables
  - Log levels
  - CLI daemon mode
  - Home directory
- Home directory structure
  - Location and types of logs
- Node.js and npm
  - npm configuration
  - npm log files
- Using cURL to troubleshoot Zowe CLI
  - Installing cURL
  - Understanding cURL commands
    - --location
    - --request <API method>
    - "https://<host>:<port>/<API>"
    - --header "X-CSRF-ZOSMF-HEADER;"
    - --insecure
    - --user "<ID>:<PASSWORD>"
  - Comparing commands
    - z/OSMF Info API
      - Submitting the cURL command:
      - Submitting the Zowe CLI command:
    - z/OSMF Files API
      - Submitting the cURL command:
      - Submitting the Zowe CLI command:
    - z/OSMF Jobs API
      - Submitting the cURL command:
      - Submitting the Zowe CLI command:
- z/OSMF troubleshooting
  - Alternate methods
- Troubleshooting Zowe CLI credentials
  - Secure credentials
    - Authentication mechanisms
    - PEM certificate files
- Known Zowe CLI issues
  - Zowe commands fail with secure credential errors
  - Chain commands fail in a batch script
  - Command not found message displays when issuing npm install commands
  - EACCESS error when issuing npm install command
  - Installation fails on Oracle Linux 6
  - Node.js commands do not respond as expected
  - npm install -g command fails due to an EPERM error
  - Paths converting in Git Bash
  - Sudo syntax required to complete some installations
  - Missing data set search results with --mainframe-search option
  - Error message with PowerShell scripts

- Raising a CLI issue on GitHub
  - Raising a bug report
  - Raising an enhancement report
- Troubleshooting Zowe CLI plug-ins
  - When there is a problem
    - Error codes
    - Reaching out for support
- IBM Db2 Database Plug-in troubleshooting
  - Incompatible glibc version
  - ODBC driver install failure
    - Timeout error
    - Unpacking error
- Troubleshooting Zowe Explorer
  - Before reaching out for support
  - Connection issues with Zowe Explorer
  - Resolving invalid profiles
  - Missing write access to VS Code extensions folder
- Known Zowe Explorer issues
  - Bidirectional languages
  - Client certificate support
  - Data Set creation error
  - Opening binary files error
  - Visual Studio Code mainframe connection error
- Known Zowe Explorer limitations
  - Data set pagination and descending sort for PDS members
    - Limitation
    - Workarounds
  - Mismatched credentials when using Zowe Explorer and Zowe CLI
    - Limitation
    - Workaround
- Raising a Zowe Explorer issue on GitHub
  - Raising a bug report
  - Submitting a feature request
- Troubleshooting Zowe Explorer plug-in for IntelliJ IDEA
  - Troubleshooting IntelliJ IDEA platform issues
  - Troubleshooting the plug-in
- Troubleshooting Zowe Chat
  - Check the chatServer.log
  - Raising a Zowe Chat issue on GitHub
  - Contacting support via Slack
- Contributing to Zowe
  - Report bugs and enhancements
  - Fix issues
  - Send a Pull Request
  - Report security issues
  - Contribution guidelines
  - Promote Zowe
  - Helpful resources

- Code categories
  - Programming languages
  - Component-specific guidelines and tutorials
- General code style guidelines
  - Whitespaces
  - Naming Conventions
    - Functions and methods
    - Variables
- Pull requests guidelines
- Documentation Guidelines
  - Contributing to external documentation
  - Component Categories
    - Server Core
    - Server Security
    - Microservices
    - Zowe Desktop Applications
    - Web Framework
    - CLI Plugins
    - Core CLI Imperative CLI Framework
  - Programming Languages
    - Typescript
    - Java
    - C
- UI Guidelines
  - Introduction
  - Clear
  - Consistent
  - Smart
- Colors
  - Color palette
    - Light theme
    - Dark theme
  - Color contrast | WCAG AA standards
- Typography
  - Typeface
  - Font weight
  - Body copy
  - Line scale
  - Line-height
  - Embed font
  - Import font
  - Specify in CSS
- Grid
  - 12 column grid
  - Gutters
  - Columns
  - Margins
- Iconography

- Application icon
  - General rules
  - Shape, size, and composition
  - Colors and shades
    - Verify the contrast
    - Use the Zowe palette
    - Layer Shadows
    - Use the long shadow for consistency.
- Contributing to Zowe Documentation
  - Before You Get Started
  - Getting started checklist
  - The Zowe documentation repository
  - Sending a GitHub Pull Request
  - Opening an issue for Zowe documentation
  - Documentation style guide
    - Headings and titles
      - Use sentence-style capitalization for headings
      - For tasks and procedures, use gerunds for headings
      - For conceptual and reference information, use noun phrases for headings
      - Use headline-style capitalization for only these items
    - Technical elements
      - Variables
      - Message text and prompts to the user
      - Code and code examples
      - Command names, and names of macros, programs, and utilities that you can type as commands
      - Interface controls
      - Directory names
      - File names, file extensions, and script names
      - Search or query terms
      - Citations that are not links
    - Tone
      - Use simple present tense rather than future or past tense, as much as possible
      - Use simple past tense if past tense is needed
      - Use active voice as much as possible
      - Using second person such as "you" instead of first person such as "we" and "our"
      - End sentences with prepositions selectively
      - Avoid anthropomorphism
      - Avoid complex sentences that overuse punctuation such as commas and semicolons.
    - Release notes
    - Word usage and punctuation
      - Admonitions
      - Use of "following"
      - Use a consistent style for referring to version numbers
      - Avoid "may"
      - Use "issue" when you want to say "run"/"enter" a command
      - Use of slashes
      - Punctuation in lists
      - Punctuation in numbered lists

    - Abbreviations
        - Do not use an abbreviation as a noun unless the sentence makes sense when you substitute the spelled-out form of the term
        - Do not use abbreviations as verbs
        - Do not use Latin abbreviations
        - Spell out the full name and its abbreviation when the word appears for the first time. Use abbreviations in the texts that follow
    - Structure and format
    - Word usage
- Zowe CLI command reference guide
- Zowe YAML server configuration file reference
    - High-level overview of YAML configuration file
    - Extract sharable configuration out of zowe.yaml
    - Creating portable references
    - Configuration override - defaults.yaml
    - Configuration override - inside zowe.yaml
    - YAML configurations - certificate
    - YAML configurations - zowe
        - Directories
        - Zowe Job
        - Domain and port to access Zowe
        - Extra environment variables
        - Certificate
        - Launcher and launch scripts
        - Setup
    - YAML configurations - java
    - YAML configurations - node
    - YAML configurations - zOSMF
    - YAML configurations - components
        - Configure component gateway
        - Configure component discovery
        - Configure component api-catalog
        - Configure component Caching Service
        - Configure component app-server
        - Configure component zss
        - Configure external extension
    - YAML configurations - haInstances
    - Auto-generated environment variables
    - Troubleshooting your YAML with the Red Hat VS Code extension
- ZWE Server Command Reference
    - Using the zwe command
    - Accessing zwe help
- zwe
    - Sub-commands
    - Description
    - Examples
    - Parameters
    - Errors

- zwe certificate keyring-jcl clean
  - Description
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe certificate keyring-jcl connect
  - Description
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe certificate keyring-jcl generate
  - Description
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe certificate keyring-jcl import-ds
  - Description
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe certificate keyring-jcl
  - Sub-commands
  - Description
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe certificate pkcs12 create ca
  - Description
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors

    - Inherited from parent command
- zwe certificate pkcs12 create cert
    - Description
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe certificate pkcs12 create
    - Sub-commands
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe certificate pkcs12 export
    - Description
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe certificate pkcs12 import
    - Description
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe certificate pkcs12 lock
    - Description
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe certificate pkcs12 trust-service
    - Description
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors

    - Inherited from parent command
- zwe certificate pkcs12
    - Sub-commands
    - Description
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe certificate verify-service
    - Description
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe certificate
    - Sub-commands
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe components install extract
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe components install process-hook
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe components install
    - Sub-commands
    - Description
    - Examples
    - Parameters only for this command
    - Parameters
        - Inherited from parent command
    - Errors

    - Inherited from parent command
- zwe components disable
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe components enable
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe components search
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe components uninstall
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe components upgrade
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe components
    - Sub-commands
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe config get
    - Description
    - Examples
    - Parameters
        - Inherited from parent command

    - Errors
        - Inherited from parent command
- zwe config validate
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe config
    - Sub-commands
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe init apfauth
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe init certificate
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe init mvs
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe init security
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe init stc
    - Description
    - Examples
    - Parameters
        - Inherited from parent command

    - Errors
        - Inherited from parent command
- zwe init vsam
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe init
    - Sub-commands
    - Description
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe internal config get
    - Description
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe internal config output
    - Description
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe internal config set
    - Description
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors
        - Inherited from parent command
- zwe internal config
    - Sub-commands
        - Inherited from parent command
    - Examples
    - Parameters
        - Inherited from parent command
    - Errors

    - Inherited from parent command
- zwe internal container cleanup
  - Description
    - Inherited from parent command
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe internal container init
  - Description
    - Inherited from parent command
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe internal container prestop
  - Description
    - Inherited from parent command
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe internal container
  - Sub-commands
  - Description
    - Inherited from parent command
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe internal start component
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe internal start prepare
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe internal start
  - Sub-commands
    - Inherited from parent command
  - Examples

- Parameters
  - Inherited from parent command
- Errors
  - Inherited from parent command
- zwe internal get-launch-components
  - Description
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe internal
  - Sub-commands
  - Description
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe migrate for kubernetes
  - Description
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe migrate for
  - Sub-commands
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe migrate
  - Sub-commands
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe sample sub deep
  - Description
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe sample sub second
  - Description

    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe sample sub
  - Sub-commands
  - Description
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe sample test
  - Description
    - Inherited from parent command
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe sample
  - Sub-commands
  - Description
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe support verify-fingerprints
  - Description
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe support
  - Sub-commands
  - Description
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe diagnose
  - Description
  - Examples

- Parameters
  - Inherited from parent command
- Errors
  - Inherited from parent command
- zwe install
  - Description
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe start
  - Description
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe stop
  - Description
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- zwe version
  - Description
  - Examples
  - Parameters
    - Inherited from parent command
  - Errors
    - Inherited from parent command
- Bill of Materials

Version: v3.2.x LTS

Zowe announcements

Hello Zowe V3!

Zowe Version 3.x is live. Find out what is included in Zowe 3.x with the new Zowe V3 Office Hours.

For information about changes to Zowe components introduced in Zowe V3, see Important updates in Zowe V3. For more details, review the Zowe V3 release notes.

Got questions? Check the Zowe V3 FAQs to see if it is already answered.

Future Zowe V2 releases

Zowe 2.0.x is now in maintenance state. Only patch releases are planned until the Zowe V2 End of Service scheduled for early 2027.

Archiving Zowe Version 1.0

Zowe V1 was scheduled to end support on September 30, 2024. Consumers should plan to upgrade in the first or second quarter of the 2024 calendar year.

Version: v3.2.x LTS

Release Notes

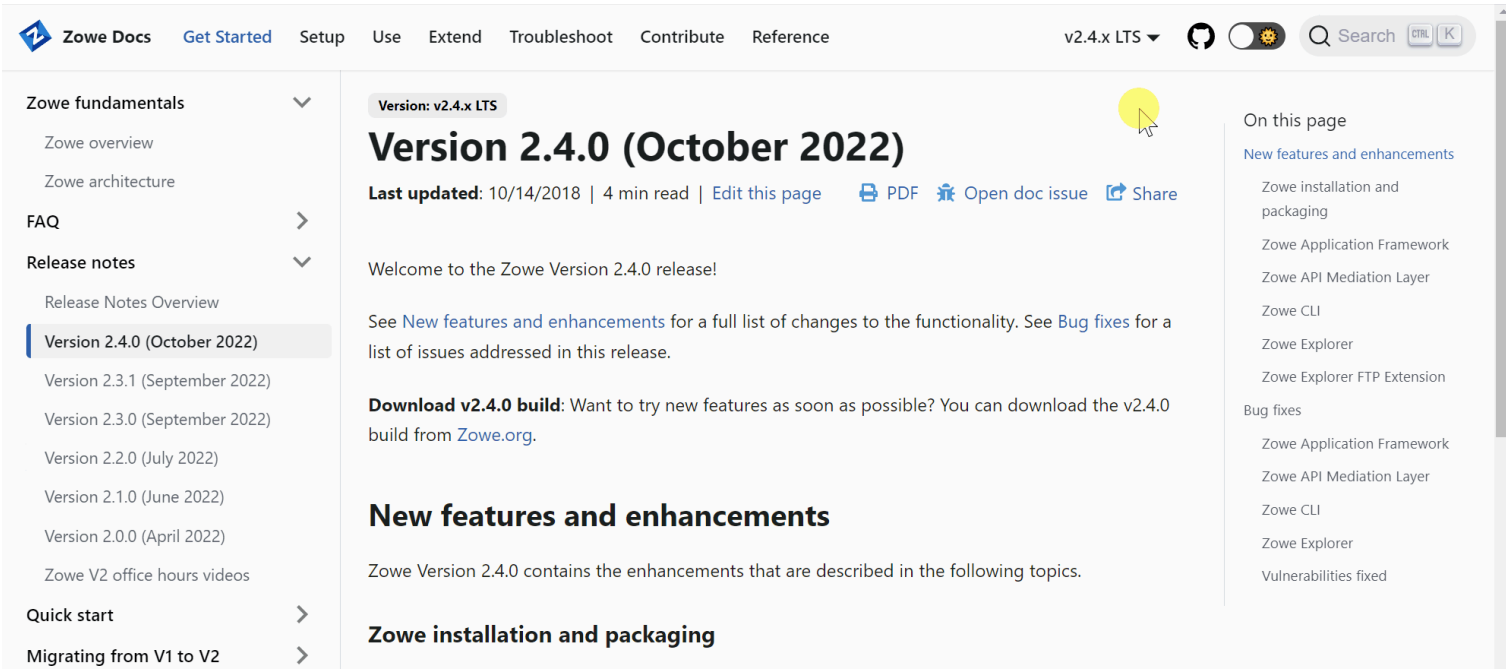
The release notes for all Zowe V2 minor releases are published in this section.

Release notes detail all the new features, enhancements, bug fixes, and security vulnerabilities fixed in a particular Zowe minor release.

Select a Zowe release version on the **Table of Contents** located on the left of the page to view its release notes.

Accessing older release notes

To access notes for an older release, go to the **Zowe Docs Version** dropdown menu at the top right of the page and select a release. The release notes for the selected version display under the **Release Notes** section in the **Table of Contents**.



Version: v3.2.x LTS

Version 3.2.0 (May 2025)

Welcome to the Zowe Version 3.2.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v3.2.0 build: Want to try new features as soon as possible? You can download the v3.2.0 build from Zowe.org.

New features and enhancements

Zowe Version 3.2.0 contains the enhancements that are described in the following topics.

Server Install

- Added an enhancement so that the `zwe` support command collects more environment details. (#4147)
- Added an enhancement in the form of a new library function named `formatZosVersion()` in zosUtils to standardize the formatting of z/OS versions during installation checks. (#4134)
- Added an enhancement so that when you run the `zwe support verify-fingerprints` command, you no longer have to specify a configuration file, such as `zowe.yaml`, as a command-line parameter. (#4147)

Zowe Application Framework

- Added an enhancement to compress the size of assets within the Zowe v3 Desktop so that the Desktop loads faster despite a slow internet connection. The enhancement increases the speed of loading the desktop. (#658)
- Added an enhancement to validate certificate properties on startup, ensuring a secure and valid configuration. (#338)

ZSS

- Added a new feature with a `MODIFY` command to display module registry information. Users can use the information to easily monitor, troubleshoot, and manage the current state of registered modules. (#519)
- Added a feature to reset the module registry at cross-memory server startup, ensuring a clean and consistent environment for the server's operation by clearing outdated data and reducing the risk of errors caused by stale module configurations. (#754)
- Added an enhancement to include the stub version in the generated HLASM stub, enabling improved version tracking and compatibility. (#743)
- Added an enhancement to expose new `cmutils` functions, providing additional capabilities for managing and interacting with system components. (#740)
- Added support for passing multiple parameters to Zowe Integration Server (ZIS) via the `START` command. This is an enhancement on its own, all it means is there is more flexibility available for configuration at start up. The `START` command is mostly run from a terminal window or CLI on the system where Zowe is installed. (#753), (#755)
- Added a parameter to reset the module registry at ZIS startup, preventing issues with outdated or conflicting module data. (#519)

- Added an enhancement to make the `modregReset` function available through dynlink, enabling dynamic linking for module registry resets. (#754)

Zowe API Mediation Layer

- Users can now configure the connect and read timeout for the Eureka HTTP client. (#4045)
- Zowe now supports API ML components that were built on Java 17 compatibility level to run using Java 21. (#4028)

Zowe CLI

Zowe CLI (Core)

- Search data sets with regex patterns by passing the new `--regex` option into the search command. (#2432)
- Overwrite all members of a target data set with source data set members by including the new `overwrite` flag with the `zowe files copy ds` command. (#2450)
- See secure properties when issuing the `zowe config list` command when the `ZOWE_SHOW_SECURE_ARGS` environment variable is set to `true`. (#2259)
- Create extended and large formatted sequential data sets by adding the new `--data-set-type` flag to the `zowe files create ps` command. (#2141)
- Select a specific range of records to output from a spool file with the new `--recordRange` flag for the `zowe jobs download output` command. (#2411)
- The `zowe zos-files copy data-set` command no longer requires the target data set to be preallocated. (#2349)

Zowe CLI Imperative Framework

- Added a line to the output to display the authentication type when using the `--show-inputs-only` option. (#2462)
- A Web Help favicon now displays in browser tabs. (#801)
- Allowed instances of the `ProfileCredentials` class to check only for the active layer to determine if the user's credentials are secure. (#2460)
- Consolidated all sensitive data hiding logic into the `Censor` class. (#2424)
- Added the `showSecureArgs` environment variable to the `EnvironmentalVariableSettings` class to allow extenders to determine if they should mask secure values. (#2424)
- See secure properties when issuing the `zowe config list` command when the `ZOWE_SHOW_SECURE_ARGS` environment variable is set to `true`. (#2259)
- Deprecated the `LoggerUtils` class. Use the `Censor` class instead. (#2424)
- Deprecated the `CliUtils.CENSOR_RESPONSE` property. Use the `Censor.CENSOR_RESPONSE` property instead. (#2424)
- Deprecated the `CliUtils.CENSORED_OPTIONS` property. Use the `Censor.CENSORED_OPTIONS` property instead. (#2424)
- Deprecated the `CliUtils.censorCLIArgs` function. Use the `Censor.censorCLIArgs` function instead. (#2424)
- Deprecated the `CliUtils.censorYargsArguments` function. Use the `Censor.censorYargsArguments` function instead. (#2424)
- Changed `DeferredPromise` and `DeferredPromise.unit.test` comment format to match standard. (#2413)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Bug fixes

Zowe Version 3.2.0 contains the bug fixes that are described in the following topics:

Zowe Application Framework

- Fixed an issue where it was not possible to configure the app-server as the configuration property `components.app-server.node.mediationLayer.eureka` was not documented in the schema. (#336)
- Fixed an issue that prevented the Desktop from selecting the most efficient and direct route to access ZSS. After the fix, the Desktop has the necessary information to identify and use a direct route to access ZSS. (#588)
- Fixed an issue that caused a large memory consumption and a high memory utilization after every startup. The issue was due to a defect in the `axios` library. The functionality of the app-servers does not alter due to this change. (#600)
- Fixed an issue where troubleshooting information became unavailable when there was a network failure during the eureka registration process. The `components.app-server.node.mediationLayer.traceTls` property was introduced to troubleshoot TLS issues. The property can trace the connection the app-server forms with the discovery server, revealing the cause of low-level networking issues. (#592)

ZSS

- Storage has now been configured to allow execution with the `EXECUTABLE=YES` setting, which enables the specified storage to be used as executable code. This is typically done to allow the storage to hold executable programs or modules. (#507)
- Fixed a memory leak in the rsusermap code, preventing unnecessary memory consumption and improving system performance. (#467)
- Enabled the use of single-line WTOs for efficient handling of single-line system console messages and improving the readability of generated system logs. (#509)
- Ensured that Zowe does not delete `modreg` based modules, thus preventing the loss of critical module data. (#749)
- Fixed an issue where the schema entry for JWT tracing was being updated with an incorrect name `_zss.jwt`. After the fix, the schema entry is updated with the correct name `_zss.jwtTrace`, which helps users to identify the log level that can enable JWT tracing. (#757)
- Corrected the `modregRegister` entry in the dynlink stub. (#754)
- Fixed the incorrect checking of the look-up anchor reset parameter. (#754)
- Fixed an issue where ZSS was not accessible from the Gateway when a user used AT-TLS. After the fix, ZSS is accessible from the Gateway if a user uses AT-TLS. (#758)

Zowe API Mediation Layer

- Disabled hostname verifier with non-strict mode. (#4069)
- The jacoco agent in jib containers previously unsupported with the Java 21 are now supported. (#4060)
- The username is now always valid when authentication for zaas/scheme/* endpoints passes. Username and applicationName validation is improved by moving validation to the PassTicketService. (#4054)
- Changed error code SERVICE_UNAVAILABLE to INTERNAL_SERVER_ERROR when PassTicket generation fails in Zowe v3. (#4047)
- Fixed the incorrect pattern for loggers through Personal Access Token validation log messages. (#4036)
- For keystores containing multiple keys, the correct client certificate is now chosen for outbound communication from the Gateway. (#4033)
- The use of a double slash in a url are now allowed. (#4030)
- Updated ciphers list v3. (#4025)
- Fixed the file log appender for debug profile. (#4020)
- Improved WebSocket generic 500 response in message. (#4019)
- Special characters are now allowed in url. (#4008)
- Introduced a workaround for API Catalog redirect behavior in the Desktop. (#4007)
- Added Authorization header for routed requests to ensure backwards compatibility with v2. (#4000)
- Added newPassword to the Swagger. (#3999)
- Authorization header is now supported in deterministic routing. (#3998)
- The TLS minimum setting has been fixed supporting TLSv1.2 as the minimum with TLSv1.3 supported by default. (#3993)
- Updated the React router to v7. (#3977)
- Replaced default Spring x509 Authentication in ZAAS. (#3971)
- HA instance ID is now used in the path to infinispan storage location (v3). (#3960)

Zowe CLI

Zowe CLI (Core)

- Updated the Daemon binary version for technical currency. (#2479)
- Fixed a bug that resulted in daemon commands running slower with every additional command. (#2470)
- Fixed the `--show-inputs-only` option on commands with chained command handlers, such as `zowe zos-files copy data-set-cross-lpar`. (#2446)
- When using the `copy` command, if a target partitioned data set has a smaller record length than a source partitioned data set, the operation for subsequent members no longer stops. The user can now view the affected members in a local file. (#2349)
- Users were not warned when copying partitioned data sets with identical member names. Now, the user is prompted to confirm before continuing the copy operation to avoid potential data loss. (#2349)
- The `zowe zos-files copy data-set` command overwrites the contents of the target data set without user confirmation. A `--safe-replace` option was added to prompt the user to confirm before overwriting the contents of the target data set. (#2369)

Zowe CLI Imperative Framework

- Ensured that the `ProfileCredentials` class evaluates all layers to determine if the user's credentials are secure. (#2460)
- Fixed a bug that resulted in daemon commands running slower with every additional command. (#2470)
- When in daemon mode, the user would not see Imperative initialization errors, but now the errors are passed back to the user's terminal window. (#1875).
- Fixed the `--show-inputs-only` option on commands with chained command handlers. (#2446)
- Fixed the help text example section's wrapping issue where the first line of the description is wrapped differently than the rest of the lines. (#1945).
- Fixed inconsistent behavior with the `ZOWE_SHOW_SECURE_ARGS` environment variable continuing to mask secure properties when it should not. (#2430)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 3.1:

- BDSA-2024-4090
- CVE-2024-39338 (BDSA-2024-5295)
- BDSA-2024-3717
- CVE-2023-28155
- CVE-2016-1000027
- BDSA-2024-6258
- CVE-2023-26136 (BDSA-2023-1661)
- CVE-2021-21366 (BDSA-2021-2314)
- CVE-2021-32796 (BDSA-2021-2903)
- CVE-2022-37616 (BDSA-2022-3398)
- CVE-2022-39353 (BDSA-2022-3404)

Version: v3.2.x LTS

Version 3.1.1 (April 2025)

Welcome to the Zowe Version 3.1.1 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v3.1.1 build: Want to try new features as soon as possible? You can download the v3.1.1 build from Zowe.org.

New features and enhancements

Zowe Version 3.1.1 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Bug fixes

Zowe Version 3.1.1 contains the bug fixes that are described in the following topics.

Zowe CLI

DB2 Plug-in for Zowe CLI

- Updated `tar-fs` transitive dependency to resolve technical debt. (#176)
- Updated `axios` transitive dependency to resolve technical debt. (#174)
- Updated `axios` transitive dependency to resolve technical debt. (#172)

Version: v3.2.x LTS

Version 3.1.0 (February 2025)

Welcome to the Zowe Version 3.1.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v3.1.0 build: Want to try new features as soon as possible? You can download the v3.1.0 build from Zowe.org.

New features and enhancements

Zowe Version 3.1.0 contains the enhancements that are described in the following topics:

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Server Install

- The `zwe init` command does not require NodeJS, when `--update-config` is not used. (#4088)
- The `zwe install` command does not require NodeJS. (#4069)
- Use a new javascript funtion `getStatvfs()` to obtain information about the file system. (#3994)
- Use the command `zwe diagnose` in javascript only. (#4061)
- The schema is validated for `zowe.job.name` and `zowe.job.prefix`. (#4060)

Zowe Application Framework

Zlux App Server package

- If `zowe.logDirectory` is not defined in the configuration, logging is disabled. (#317)
- App-server tries to detect ssh and telnet ports (used by terminals) automatically. (#326)

Zowe API Mediation Layer

- The external URL is now overridden for additional registration. (#3935)
- OIDC token (Okta token) is now supported for authentication in API Catalog. (#3925)
- Topology of API ML services on multiple sysplexes is now supported wherein certificates can be obtained from multiple sources. This feature allows communication to start on any sysplex and going through any sysplex to any other sysplex. #3914
- Users can now set the number of concurrent requests to be routed at the same time to a specific service. The feature: "Limit API usage" is part of this solution. (#3903)

- Limit API usage. A custom inmemory rate limiter has been added to limit usage of predefined services. (#3868)
- A validate OIDC token call to ZAAS client has been added to validate OIDC via ZAAS client. (#3897)
- A Java sample has been added to show how to build a Java application that uses a client certificate to authenticate against API ML. (#3862)
- A client AT-TLS setting is now supported. (#3828)

Zowe CLI

Zowe CLI (Core)

- The `zowe zos-files copy data-set` command now copies members from a source partitioned data set to an existing target partitioned data set. (#2386)
- Download members matching a specified pattern with the new command `zowe zos-files download all-members-matching` (`zowe files dl amm`). (#2359)
- Pass a `.zosattributes` file path for the download encoding format by adding the new `--attributes` flag to the `zowe zos-files upload` command. (#2322)
- Add the new `--ignore-not-found` flag to avoid file-not-found error messages when deleting files so scripts are not interrupted during automated batch processing. The flag bypasses warning prompts to confirm delete actions. (#2254)
- Added `--wait-for-active` and `--wait-for-output` options to the `zowe zos-jobs download output` command. (#2328)
- Added support for running applications on TSO/E address spaces. Start applications and receive/transmit messages using the new `tso start`, `tso receive`, and `tso send` commands. (#2280)
- Added optional `--attributes` flag to the `zowe zos-files upload file-to-uss` command to allow passing a `.zosattributes` file path for upload encoding format. (#2319)
- Issue the `zowe files search data-sets` command with the new `--encoding` option to use a different code page when searching data set contents. (#2161)
- Add the new `--stateful` flag to `zos-tso issue cmd` to allow declaring the statefulness of the address space being created. (#2240)
- To minimize the amount of unnecessary text returned from TSO commands, the `--suppress-startup-messages` flag default value changed to `true`. (#2240)

Zowe CLI Imperative Framework

- Added the `DeferredPromise` class to Imperative to provide utilities for data synchronization. (#2405)

DB2 Plug-in for Zowe CLI

- Updated the `ibm_db` dependency to support Node.js 22 and native installation on M1 Macs. (#169)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Bug fixes

Zowe Version 3.1.0 contains the bug fixes that are described in the following topics:

Server Install

- When logging `zwe` command, sometimes the log has a wrong file tag and the log is unreadable. (#4071)
- When the `--log-dir` parameter for the `zwe` command is a file, there might be an error "InternalError: stack overflow". (#4064)

Zowe Application Framework

Zlux App Server package

- The app-server no longer causes Zowe to display "FSUM7422 node is not found" and "Node found in NODE_HOME" after starting Zowe. This avoids confusion about if node requirements are met. (#325)

Zlux Server Framework

- App-server could not register with discovery server when AT-TLS was enabled for app-server. (#580)

Zowe Common C

- Removed `ByteOutputStream` debug message, which was a part of the zwe command output. (#491)
- `HEAPPOOLS` and `HEAPPOOLS64` no longer need to be set to `OFF` for `configmgr`. (#497)

Zowe API Mediation Layer

- Made "native" the default SAF authorization provider. (#3937)
- Provided /zOSMF static definition conversion. (#3938)
- Prevented leaking of 'exampleSetFlag' in api doc (v3.x.x). (#3933)
- Improved error handling in case of failure when retrieving API doc. (#3932)
- Remove dthe word 'central' from the log messages. (#3929)
- Fixed services endpoint to show correct list of onboarded services. (#3919)
- Provided for Auto conversion during z/OSMF static definition creation. (#3930)
- Improved untrusted certificate message when certificate is not forwarded. (#3321)
- Corrected apiBasePath & server URL for primary and additional Gateways. (#3922)
- Enabled infinispan debug logs messages with caching service in debug mode. (#3905)
- Specified content type when validating OIDC. (#3902)
- Fixed handling unavailable services (#3879)
- Semantic of onboarded Gateways in the multitenancy deployment. (#3884)

- Upgraded spring boot with HTTP headers workaround (#3882)
- Exceptions now handled that could arise in the passticket authentication schema. (#3871)
- Default JDK DNS resolver now used. (#3877)
- Now permitting trailing quotes in z/OSMF static definition not having matching initial ones. (#3875)
- Restored handling mode of x-forwarded-prefix as it is used in v2. (#3874)
- Preventing fail when headers cannot be modified. (#3845)
- Fixed error message in case of TLS error. (#3864)
- Updated Gateway schema with OIDC config parameters. (#3867)
- SSL strictness in enabler now respected.(#3813)
- SSL context now configured for webclient. (#3811)
- Applied minor fixes in logs. (#3806)
- Changed refill strategy to allow for API rate limiting. (#3949)
- Fixed LogBack turbofilters configuration. (#3954)
- Fixed LogBack configuration. (#3962)
- Fixed the order of the Gateway filter to avoid random malfunction of routing. (#3966)

Zowe CLI

Zowe CLI (Core)

- Fixed an issue where the `zowe files upload dir-to-uss` command was missing a progress bar to track progress of file uploads. (#2344)
- The `zowe files copy data-set` command no longer copies all partitioned data set members if a member is specified. (#2402)
- Added support for the `--encoding` flag to the `zowe upload dir-to-uss` to allow for encoding uploaded directories for command group consistency. (#2337)
- Improved output formatting for the `zowe zos-tso start app` and `zowe zos-tso send app` commands by parsing and displaying relevant data rather than the entire JSON response. (#2347)
- Resolved an issue where `zowe zos-files upload file-to-uss` was not properly handling command flags. (#2234)
- Fixed an issue where the `zowe zos-logs list logs` command could fail or not return all logs if a start time was not supplied. (#2336)
- Fixed issues flagged by Coverity. (#2291)

Zowe CLI Imperative Framework

- Fixed a typo in the syntax validation code for positional arguments which caused validation to never fail. (#2375)
- Resolved an issue where extraneous base profiles were created in project configurations when a nested profile property was updated. (#2400)
- Resolved an issue where base profiles in a team configuration file were overwritten when a user configuration file did not include a base profile. (#2383)
- Modified location of Proxy-Authorization header to be located in the agent instead of the request. (#2389)
- Modified 8.8.2 bugfix to correct web help alias. (#2361)
- Resolved issue where special characters could be corrupted when downloading a large file. (#2366)
- Fixed an issue where the Imperative Event Emitter could skip triggering event callbacks. (#2360)
- Updated `--help-web` commands to work even in the presence of a faulty configuration. (#2361)

- Fixed an issue where the `ProfileInfo.profileManagerWillLoad` method failed if profiles were not yet read from disk. (#2284)
- Fixed an issue where the `ProfileInfo.onlyV1ProfilesExist` method could wrongly return true when V2 profiles exist. (#2311)
  - Deprecated the static method `ProfileInfo.onlyV1ProfilesExist` and replaced it with an `onlyV1ProfilesExist` instance method on the `ProfileInfo` class. (#2313)
- Fixed an issue where the `ConvertV1Profiles.convert` method may create team configuration files in the wrong directory if the environment variable `ZOWE_CLI_HOME` is set. (#2312)
- Fixed an issue where the Imperative Event Emitter would fire event callbacks for the same app that triggered the event. (#2279)
- Fixed an issue where the `ProfileInfo.updateKnownProperty` method could rewrite team config file to disk without any changes when storing secure value. (#2324)

CICS Plug-in for Zowe CLI

- Removed bundled dependencies from the npm package. (#192)
- Restored the npm-shrinkwrap file in the npm package. (#187)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

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Zowe Explorer FTP Extension

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Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 3.0.

- BDSA-2023-3495
- BDSA-2024-5686

Version: v3.2.x LTS

Version 3.0.0 (October 2024)

Welcome to the Version 3.0.0 release of Zowe!

Version 3.0 introduced breaking changes and a number of new features.

- See Important updates for a full list of changes to the functionality.
- See Conformance and release compatibility for V3 Conformance Criteria updates and compatibility with V2.

Download v3.0.0 build: Want to try new features as soon as possible? You can download the v3.0.0 build from Zowe.org.

V3 office hours videos A series of Zowe V3 LTS office hours are available which detail all changes introduced in Zowe V3. For more information about these office hours and the new features in Zowe V3, see Zowe V3 Office Hours.

Important updates

Zowe installation and packaging

Breaking changes in Zowe installation and packaging

- The original V2 configuration management, `zowe.useConfigmgr=false` has been dropped in Zowe V3. The Configuration Manager remains as the only supported method for configuring Zowe.

New features and enhancements in Zowe installation and packaging

- Introducing *Zowe Server Install Wizard*, a wizard to simplify installation and configuration of Zowe server side components via a UI.
- Added explanation to possible error message when checking z/OSMF setting. (#3956)

Zowe Application Framework

Breaking changes in Zowe Application Framework

- Updated Angular to Version 18 from Version 12. Apps built upon Angular, excluding iframe apps, will need to be updated to be compatible with the V3 Desktop.

New features and enhancements in Zowe Application Framework

Zlux App Manager

- Updated the Desktop Angular version from 12 to 18. Angular apps written for V2 will need to be upgraded to work in V3. `Iframe` and `React` is unaffected. (#639)
- The V2 Desktop is included alongside the V3 Desktop as a temporary compatibility option for the duration of the V2 maintenance schedule. Any user can switch to the V2 Desktop via the `?use-v2-desktop=true` parameter. (#639)

Zlux App Server

- Added new `pluginDefinition` property to allow plugins to simultaneously contain v2 and v3 web assets. This property, `webContent.entryPoint`, can contain a "3.0" element which states the location of the entry JS file that the Desktop would load. See the `tn3270-ng2` app for an example of its usage. (#323) (#567)

Zowe Common C

- Added javascript `zos.getStatvfs`(path) function to obtain file system information. (#482)
- Added support for `LE 64-bit` in isgenq.c. (#422)
- Added more arguments to `httpClientSessionInit` to allow passing back rc. (#467)

ZSS

- If no `zowe.logDirectory` is defined in config, logging is disabled. (#726)
- Exposed new cross-memory server's functions in dynlink. (#684)

Bug fixes in Zowe Application Framework

Zowe Common C

- `IARV64` results must be checked for `0x7FFFF000` (#474)
- `SLH` should not `ABEND` when `MEMLIMIT` is reached (additional NULL check)

ZSS

- Added Support for cross-memory server parameters longer than 128 characters. (#684)

Known Issues

Some apps and features of V2 Desktop have not yet been added to the V3 Desktop

- The Editor app is not present on the V3 Desktop, but you can access it in the V2 desktop by including `?use-v2-desktop=true` at the end of your Desktop URL.
- Support for languages other than English is limited. You can set your language preference in the V2 desktop, but this menu is not yet present in the V3 desktop and some parts of the V3 desktop will not yet honor the language choice.

API Mediation Layer (API ML)

Breaking changes in API ML

Change in Zowe V3	Required action
Authentication endpoints no longer support the route `/api/v1/gateway`. Only `/gateway/api/v1` is now supported.	If you use the endpoints directly, change the URLs to start with `/gateway/api/v1`. If you use ZAAS client to integrate with API Mediation Layer, no action is required as the change is handled in the ZAAS client code.
Spring Enabler has been updated to	Upgrade extending services based on the Spring Enabler to Spring Boot 3 and Spring 6.

Change in Zowe V3	Required action
Spring Boot 3 and Spring 6. Spring Boot 2 and Spring 5 versions are no longer be supported	
Datasets API has been archived	This service was disabled by default in Version 2. If you enable the service via `components.data-sets.enabled: true` and use the APIs documented in Data sets Swagger, it is necessary to move to the usage of the similar z/OSMF endpoints.
Jobs API will be archived	The service was disabled by default in Version 2. If you enable the service via `components.jobs.enabled: true` and use the APIs documented in Jobs Swagger, it is necessary to move to the usage of the similar z/OSMF endpoints.
Metrics service has been archived	The service was in Technical Preview. Currently there is no replacement. In V3, the Open Telemetry standard will be implemented, which will serve as a replacement.
IMS API has been archived	The service was not fully supported. If you were using the API, please reach out to the IBM team for follow-up steps.
Java 17 is required to run the API Mediation Layer	For V3, it is necessary to update z/OS to version 2.5 or later as this brings support of Java 17. It is necessary to install Java 17 and provide the path to Java 17 to Zowe Java configuration.
z/OSMF in version V2R5 with APAR PH12143 applied	If you are running a version of z/OS before 3.1, validate that the PH12143 APAR was applied to the z/OSMF installation used by Zowe. The Zowe YAML parameter `components.gateway.apiml.security.auth.zosmf.jwtAutoconfiguration` for the gateway component has changed. The value `auto` is no longer allowed. Choose either the default `jwt` or `ltpa` depending on if your z/OSMF is set up for JWT use as recommended. See example-zowe.yaml for new component values.
Configuration of keyrings now requires transformation from `safkeyring:////` to `safkeyring://`	If your Zowe configuration contains `safkeyring:////`, change this part to `safkeyring://`.
Support access to z/OSMF only through `/ibmzosmf` route. V3 will not support access through the `/zosmf` route	If you use z/OSMF via `{apimlUrl}/zosmf/{zosmfEndpoint}` you need to move to `{apimlUrl}/ibmzosmf/{zosmfEndpoint}.`
Error code change for nonexistent services	Nonexistent service returns 404 with error code ZWEAO404E

New features and enhancements in API ML

The current API Gateway contains the Authentication and Authorization Service. This service will be separated as a standalone service. The Authentication and Authorization Service is the only API ML service that directly requires z/OS.

- The networking standard configuration has been improved allowing for proper use and handling of TLS configuration in a unified way across the Zowe. (#3765)
- Now providing a GraphiQL Playground to allow for visualizing GraphQL APIs in the API Catalog. (#3660)
- Users can now extend WebSocket connection timeouts and increase header and payload capacity (#3700)
- Spring Cloud Gateway has now replaced Netflix Zuul API Gateway. (#3294) (#3658) (#3567) (#3571) (#3572) (#3545)
- Catalog version is now added in the footer for Login, Dasboard and Detail pages. (#3554)
- Added OIDC login flow schema and `allowedUsers` customization in zowe.yaml now enabled. (#3533)
- API ML has implemented OIDC authentication flow in the Cloud Gateway component. The user obtains an access token in the cookies after a successful authentication against the Identity provider. (#3510)

Bug Fixes in API ML

- Fixed Discovery Eureka response if the service is not registred to allow to reconnect by Enabler. (#3795)
- Moved security configuration back to gateway section. (#3775)
- Gateway now ends with internal server error if cookies are invalid. (#3767)
- `hostname` is now not resolved when not required. (#3751)
- Addressed `ClosableHttpClient.execute()` resource leak on API Catalog. (#3722)
- Fixed API ML prefix for registry configuration. (#3746)
- ZAAS now reads configuration from Gateway as default with possibility to override with local configuration. (#3744)
- Removed "AUTO" from JWT configuration and clean up outdated APARs from mock service. (#3717)
- Updated default javax.net.ssl log levels. (#3716)
- Enable the use of Zowe provided java location if available. (#3714)
- Allow for Stacktrace on unreachable swagger and removed handling for deprecated method. (#3699)
- Protected health endpoint with authentication as default. (#3676)
- Enabled Pretty path URL in Gateway Swagger documentation in the API Catalog. (#3679)
- Fixed Swagger API documentation for Gateway. (#3678)
- Now supporting customized code snippets in case of endpoint with query params. (#3666)
- Tweaked gateway status page to have consistent casing. (#3560)
- Allow for Independent scanning and loading of extension's classes. (#3548)
- Fixed SSL Context switching. (#3531)
- Fixed z/OSMF URL. (#3478)
- Updated of SSL configuration in the Tomcat. (#3403)
- Apply fixes to Keyring init z/OS. (#3314)
- Use `ibmzosmf` as service ID. (#3302)
- Updated z/OSMF service ID. (#3296)
- Updated serviceId in the Gateway starting script. (#2889)
- Fixed truststore for websockets in Spring Cloud Gateway. (#3248)
- Fixed static definition of z/OSMF in discovery package. (#2889)

ZSS

Breaking changes in ZSS

- ZSS now defaults to running in 64-bit mode, which requires extensions that include ZSS plugins to also have 64-bit editions. Although 64-bit is recommended to avoid 31-bit memory consumption, The YAML property `components.zss.agent.64bit=false` can be used to switch back to 31-bit if needed for extension that have not yet been updated for 64-bit. Note that only one version of ZSS can run at a time.

Explorer for Intellij IDEA

New features and enhancements in Explorer for Intellij IDEA

- Explorer for IntelliJ IDEA will be part of the Zowe Core
- Working with USS Files
- Working with Data Sets
- Working with JES Working Sets
- Interactive TSO Console

Explorer for Visual Studio Code

Breaking changes in Explorer for Visual Studio Code

Change in Zowe V3	Required action
V1 profile support removed.	Implement a team configuration or use Zowe Explorer's built-in V1 profile conversion functionality
Deprecated items removed.	Zowe Explorer extenders or users of the Zowe Explorer APIs need to review the breaking changes and adjust their code to account for removed/changed classes, functions, and constants. See changes listed in Issue 2238.
Extension settings stored in local storage.	Settings and history previously stored in the `.vscode` settings folder are no longer available. Users will have to adjust their Zowe Explorer settings after updating to V3.
No longer using a temporary directory for storing data sets and USS files. All settings related to the temporary downloads folder have been removed.	Refer to the FileSystemProvider documentation for information on how to build and access resource URIs. Extenders can detect changes to resources using the `onResourceChanged` function in the `ZoweExplorerApiRegister` class.
Data set templates moved out of data set history settings into new setting `zowe.ds.templates`.	Use the new `zowe.ds.templates` setting.

New features and enhancements in Explorer for Visual Studio Code

- Storing persistent settings in local storage.

- Use a right-click option to compare files in MVS view, USS view, and across the two views.
- Minimized activation function for Zowe Explorer to load only necessary items on activation. (#1985)
- Added UI migration steps on startup for users with V1 profiles to either convert existing V1 profiles to a team configuration file or create a new team configuration file. (#2284)
- Added support for logging in to multiple API ML instances per team configuration file. (#2264)
- Added remote lookup functionality for data sets and USS files, allowing Zowe Explorer to locate and resolve mainframe resources on demand. (#3040)
- Implemented change detection in the data sets and USS filesystems so that changes on the mainframe are reflected in opened editors for data sets and USS files. (#3040)
- Implemented a "Show as Table" option for profile nodes in the Jobs tree, displaying lists of jobs in a tabular view. Jobs can be filtered and sorted within this view, and users can select jobs to cancel, delete, or download. (#2258)
- Implemented the VS Code FileSystemProvider for the Data Sets, Jobs, and USS trees to handle all read/write actions as well as conflict resolution. See the FileSystemProvider wiki page for more information on the FileSystemProvider. (#2207)
- Added a new command called `Issue UNIX Command` that is available in the VS Code command palette or via right-click action in the USS tree view. (#1326)
- Added a prompt to create a new Zowe client configuration for an environment that does not have any Zowe client configurations. (#3148)
- Implemented support for saving as a Favorite a data set search query that contains member wildcards. (#1164)
- Changed default base profile naming scheme in newly generated configuration files to prevent name and property conflicts between Global and Project profiles. (#2682)
- Set up POEditor project for contributing translations. Cleaned up redundant localization strings. (#546)
- Added integration and end-to-end test framework to verify extension behavior and catch issues during Zowe Explorer development. (#2322)

Bug fixes in Explorer for Visual Studio Code

- The "Zowe Resources" panel is now hidden by default until Zowe Explorer reveals it to display a table or other data. (#3113)
- Fixed behavior of logout action when token is defined in both a base profile and parent profile. (#3076)
- Fixed bug that displayed obsolete profiles in the Zowe Explorer tree views after the associated team configuration file was deleted. (#3124)
- Fixed issue with extender profiles not being included in configuration files created by Zowe Explorer. (#3122)
- Fixed issue where file extensions were removed from data sets, causing language detection to sometimes fail for Zowe Explorer extenders. (#3121)
- Fixed an issue where copying and pasting a file/folder in the USS tree would fail abruptly, displaying an error. (#3128)
- Removal of broken VSC command to `Zowe Explorer: Refresh Zowe Explorer`, use VS Code's `Extensions: Refresh` command instead. (#3100)
- Fixed issue where Zowe Explorer would reload the VS Code window during initialization when no configuration files are present. (#3147)
- Fixed issue where obsolete credentials persisted for PDS member nodes in Data Sets tree. (#3112)
- Fixed issue where Search operation did not prompt for credentials if profile contains expired token. (#2259)
- Fixed issue where inactive status was not displayed for profiles loaded from global configuration. (#3134)

- Fixed issue where switching from token-based authentication to user/password would cause an error for nested profiles. (#3142)
- Fix issue with outdated SSH credentials stored securely in the SSH profile causing errors. (#2901)
- Fixed vNext-only issue where users are not able to create data sets. (#2783)
- Omitted the following Zowe Explorer commands from the Command Palette that do not execute properly when run as a standalone command:
  - `Zowe Explorer: Cancel job`
  - `Zowe Explorer: Filter jobs`
  - `Zowe Explorer: Filter PDS members`
  - `Zowe Explorer: Sort jobs`
  - `Zowe Explorer: Sort PDS members`
  - `Zowe Explorer: Start Polling`
  - `Zowe Explorer: Stop Polling`
- Ported the following fixes from V2:
  - Moved schema warnings into the log file (rather than a UI message) to minimize end-user disruption. (#2860)
- Fix issue with base profile not being included in configuration files created by Zowe Explorer. (#2887)
- Fixed an issue where the `onProfilesUpdate` event did not fire after secure credentials were updated. (#2822)
- Fixed issue where saving changes to favorite PDS member fails when custom temp folder is set on Windows. (#2880)
- Fixed issue where multiple extensions that contribute profiles to a tree view using the Zowe Explorer API may fail to load. (#2888)
- Fixed regression where `getProviderForNode` returned the wrong tree provider after performing an action on a Zowe tree node, causing some commands to fail silently. (#2967)
- Fixed issue where creating a new team configuration file could cause Zowe Explorer to crash, resulting in all sessions disappearing from trees. (#2906)
- Addressed breaking changes from the Zowe Explorer API package. (#2952)
- Fixed data set not opening when the token has expired. (#3001)
- Fixed an issue where upgrading from Zowe Explorer V1 and selecting "Reload Extensions" causes Zowe Explorer V3 to fail during initialization. (#3051)
- Fixed an issue where remote lookup functionality caused the local side of a conflict to be overwritten with the remote contents. (#3085)
- Fixed an issue where the remote conflict icons showed when using the "Compare with Selected" feature. (#3085)
- Resolved an issue where extender event callbacks were not always fired when the team configuration file was created, updated, or deleted. (#3078)
- Fixed issue with UnixCommand prompting for credentials. (#2762)
- Fixed issue where listing data sets or USS files would cause a drastic increase in API calls, causing delays or a complete halt in Zowe Explorer. (#3093)
- Fixed issue where "Allocate Like" input box placeholder was showing a localization ID instead of the intended message ("Enter a name for the new data set"). (#2759)
- Fixed concerns regarding Unix command handling work. (#2866)
- Fixed default behavior of "Create a new Team Configuration File" to create a Project Config instead of Project User Config. (#2684)
- Adjusted order of "Manage Profile" and "Edit History" options in the Jobs tree's context menu to match the other trees. (#2670)

- Fixed issue where spools with duplicate DD names would overwrite each other causing less spools in job output view (#2315)
- Changed ZoweExplorerExtender.initForZowe `profileTypeConfigurations: imperative.ICommandProfileTypeConfiguration[]` to a required argument to address issues seen after registration of profile type when not passed. (#2575)
- Updated various dependencies for technical currency. (#3146, #3057, #2754)

Complete changelogs for Zowe Explorer for Visual Studio Code and Zowe Explorer plug-ins

For a complete list of enhancements and bug fixes, see the following changelogs:

- Zowe Explorer
- Zowe Explorer CICS Extension
- Zowe Explorer FTP Extension

Zowe CLI (Core)

Breaking changes in Zowe CLI

Change in Zowe V3	Required action
New format for error messages to improve clarity.	Adjust Zowe CLI scripts that parse error messages to handle the new error format
V1 profile support removed.	Implement a team configuration or use Zowe CLI's built-in V1 profile conversion command: `zowe config convert`
Deprecated items removed.	Zowe CLI extenders or users of the Zowe Client Node.js SDK will need to review the breaking changes and adjust their code to account for removed/changed classes, functions, and constants. See changes listed in Zowe CLI Issue 1694 and Imperative Issue 1873.
Added informative messages identifying why a user is being prompted for connection property values during a CLI command.	N/A
Removed record format (recfm) validation when issuing `zowe files create` commands.	N/A
Added Zowe release version output for `--version`.	Update scripts that run the `zowe --version` command to handle the new format
Removed all `profiles` commands, since they only worked with now-obsolete V1 profiles.	N/A

Change in Zowe V3	Required action
Replaced the `ZOWE_EDITOR` environment variable with `ZOWE_OPT_EDITOR` and `--editor` option on commands.	Use `ZOWE_OPT_EDITOR` to set your default text editor
Removed the `bright` command from the product.	Replace `bright` with `zowe` in scripts

New features and enhancements in Zowe CLI

- The 'zowe config auto-init' command now generates two base profile types, 'global_base' or 'project_base', depending on whether a global or project configuration file is generated. (Zowe Explorer #2682).
- Use the `zowe zos-files search data-sets` command to search for a string in a data set or PDS member matching a pattern. (#2095)
- Zowe client log files are consolidated into the same directory. (#2116)
- Changed references in command output from 'Team Configuration' to 'Zowe client configuration' to align with Zowe terminology. (#2019)
- Prompt for user/password on `SSH` commands when a token is stored in the configuration file. (#2081)
- Replaced the term "Team configuration" with "Zowe client configuration" in the `zowe config report-env` command to align with Zowe terminology.
- Search spool files for a specified string or regular expression with the new `zowe zos-jobs search job` command.
- Use the new `name-only` alias to `root` on `config list` command. (#1797)
- Use the new `--binary` and `--encoding` options with the `zosfiles edit` command.
- Revised the help text for consistency and improved user experience. (#1756)

Bug fixes in Zowe CLI

- Updated documentation for the `zos-files search ds` command's `--mainframe-search` option to include a disclaimer about z/OSMF API limitations. (#2160)
- Fixed a bug where a data set search would not return a search term if it was at the beginning of a line. (#2147)
- Fixed an error in the `zos-files list all-members` command that could occur when members contain control characters in the name. (#2104)
- Removed stack trace for zosjobs errors. (#2078)
- Fixed default base profile missing in configuration generated by `zowe config auto-init`. (#2088)
- Eliminated a Node Version Manager (NVM) GUI popup dialog which NVM now displays during the `zowe config report-env` command by removing the NVM version number from our report.
- Properly construct workflow error messages to display properly with V3 error formatting.
- Fixed typo in command help for `zowe zos-workflows create` commands.
- Updated various dependencies for technical currency. (#2242, #2188, #2158, #2102, #2107, #2077, #2061, #2057)

Complete changelogs for Zowe CLI and Zowe CLI plug-ins

- Zowe CLI
- Zowe CLI Imperative

- IBM CICS Plug-in for Zowe CLI
- IBM Db2 Databse Plug-in Zowe CLI
- IBM z/OS FTP Plug-in Zowe CLI
- IBM MQ Plug-in Zowe CLI

Version: v3.2.x LTS

Version 2.18.2 (July 2025)

Welcome to the Zowe Version 2.18.2 release!

See Bug fixes for a list of issues addressed in this release.

Download v2.18.2 build: Want to try new features as soon as possible? You can download the v2.18.2 build from Zowe.org.

New features and enhancements

Zowe Version 2.18.2 contains the enhancements that are described in the following topics.

Zowe API Mediation Layer

- The configuration property `apiml.security.forwardHeader.trustedProxies` has been added to specify the regular expression pattern used to identify trusted proxies from which `X-Forwarded-*` headers are accepted and forwarded. This mitigates CVE-2025-41235. The API ML gateways (including cloud gateways) in Multitenancy Configuration are trusted by default. (#4148 and #4188)
- A Java sample app has been added to assist users to authenticate client certificates. (#4009)
- Users can now configure the `connectTimeout` and `readTimeout` for Eureka HTTP client. (#4046)
- Java 21 is now supported. (#4027)

Bug fixes

Zowe Version 2.18.2 contains the bug fixes that are described in the following topics.

Zowe API Mediation Layer

- Fixed gateway returning empty auth keys from z/OSMF when `apiml.security.auth.zosmf.jwtAutoconfiguration` is set to `jwt`. (#4092)
- Fixed an error where NPE in `ApimlPeerEurekaNode` stops heartbeats. (#4195)
- Fixed logout implementation in API Catalog in which cookies from the browser were deleted but JWT against the Gateway instance of the Zowe installation are not invalidated. (#4185)
- Applied fix for disabling infinispan diagnostics by default. (#4170)
- Fixed a resource leak in the http client, whereby all objects are now closed after use. (#4153)
- Added HSTS header when AT-TLS enabled for V2. (#4071)
- Changed error code SERVICE_UNAVAILABLE to INTERNAL_SERVER_ERROR when ticket generation fails. (#4043)

Zowe CLI

DB2 Plug-in for Zowe CLI

- Updated `tar-fs` transitive dependency to resolve technical debt. (#177)
- Updated `axios` transitive dependency to resolve technical debt. (#175)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Version: v3.2.x LTS

Version 2.18.1 (March 2025)

Welcome to the Zowe Version 2.18.1 release!

See Bug fixes for a list of issues addressed in this release.

Download v2.18.1 build: Want to try new features as soon as possible? You can download the v2.18.1 build from Zowe.org.

New features and enhancements

Zowe Version 2.18.1 contains the enhancements that are described in the following topics.

Zowe API Mediation Layer

- The Zowe client AT-TLS setting `network.tls.client.attls` is now supported. (#3825)

Bug fixes

Zowe Version 2.18.1 contains the bug fixes that are described in the following topics.

Zowe API Mediation Layer

- Fixed login filter check causing 400 Invalid credentials. (#4014)
- Added missing OIDC documentation to OpenAPI. (#4013)
- Added newPassword to Open API Documentation of the login endpoint. (#4002)
- Fixed four slashes support in SSE class. (#4001)
- Fixed failing LoginFilter in AccessToken generate filter chain. (#3984)
- Fixed the ssl.protocol default value. (#3994)
- Improved PassTicket logging. (#3996)
- Fixed 'exampleSetFlag' leaking in api doc. (#3934)
- Fixed Cloud Gateway configuration. (#3956)
- Fixed initialization of the API Catalog. (#3959)
- Improved error handling in case of failure when retrieving API doc. (#3936)
- Improved untrusted certificate message when certificate is not forwarded. (#3926)
- User can now configure the TLS version and cipher suite list. (#3943)
- Fixed order of Cloud Gateway filters and solve the conflict with RequestAttributesProvider. (#3965)
- Fixed z/OSMF static definition file processing. (#3975)
- Removed global setup of keystores. (#3702)
- Fixed Sonar analysis issues. (#3800)
- Changed port to handle AT-TLS client aware mode. (#3863)
- Updated default javax.net.ssl log level. (#3872)
- The insecureHttpWarning message is now thrown only when AT-TLS is not enabled. (#3810)

- Fixed WebSocket session opening to be non-blocking and callback-based. (#3695)
- Fixed Zowe CLI plugin and enable manual trigger only. (#3804)

Zowe CLI

Zowe CLI (Core)

- Added support for the `--encoding` flag to the `zowe upload dir-to-uss` command to allow for encoding uploaded directories for command group consistency. (#2356)

Zowe CLI Imperative Framework

- Updated transitive dependencies for technical currency. (#2425)
- Resolved an issue where extraneous base profiles were created in project configurations when a nested profile property was updated. (#2404)
- Fixed an issue where the `ProfileInfo.profileManagerWillLoad` method failed if profiles were not yet read from disk. (#2284)
- Fixed an issue where the `ProfileInfo.updateKnownProperty` method could rewrite the team configuration file to disk without any changes when storing a secure value. (#2324)
- Updated the `cross-spawn` dependency for technical currency. (#2374)
- Fixed issues flagged by Coverity. (#2292)
- Updated `dataobject-parser` dependency for technical currency. (#2262)
- Updated `fs-extra` and `jsonfile` dependencies for technical currency. (#2264)

CICS Plug-in for Zowe CLI

- Removed bundled dependencies from npm package and restored the npm-shrinkwrap file. (#188)

DB2 Plug-in for Zowe CLI

- Updated `ibm_db` dependency to support Node.js 22 on Windows.

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.18.0.

- BDSA-2024-4117
- BDSA-2024-3717
- BDSA-2024-0402
- BDSA-2024-0625
- BDSA-2024-1160

Version: v3.2.x LTS

Version 2.18.0 (August 2024)

Welcome to the Zowe Version 2.18.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.18.0 build: Want to try new features as soon as possible? You can download the v2.18.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.18.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe Application Framework

ZSS

- Changed log level for setting default value of `httpRequestHeapMaxBlocks` to `DEBUG` instead of `INFO`. (#719)

Zowe API Mediation Layer

- OIDC token can now be validated via the user info endpoint. (#3670)
- It is now possibile to use custom logback.xml in all API ML services. Configuration for separate services can be performed by adding logging.config parameter under each API ML component in Zowe YAML file. (#3669)

Zowe CLI

Zowe CLI Imperative Framework

- Updated `ProfileInfo.updateProperty` function to support updating properties in typeless profiles. (#2196)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Bug fixes

Zowe Version 2.18.0 contains the bug fixes that are described in the following topics.

Zowe API Mediation Layer

- Added the optional authentication requirement for `application/health` endpoints. (#3636)
- Customized code snippets for endpoints with query parameters is now supported. (#3665)

Zowe CLI

Zowe CLI (Core)

- Refactored code to reduce the use of deprecated functions to prepare for upcoming Node.js 22 support. #2191

Zowe CLI Imperative Framework

- Modified the `showMsgWhenDeprecated` function to allow an empty string as a parameter when no replacement is available for the deprecated command. When no replacement is available, an alternative message is printed. (#2041)
- Resolved a bug that resulted in the user not being prompted for a key passphrase if it is located in the secure credential array of the `ssh` profile. (#1770)
- Fixed an issue in the local web help that highlighted the wrong sidebar item. (#2215)
- Updated web help dependencies for technical currency. (#2215)
- Refactored code to reduce the use of deprecated functions to prepare for upcoming Node.js 22 support. (#2191)
- Fixed error in REST client when making requests with session type of `SessConstants.AUTH_TYPE_NONE`. (#2219)
- Fixed missing export for `Proxy` class in Imperative package. (#2205)

DB2 Plug-in for Zowe CLI

- Updated axios transitive dependency to resolve technical debt. (#154)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.17.

Version: v3.2.x LTS

Version 2.17.0 (July 2024)

Welcome to the Zowe Version 2.17.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.17.0 build: Want to try new features as soon as possible? You can download the v2.17.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.17.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe installation and packaging

- Added `JCL` sample templates within `SZWESAMP` dataset, also seen within `"files/SZWESAMP"`. Datasets beginning with `ZWEI` are intended to be an alternative but not replacement of `zwe init` operations. `ZWEIRAC`, `ZWEITSS`, and `ZWEIACF` are derived from and intended to replace `ZWESECUR` in the future. `ZWEIKR*` are derived from and intended to replace `ZWEKRING` in the future. (#3890)
- Added a job, `ZWEGENER` within the `SZWESAMP` dataset. When provided the location of Zowe's runtime directory and `YAML` files, this job will take the `SZWESAMP` sample JCL templates and resolve parameter values with those found in the `YAML` configuration after validation, placing the results into the `CUST.JCLLIB` dataset. This can be used to simplify setup of jobs for Zowe installation. (#3890)
- Startup performance has been improved by moving extension schema validation of application framework plugins from runtime to install time. This additionally helps identify schema errors at install time that would previously have been shown only at runtime. (#3866)
- Added `zowe.network.server.tls.attls` and `zowe.network.client.tls.attls` as Booleans for controlling global or per-component way to tell Zowe servers that they should operate in a mode compatible with an `AT-TLS` setup. (#3463)
- Startup performance has been improved by reducing the quantity of processes involved during startup. (#115)
- Reduction in resource consumption. Each Zowe component uses one less shell process at runtime. (#115)
- Added a "files/defaults.yaml" file which contains default `YAML` properties to reduce the chance of errors found during an upgrade of Zowe when re-using an older `YAML` configuration file. This file should not be edited but can be reviewed to learn default behaviors, and overridden within user `YAML` files. (#3883)

Zowe Application Framework

Zlux App Server

- The `app-server` can now use Zowe's standardized and simplified `AT-TLS` configuration simply by toggling `zowe.network.server.tls.attls: true` or `components.app-server.zowe.network.server.tls.attls: true`. If you wish to control client tls separately from server `tls`, you can also use `zowe.network.client.tls.attls` or `components.app-server.zowe.network.client.tls.attls`. (#300) (#303)
- Reduced startup time by removing a check for DNS behavior on node versions 14 and less. Node 14 has not been supported since September 2023. (#304)
- Reduced startup time by consolidating startup configuration script actions into one process. (#305)

Zlux Server Framework

- Added function `isClientAttls(zoweConfig)` within `libs/util.js.` whenever a plugin makes a network request, it should always use this to determine, if a normally `HTTPS` request should instead be made as `HTTP` due to `AT-TLS` handling the `TLS` when enabled. (#544)

Zowe Common C

- Fixed `xplatform.loadFileUTF8` when trying to open `nonexistent` file. (#454)
- Allocated `SLH` for `http server` with configurable value `httpRequestHeapMaxBlocks` in `YAML`. (#447)

ZSS

- Added code to configure the `SLH` block size of the `http server` through `httpRequestHeapMaxBlocks` in the YAML. (#701)

Zowe API Mediation Layer

- Cloud gateway can now run with AT-TLS enabled in the environment. (#3564)
- The request buffer size for WebSocket connections is now customizable. (#3609)

Zowe CLI

Zowe CLI (Core)

- Added the ability to set JCL reader properties for `--jobRecordLength`, `--jobRecordFormat`, and `--jobEncoding` on the `zowe jobs submit local-file` and `zowe jobs submit stdin` commands. (#2139)
- Added the ability to download job spool files using other codepages with `--encoding` on the `zowe jobs download output`, `zowe jobs view spool-file-by-id`, and `zowe jobs view all-spool-content` commands. This allows users to download job spool files in other languages (i.e. IBM-1147 for French). (#1822)

Zowe CLI Imperative Framework

- Added the `ProfileInfo.profileManagerWillLoad` function to verify that the credential manager can load. (#2111)
- Added support for proxy servers using a proxy http agent. Supports the usage of the environment variables HTTP_PROXY and HTTPS_PROXY (not case sensitive).
  - If any of these environment variables is set, and depending on how the Zowe session is configured for http or https, the REST client instantiates an appropriate http agent.
  - If the z/OS system uses self-signed certificates then the proxy server must be configured to accept them.

    - If the proxy server itself is configured with self-signed certificates then the user needs to either import these certificates on their workstation, use `rejectUnauthorized` in their Zowe profile, or use the (not recommended) nodejs variable `NODE_TLS_REJECT_UNAUTHORIZED=0`.
    - Zowe also looks for the environment variable `NO_PROXY`. These work with a simple comma-separated list of hostnames that need to match with the hostname of the Zowe profile.

- Added the `BufferBuilder` utility class to provide a convenient way of downloading to a stream that can be read as a buffer. (#2167)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Bug fixes

Zowe Version 2.17.0 contains the bug fixes that are described in the following topics.

Zowe installation and packaging

- Removed references to nonexistant STC `ZWESVSTC` from `z/OSMF` workflows. This was replaced with `ZWESLSTC` within `Zowe v2.x` and already existed within the workflows. (#3881)
- Updated messages `ZWEL0121E` and `ZWEL0122E` to clarify how to resolve these errors if encountered. (#3884)
- Fixed schema validation issue preventing startup when having null entries within the `zowe.certificates` section of the `YAML` configuration. (#3905), (#3901)

Zowe Application Framework

Zlux Server Framework

- Fixed function `isServerAttls(zoweConfig)` within `libs/util.js`, which was preventing using `AT-TLS` with `app-server`. (#544)

Zowe Common C

- Fixed an incorrect check in the recovery router code, which might lead to the state `cell-pool` being released prematurely. (#446)

Zowe API Mediation Layer

- Updated attls icsf condition. (#3635)
- Added missing PAT documetantion. (#3618)
- Added requestConnectionTimeout as a zowe.yaml property. (#3629)
- Disabled auto conversion for tagged files on z/OS. (#3619)
- The keystore is now not loaded when AT-TLS is set, thereby allowing ICSF keys. (#3612)
- Health endpoints can now be optionally protected. (#3625)
- The external URL in the ZUUL Gateway if AT-TLS is enabled has been corrected. (#3565)
- The protocol in the start.sh is now specified. (#3593)
- Fixed consistency between UI titles and messages. (#3502)
- WebSocket client default timeout is now customizable. (#3613)

Zowe CLI

Zowe CLI (Core)

- Updated `braces` dependency for technical currency. (#2157)
- Fixed `zowe daemon enable` installing an invalid daemon binary on macOS. (#2126)

Zowe CLI Imperative Framework

- Fixed error in REST client that when using stream could cause small data sets to download with incomplete contents. (#744)
- Updated `micromatch` dependency for technical currency. (#2167)
- Updated `braces` dependency for technical currency. (#2157)
- Modified error text in `SyntaxValidator.invalidOptionError`. (#2138)
- Updated error text for invalid command options so that allowable values are displayed as strings instead of regular expressions when possible. (#1863)
- Fixed issue where the `ConfigSecure.securePropsForProfile` function did not list secure properties outside the active config layer. (Zowe Explorer #2633)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.16.

- CVE-2024-24549 (BDSA-2024-0623)
- BDSA-2024-0622
- BDSA-2021-2621
- BDSA-2023-2855
- CVE-2023-26159 (BDSA-2023-3572)
- CVE-2024-28849 (BDSA-2024-0638)
- CVE-2022-25883 (BDSA-2023-2207)
- CVE-2024-22243 (BDSA-2024-0402)
- CVE-2024-22257 (BDSA-2024-0647)

Version: v3.2.x LTS

Version 2.16.0 (May 2024)

Welcome to the Zowe Version 2.16.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.16.0 build: Want to try new features as soon as possible? You can download the v2.16.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.16.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe Install Packaging

- Reduced resource consumption by removal of one shell process per server that was used when starting each server. (#3812)
- The command `zwe support` now includes `CEE Runtime` option output to better diagnose issues related to environment customization. (#3799)

Zowe Application Framework

Zowe Common C

- No YAML value converted to null. (#442)
- Added `zos.getZosVersion()` and `zos.getEsm()` calls for `configmgr QJS`. (#429)
- For correct `base64` encoding scheme the buffer size is made to be divisible by 3. (#431)
- Now the leap seconds are taken into account in `xmem log messages' timestamps`. (#432), (#433)
- Using a temporary buffer pointer to avoid pointer corruption during file write. (#437).

Zowe API Mediation Layer

- The log message `ZWEAM001I` is now issued when API Mediation Layer starts. (#3523)
- SSL is now disabled when profile `attls` is active to simplify AT-TLS configuration. (#3521)
- Valid OIDC tokens are now forwarded to the downstream service when the distributed ID is not mapped. (#3497)
- Included OIDC JWKSet in the gateway JWKs. JWKs retrieved from the Identity Provider allow clients and services to validate the OIDC access token locally. (#3499)

- Moved OIDC access token from cookie to special header. If the user ID from the token cannot be mapped to a mainframe account, the access token is now sent via the request header OIDC-token. (#3513)

Zowe CLI

Zowe CLI (Core)

- Added a prompt for user ID/password on SSH commands when a token is stored in configuration. (#2081)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Bug fixes

Zowe Version 2.16.0 contains the bug fixes that are described in the following topics.

Zowe Install Packaging

- `zowe.network.validatePortFree` and `zowe.network.vipaIp` variables were moved from `zowe.network` to `zowe.network.server` in the schema but not in the code, causing inability to use them without the workaround of specifying them as environment variables ZWE_NETWORK_VALIDATE_PORT_FREE and ZWE_NETWORK_VIPA_IP instead. Now, the variables match the schema: `zowe.network.server` is used instead of `zowe.network`. (#3784)
- `configmgr` operations now run with `HEAPPOOLS64` set to `OFF` to avoid abends caused when this parameter is not `OFF`. (#3799)

Zowe Application Framework

Zluz App Server

- Removed message saying node not found prior to discovery of node. Now, you will only get an error message if node is not found after lookup in `NODE_HOME`. (#301)

ZSS

- `AUX` should take leap seconds into account in their `log messages' timestamp`. (#690), (#691)

Zowe API Mediation Layer

- Allow key exchange port configuration (#3453)
- Changed the scheme of the service homepage when AT-TLS is enabled and fix a bug in the UI. (#3346)
- Checked for NullPointerException when the JWK key cannot be retrieved. (#3503)
- Fixed an issue when PAT passed as the authorization header with the auth scheme zoweJwt (#3505)
- Fixed the header position in the API Catalog. (#3345)
- Fixed the log message about unauthorized calls. (#3326)
- Allow for more general exception handling to detect TCP Stack restart. (#3462)
- Fixed configuration enabling JWT Token Refresh Functionality. (#3474)
- Fixed the Zowe logo and trademark info in the API Catalog. (#3338)

Zowe CLI

Zowe CLI (Core)

- Fixed the command `zowe daemon enable` installing an invalid daemon binary on macOS. (#2126)
- Fixed error in the `zos-files list all-members` command that could occur when members contain control characters in the name. (#2104)
- Resolved technical currency by updating the `tar` dependency. (#2101)
- Resolved technical currency by updating the `markdown-it` dependency. (#2106)
- Fixed default base profile missing in configuration generated by the `zowe config auto-init` command. (#2084)
- Updated dependencies of the daemon client for technical currency. (#2076)

DB2 Plug-in for Zowe CLI

- Updated follow-redirects transitive dependency to resolve technical debt. (#147)

FTP Plug-in for Zowe CLI

- Fixed error when listing spool for active jobs to. Now prints a warning that says that no spool files are available. (#156)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.15.

- BDSA-2023-1804
- CVE-2023-46589 (BDSA-2023-3298)
- BDSA-2021-2621
- CVE-2023-45857 (BDSA-2023-2855)
- BDSA-2023-3572

Version: v3.2.x LTS

Version 2.15.0 (March 2024)

Welcome to the Zowe Version 2.15.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.15.0 build: Want to try new features as soon as possible? You can download the v2.15.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.15.0 contains the enhancements that are described in the following topics:

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe API Mediation Layer

- Timeout configuration values of the websocket webclient are now supported in the API Gateway. (#3315)

Zowe CLI

Zowe CLI (Core)

- Added `--binary` and `--encoding` options to the `zos-files edit` command in Zowe CLI V2, allowing users to download and edit binary files and data sets, or to edit files and data sets with a user-specified encoding. (#1725)
- Hid the progress bar if the `CI` environment variable is set, or if the `FORCE_COLOR` environment variable is set to `0`, to prevent the progress bar from displaying improperly in some cases. (#1845)

Zowe CLI Imperative Framework

- Added multiple APIs to the `ProfileInfo` class to help manage schemas between client applications. (Zowe CLI #2012)
- Hid the progress bar if the `CI` environment variable is set, or if the `FORCE_COLOR` environment variable is set to `0`, to prevent the progress bar from displaying improperly in some cases.. (Zowe CLI #1845)

IMS Plug-in for Zowe CLI

- Deprecated the IMS Plug-in for Zowe CLI due to compatibility issues between the plug-in, the Zowe IMS Operations API, and IBM IMS running on the mainframe.

- Added notices in documentation announcing the deprecation of the IMS Plug-in for Zowe CLI. (#66)

z/OS FTP Plug-in for Zowe CLI

- Updated the version of zos-node-accessor to 1.0.16. (#149)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Bug fixes

Zowe Version 2.15.0 contains the bug fixes that are described in the following topics:

Zowe installation and packaging

- `zwe diagnose` has been updated to use `configmgr` (#3627)
- The Zowe PSWI has been updated to address known installation and configuration issues in prior versions. (#3779)

Zowe Application Framework

Zowe Common C

- Removed obsolete building script `build_configmgr.sh`. (#410) and (#423)

Zlux Server Framework

- App-server is now able to merge `HTTPS` and `HTTP` addresses and can run in `HTTP` mode for `AT-TLS` setup. (#532)

Zowe API Mediation Layer

- Displaying the base path in API Catalog has been fixed. (#3297)
- Disabling EhCache using `apiml.caching.enabled=false` has been fixed. (#3280)

Zowe CLI

Zowe CLI (Core)

- Fixed race condition in the `config convert-profiles` command that may fail to delete secure values for old profiles.
- Resolved technical currency by updating `socks` transitive dependency. (#2049)
- Updated zos-files copy dsclp system tests to include large mock files. This improves system test coverage for edge cases involving large data sets. (#2023)

Zowe CLI Imperative Framework

- Fixed race condition in the `config convert-profiles` command that may fail to delete secure values for old profiles. (Zowe CLI #2055)
- Resolved issue in `ProfileInfo` where schema comparisons fail, specifically when comparing the cached schema against a command-based schema during registration. (Zowe CLI #2045)
- Resolved technical currency by updating `socks` transitive dependency. (Zowe CLI #2049)
- Updated `mustache` and `jsonschema` dependencies for technical currency. (Zowe CLI #2024)
- Fixed issue where secure property names could be returned for the wrong profile. (Zowe Explorer #2633)
- Fixed issue when a property is not found in `ProfileInfo.updateProperty({forceUpdate: true})` so extenders can set or update a property in a team configuration even if it is not defined in the schema without their application/extension failing. (Zowe Explorer #2493)

IMS Plug-in for Zowe CLI

- Added missing shrinkwrap to specify versions of dependencies installed with the plug-in. (#65)

z/OS FTP Plug-in for Zowe CLI

- Fixed an issue specific to Windows where uploading a data set with JCL content hangs, preventing further actions through the zFTP VSCode Extension. (#2533)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.14.

- BDSA-2023-2553
- CVE-2023-35116 (BDSA-2023-1491)
- CVE-2023-6378 (BDSA-2023-3307)
- BDSA-2023-3341
- BDSA-2018-4022
- CVE-2023-34055 (BDSA-2023-3275)
- BDSA-2023-2481

Version: v3.2.x LTS

Version 2.14.0 (January 2024)

Welcome to the Zowe Version 2.14.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.14.0 build: Want to try new features as soon as possible? You can download the v2.14.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.14.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe installation and packaging

- The code has been revised to return a Zowe configuration along with the information of the High Availability (HA) instance (if requested). After the enhancement, we get the correct information about if the component is enabled or disabled and more configuration details with the information of the requested HA instance. (#3692)

Zowe Application Framework

Zlux App Server

- Updated schema to specify multiple discovery servers instead of juse one.(#290)

Zowe API Mediation Layer

- Introduced a native identity mapper as a replacement for ZSS identity mapping of x509 and OIDC id. The native identity mapper removes a dependency on an external component and significantly improves performance by switching from an HTTP request to an in-memory call for certificate mapping. (#3252)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Bug fixes

Zowe Version 2.14.0 contains the bug fixes that are described in the following topics.

Zowe installation and packaging

- Environment variables were not using the values specified for each High Availability (HA) instance when `zowe.useConfigmgr` was set to `true`. (#3692)

Zowe Application Framework

Zlux Server Framework

- `App-server` could not load when multiple discovery servers were present and the App-server was unable to reach the first one specified. Now, the `App-server` will iterate through the list of servers until an accessible one is reached. (#522)
- `App-server` would not correctly detect when it was running in a high-availability configuration environment. (#521)
- A call to `GET /plugins` would trigger an authorization check regardless of if `rbac` was set `ON` or `OFF`.(#523)

Zowe API Mediation Layer

- Fixed the truststore for websockets in the Spring Cloud Gateway (v2). (#3249)
- Fixed the keyring path update to properly support keyring paths by Spring Cloud Gateway. (#3265)
- Fixed a conflict of XML processing between EhCache and the onboarding process. (#3266)
- Fixed using a keystore during creation of a request without a client certificate in Spring Cloud Gateway. (#3273)
- Fixed closing WebSocket to prevent a memory leak. (#3271)
- Fixed disabling EhCache. (#3276)
- Fixed enabling CORS by default in AT-TLS mode used in the API Gateway. (#3270)

Zowe CLI

Zowe CLI (Core)

- Corrected extra character being displayed at the end of lines when issuing command `zowe files compare` on Windows. (#1992)
- Corrected the online help description for `zowe files compare uss`. (#1754)
- Fixed typo in command help for `zowe zos-workflows create` commands. (#2003)

Zowe CLI Imperative Framework

- Updated the error message shown for a command with a `null` or undefined option definition to include the command handler file path to better identify the command causing the error. (#2002)

DB2 Plug-in for Zowe CLI

- Updated follow-redirects transitive dependency to resolve technical debt. (#139)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.13.

BDSA-2023-2855

Version: v3.2.x LTS

Version 2.13.0 (December 2023)

Welcome to the Zowe Version 2.13.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.13.0 build: Want to try new features as soon as possible? You can download the v2.13.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.13.0 contains the enhancements that are described in the following topics.

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>
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>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe installation and packaging

- Added utility `getesm` into `bin/utils`. It tells you which `ESM` your system is using. (#3662)

Zowe Application Framework

ZLUX App Server

- Updated schema to allow `cipher` customization in `IANA` format. (#284)
- Updated schema to allow `curve` customization. (#284)
- Updated defaults to read `TLS` settings and `IP` settings from the `zowe.network.server` attribute of `Zowe.yaml`. (#284)

ZLUX Server Framework

- Added support for using `zowe.network` and `components.app-server.zowe.network` to set listener IP and TLS properties including `max and min version`, `ciphers`, and `ECDH curves`. (#511)

Zowe Common C

- Added support for using `zowe.network` and `components.zss.zowe.network` to set `TLS` version properties. (#411

ZSS

- Added support for using `zowe.network` and `components.zss.zowe.network` to set listener `IP` and `TLS` version properties. (#659)

- Added support for using `zowe.network` and `components.zss.zowe.network` to set `cipher` suites.
- Changed pattern matching for keyrings to allow more types of keyrings in the future. (#581)
- Consolidated `JWK warnings` into improved `ZWES1606W message`. (#663)

Zowe API Mediation Layer

- CORS is now enabled in default mode with AT-TLS profile. This configuration allows for AT-TLS to allow all origins by default. (#3221)
- Zowe authentication scheme has been added to the Cloud Gateway. (#3214)
- The endpoint `/zaas/zoweJwt` has been added to provide Zowe JWT token for Spring Cloud Gateway. (#3199)
- The endpoint `/zaas/zosmf` has been added to provide z/OSMF JWT/LTPA2 token for Spring Cloud Gateway. (#3153)
- The endpoint `/zaas/safIdt` has been added to provide the SAF IDT token for Spring Cloud Gateway. (#3220)
- z/OSMF scheme in Spring Cloud Gateway is now supported. (#3190)
- Fixes have been applied for Azure JWKS reader. (#3200)
- Additional Discovery Service registration by Spring Cloud Gateway is now supported. (#3181)
- Gateway additional registrations HA (#3127)
- Fetch JWK from OIDC providers. This feature implements a mechanism and new properties in OIDC to configure the JWK keys location obtained according to documentation from the authorization server's metadata. (#3137)
- The following two properties in the zowe.yaml file have been deprecated in the current release as OIDC configuration has become more general:
  - `components.gateway.apiml.security.oidc.clientId`
  - `components.gateway.apiml.security.oidc.clientSecret`

Zowe CLI

Zowe CLI (Core)

- Incorporated all source code from the `zowe/imperative` Github repository into the `zowe/zowe-cli` repository for a more streamlined code architecture. This change should have no user impact. (#1821)
- Deprecated `getDataSet` in the `zosfiles` command group utility functions. `getDataSet` will be removed in Zowe V3. Use `zosfiles` SDK's `ZosFilesUtils.getDataSetFromName` command instead. (#1696)

z/OS FTP Plug-in for Zowe CLI

- Added a step to check the validity of a USS file path for the `upload` and `stdin-to-uss-file` commands. (#145)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Bug fixes

Zowe Version 2.13.0 contains the bug fixes that are described in the following topics.

Zowe installation and packaging

- Users were not able to use zOSMF workflows because the workflow files were not encoded in ASCII format. In this release, the workflow files in the Zowe PAX are encoded in ASCII format. (#3591).

Zowe API Mediation Layer

zss

- Corrected build environment file's use of IP address to github.com. (3660)
- Fixed signing the outgoing call from Cloud Gateway where necessary. (#3203)
- Fixed AT-TLS support by fixing the AT-TLS filter setup, adding a debug message for AT-TLS support mode initialization, disabling routing to the Discovery service from the Gateway, and updating dsl in the security chain setup. (#3186)
- Fixed read public key from keyring. (#3212)
- Updated bean definitions for noop cache mode. (#3197)
- Changed ehCache storage location. This fix uses the correct environment variable to avoid a resource lock when reading the cache directory in HA setup. (#3184)
- Fixed qualifier for the JWT clock. (#3180)
- Set HTTP client timeouts. (#3174)
- Made style updates for Catalog UI and Caching Fix for static file distribution in API Catalog. (#3168)
- Gateway additional registration fixes. (#3172)
- Set defaults in the cloud-gateway-service application.yml. (#3167)
- Added Qualifier for clock to avoid conflict in extension. (#3166)
- Enhanced error handling in the UI. (#3158)
- Fixed context path from the application property in the mock catalog controller. (#3159)

Zowe CLI

Zowe CLI Imperative Framework

- Added missing `npm-shrinkwrap.json` file to `package.json`. (#1978)

- Added missing z/OSMF connection options to the z/OS `logs` command group. (#1842)
- Removed out-of-date `Perf-Timing` performance timing package to improve Zowe CLI maintainability. (#1830)
- Fixed behavior where a specified directory name was being lowercased on non-PDS data sets when downloading all data sets. (#1722)
- Fixed bug where encoding is not passed to the `Download USS Directory` API. (#1825)

Zowe CLI Imperative Framework

- Fixed `AbstactRestClient` command failing to return when streaming a large data set or USS file. (#1805, #1813, #1824)

DB2 Plug-in for Zowe CLI

- Added missing `npm-shrinkwrap.json` file to `package.json`. (#137)
- Updated `ibm_db` dependency for technical currency. (#134)

z/OS FTP Plug-in for Zowe CLI

- Added missing `npm-shrinkwrap.json` file to `package.json`. (#147)
- Provided new utility function to check file names for valid characters. (#143)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.12.

- CVE-2023-33201 (BDSA-2023-1625)
- CVE-2022-25883
- CVE-2023-34034 (BDSA-2023-1825)

- CVE-2023-38286 (BDSA-2023-1804)

Version: v3.2.x LTS

Version 2.12.0 (October 2023)

Welcome to the Zowe Version 2.12.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.12.0 build: Want to try new features as soon as possible? You can download the v2.12.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.12.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe Application Framework

Zlux App Server

- New versions of the components can change the location of their plug-ins, as the app-server will now re-inspect the plugin locations on each startup. (#280)

ZLUX Server Framework

- Auth plug-ins that are not requested by any dataservice found at startup are no longer loaded by the server. (#504)

ZSS

- ZSS now defaults to using `TLS 1.3`, which requires a minimum of zOS Version `2.4`. (#646)
- Added configuration parameter `components.zss.agent.https.maxTls` to control which level of TLS to use, allowing downgrading to `tls 1.2` if desired with value `TLSv1.2`. (#654)
- Added configuration parameter `components.zss.agent.https.trace` which can be set to `true` if desired to capture a `GSK` trace, which will be put into the log directory. (#654)

Zowe API Mediation Layer

- Added a Central API ML registry endpoint to the Cloud Gateway to access an aggregated view of all services from all domains. (#3076)
- It is now possible to forward the client certificate from Central Gateway to Domain Gateway in the request header. (#3046)

- You can now register the Gateway to an additional Discovery service. Clients outside of the API ML cluster can now know about other gateways to facilitate routing to clusters and domains. (#3068 and #3044)
- You can now verify service SSO support from API ML. (#3054)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog for updates included in this release.

Zowe Explorer API

- See the Zowe Explorer API changelog for updates included in this release.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog for updates included in this release.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog for updates included in this release.

Bug fixes

Zowe Version 2.12.0 contains the bug fixes that are described in the following topics.

Zowe Installation and packaging

- Fixed a rare bug where zwe could hang when running a unix program. (#3590)

Zowe Application Framework

ZLUX App Server

- Removed error message `components/app-server/bin/configure.sh 26: .: FSUM6807 expression syntax error` seen in startup of Zowe in Version `2.11.0`, caused by incorrect shell syntax. (#283)

Zowe API Mediation Layer

- Fixed normalization of `baseUrl` in ZAAS client. (#3123)
- Added the JVM heap configuration to `zowe.yaml`. (#3087)
- Fixed an error preventing the Catalog UI to load when a service does not have a required parameter. (#3050)
- Fixed a navigation issue in the Catalog when using the browser back button. (#3135)

Zowe CLI

Zowe CLI (Core)

- Fixed bug where encoding is not passed to the Download USS Directory API. (#1825)
- Bumped Imperative to Version `5.18.2` to fix issues with normalizing newlines on file uploads. (#1815)

- Bumped Secrets SDK to Version `7.18.6` to use `core-foundation-rs` instead of the now-archived `security-framework` crate; to include the edge-case bug fix for Linux; and to resolve build failures for FreeBSD users.

Zowe CLI Imperative Framework

- Fixed normalization on stream chunk boundaries. (#1815)

Zowe Explorer

Zowe Explorer (Core)

- See the Zowe Explorer changelog.

Zowe Explorer API

- See the Zowe Explorer API changelog.

Zowe Explorer FTP Extension

- See the Zowe Explorer FTP Extension changelog.

Zowe Explorer ESLint Plug-in

- See the Zowe Explorer ESLint Plug-in changelog.

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.11.

- CVE-2023-33546 (BDSA-2023-1535)
- CVE-2023-34462 (BDSA-2023-1556)
- BDSA-2023-1804
- CVE-2023-26136

Version: v3.2.x LTS

Version 2.11.0 (September 2023)

Welcome to the Zowe Version 2.11.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.11.0 build: Want to try new features as soon as possible? You can download the v2.11.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.11.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe V2 minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe Installation and Packaging

- Added `zowe.sysMessages` as a property to the `Zowe YAML` configuration file. This property is a new array that allows you to select messages that will be duplicated into the z/OS syslog, when found in Zowe's job log. (#93)

Zowe Application Framework

- The title and description of the app server tile within the `API Catalog` has been updated to be more accurate and detailed. (#497)

Zowe Common C

- Functions for printing messages to `z/OS syslog` via `WTO` have been added to zos.(#397)

Zowe API Mediation Layer

Swagger is now validated for registered services whereby all endpoints listed in the swagger can be called and give a documented response. This feature also checks that the API is correctly versioned. (#3039)

Zowe CLI

Zowe CLI (Core)

- Bumped Secrets SDK to `7.18.3`. It uses more reliable resolution logic for `prebuilds` folder; adds static CRT for Windows builds. (#1791)
- Updated daemon on MacOS to use universal binary which adds support for Apple Silicon. (#1766)

- Added support for mutliple `zowe auth login apiml` operations on a single `zowe config secure` call. (#1734)
- Replaced use of `node-keytar` with the `keyring` module from `@zowe/secrets-for-zowe-sdk`. See Secrets SDK for more information.
- Updated the Imperative Framework to add support for unique cookie identifiers from API ML. (#1734)
- Created zos-files edit commands to edit a data set or uss file locally. (PR #1672)
-

Zowe CLI Imperative Framework

- Replaced use of `node-keytar` with the new `keyring` module from `@zowe/secrets-for-zowe-sdk`. See Secrets SDK for more information. (Zowe CLI #1622)
- Added `inSchema` property for ProfileInfo to indicate if argument is a known schema argument. (#899)
- Handled unique cookie identifier in the form of dynamic token types. (#966)
- Added a new utility method to `ImperativeExpect` to match regular expressions. (#966)
- Added support for multiple login operations in a single `config secure` command execution. (#966)

Bug fixes

Zowe Version 2.11.0 contains the bug fixes that are described in the following topics.

Zowe Installation and Packaging

- Fixed a bug where using recent versions of `Java 8` to generate a `Zowe PKCS12 keystore` would result in an unusable keystore to `ZSS` and other z/OS software that utilizes GSK / SystemSSL. The fix uses a compatibility option in Java to revert its keystore generation behavior to prior behavior that worked for Zowe.(#3507)

Zowe Application Framework

- Fixed regression that prevented use of multiple certificatate authorities when specified via the `zowe.certificate.pem.certificateAuthorities` section of the `Zowe YAML` configuration file. (#266)

Zowe API Mediation Layer

- The default value of `nonStrictVerifySslCertificatesOfServices` is now set to false. (#3029)
- Fixed newlines and SSL error message in z/OSMF validation. (#3024)
- Improvements have been made in z/OSMF logging in debug and error handling. (#2998)

Zowe CLI

Zowe CLI (Core)

- Fixed an issue in the Daemon server which prevents users on Windows with uppercase letters in their username from using the Daemon. (#1765)
- Added a check to the `zowe files create data-set` command to prevent users from specifying an invalid block size for sequential data sets with variable block format. (#1439)
- Fixed a failure with the `zowe auth logout apiml` command that occurred if the user had an invalid or expired token. A user with an invalid or expired token can use the `zowe auth logout apiml` command to remove the expired token

from their secure credential storage. (#1734)

- Removed the need to check for basepath when the user was logging out to prevent misleading `basePath error` when credentials are invalid. (#1734)

Zowe CLI Imperative Framework

- Fixed merging of profile properties in `ProfileInfo.createSession`. (#1008)
- Fixed an issue to now allow a user to run the `zowe auth logout apiml` command multiple times without failing. (#966)
- Updated the `auto-init` command to prevent an unwanted second login request if the user already has a token. (#966)

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.10.

- BDSA-2023-1491
- CVE-2023-33546
- CVE-2022-1471 (BDSA-2022-3447)
- BDSA-2023-0953
- CVE-2023-20883 (BDSA-2023-1225)
- CVE-2023-20873

Version: v3.2.x LTS

Version 2.10.0 (July 2023)

Welcome to the Zowe Version 2.10.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.10.0 build: Want to try new features as soon as possible? You can download the v2.10.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.10.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe V2 minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe installation and packaging

- Added a new zwe `diagnose` command to get help on zowe error messages. (#3455)

Zowe Application Framework

Zowe API Mediation Layer

- The API Catalog now allows pre-defined style customizations. (#2965)

Zlux App Server

- Migrated app-server configuration options into a `defaults.yaml` file which adheres to the schema of the Zowe config. This allows users to see the default behaviors more clearly and can serve as an example by which users can customize their Zowe config to override such defaults. (#247)

Zlux Server Framework

- Avoid going directly to the Desktop when the gateway is active, by redirecting to the gateway equivalent homepage when the homepage is accessed. The redirect behavior can be prevented if desired by using the query parameter `?zwed-no-redirect=1` in your URL. (#449)

Zowe Common C

- The `configmgr` can now use the `zos` module in YAML config templates. The `zos` module is only added when run on zOS. For a list of available functions, see this link. (#384)

Zowe CLI

Zowe CLI Imperative Framework

- Performed back-end preparation for the upcoming `ZOWE_V3_ERR_FORMAT` environment variable to enable the ability to display errors in a more reader-friendly format. (Zowe CLI #935)

Bug fixes

Zowe Version 2.10.0 contains the bug fixes that are described in the following topics.

Zowe Application Framework

Zlux App Server

- Fixed the URLs that app-server would print in the logs describing where it was accessible from. Messages were incorrectly providing URLs indicating the app-server's location from the discovery server instead of the gateway server. (#247)

Zlux App Manager

- Fixed a timing issue with the `iframe-adapter` for Firefox. (#532)

ZSS

- Datasets with `VOLSER` set to an `MVS` symbol would cause dataset read, write, and metadata API calls to fail for those datasets. It is fixed now.(#603)
- Previously, the `zss/datasetMetadata` API could encounter an `0C9-09` error when accessing a dataset with 0 block size. This is fixed. Now it does not have an error while accessing such datasets. (#606)

Zowe Common C

- `configmgr` parsing of `YAML` to `JSON` has been updated to 1024 characters to allow for up to max unix path strings. Earlier it was limited to 256 characters for strings. (#383)

Zowe API Mediation Layer

- The client is provided with information about an expired password. (c4dc217, closes #2969)

Zowe CLI

Zowe CLI (Core)

- Fixed the `zowe files create data-set` command failing when no additional options are specified. (#1736)
- Added check for invalid block size when creating a sequential data set. (#1439)
- Added the ability to list all data set members when some members have invalid names. (#1730)
- Removed extra calls to list data sets matching patterns if authentication to z/OSMF fails. (#1731, Zowe Explorer #2262)

Zowe CLI Imperative Framework

- Enabled `NextVerFeatures.useV3ErrFormat()` to form the right environment variable name even if `Imperative.init()` has not been called. (Zowe CLI #935)

- Handle logic for if a null command handler is provided. (#990)

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.9.

- BDSA-2023-1491
- CVE-2023-33546
- CVE-2022-1471 (BDSA-2022-3447)
- BDSA-2023-0953
- CVE-2023-20883 (BDSA-2023-1225)
- CVE-2023-20873

Version: v3.2.x LTS

Version 2.9.0 (June 2023)

Welcome to the Zowe Version 2.9.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.9.0 build: Want to try new features as soon as possible? You can download the v2.9.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.9.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe V2 minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
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Zowe installation and packaging

- Users who have not set the value of `zowe.useConfigmgr` will now have the behavior set to `true`. If you still wish to use false, set `zowe.useConfigmgr=false` explicitly. (#3423)

Zowe Application Framework

Zlux Server Framework

- `zowe.certificates.pem` is no longer needed when using keyrings. (#448)

Zowe Common C

- `configmgr's` z/OS module now has a `resolveSymbol` function which takes a string starting with `&` which can be used to resolve static and dynamic z/OS symbols. (#378)

Zowe API Mediation Layer

- Personal access tokens are now accepted as Bearer authentication and in the `apimlAuthenticationToken` cookie. (7c393a6, closes #2908)
- A OAuth2 access token is now accepted as an authentication source. (3809622, closes #2835)
- The maximum idle timeout for websocket connections (between the gateway and the registered service) is now configurable. (020da87, closes #2914)

Imperative CLI Framework

- Added the function `IO.giveAccessOnlyToOwner` to restrict access to only the currently running user ID for security. (#987)
- Enabled command arguments to change `{$Prefix}_EDITOR`. Updated `IDiffOptions` to include names for the files that are to be compared. Updated `IO.getDefaultTextEditor()` for different OS versions. Updated return value types for `CliUtils.readPrompt`. This prepares development of future commands in Zowe CLI. (#967)
- Altered `TextUtils` behavior slightly to enable daemon color support without TTY. (#977)

Zowe CLI

- Updated daemon to use `tokio` library instead of the unmaintained `named_pipe` library for technical currency. (#1710)
- Added the `zowe files copy dsclp` command to copy a data set from one LPAR to another, making data transfer between LPARs easier. (#1098)
- Re-enabled color in the daemon client to differentiate text displayed in the terminal. (#1379)

Zowe Explorer

- Added option to save unique data set attributes as a template after allocation for future use. (#1425)
- Added "Cancel Job" feature for job nodes in Jobs panel view. (#2251)
- Enhanced ID generation for parent tree nodes to ensure uniqueness. (#2325)
- Added support for custom credential manager extensions. (#2212)

Bug fixes

Zowe Version 2.9.0 contains the bug fixes that are described in the following topics.

Zowe Application Framework

ZLux App Server

- Recognizers from multiple plug-ins could not be merged due to an error in the merge code execution at startup. (#256)

Zowe API Mediation Layer

- Client certificates in a request are ignored when x509 authentication is not enabled. (406f588, closes #2930)
- The correct list of public keys are returned when z/OSMF is not available. (030a34f, closes #2936)

Imperative CLI Framework

- Added logic to display a warning in cases where a `null` command handler is provided. (#990)
- Fixed a logic error in the `config list` command that caused unwanted behavior when a positional argument and the `--locations` option were both passed in the command. (#989)
- Reduced file loading time by searching for command definitions with the `fast-glob` NPM module instead of the `glob` module. (#986)
- Removed validation of the deprecated `pluginHealthCheck` property because it was an unused feature. (#980)

Zowe CLI

- Enabled ANSI in Windows-based terminals to better display progress bars when using daemon mode. (#1701)
- Changed daemon to spawn as its own process to avoid unintentional termination of the daemon mode. (#1241, #1277, #1309)
- Fixed `--secondary` data set allocation option being specified as `1` unit on `BLANK` type data sets with the `zowe files create data-set` command. (#1595)
- Fixed `--range` option so it is not ignored on the `zowe files view uss-file` command. (#1717)
- Fixed `--binary` option ignored by commands that upload and download USS directories when the `.zosattributes` file is used. (#1717)
- Fixed `--include-hidden` option ignored by the `zowe files upload dir-to-uss` command when it was used without the `--recursive` option. (#1717)
- Implemented several updates for technical currency. Updated Imperative to allow for special handling of chalk and coloring in daemon client (#1721). Updated `imperative` to fix undesired behavior in the `zowe config list` command in certain situations (#1721). Updated `tar` dependency (#1719).

IBM Db2 Database Plug-in for Zowe CLI

- Updated `ibm_db` dependency for better support with Node.js 18. (#125)

Zowe Explorer

- Fixed issue where the **Disable Validation for Profile** context menu option did not update to **Enable Validation for Profile** after use. (#1897)
- Removed "/" characters in `path.join()` calls. (#2172)
- Fixed issue where user was not able to view job spool file with the same DD name in different steps because of duplicated local file name. (#2279)
- Fixed issue where user was not able to view job spool file from jobs with duplicated step names because of duplicated local file name. (#2315)
- Fixed issue with Windows path when uploading file to data set. (#2323)
- Fixed an issue with mismatch etag error returned not triggering the diff editor and possible loss of data due to the issue. (#2277)
- Fixed issue where refreshing views collapsed the tree views in their respective panels. (#2215)

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

Version: v3.2.x LTS

Version 2.8.0 (April 2023)

Welcome to the Zowe Version 2.8.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.8.0 build: Want to try new features as soon as possible? You can download the v2.8.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.8.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe V2 minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe installation and packaging

- Component installation can now print stdout of install scripts. (#3361)

Zowe Application Framework

ZSS

- Added the API `/datasetCopy` to copy data sets.
- `/datasetMetadata` now returns prime, secnd, and space fields for showing the primary and secondary extent sizes and the unit type for them. (#582)
- ZSS data set creation API now supports space values of `BYTE`, `KB`, and `MB`, instead of just `CYL` and `TRK`.

Zowe Common C

- `fileCopy` now copies with the target having the permissions of the source, as opposed to the previous 700 permissions.

Zlux App Manager

- Added new `isSingleAppModeSimple()` to `iframe-adapter` to differentiate between **standalone mode** and **simple standalone mode**.
- Replaced existing snapshot preview with lighter UI to significantly increase multi-app Desktop performance.

Zlux Server Framework

- Added support for `zowe.verifyCertificates=NONSTRICT`. (#468)
- Allow dataservices to pass CAs into the `call()` function. (#462)

Zlux Editor

- Renamed `openFile` to `openBuffer` in `editor-control.serverice.ts`.

Zowe API Mediation Layer

- A unique authentication cookie name has been added for multi-instance deployment (#2812) (6654271), closes #2812.

Zowe CLI

Zowe CLI (Core)

- Updated Imperative to add `--prune` option to `zowe config secure` command to delete unused properties. (Imperative #547)
- Added `range` option to `zos-files view uss-file` command.

Imperative CLI Framework

- Added `--prune` option to `zowe config secure` command to delete unused properties. (#547)
- Added `credMgrOverride` property to `IProfOpts` interface that can be used to override credential manager in the `ProfileInfo` API. (Zowe CLI #1632)
- Deprecated the `requireKeytar` property on the `IProfOpts` interface. Use the `credMgrOverride` property instead and pass the callback that requires Keytar to `ProfileCredentials.defaultCredMgrWithKeytar`.
- Added `AbstractPluginLifeCycle` to enable plug-ins to write their own `postInstall` and `preUninstall` functions, which will be automatically called by the Zowe plug-in's `install` and `uninstall` commands.
- Added `pluginLifeCycle` property to `IImperativeConfig` to enable a plug-in to specify the path name to its own module which implements the `AbstractPluginLifeCycle` class.
- Added a list of known credential manager overrides to Imperative. When a credential manager cannot be loaded, a list of valid credential managers displays in an error message.
- Added a `CredentialManagerOverride` class containing utility functions to replace the default CLI credential manager or restore the default CLI credential manager. Plug-ins which implement a credential manager override can call these utilities from their `AbstractPluginLifeCycle` functions.
- Added documentation Overriding_the_default_credential_manager describing the techniques for overriding the default CLI credential manager with a plug-in.

z/OS FTP Plug-in for Zowe CLI

- Updated example of `upload file-to-data-set` command in the plug-in help.

Zowe Explorer

- Added a new Zowe Explorer setting, `zowe.logger`, with a default setting of `INFO` to allow users to select the level of logging they want to see. Logging levels range from TRACE (most verbose) to FATAL (only fatal).
- Added an output channel, `Zowe Explorer`, for logging within VS Code's Output view so users can view Zowe Explorer logs within VS Code. The log level is set by the new Zowe Explorer setting, `zowe.logger`.
- Opening a dialog for Upload or Download of files will now open at the project level directory or the user's home directory if no project is opened. (#2203)
- Updated linter rules and addressed linter errors throughout the codebase. (#2184)
- Added the new setting `zowe.files.logsFolder.path` that can be used to override the Zowe Explorer logs folder if the default location is read-only. (#2186)

Bug fixes

Zowe Version 2.8.0 contains the bug fixes that are described in the following topics.

Zowe installation and packaging

- Component environment variables will not be aliased to the `configs` shorthand when the component had a configure script, but not a validate script, and `zowe.useConfigmgr` was enabled.
- When `zowe.useConfigmgr=true`, component installation will not run the installation script from the component root directory, but instead from the place `zwe` was executed, causing relative path differences versus `zowe.useConfigmgr=false`.

Zowe Application Framework

ZSS

- Changed conflicting message IDs in the ZIS dynamic linkage base plug-in.

Zowe Common C

- `fileCopy` would not work when convert encoding was not requested. The destination file would be created, but without the requested content.
- `respondWithUnixFileMetadata` would not return UID or GID of a file if the id-to-name mapping failed, which is possible when an account is removed.

Zlux App Manager

- Fixed the iframe-adapter not properly recognizing **standalone mode**.
- Fixed Iframes from unintentionally loading their sources multiple times during refocus and multi-app situations.

Zlux Editor

- Fixed app2app `openDataset` function.
- Renamed `openFile` to `openBuffer` in `editor-control.serverice.ts`.

Zowe API Mediation Layer

- Mitigate storing password in memory for V2 (#2858) (b1596eb), closes #2858.
- Mitigate storing password in memory for V1 (#2867) (3356b7c), closes #2867.
- Read response from http client to prevent exahusting connection pool (#2854) (137be23), closes #2854.
- Passticket generation and limit Eureka replication peers threads (#2845) (42b491e), closes #2845.
- Refactor SSL configuration (#2832) (33f4882), closes #2832.

Zowe CLI

Zowe CLI (Core)

- Fixed `encoding` option for `zos-files view uss-file` command. (#1495)
- Added notification that `encoding`, `binary`, and `record` options conflict on the `zos-files view data-set` and `zos-files view uss-file` commands.
- Updated Imperative to fix the `zowe auth li` and `zowe auth lo` aliases. (Imperative #964)
- Fixed URI encoding on `zos-jobs` commands. (#1596)
- Updated Imperative to fix an error on Windows preventing plug-ins from installing if a local file or directory contains a space. (Imperative #959)
- Updated daemon executable to resolve technical debt.
- Fixed URI encoding on `zos-files` commands. (#1073)
- Solved daemon issue where Windows usernames were treated as case-sensitive when checking the daemon process owner during Zowe commands.
- Fixed the `login` and `logout` handlers, fixing the `li` and `lo` aliases.
- Fixed broken plug-in install command for Windows when a file has a space in the name.
- Fixed plug-in install error not displayed correctly. (#954)
- Fixed environment file not applying to daemon client environment variables.

CICS Plug-in for Zowe CLI

- Updated `xml2js` dependency to resolve security vulnerability.

MQ Plug-in for Zowe CLI

- Fixed GitHub repository URL in `package.json`.

Zowe Explorer

- Fixed issue with silent failures when uploading members into a data set. (#2167)
- Added back fix that was accidentally removed between updates: Resolved an issue where VS Code did not provide all context menu options for a profile node after a multi-select operation. (#2108)
- Fixed issue where `Paste` option is shown for a multi-select operation in the `Data Sets` pane.
- Fixed z/OSMF profiles issue with Data Sets and Jobs with special characters in the names. (#2175)
- Fixed redundant text in error messages that included the same error details twice.
- Fixed error message when no data sets found that match pattern.
- Fixed secure credential storage not possible to enable in Theia.

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

Version: v3.2.x LTS

Version 2.7.0 (March 2023)

Welcome to the Zowe Version 2.7.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.7.0 build: Want to try new features as soon as possible? You can download the v2.7.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.7.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe V2 minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe installation and packaging

The zowe authorized `loadlib` now contains a new ZIS plug-in as a member named `ZWESISDL`. This is the ZIS Dynamic Plug-in, and exists for use by other plug-ins that wish to access `zowe-common-c` utilities at runtime without needing to statically link them in the other plug-in. This plug-in must be referenced in the `ZWESIP00` parmlib member before use. The samplib for `ZWESIP00` now references this `ZWESISDL` member and it is recommended that you update your `ZWESIP00` member using the samplib if you need to use this plug-in.

Zowe Application Framework

ZSS

A new ZIS plug-in, `ZISDYNAMIC`, is available within the LOADLIB as ZWESISDL. This plug-in allows for ZIS plug-ins to access utility functions of the `zowe-common-c` libraries without needing to statically build them into the plug-in itself.

New REST endpoint that maps distributed username to `RACF` user ID.

Zlux Editor

Added the feature to copy the line content and copy URL link to open a file at a specific line.

Zowe API Mediation Layer

API ML now supports additional keyring types (#2799) (952bf2b), closes #2799.

OIDC info is now available via webfinger (#2757) (71e88ba), closes #2757.

The API Catalog can now be configured to hide service information (#2743) (2fbbc65), closes #2743.

Zowe CLI

Zowe CLI (Core)

Added support for a CLI-specific environment variable file for users who are not able to set system environment variables. (#1484)

Added support for downloading job spool content in binary and record formats so you have more options in how to view results. (#1607)

Zowe CLI Imperative Framework

Added the `~/.<cli_name>.env.json` file to provide environment variables to the Imperative framework during Imperative initialization. This allows sites without environment variable access to specify process specific environment variables. (#943)

Added `ProfileInfo.removeKnownProperty` to delete profile properties to use as an alternative to the existing `ProfileInfo.updateKnownProperty` to update a property with an undefined value. To do so, allowed type `IProfArgValue` to be of type `undefined` to support removing properties more easily. (#917)

Zowe Explorer

Added Job search label to the Jobs tree to display the current search query. (#2062)

Added feature to copy datasets (partitioned datasets, sequential, members across partitioned datasets) with multi-select capabilities. (#1150)

Bug fixes

Zowe Version 2.7.0 contains the bug fixes that are described in the following topics.

Zowe installation and packaging

When `zwe` components install detects that the given component is already installed, you will get a message to run `zwe` components upgrade.

Launcher parameters such as `shareAs` could not be customized globally due to `zowe.launcher` schema being wrong with some parameters nested inside another.

Launcher parameters within an individual component were not documented to exist despite the launcher allowing per-component customization.

`zwe` detects and warns against `nodejs` lower than version 14 (due to end of life of v12).

Tracing and writing to log files would not work for component scripts when zowe.useConfigmgr=true.

Zowe Application Framework

Zlux App Server

Explicitly prefer `ipv4` dns results to be compatible with `node 18` since it switched to prefer `ipv6` without configuration. This behavior can be cusomized via `components.app-server.dns.lookupOrder='ipv4'` or `ipv6`. It defaults to `ipv4`.

ZSS

Fixed `/unixfile/metadata` not working when URL encoded spaces were present in file names.

Zlux Editor

Added a few rules for `JCL` syntax highlighter.

Set `USS` path to correct directory, when opening the directory or file in new browser tab respectively.

Getting `400 BAD REQUEST` in the browser when opening the file or data set in a new browser tab.

When opening `New File`, editor keeps on using the earlier opened file and its model.

Zowe API Mediation Layer

Updated keyring config (#2828) (c1e1cc9), closes #2828.

Ran gateway instances with own cache storage (#2807) (4d08707), closes #2807.

Fixed stack overflow during cleaning websocket client (#2815) (376f818), closes #2815.

Fixed support of different type of keyrings in proper format (just two slashes) (#2687) (dfb0168), closes #2687.

Addressed WebSocket connection failure (#2805) (232bade), closes #2805.

Enabled Periodical clean of the connection pool (#2797) (7058290), closes #2797.

Recognized profile settings (#2789) (adf5ea5), closes #2789.

Eureka peer connections loop (#2775) (85a27ea), closes #2775.

Reduced the number of WARN logs (#2780) (df0243f), closes #2780.

Fixed bug in Wizard static onboarding method (#2773) (c8d7c66), closes #2773.

Improved handling of SSL errors (#2744) (bb9792b), closes #2744.

Zowe CLI

Zowe CLI (Core)

Enabled option to download output from a submitted job with the -d flag. The -e flag now enables changes to file extension as originally intended. (#729)

Changed default value for `modify-jobs` option in the Zowe jobs command group to `2.0`. This change results in calls to z/OSMF becoming synchronous, and a successful response from the `modify`, `cancel`, and `delete` commands indicates the requested action was completed successfully. (#1459)

Fix in employing `--context-lines` option for all diff/compare commands. Fixed broken `--seqnum` option implementation. (#1529)

Updated Imperative to include bug fixes in version 5.8.2.

Zowe CLI Imperative Framework

Fixed `--help-examples` option failing on command groups. (Zowe CLI #1617)

Fixed npm not found on `zowe plugins install` when using daemon mode in Windows. (Zowe CLI #1615)

Fixed web help not showing top-level options like `--version` for the `zowe` command. (#927)

Removed `--help-examples` option from CLI help for commands as it only applies to groups. (#928)

Zowe Explorer

Fixed issue where job search queries were not working properly when favorited. (#2122)

Fixed issues where document changes may fail to upload if the environment has a slow filesystem or mainframe connection, or when VS Code exits during an upload operation. (#1948)

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.6.

- CVE-2022-40159
- CVE-2022-42252 (BDSA-2022-3105)
- CVE-2022-31159
- CVE-2022-24999 (BDSA-2022-3375)
- CVE-2022-31690 (BDSA-2022-3109)
- CVE-2022-31692 (BDSA-2022-3106)
- BDSA-2022-2580
- BDSA-2022-2582
- BDSA-2022-2583
- CVE-2022-40151 (BDSA-2022-2580)
- CVE-2022-40152 (BDSA-2022-2582)
- CVE-2022-3517
- CVE-2022-37603 (BDSA-2022-3812)
- CVE-2022-37601 (BDSA-2022-3814)
- CVE-2022-37599 (BDSA-2022-3811)

Version: v3.2.x LTS

Version 2.6.1 (February 2023)

Welcome to the Zowe Version 2.6.1 release!

This release contains a minor packaging fix, no user action is required.

See Zowe's Version 2.6.0 release notes for the latest features, enhancements, and bug fixes.

Download v2.6.1 build: Want to try new features as soon as possible? You can download the V2.6.1 build from Zowe.org.

Version: v3.2.x LTS

Version 2.6.0 (January 2023)

Welcome to the Zowe Version 2.6.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.6.0 build: Want to try new features as soon as possible? You can download the v2.6.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.6.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe V2 minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe API Mediation Layer

- Spring Cloud Gateway implementation - Support of remapping to Passticket (#2046)
- Spring Cloud Gateway implementation - Support of remapping to client certificate (#2044)

Zowe Explorer

- Added Job search prefix validator. (#1971)
- Added file association for zowe.config.json and zowe.config.user.json to automatically detect them as JSON with Comments. (#1997)
- Added the ability to list all datasets, even those with Imperative Errors. (#235, #2036)
- Added favorite job query to jobs view. (#1947)
- Added confirmation message for "Submit Job" feature as an option in extension settings (set to "All jobs" by default). (#998)
- Updated error dialog when Zowe config is invalid, with option to "Show Config" within VS Code for diagnostics. (#1986)

Bug fixes

Zowe Version 2.6.0 contains the bug fixes that are described in the following topics.

Zowe installation and packaging

- When a component configure script failed during startup, no warning would be printed. Starting in 2.6, a warning will be printed and there's also an option to prevent Zowe from continuing startup when this failure is seen, by setting `zowe.launchScript.onComponentConfigureFail` to "exit".
- Tar archived components would not be installed when zowe.useConfigmgr=true was set.
- Various bugfixes made for reading and writing of parmlib configuration files when using the PARMLIB() syntax with zwe commands or the ZWESLSTC job.
- Revised help documentation syntax for substitution values to fix auto-documentation, by changing angle brackets to square brackets.

Zowe Application Framework

zLUX Editor

- Getting 400 BAD REQUEST in browser when opening the file or dataset in a new browser tab.

Zowe API Mediation Layer

- Improve the information for failure of extension loading (#2721)
- Correctly process metadata for the Plain Java Enabler running on z/OS (#1927)

Zowe CLI

Zowe CLI (Core)

- Removed all line break encodings from strings for zos-files compare local-file-data-set (#1528)

Zowe CLI Imperative Framework

- Exported `AppSettings` for CLI and other applications to use. (#840)
- Exported the IAuthHandlerApi from imperative package. (#839)
- Fixed ProfileInfo API failing to load schema for v1 profile when schema exists but no profiles of that type exist. (#645)
- Updated return type of ProfileInfo.getDefaultProfile method to indicate that it returns null when no profile exists for the specified type.
- Fixed a logic error where chained command handlers would cause plugin validation to fail. (#320)
- Fixed IO.writeFileAsync method throwing uncatchable errors. (#896)

z/OS FTP Plug-in for Zowe CLI

- Updated the `list jobs` command to throw an error when an invalid prefix or owner is specified. (Zowe Explorer #1971)

Zowe Explorer

- Updated UI/UX method calls to use standalone Gui module for better usability and maintainability. (#1967)
- Fixed issue where responseTimeout (in Zowe config) was not provided for supported API calls. (#1907)
- Fixed lack of legibility when "Show Attributes" feature displayed unsuitable colors with light Visual Studio Code themes. (#2048)
- Fixed settings not persisting in Theia versions >=1.29.0. (#2065)
- Fixed issue with a success message being returned along with error for Job deletion. (#2075)
- Removed extra files from the VSIX bundle to reduce download size by 64%. (#2042)
- Surfaced any errors from a data set Recall/Migrate operation. (#2032)
- Re-implemented regular dataset API call if the dataSetsMatching does not exist. (#2084)

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.5:

- BDSA-2018-5235
- CVE-2018-10237 (BDSA-2018-1358)
- CVE-2020-8908 (BDSA-2020-3736)
- CVE-2022-42003 (BDSA-2022-2765)
- CVE-2022-42004 (BDSA-2022-2768)
- CVE-2022-38752 (BDSA-2022-2590)
- BDSA-2022-2584
- BDSA-2022-2585
- BDSA-2022-2586

Version: v3.2.x LTS

Version 2.5.0 (December 2022)

Welcome to the Zowe Version 2.5.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.5.0 build: Want to try new features as soon as possible? You can download the v2.5.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.5.0 contains the enhancements that are described in the following topics.

> **FIND OUT MORE**
>
> To watch a demo of new enhancements and updated features included in a Zowe V2 minor release, look for the release demo recording in the Zowe V2 System Demo playlist on YouTube.
>
> System demos are typically held the week after a minor release becomes available. Check the Open Mainframe Project Calendar for the latest schedule.

Zowe installation and packaging

- `zwe` now has a `zwe config get` and `zwe config validate` command. The get command can be used to get a part of the zowe yaml configuration without needing to read the yaml yourself. `zwe config get` only returns values upon proving the configuration is valid first. `zwe config validate` can be used to perform validation of the zowe configuration files without running any additional actions. This is useful for verifying that a change is valid before starting zowe, for example.
- A new component management command `zwe components upgrade` allows you to install an already-installed component.
- A new component management command `zwe components uninstall` allows you to remove an installed extension.
- A new component management command `zwe components search` allows you to query for extensions.
- `zwe components` subcommands can now search for, install, and upgrade extensions retrieved via an on-prem or remote package registry. At this time, npm is supported as the registry and package manager technology that `zwe` can use to download content. This is an optional feature and is not enabled by default: it must be configured. View the schema for zowe.yaml to learn more about the "package registry" and "registry handler" technologies to configure for this feature. More information and a recorded demo is available at https://github.com/zowe/zowe-install-packaging/pull/2980

Zowe Application Framework

ZSS

- Support ZIS runtime version check
- Update the dynamic linkage stub vector to include new functions

- Add ZIS plugin development documentation and samples

zLUX Editor

- Added the feature to copy the line content and copy URL link to open a file at a specific line

Zowe Common C

- Added embeddedjs command `xplatform.appendFileUTF8` for appending to files rather than writing whole files.

Zowe API Mediation Layer

Zowe CLI

Zowe CLI (Core)

- Added new functions to support the changing of a job class and the hold status of a job. Can now call `zowe jobs modify job [jobid]` with options `--jobclass`, `--hold`, and `--release`. (#1156)
- Updated Imperative to incorporate new `zowe config report-env` command from version `5.7.0`.
- To view a subset of data set content instead of the entire file, added new command `zowe files view ds ... --range SSS-EEE | SSS,NNN`. (#1539)
- To define the unit of space allocation when creating a data set, added `ZosFilesCreateOptions.alcunit` option to PDS definition. (#1203)

Zowe CLI Imperative Framework

- Exported `AppSettings` for CLI and other applications to use (#840)
- To view a diagnostic report of the CLI working environment, added the `zowe config report-env` command.
- To show information for a plug-in's first steps, added the `show-first-steps` command. (#1325)

Zowe Explorer

- Added ability to filter jobs by status. (#1925)
- Added option to view PDS member attributes, and updated formatting for attributes webview. (#1577)
- Streamlined attribute viewing options into one feature - "Show Attributes".

Bug fixes

Zowe Version 2.5.0 contains the bug fixes that are described in the following topics.

Zowe installation and packaging

- Use of DVIPA may cause Zowe to believe a port is not free when it is. Starting in this release, Zowe can narrow its port validation to a specific IP via `zowe.network.vipaIp=some.ip` or bypass the verification via `zowe.network.validatePortFree=false`. Setting this to false will still cause the servers to be unable to connect if the port is not free, but this can be a more accurate and portable setting.
- component configure stages will now have their STDOUT printed when running at the INFO level of zwe verbosity.
- `zwe` was not guaranteeing that the workspace folder had 770 permission when `zowe.useConfigmgr=true` was set

Zowe Application Framework

ZSS

- In 2.3 and 2.4, `safkeyring://` syntax stopped working, only allowing `safkeyring:////`. Now, support for both is restored.

zLUX Editor

- Added a few rules for JCL syntax highlighter
- Set USS path to correct directory, when opening the directory or file in new browser tab respectively

Zowe Common C

- Fixed a bug that the configmgr binary would always return rc=0. Now, it has various return codes for the various internal errors or config invalid responses.

Zowe API Mediation Layer

Zowe CLI

Zowe CLI (Core)

- Documented in the CLI web help that the `--token-type` and `--token-value` options do not apply to SSH commands.
- Updated Imperative to include bug fixes in version `5.7.2`.
- Updated the `zowe zos-files create data-set` command to work without the `--like` flag. (#1252)

Zowe CLI Imperative Framework

- Added validation for null/undefined command definitions. (#868)
- Updated plugins `--login` command option to behave as expected when running in an NPM 9 environment.
- Cleaned up uses of execSync in Imperative where it makes sense to do so.

Zowe Explorer

- Fixed missing localization for certain VS Code error/info/warning messages. (#1722)
- Fixed "Allocate Like" error that prevented proper execution. (#1973)
- Fixed de-sync issue between Data Set and Favorites panels when adding or deleting datasets/members that were favorited. (#1488)
- Added logging in places where errors were being caught and ignored.
- Fixed issue where parent in Jobs list closes after single/multiple job deletion. (#1676)

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.4.

- CVE-2022-31159
- BDSA-2022-2590
- BDSA-2022-2580
- BDSA-2022-2582

Version: v3.2.x LTS

Version 2.4.0 (October 2022)

Welcome to the Zowe Version 2.4.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.4.0 build: Want to try new features as soon as possible? You can download the v2.4.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.4.0 contains the enhancements that are described in the following topics.

Zowe installation and packaging

- Updated ZWEWRF03 workflow to be up to date with the installed software.

Zowe Application Framework

ZSS

- ZSS /datasetContents now has a PUT API for creating datasets.
- ZIS dynamic linkage support

Zowe API Mediation Layer

- Validate OIDC token (#2604) (cdd4a43)
- Introduced service routing based on header to enables the Cloud Gateway to route to a southbound service by information in the request header. (#2600) (6fafb60)
- Introduced a new cloud gateway service that provides routing functionality for multi-sysplex environments. (#2576) (7c618c0)

Zowe CLI

Zowe CLI (Core)

- Added the `zowe files download uss-dir` command to download the contents of a USS directory. (#1038)
- Updated the `zowe files upload file-to-uss` and `zowe files upload dir-to-uss` commands to improve how they handle file encoding. (#1479)
  - Both commands now "chtag" files after uploading them to indicate their remote encoding. This matches the already existing behavior of the `zowe files download uss-file` command which checks file tags before downloading.
  - The behavior of `.zosattributes` files which can specify local and remote encoding has been changed. Files are now converted to remote encoding, not just tagged. If no encoding is specified, the default transfer mode is *text* instead of *binary* to be consistent with z/OSMF default behavior.

z/OS FTP Plug-in for Zowe CLI

- Added a new profile property to support encoding for data sets. (#120)
- Added the ability to filter jobs based on status (e.g., Active, Held, Output, Input). (#119)

Zowe Explorer

- Added check for existing team configuration file in location during create, prompting user to continue with the create action. (#1923)
- Added a solution to allow Zowe Explorer extensions with a dependency on Zowe Explorer to work as web extension without Zowe Explorer functionality in `vscode.dev`. (#1953)

Zowe Explorer FTP Extension

- Added support for profile file encoding used for upload and download of MVS files. (#1942)

Bug fixes

Zowe Version 2.4.0 contains the bug fixes that are described in the following topics.

Zowe Application Framework

Zowe App Server

- Plugin register/deregister would not consider app2app actions and recgonizers. Now, they are added on registration and removed on deregistration.

Zowe API Mediation Layer

- Do not require clientAuth extension (#2595) (e9e8092)
- snakeyml update, scheme validation fix (#2577) (ae48669)
- Add build info to the manifest.yaml (#2573) (93298dd)
- Fix bug in the swagger (#2571) (36997c6)

Zowe CLI

Zowe CLI (Core)

- Updated example for the `zowe profiles create zosmf-profile` command. (#1152)
- Restored info message on daemon startup. (#1506)
- Updated `ssh2` dependency to fix "Received unexpected packet type" error on SSH commands. (#1516)
- Updated the `minimatch` and `keytar` dependencies for technical currency.

Zowe CLI Imperative Framework

- Updated the `Config.search` API to skip loading project config layers when project directory is `false`. (#883)
- Updated `glob`, `js-yaml`, `diff2html`, and `npm-package-arg` dependencies for technical currency.

Zowe Explorer

- Fixed failed job status update for refresh job and spool file pull from mainframe. (#1936)
- Fixed project profiles loaded when no workspace folder is open. (#1802)
- Fixed serial saving of data sets and files to avoid conflict error. (#1868)

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.3.

- CVE-2022-34305 (BDSA-2022-1742)
- BDSA-2022-1887
- BDSA-2022-1891
- CVE-2016-1000027

Version: v3.2.x LTS

Version 2.3.1 (September 2022)

Welcome to the Zowe Version 2.3.1 release!

This release contains a minor packaging fix, no user action is required.

See Zowe's Version 2.3.0 release notes for the latest features, enhancements, and bug fixes.

Download v2.3.1 build: Want to try new features as soon as possible? You can download the V2.3.1 build from Zowe.org.

Version: v3.2.x LTS

Version 2.3.0 (September 2022)

Welcome to the Zowe Version 2.3.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.3.0 build: Want to try new features as soon as possible? You can download the V2.3.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.3.0 contains the enhancements that are described in the following topics.

Zowe installation and packaging

- Added a new dataset SZWELOAD. It contains versions of configmgr named `ZWECFG31`, `ZWECFG64`, and `ZWERXCFG` which can be used to invoke configmgr from within a rexx program. The expected use case is to simplify how complex JCL gets configuration information about Zowe.
- Zowe can now start in a mode called `configmgr` mode. You can enable this in certain `zwe` commands by adding `--configmgr`. Not all commands support this yet. For now, you can use it in `zwe start`, `zwe stop`, and `zwe components`. This mode is generally significantly faster to start up Zowe, but also enforces validation of the `zowe.yaml` configuration against the `zowe.yaml` schema files (found in /schemas).
- Zowe can now start using multiple `zowe.yaml` files when using the `configmgr` mode. This works for the STC startup as well as the `zwe start`, `zwe stop`, and `zwe components` commands. Each file must follow the same `zowe.yaml` schema as before, but in the list of files, properties found in a file to the right will be overridden by the file to the left. Through this, you can separate portions of Zowe configuration any way you want. To use multiple files, change your existing --config / CONFIG input to instead be a list of FILE() entries which are colon `:` separated. For example, `zwe start --config FILE(/my/customizations.yaml):FILE(/zowe/defaults.yaml)`
- Zowe server YAML files can now have templates within them when using `configmgr` mode. When the value of any attribute contains `${{ }}`, the content within the brackets will be replaced with whatever the template evaluates to. The entries are processed as ECMAScript2020-compatible JavaScript assignments. You can, for example, set one property to the value of another, such as having `parmlib: ${{ zowe.setup.dataset.prefix }}.MYPARM` rather than needing to type the prefix explicitly. You can also use this to set conditionals. For examples, check the ZSS default yaml file.

Zowe Application Framework

Zowe App Server

- app-server can now be configured by using configmgr. This increases startup time and validation of components and their plugins to increase automatic detection of plugin compatibility issues. This mode can be enabled or disabled with Zowe configuration property `zowe.useConfigmgr=true/false`.

Zowe Common C

- Added a new build target `configmgr-rexx`, which builds a version of configmgr that can be used within rexx scripts.

ZSS

- ZSS now utilizes the configuration parameters present in the zowe configuration file via the configmgr, simplifying the startup of ZSS and increasing the validation of its parameters. The file `zss/defaults.yaml` shows the default configuration parameters of zss, in combination with the schema of the parameters within zss/schemas, though some parameters are derived from zowe-wide parameters or from other components when they involve those other components.
- Improved startup time due to using the configmgr to process plugin registration, and only when the app-server is not enabled, as the app-server does the same thing.

Zowe API Mediation Layer

- Introduction of a new cloud gateway service to provide routing functionality for multi-sysplex environments. (#2576) (7c618c0), closes #2576
- Introduced a new Personal Access Token (PAT) API to evict non-relevant tokens and rules (#2554) (f3aeafa), closes #2554
- Added a Redis sentinel enabled field that allows Sentinel configuration to be added to a file and kept available even when Sentinel is not in use. (#2546) (3779072), closes #2546
- Added customized code snippets to API Catalog. Customized snippets can now be defined as part of the service metadata to be displayed in the API Catalog UI (#2526) (602392e), closes #2526
- Code snippet configuration now enables direct integration of an endpoint into an application without requiring code to integrate the other application's REST APIs. (#2509) (4d2298e), closes #2509
- A Personal Access Token (PAT) for SSO is now accepted. The PAT can now be validated and invalidated using a REST API on the Gateway (#2499) (ad17c18), closes #2499

Zowe CLI

Zowe CLI (Core)

- Added the browser-view option to the `zowe zos-files compare data-set` command to compare two data sets, and display the differences in the browser. (#1443)
- Added the command `zowe zos-files compare local-file-data-set` to compare a local file and a data set, and display the differences in the browser and terminal. (#1444)
- Added the command `zowe zos-files compare uss-files` to compare two uss files, and display the differences in the browser and terminal. (#1445)
- Added the command `zowe zos-files compare local-file-uss-file` to compare a local file and a uss file, and display the differences in the browser and terminal. (#1446)
- Added the command `zowe zos-files compare spool-dd` to compare two spool dds, and display the differences in the browser and terminal. (#1447)
- Added the command `zowe zos-files compare local-file-spool-dd` to compare a local file and a spool dd, and display the differences in the browser and terminal. (#1448)
- Added the `ZOWE_CLI_PLUGINS_DIR` environment variable to override the location where plug-ins are installed. (#1483)
- Added the `zowe zos-files compare data-set` command to compare two data sets, and display the differences in the terminal. (#1442)

Zowe CLI Imperative Framework

- Added `ZOWE_CLI_PLUGINS_DIR` environment variable to override the location where plug-ins are installed. (Zowe CLI #1483)

- Added Diff utility features for getting differences between two files and open diffs in browser. Also added web diff generator for creating web diff dir at the CLI home.

Zowe Explorer

- Added option to edit team configuration file via the `+` button for easy access. #1896
- Added multiple selection to manage context menu of Datasets, USS, and Jobs views. #1428
- Added Spool file attribute information to a hover over the Spool file's name. #1832
- Added support for CLI home directory environment variable in Team Config file watcher, and support watching Team Config files named `zowe.config.json` and `zowe.config.user.json` at both locations. #1913
- Update to Job's View Spool file label to display PROCSTEP if available, if PROCSTEP isn't available the label will display the Spool file's record count. #1889 #1832

Extensibility API for Zowe Explorer

- New API `ZoweVsCodeExtension.updateCredentials` for credential prompting that updates the ProfilesCache after obtaining credentials from user. #1852
- New API `ProfilesCache.updateProfilesArrays` to update `ProfilesCache.allProfiles` for profiles that don't store credentials locally in profile file. #1852
- New API `ProfilesCache.isCredentialsSecured` to check if credentials are stored securely. #1852

Bug fixes

Zowe Version 2.3.0 contains the bug fixes that are described in the following topics.

Zowe installation and packaging

- Schema pattern for semver range has been simplified as it was not compiling in configmgr
- When zwe components install could not find or set the PC bit of a ZSS plugin, it would print out an example command for fixing the issue. Now, it shows the exact command you could execute to fix the PC bit problem.

Zowe Application Framework

Zowe App Server

- Schema regex pattern for semver range was not working in configmgr, and has been corrected.

Zowe Common C

- Fixed `lht` functions of `collections.c` to avoid memory issues on negative keys
- Fixed the help message on configmgr

ZSS

- Fixed an 0C4 error within the /unixfile API in 31-bit mode. This was preventing files from being shown in the editor.

- 0C4 error messages from dataservices are now shown under the SEVERE log instead of the DEBUG log, so that issues can be spotted more easily.
- 0C4 when lht hashmap functions were called with negative key

Zowe API Mediation Layer

- snakeyml update, scheme validation fix (#2577) (ae48669), closes #2577
- Add build info to the manifest.yaml (#2573) (93298dd), closes #2573
- Fix bug in the swagger (#2571) (36997c6), closes #2571
- AdditionalProperties must be outside of properties attribute (#2567) (fea515a), closes #2567
- Enable hsts (#2565) (4cffe97), closes #2565
- Fix code snippets bug (#2564) (23bed56), closes #2564
- Enable redis storage mode in tests (#2522) (11bf491), closes #2522
- Gradle publish after update (#2528) (1baa6f7), closes #2528
- Remove multiple tokens from cookies (#2514) (d5bc187), closes #2514
- Retrieve swagger api docs with or without certificate configuration enabled (#2500) (16ca734), closes #2500

Zowe CLI

Zowe CLI and related components contain the following bug fixes:

- Updated Imperative to include bug fixes in version 5.5.1.
- Renamed `download data-set-matching` to `download data-sets-matching`. The old name still exists as an alias.
- Fixed output of `download data-sets-matching` being printed twice when some data sets fail to download.
- Altered the `zowe daemon disable` command to kill only the daemon running for the current user.

Zowe CLI (Core)

Zowe CLI Imperative Framework

- Prevented base profile secure-property lookup on the global layer when there is not default base profile. (#881)
- Fixed exception when non-string passed to `ImperativeExpect.toBeDefinedAndNonBlank()`. (#856)
- Removed periods in command example descriptions so descriptions look syntactically correct. (#795)
- Improved performance of ProfileInfo API to load large team config files. (Zowe Explorer #1911)
- Fixed dot-separated words incorrectly rendered as links in the web help. (#869)
- Web-diff template directory included in files section of package.json file.
- Changed the default log level of `Console` class from "debug" to "warn" so it is consistent with `Logger` class behavior. In Zowe v2.0 the `Logger` class was changed to have a default log level of "warn" but the `Console` class was not changed. To modify a log level, you can change it after initializing the console like this: `console.level = "info";` (Zowe CLI #511)
- Introduced examples for setting default profiles in `zowe config set` Examples section. (Zowe CLI #1428)
- Fixed error when installing plug-ins that do not define profiles. (#859)
- Removed some extraneous dependencies. (#477)

Db2 Plug-in for Zowe CLI

- Updated ibm_db dependency to be compatible with Node.js 18.

Zowe Explorer

- Fixed extension being slow to load large team config files. #1911
- Fix issue with cached profile information after updates to profiles. #1915
- Fix for saving credentials to v1 profile's yaml file when un-secure and save is selected after credential prompting. #1886
- Fix for outdated cached information after Update Credentials. #1858
- Fix to support ZOWE_CLI_HOME environment variable. #1747
- Fixed activation failure when error reading team configuration file. #1876
- Fixed Profile IO errors by refactoring use of Imperative's CliProfileManager. #1851
- Fixed runtime error found in initForZowe call used by extenders. #1872
- Added error notification for users when OS case sensitivitiy is not set up to avoid issues found with USS files in single directory of same name but different case. #1484
- Added file watcher for team configuration files to fix v2 profile update issues experienced during creation, updating, and deletion of global or project level configuration files in VS Code. #1760
- Updated dependencies for improved security. #1878
- Optimized saving of files on DS/USS when utilizing autosave or experiencing slow upload speeds. #1800
- Updates to use new Zowe Explorer APIs `ZoweVsCodeExtension.updateCredentials` for credential prompting and `ProfilesCache.updateProfilesArrays` for profiles that don't store credentials locally in profile file. #1852

Zowe Explorer Extension for FTP

- Fixed for profile properties like "rejectUnauthorized" being ignored.

Extensibility API for Zowe Explorer

- Fix for extenders that call `registerCustomProfileType()` and recieved error when team configuration file was in place. #1870
- Deprecated `ZoweVsCodeExtension.promptCredentials` in favor of `ZoweVsCodeExtension.updateCredentials`. #1852

Vulnerabilities fixed

Zowe discloses fixed vulnerabilities in a timely manner giving you sufficient time to plan your upgrades. Zowe does not disclose the vulnerabilities fixed in the latest release as we respect the need for at least 45 days to decide when and how you upgrade Zowe. When a new release is published, Zowe publishes the vulnerabilities fixed in the previous release. For more information about the Zowe security policy, see the Security page on the Zowe website.

The following security issues were fixed by the Zowe security group in version 2.2.

- BDSA-2019-3199

Version: v3.2.x LTS

Version 2.2.0 (July 2022)

Welcome to the Zowe Version 2.2.0 release!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.2.0 build: Want to try new features as soon as possible? You can download the V2.2.0 build from Zowe.org.

New features and enhancements

Zowe Version 2.2.0 contains the enhancements that are described in the following topics.

Zowe installation and packaging

- A new command `configmgr` is now present in `/bin/utils`. It can load, validate, and report on the Zowe configuration file.

Zowe Application Framework

- Added a script `dependencies.sh` which assists in managing external dependencies needed for project compilation
- Added a new build target, `configmgr`, which builds a tool that can be called to either load, validate, and print the zowe configuration, or load, validate, and run a JS script that is given the configuration.
- Added an automated build for `configmgr` which is consumed by the Zowe packaging

Zowe API Mediation Layer

- Revoke a Personal Access Token by admin (#2476) (e4d42a9), closes #2476
- Caching Service can store invalidated token rules (#2460) (055aac9), closes #2460
- Exchange client certificate for SAF IDT (#2455) (303087c), closes #2455 #2384
- Fix SAF IDT scheme and service (#2224) (7772401), closes #2224
- Generate Personal Access Token (#2452) (0e39aa7), closes #2452
- Limit the scope of a Personal Access Token (#2456) (cc0aba4), closes #2456
- Revoke a Personal Access Token (#2422) (c7f79d5), closes #2422
- Validate ServiceId with Endpoint (#2413) (9f3825f), closes #2413

Zowe CLI

Zowe CLI (Core)

- Added the `zowe files download data-sets-matching` command to download multiple data sets at once. (#1287)

  Note: If you used this command previously in the extended files plug-in for Zowe v1, the `--fail-fast` option now defaults to true which is different from the original behavior.

- Added the `zowe zos-files compare data-set` command to compare two datasets and display the differences on the terminal. (#1442)

Zowe Explorer

- `Pull from Mainframe` option added for JES spool files. #1837
- Updated Licenses. #1841

Bug fixes

Zowe Version 2.2.0 contains the bug fixes that are described in the following topics.

Zowe API Mediation Layer

- Immediately expire a passticket command to generate a passticket for each call (#2496) (8adca78), closes #2496
- Optimize image builds (#2445) (e220cbd), closes #2445
- Extend Tomcat to be able to recover after TCP/IP stack is restarted, so that the service does not require restart. (#2421) (a851b8f), closes #2421

Zowe CLI

Zowe CLI and related components contain the following bug fixes.

Zowe CLI (Core)

- Updated Imperative to address `ProfileInfo` related issues.
- Fixed the Zowe Daemon binary exiting with an error if the daemon server does not start within 3 seconds.
- Alter the zowe daemon disable command to only kill the daemon running for the current user.

Zowe CLI Imperative Framework

- Expose the isSecured functionality from the ProfilesCredentials. (#549)
- Allow the ConfigAutoStore to store plain-text properties that are defined as secure in the schema (for example, user, password). (zowe/vscode-extension-for-zowe: #1804)
- Added ANSI escape codes trimming for the Web Help. (#704)
- Fixed `AbstractRestClient` not converting LF line endings to CRLF for every line when downloading large files on Windows. (zowe/zowe-cli/#1458)
- Fixed `zowe --version --rfj` including a trailing newline in the version field. (#842)
- Fixed `--response-format-json` option not supported by some commands in daemon mode. (#843)
- Removed some extraneous dependencies. (#477)

z/OS FTP Plug-in for Zowe CLI

- Pick up `zos-node-accessor` v1.0.11 to fix listing single USS file or symbol link and update PDS dataset allocation.
- Refine help of partitioned dataset allocation.

Zowe Explorer

- Updated imports to use the imperative instance provided by the CLI package. #1842
- Fixed unwanted requests made by tree node when closing folder. #754
- Fix for credentials not being updated after the invalid credentials error is displayed. #1799
- Fixed hyperlink for Job submitted when profile is not already in JOBS view. #1751
- Fixed key bindings for `Refresh Zowe Explorer` to not override default VSC key binding. See README.md for new key bindings. #1826
- Fixed `Update Profile` issue for missing nonsecure credentials. #1804
- Fixed errors when operation cancelled during credential prompt. #1827
- Login and Logout operations no longer require a restart of Zowe Explorer or VSC. #1750
- Fix for Login token always being stored in plain text. #1840
- Fixed Theia tests. #1665

Version: v3.2.x LTS

Version 2.1.0 (June 2022)

Welcome to the Version 2.1.0 release of Zowe!

See New features and enhancements for a full list of changes to the functionality. See Bug fixes for a list of issues addressed in this release.

Download v2.1.0 build: Want to try new features as soon as possible? You can download the V2.1.0 build from Zowe.org.

New features and enhancements

Zowe API Mediation Layer

- Added trivial schema files for lib components. Updated manifests to remove build metadata (#2379) (6eba58f), closes #2379
- Extended API operation filter in the Swagger UI (#2397) (cffd6cf), closes #2397
- Generate basic code snippets (#2387) (79c67d0), closes #2387
- New endpoint to retrieve default API doc for service (#2327) (502ba3c), closes #2327
- Enhanced Discovery service health check (#2312) (2f167ff), closes #2312
- Support for TLS v1.3 (#2314) (e96135a), closes #2314 #2269
- Enhanced x509 authentication scheme to support client certificates (#2285) (a053b00), closes #2285
- Enhanced zowejwt authentication scheme to support client certificates (#2292) (c602080), closes #2292
- Enhanced z/OSMF authentication scheme to support client certificates (#2207) (5750072), closes #2207
- Added support to change password via z/OSMF (#2095) (51e8bd3), closes #2095
- Enabled Discovery Service and Gateway Service native library extensions (#1987) (fd03db5), closes #1987
- Added methods for ZaaS client to support password change (#1991) (7597bd7), closes #1991
- API ML sample extension (#1947) (a085cf3), closes #1947

Zowe Application Framework

USS Explorer contains the following enhancement.

- Added the feature to download a file.

MVS Explorer contains the following enhancement.

- Disabled the submit button and gave a warning message in Dialogs when dataset or dataset member name is invalid.

JES Explorer contains the following enhancements.

- Highlighted the selected Jobs and Job Files.
- Updated the Job tree when a job is deleted or cancelled.
- Added `*` support for job ID.

- Added app2app arguments: `expand` - Boolean that says to expand the job. In a list of jobs, this expands the first result. `showDD` - string that auto-opens any dataset definition with this name when expanding the job.

Zowe CLI

Zowe CLI contains the following enhancements and changes.

Zowe CLI (Core)

- Updated the `zowe config auto-init` command to allow using certificates for authentication. (#1359)
- Exposed profile type configuration from the respective SDKs.
- Added the `zowe zos-jobs view all-spool-content` command to view all spool content given a job ID. (#946)
- Added the `zowe jobs submit uss-file` command to submit a job from a USS file. (#1286)
- Added the `zowe files view data-set` and the `zowe files view uss-file` commands to view a data set or a USS file. (#1283)
- Added the `zowe jobs delete old-jobs` command to delete (purge) jobs in OUTPUT status. (#1285)

Zowe CLI Imperative Framework

- Added the ability for CLIs and Plug-ins to override some of the prompting logic if an alternate property is set.
- Introduced the `--show-inputs-only` flag to show the inputs of the command that would be used if a command were executed.
- Added the dark theme mode to web help that is automatically used when system-wide dark mode is enabled.
- Added environmental variable support to the ProfileInfo APIs by defaulting `homeDir` to `cliHome`. (#1777)

Bug fixes

Zowe API Mediation Layer

- Add log masking class for sensitive logs (#2003) (994b483), closes #2003
- API Catalog swagger link (#2344) (be07fda), closes #2344
- Use same key and record lengths as jcl (#2341) (d8644f2), closes #2341
- Add server-side logging for swagger handling code (#2328) (7b0455d), closes #2328
- Preserve request cookies (#2293) (71c6649), closes #2293 #2269
- ZaaS client compatibility with Zowe v2 (#2227) (abdf995), closes #2227
- Add BearerContent filter to enable bearer auth (#2197) (1d41704), closes #2197
- Configure southbound timeout with APIML_GATEWAY_TIMEOUT_MILLIS (#2154) (6af5d6f), closes #2154
- Improve error handling for API diff endpoint (#2178) (1581e39), closes #2178
- Update data model for infinispan storage in Caching service (#2156) (38a1348), closes #2156
- Versioning in image publishing workflow (#2159) (db52527), closes #2159
- Add x509 auth info to gw api doc (#2142) (0205470), closes #2142
- Properly remove services when instances are removed from Discovery Service (#2128) (c675b91), closes #2128
- Use ribbon LB for Web sockets (#2147) (4751dbc), closes #2147
- Add missing fields in error response (#2118) (3b9745c), closes #2118
- Do not require keyAlias for SSL configuration (#2110) (03bee79), closes #2110

Zowe CLI

Zowe CLI (Core)

Zowe CLI (Core) contains the following bug fixes:

- Fixed an issue where `config auto-init` could report that it modified a config file that did not yet exist.
- Updated Imperative to fix the `config import` and `config secure` commands that were not respecting the `--reject-unauthorized` option.
- Fixed an issue where privateKey is not being respected. (#1398 and #1392)
- Moved the `authConfig` object from the core SDK into the CLI's base profile definition to fix invalid handler path.
- Fixed an issue where SSH command waits forever when user has expired password. (#989)
- Fixed the name of the positional in `zowe zos-jobs submit uss-file` command.
- Updated the description of the `zowe zos-jobs view all-spool-content` command.
- Updated the descriptions of the `zowe zos-files view uss-file` and `zowe zos-files view data-set` commands.
- Removed the `zowe zos-files view uss-file <file> --record` option.
- Fixed the description of the `zowe zos-jobs delete` command group.
- Added the `--modify-version` option to the `zowe zos-jobs delete old-jobs` command for feature parity with `zowe zos-jobs delete job`.
- Updated Imperative to address `ProfileInfo` related issues.

Zowe CLI Imperative Framework

Zowe CLI Imperative Framework contains the following bug fixes:

- Fixed ProfileInfo API `argTeamConfigLoc` not recognizing secure fields in multi-layer operations. (#800)
- Fixed ProfileInfo API `updateKnownProperty` possibly storing information in the wrong location due to optional osLoc information. (#800)
- Fixed `osLoc` information returning project level paths instead of the global layer. (#805)
- Fixed `autoStore` not being checked by `updateKnownProperty`. (#806)
- Fixed the `plugins uninstall` command failing when there is a space in the install path.
- Fixed an issue where `config auto-init` might fail to create project config when global config already exists. (#810)
- Fixed `config secure` not respecting the `rejectUnauthorized` property in team config. (#813)
- Fixed `config import` not respecting the `rejectUnauthorized` property in team config. (#816)
- Updated the `cli-table3` dependency for performance improvements.
- Fixed `config init` not replacing empty values with prompted for values in team config. (#821)
- Fixed `config init` saving empty string values to config file when prompt was skipped.
- Fixed `ConfigLayers.read` skipping load of secure property values.

- Improved the performance of `ConfigLayers.activate` by skipping config reload if the active layer directory has not changed.
- Removed the `async` keyword from the `ConfigLayers.read` method and the `ConfigLayers.write` method because they do not contain asynchronous code.
- Fixed `ProfileInfo.readProfilesFromDisk` failing when team config files and old-school profile directory do not exist.
- Fixed `ProfileInfo.updateProperty` not updating properties that are newly present after reloading team config.

  Note: If you are developing an SDK that uses the ProfileInfo API, use the method `ProfileInfo.getTeamConfig` instead of `ImperativeConfig.instance.config` which may contain outdated config or be undefined.
- Fixed ProfileInfo API not detecting secure credential manager after profiles have been reloaded.

Zowe Application Framework

USS Explorer contains the following fix.

- Fixed the bug where opening a file fails when USS path has `/` at the end.

JES Explorer contains the following fixes.

- Fixed bug where URL requests fail when using `#` character in prefix.
- Fixed a bug where using app2app params at launch would not use desired data.

Zowe Explorer

- Fixed Quick-key Delete in USS and Jobs trees. #1821
- Fixed issue with Zowe Explorer crashing during initialization due to Zowe config file errors. #1822
- Fixed issue where Spool files failed to open when credentials were not stored in a profile. #1823
- Fixed extra space in the Invalid Credentials dialog, at profile validation profilename. #1824
- Updated dependencies for improved security. #1819
- Fixed USS search filter fails on credential-less profiles. #1811
- Fixed Zowe Explorer recognizing environment variable ZOWE_CLI_HOME. #1803
- Fixed Zowe Explorer prompting for TSO Account number when saved in config file's TSO profile. #1801
- Improved logging information to help diagnose Team Profile issues. #1776
- Fixed adding profiles to the tree view on Theia. #1774
- Updated Log4js version to resolve initialization problem on Eclipse Che. #1692
- Fixed dataset upload issue by trimming labels. #1789
- Fixed duplicate jobs appearing in the jobs view upon making an owner/prefix filter search for extenders. #1780
- Fixed error displayed when opening a job file for extenders. #1701

Version: v3.2.x LTS

Version 2.0.0 (April 2022)

Welcome to the Version 2.0.0 release of Zowe!

Version 2.0 introduced breaking changes and a number of new features.

- If you are upgrading from V1 to V2, review the Breaking changes first.
- See New features and enhancements for a full list of changes to the functionality.
- See Bug fixes for a list of V1 issues addressed in this release.
- See Conformance and release compatibility for V2 Conformance Criteria updates and compatibility with v1.

Download v2.0.0 build: Want to try new features as soon as possible? You can download the V2.0.0 build from Zowe.org.

v2 office hours videos: Zowe held a series of v2 LTS office hours for extenders and consumers to introduce all the V2 changes. Watch the videos to learn more about the new features.

Breaking changes

Zowe installation

- You must pass `-ppx` when you unpax the Zowe convenience build to preserve extended file attributes.
- All utility scripts, like `zowe-install.sh`, `zowe-install-xmem.sh`, `zowe-install-proc.sh`, `validate-directory-is-accessible.sh`, are removed and migrated to the new `zwe` server command format.
- If you rely on some of the scripts, find the alternative new `zwe` command or shell library functions.
- `ZWESVSTC` is removed and `ZWESLSTC` will replace it to start Zowe.
- `instance.env` is deprecated and replaced by `zowe.yml`.
- In V2, you use the `P` command to terminate Zowe instead of the `C` cancel command.
- Zowe now allows fine-grained customization of log, workspace, and configuration directories. By default, these directories remain grouped under an `instance` directory (same as Zowe v1).
- Environment variables are reorganized to better describe itself. All `zowe.yaml` configuration entries will be automatically converted to environment variables for easy consumption. Check with the community what the new alternative variable names are.
- During Zowe configuration, redundant `ip` fields will be removed or consolidated in favor of `hostname` or `domains`.
- Component or extension manifest is mandatory. You must use the `zwe components install` command to install the extension.

API Mediation Layer

- Removed the support for the old path pattern (#1770). This includes the changes to the endpoints used in ZAAS client. If your application uses ZAAS client, please verify whether the configuration properties use the new path pattern (`/gateway/api/v1` instead of `/api/v1/gateway`).
- Removed the support for different authentication schemas for different instances of service (#1051).

Zowe Application Framework

Some configuration, such as port and IP values, are different by default in V2 but can be reconfigured to old values. However, some application framework extensions may not work in V2 without enhancements.

- zLUX App Manager

  Due to new library versions, native apps such as Angular and React apps written for Zowe v1 may not work in Zowe v2. Rebuilding the apps with the same versions and the latest webpack build scripts is recommended.

- zLUX Server Framework

  - The list of properties sent back from the /server/environment has changed to reflect the different environment values present in Zowe v2
  - Adjusted the server to respect ZSS's new cookie format in which the port or HA instance ID is a suffix of the ZSS cookie. This means that the server may not work properly when paired with a v1 ZSS and works best with v2 ZSS.

- zLUX Editor

  The app now uses angular 12, making it compatible with Zowe v2 desktop and incompatible with v1 desktop.

- Basic VT Terminal Emulator

  Upgrade to Angular 12, Typescript 4, and Corejs 3 to match Desktop libraries in Zowe v2. This app may no longer work in the Zowe v1 Desktop, and v2 should be used instead.

- Basic TN3270 Display Emulator

  Upgrade to Angular 12, Typescript 4, and Corejs 3 to match Desktop libraries in Zowe v2. This app may no longer work in the Zowe v1 Desktop, and v2 should be used instead.

- Sample angular app

  The app now uses angular 12, making it compatible with Zowe v2 desktop and incompatible with v1 desktop.

Zowe CLI

- Breaking changes for Zowe CLI end users:

  - `zowe config` no longer manages app settings (Imperative and CLI)
  - `fail-on-error` default changed to true for `zowe plugins validate` (Imperative and CLI)
  - Default Imperative and CLI log level changed from DEBUG to WARN (Imperative and CLI), which potentially changes troubleshooting steps for providing information to support.

- Breaking changes that could prevent a V1 plug-in or SDK from working in V2

  - CLI package should be removed as a plug-in peer dep (Imperative)
  - `AbstractRestClient.mDecode` defaults to true so any plug-in with custom RestClient implementation that adds gzip decompression may break
  - The return value for `PluginManagementFacility.requirePluginModuleCallback` changed. Application and plug-in developers requiring a module from a plug-in's relative path using the `requirePluginModuleCallback` function no longer need to provide the plug-in name in a separate variable `this.pluginNmForUseInCallback =`

`pluginName` before binding the class `this.requirePluginModuleCallback.bind(this)`. Instead they can call `this.requirePluginModuleCallback(pluginName)`.
    - Previously in V1:
    - In V2:

- Breaking changes for Zowe CLI and Imperative plug-in developers

  These changes only impact early adopters of @next as these are breaking changes made during the technical preview validation phase. Thanks to the community for the feedback.

  - `tokenType` and `tokenValue` were combined into `authToken`, which later was reverted (Imperative and CLI)
  - Options in `zowe config` group are renamed: `--user` is renamed to `--user-config`, and `--global` to `--global-config`.
  - `Zowe.schema.json` format changed a few times (version 2, version 3): `ConfigSchemas.loadProfileSchemas` is changed to `ConfigSchemas.loadSchema`
  - `Config.set` no longer coerces string values to other types unless `parseString = true` which might impact the SDK instead of CLI plug-ins.

New features and enhancements

Zowe installation

- Introduced a new server command `zwe` to balance between simplification and flexibility on installation and configuration.
  - Almost all Zowe utility scripts in V1 are consolidated into new `zwe` server command. This new command defines consistent help messages, logging options, and so on. See the ZWE Command Reference for more information.
  - Provides shell function library to help extensions to achieve common tasks. For example, execute TSO command, operator command, submit job and check job completion, and so on.
  - Keep away from commands/functions marked as experimental and internal.
- Installation / Configuration changes
  - During installation, no new runtime directory will be created.
  - A `zowe.yaml` file can be used to centralize all configuration options. This configuration is compatible with all Zowe use cases (including high availability and containerization).
  - For almost all Zowe configuration steps, an automation option `zwe init` command is provided. You can still choose to run all steps one by one.
  - Provides the `--security-dry-run` mode that allows you to generate security commands and pass along to your system admin.
  - You can run all steps from USS now.
- A Zowe component or extension can use `manifest.yaml` to define how it interacts with Zowe and other components.
  - The component or extension must define a `manifest.yaml` or `manifest.json` file to describe itself. The manifest allows you to define how to register on Zowe API ML Discovery, how to register under Zowe Desktop, and whether it's Java extension library for API ML, and so on.
  - Components can define their own `configs` in `manifest.yaml` which shows you how to customize this component and provides default values if they are not defined. This option is compatible with Zowe running in high availability mode.

- Introduced new data sets to better organize the contents.
  - Added `SZWEEXEC` to contain few utility tools.
  - You can customize your own PARMLIB, APF Authorized LOADLIB and APF-authorized ZIS plug-ins library. `CUST.JCLIB` is a data set where Zowe will store temporary JCLs.

Zowe API Mediation Layer

- There is now the option to change your password via the Catalog UI (#2035) (139a231), closes #2035
- Discovery service can be configured to modify the service ID at registration time (#2229) (63f6fde), closes #2229
- There is now the option to specify base packages for the extensions loader(#2081) (9a4be5a), closes #2081
- There is a new design of the logout panel in the Catalog dashboard (#2102) (1382f24), closes #2102
- Add missing tooltips to all onboarding options (#2194) (5446fd5), closes #2194
- Migrate API Catalog to the Material UI library (2c595d5, 0da7f15, 95da488, c60371d, 537fa34, 81ab2ed), closes #1169
- Made various improvements to the onboarding wizard (#1772) (20dd70b), closes #1772

Zowe Application Framework

- zLUX App Manager

  - New desktop library versions are Angular 6->12, Corejs 2->3, Typescript 2->4, and so on. For more information, visit https://www.zowe.org/vnext.
  - The web-browser and admin-desktop-notification apps now contains a manifest file so that it can be installed with zwe components install.

- zLUX App Server

  - Renamed `ZLUX_` environment variables to `ZWED_` for consistency. Backwards compatible with old environment variables.
  - Added support for new `logDirectory` variable specification in `zowe.yaml`
  - Added support for reading from `zowe.yaml` instead of `server.json`

- zLUX Server Framework

  - Added support for reading `zowe.yaml` directly, as opposed to `server.json`.
  - The server can now support checks on the existence and version of APIML if a plug-in states a dependency on APIML in the "requirements.components" section of its plug-in definition.
  - The list of parameters for server configuration is now documented in json-schema for validation, you can find this in the zlux repository

- ZSS Package

  New configuration option that allows to run 64-bit ZSS

- zLUX Editor

  Cookie name now has a suffix which includes the port or if in an HA instance, the HA ID.

- Basic VT Terminal Emulator

The app now contains a manifest file so that it can be installed with zwe components install

- Sample angular app

  The app now contains a manifest file so that it can be installed with zwe components install

- USS Explorer

  USS-explorer no longer uses explorer-ui-server, but now depends on app-server. In a standard Zowe environment, this will result in less processes but does break links about getting to the explorer via APIML routes. The explorer is now available via the app-server's APIML route.

- JES Explorer

  JES-explorer no longer uses explorer-ui-server, but now depends on app-server. In a standard Zowe environment, this will result in less processes but does break links about getting to the explorer via APIML routes. The explorer is now available via the app-server's APIML route.

- MVS Explorer

  MVS-explorer no longer uses explorer-ui-server, but now depends on app-server. In a standard Zowe environment, this will result in less processes but does break links about getting to the explorer via APIML routes. The explorer is now available via the app-server's APIML route.

Zowe CLI

Zowe CLI contains the following enhancements and changes:

- **Team Configuration:**

  Team configuration significantly improves the configuration/onboarding experience and provides the ability to easily share configuration information with others in an organization.

- **Automatic Team Configuration:**

  Automatic team configuration leverages the Zowe API Mediation Layer to automatically configure connections for conformant API ML services that also have a CLI plug-in.

- **Daemon Mode:**

  Daemon Mode significantly improves the performance of Zowe CLI by not requiring separate node processes to be spawned for every command.

- **Secure by Default:**

  Secure by default provides a secure out-of-the-box experience by including the secure credential store feature, previously offered as a plug-in in V1, as part of the core Zowe CLI package.

- **Migrating to Zowe V2 Team Configuration:**

  After installing `@zowe/cli@zowe-v2-lts` and all desired plug-ins `@zowe-v2-lts`, you can easily migrate to Zowe V2 team configuration by issuing the following command:

Zowe CLI Plug-ins

Zowe maintained CLI plug-ins are Zowe V2 LTS conformant. As such, they integrate with Team configuration, daemon mode, and the team configuration migration utility. For information about enhancements and bug fixes, see the changelogs for the following plug-ins:

- IBM CICS Plug-in for Zowe CLI
- IBM Db2 Database Plug-in for Zowe CLI
- IBM z/OS FTP Plug-in for Zowe CLI
- IBM IMS Plug-in for Zowe CLI
- IBM MQ Plug-in for Zowe CLI

Imperative CLI Framework

Imperative is the infrastructure on which various Zowe technologies are built. For information about enhancements and bug fixes, see the Imperative CLI Framework changelog.

Nodejs SDK

The Nodejs SDK packages were updated to make use of key Zowe V2 features, including Team Configuration. For information about enhancements and bug fixes, see the changelogs for the following packages:

- Core Package
- Provisioning Package
- z/OS Console Package
- z/OS Files Package
- z/OS Jobs Package
- z/OS Logs Package
- z/OS Management Facility Package
- z/OS TSO Package
- z/OS USS Package
- z/OS Workflows Package

Zowe Explorer

Zowe Explorer makes use of Team Configuration and is secure by default. For information about enhancements and bug fixes, see the following changelogs:

- Zowe Explorer
- Zowe Explorer CICS Extension
- Zowe Explorer FTP Extension

Bug fixes

Zowe API Mediation Layer

- Caching service logging (#2222) (5ff64d9), closes #2222

- Add x509 Authentication information to the API Documentation of the API Gateway (#2142) (072ad23), closes #2142
- Authorization provider set empty as default (#2107) (aa77926), closes #2107
- Update URL of the API Catalog to work with the V2 version of the Zowe Desktop (6f4257a), closes #2022

Zowe Application Framework

- zLUX Server Framework

  When paired with the Zowe server infrastructure, the app-server will now automatically register and de-register plug-ins at startup depending on each plug-in's component enabled status.

- ZSS Package
  - Do not use "tee" when log destination is /dev/null
  - Cookie name now has a suffix which includes the port or if in an HA instance, the HA ID.

Conformance and release compatibility

Backward compatibility

Zowe v1 conformant extensions/plug-ins are not guaranteed to be compatible with Zowe v2 and therefore may not be operable. In general, plug-ins/extensions which leverage v2 APIs that have known breaking changes are at high risk of incompatibility and unpredictable results.

Recommendation: All v1 extenders test with Zowe v2, identify any issues, and disclose results to consumers to clearly indicate backward compatibility status in the extension documentation. If unable to test, clearly document as such.

Forward compatibility

Zowe v2 conformant (planning to earn conformance) extensions/plug-ins are not guaranteed to be compatible with Zowe v1 LTS. In general, plug-ins/extensions with no known dependency on any newly introduced Zowe v2 functions are at minimum risk.

Recommendation: All v2 extenders test with Zowe v1 LTS, identify any issues, and disclose results to consumers to clearly indicate forward compatibility status in the extension documentation. If unable to test, clearly document as such.

Conformance compatibility

Zowe v1 conformant extensions/plug-ins are likely to require changes to meet Zowe v2 conformance criteria. All extensions (regardless of v1 conformance status) must apply for v2 conformance and satisfy all required v2 testing criteria. You can find the V2 Conformance Criteria here.

Recommendation: All extenders interested in earning v2 conformance review the v2 conformance criteria, determine if technical changes are necessary, make appropriate modifications and prepare to apply for v2 conformance.

Need help? For assistance with reviewing or completing the Zowe Conformance Zowe v2 application, reach out to members of the Zowe Onboarding Squad on Slack at https://slack.openmainframeproject.org in the `#zowe-onboarding` channel.

Version: v3.2.x LTS

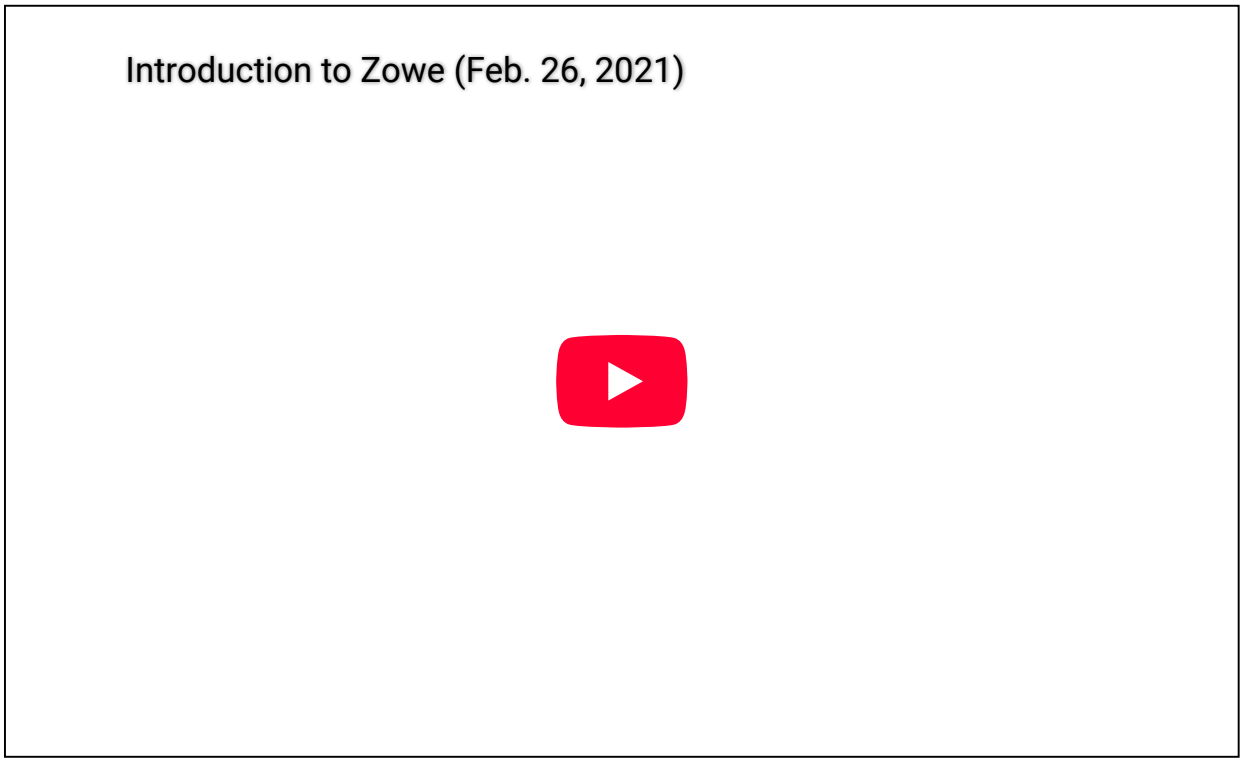
Zowe overview

Zowe™ is an open source software which provides both an extensible framework, and a set of tools that allow mainframe development and operation teams to securely manage, develop, and automate resources and services on z/OS family mainframes. Zowe offers modern interfaces to interact with z/OS and allows users to interact with the mainframe system in a way that is similar to what they experience on cloud platforms today. Users can work with these interfaces as delivered or through plug-ins and extensions created by customers or third-party vendors. All members of the IBM Z platform community, including Independent Software Vendors (ISVs), System Integrators, and z/OS consumers, benefit from the modern and open approach to mainframe computing delivered by Zowe.

Zowe is a member of the Open Mainframe Project governed by Linux Foundation™.

Zowe demo video

Watch this video to see a quick demo of Zowe.



Download the deck for this video | Download the script

Zowe component overview

Zowe is comprised of the following server side and client side components:

Zowe Launcher

The Zowe Launcher makes it possible to launch Zowe z/OS server components in a high availability configuration, and performs the following operations:

- Start all Zowe server components using the `START` (or `S`) operator command.
- Stop Zowe server components using the `STOP` (or `P`) operator command.
- Stop and start specific server components without restarting the entire Zowe instance using `MODIFY` (or `F`) operator command.

API Mediation Layer

The API Mediation Layer provides a single point of access for APIs of mainframe services, and provides a Single Sign On (SSO) capability for mainframe users.

The API Mediation Layer (API ML) facilitates secure communication between loosely coupled clients and services through a variety of API types, such as REST, GraphQL or Web-Socket. API ML consists of these core components: the API Gateway, the Discovery Service, the API Catalog, and the Caching service:

- The API Gateway provides secure routing of API requests from clients to registered API services.
- The Discovery Service allows dynamic registration of microservices and enables their discoverability and status updates.
- The API Catalog provides a user-friendly interface to view and try out all registered services, read their associated APIs documentation in OpenAPI/Swagger format.
- The API ML Caching Service allows components to store, search and retrieve their state. The Caching service can be configured to store the cached data using various backends. Recommended is usage of Inifinispan packaged with the Caching Service.

The API Mediation Layer offers enterprise, cloud-like features such as high-availability, scalability, dynamic API discovery, consistent security, a single sign-on experience, and API documentation.

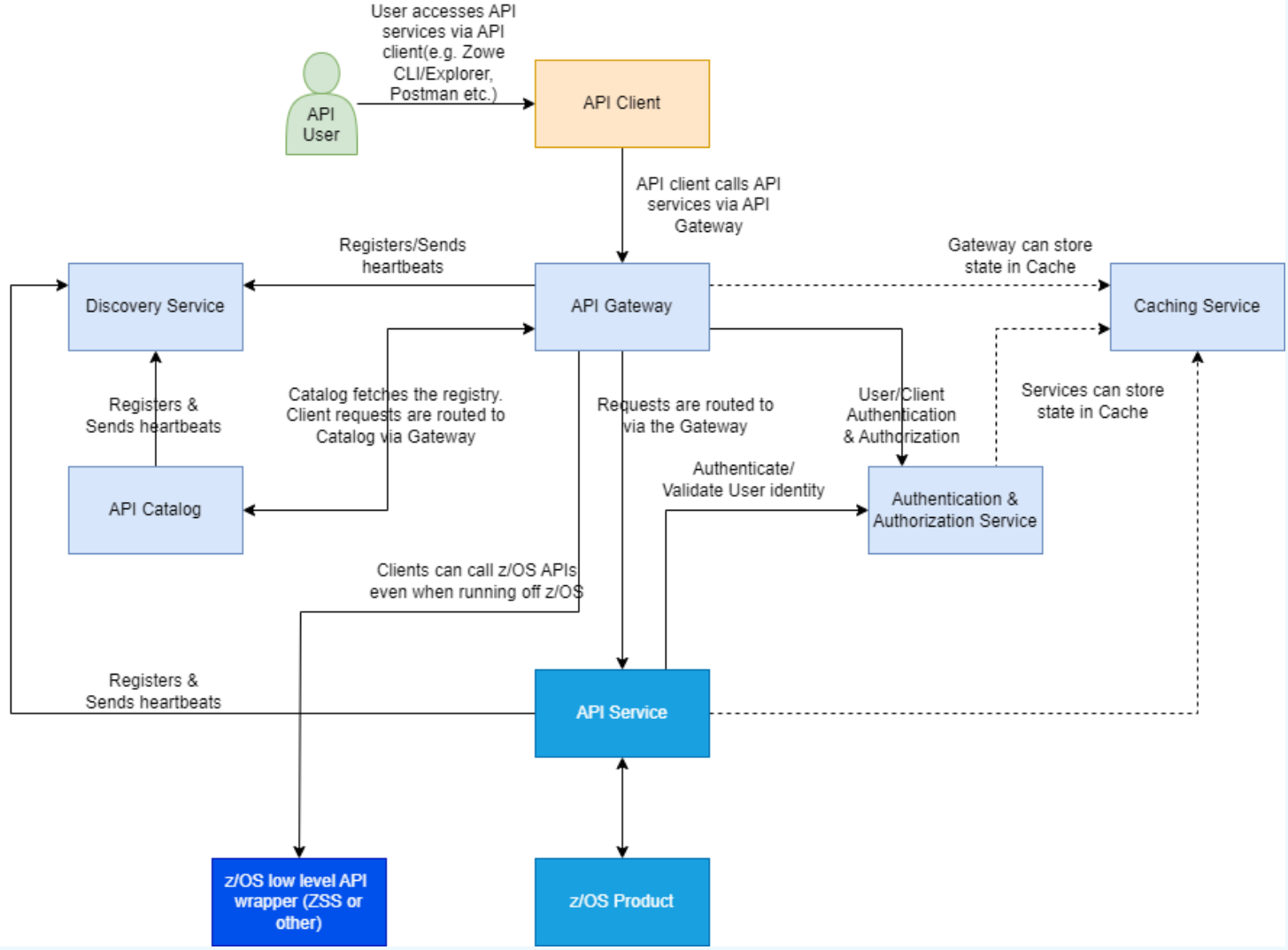
<details>
<summary>Learn more</summary>

Key features

- Consistent Access: API routing and standardization of API service URLs through the Gateway component provides users with a consistent way to access mainframe APIs at a predefined address.
- Dynamic Discovery: The Discovery Service automatically determines the location and status of API services.
- High-Availability: API Mediation Layer is designed with high-availability of services and scalability in mind.
- Caching Service: This feature is designed for Zowe components in a high availability configuration, and supports high availability of all components within Zowe. As such, components can remain stateless whereby the state of the component is offloaded to a location accessible by all instances of the service, including those which just started.
- Redundancy and Scalability: API service throughput is easily increased by starting multiple API service instances without the need to change configuration.
- Presentation of Services: The API Catalog component provides easy access to discovered API services and their associated documentation in a user-friendly manner.
- Encrypted Communication: API ML facilitates secure and trusted communication across both internal components and discovered API services.

API Mediation Layer structural architecture
</details>

The following diagram illustrates the single point of access through the Gateway, and the interactions between API ML components and services:



Components

The API Layer consists of the following key components:

Gateway Service

Services that comprise the API ML service ecosystem are located behind a gateway (reverse proxy). All end users and API client applications interact through the Gateway. Each service is assigned a unique service ID that is used in the access URL. Based on the service ID, the Gateway forwards incoming API requests to the appropriate service. Multiple Gateway instances can be started to achieve high-availability. The Gateway access URL remains unchanged. The Gateway Service is built on Spring Cloud Gateway and Spring Boot technology.

Discovery Service

The Discovery Service is the central repository of active services in the API ML ecosystem. The Discovery Service continuously collects and aggregates service information and serves as a repository of active services. When a service is started, it sends its metadata, such as the original URL, assigned serviceId, and status information to the Discovery Service. Back-end microservices register with this service either directly or by using a Eureka client. Multiple enablers are available to help with service on-boarding of various application architectures including plain

Java applications and Java applications that use the Spring Boot framework. The Discovery Service is built on Eureka and Spring Boot technology.

API Catalog

The API Catalog is the catalog of published API services and their associated documentation. The Catalog provides both the REST APIs and a web user interface (UI) to access them. The web UI follows the industry standard Swagger UI component to visualize API documentation in OpenAPI JSON format for each service. A service can be implemented by one or more service instances, which provide exactly the same service for high-availability or scalability. API Catalog requires authentication from the accessing user.

Caching Service

An API is provided in high-availability mode which offers the possibility to store, retrieve, and delete data associated with keys.

Onboarding APIs

Essential to the API Mediation Layer ecosystem is the API services that expose their useful APIs. Use the following topics to learn more about adding new APIs to the API Mediation Layer and using the API Catalog:

- Onboarding Overview
- Onboarding a Spring Boot based REST API service
- Onboarding a Micronaut based REST API service
- Onboard an existing Node.js based REST API service
- Onboard an existing Python based REST API service
- Onboarding a REST of GraphQL API without code changes required
- Using API Mediation Layer

To learn more about the architecture of Zowe, see Zowe architecture.

Zowe Application Framework

A web user interface (UI) that provides a virtual desktop containing a number of apps allowing access to z/OS function. Base Zowe includes apps for traditional access such as a 3270 terminal and a VT Terminal, as well as an editor and explorers for working with JES, MVS Data Sets and Unix System Services.

Learn more

The Zowe Application Framework modernizes and simplifies working on the mainframe. With the Zowe Application Framework, you can create applications to suit your specific needs. The Zowe Application Framework contains a web UI that has the following features:

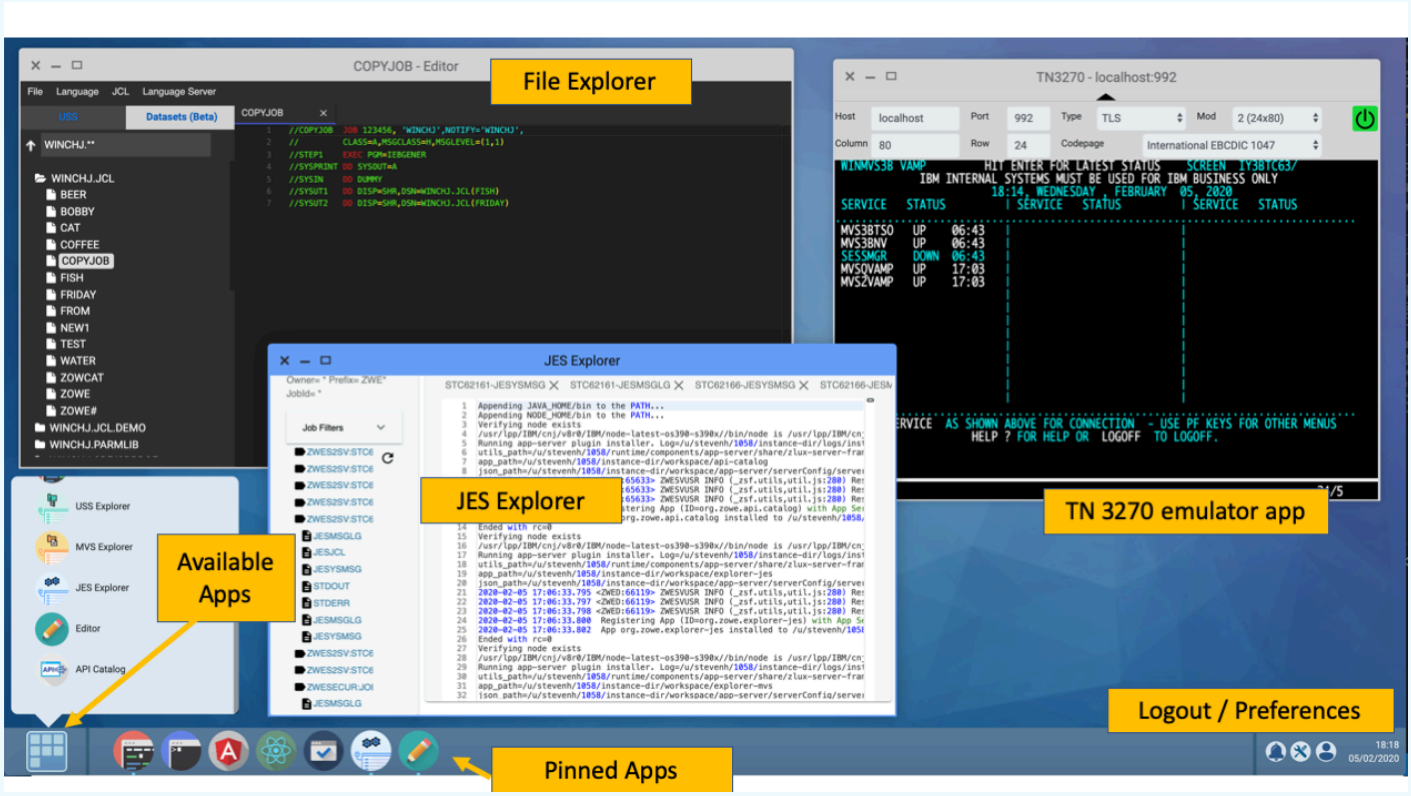
- The web UI works with the underlying REST APIs for data, jobs, and subsystem, but presents the information in a full screen mode as compared to the command line interface.
- The web UI makes use of leading-edge web presentation technology and is also extensible through web UI plug-ins to capture and present a wide variety of information.
- The web UI facilitates common z/OS developer or system programmer tasks by providing an editor for common text-based files like REXX or JCL along with general purpose data set actions for both Unix System Services

(USS) and Partitioned Data Sets (PDS) plus Job Entry System (JES) logs.

The Zowe Application Framework consists of the following components:

- **Zowe Desktop**

  The desktop, accessed through a browser. The desktop contains a number of applications, including a TN3270 emulator for traditional Telnet or TLS terminal access to z/OS, a VT Terminal for SSH commands, as well as rich web GUI applications including a JES Explorer for working with jobs and spool output, a File Editor for working with USS directories and files and MVS data sets and members. The Zowe desktop is extensible and allows vendors to provide their own applications to run within the desktop. See Extending the Zowe Desktop. The following screen capture of a Zowe desktop shows some of its composition as well as the TN3270 app, the JES Explorer, and the File Editor open and in use.



- **Zowe Application Server**

  The Zowe Application Server runs the Zowe Application Framework. It consists of the Node.js server plus the Express.js as a webservices framework, and the proxy applications that communicate with the z/OS services and components.

- **ZSS Server**

  The ZSS Server provides secure REST services to support the Zowe Application Server. For services that need to run as APF authorized code, Zowe uses an angel process that the ZSS Server calls using cross memory communication. During installation and configuration of Zowe, you will see the steps needed to configure and launch the cross memory server.

- **Application plug-ins**

  Several application-type plug-ins are provided. For more information, see Using the Zowe Application Framework application plug-ins.

Zowe CLI

Zowe CLI is a command-line interface that lets you interact with the mainframe in a familiar, off-platform format. Zowe CLI helps to increase overall productivity, reduce the learning curve for developing mainframe applications, and exploit the ease-of-use of off-platform tools. Zowe CLI lets you use common tools such as Integrated Development Environments (IDEs), shell commands, bash scripts, and build tools for mainframe development. Though its ecosystem of plug-ins, you can automate actions on systems such as IBM Db2, IBM CICS, and more. It provides a set of utilities and services for users that want to become efficient in supporting and building z/OS applications quickly.

<details>
<summary>Learn more</summary>

Zowe CLI provides the following benefits:

- Enables and encourages developers with limited z/OS expertise to build, modify, and debug z/OS applications.
- Fosters the development of new and innovative tools from a computer that can interact with z/OS. Some Zowe extensions are powered by Zowe CLI, for example the Visual Studio Code Extension for Zowe.
- Ensure that business critical applications running on z/OS can be maintained and supported by existing and generally available software development resources.
- Provides a more streamlined way to build software that integrates with z/OS.

Note: For information about software requirements, installing, and upgrading Zowe CLI, see Installing Zowe.

Zowe CLI capabilities

With Zowe CLI, you can interact with z/OS remotely in the following ways:

- **Interact with mainframe files:** Create, edit, download, and upload mainframe files (data sets) directly from Zowe CLI.
- **Submit jobs:** Submit JCL from data sets or local storage, monitor the status, and view and download the output automatically.
- **Issue TSO and z/OS console commands:** Issue TSO and console commands to the mainframe directly from Zowe CLI.
- **Integrate z/OS actions into scripts:** Build local scripts that accomplish both mainframe and local tasks.
- **Produce responses as JSON documents:** Return data in JSON format on request for consumption in other programming languages.

For detailed information about the available functionality in Zowe CLI, see Zowe CLI Command Groups.

For information about extending the functionality of Zowe CLI by installing plug-ins, see Extending Zowe CLI.

More Information:

- System requirements for Zowe CLI
- Installing Zowe CLI

</details>

Zowe Explorer

Zowe Explorer is a Visual Studio Code extension that modernizes the way developers and system administrators interact with z/OS mainframes. Zowe Explorer lets you interact with data sets, USS files, and jobs that are stored on z/OS. The extension complements your Zowe CLI experience and lets you use authentication services like API Mediation Layer. The extension provides the following benefits:

- Enables you to create, modify, rename, copy, and upload data sets directly to a z/OS mainframe.
- Enables you to create, modify, rename, and upload USS files directly to a z/OS mainframe.
- Provides a more streamlined way to access data sets, uss files, and jobs.
- Letting you create, edit, and delete Zowe CLI `zosmf` compatible profiles.
- Lets you use the Secure Credential Store plug-in to store your credentials securely in the settings.
- Lets you leverage the API Mediation Layer token-based authentication to access z/OSMF.

For more information, see Information roadmap for Zowe Explorer.

Zowe Client Software Development Kits (SDKs)

The Zowe Client SDKs consist of programmatic APIs that you can use to build client applications or scripts that interact with z/OS. The following SDKs are available:

- Zowe Node.js Client SDK
- Zowe Java Client SDK
- Zowe Kotlin Client SDK
- Zowe Python Client SDK

For more information, see Using the Zowe SDKs.

Zowe Chat (Technical Preview)

Zowe Chat is a chatbot that aims to enable a ChatOps collaboration model including z/OS resources and tools. Zowe Chat enables you to interact with the mainframe from chat clients such as Slack, Microsoft Teams, and Mattermost. Zowe Chat helps to increase your productivity by eliminating or minimizing the context switching between different tools and user interfaces.

<details>
<summary>Learn more</summary>

Zowe Chat key features

- **Manage z/OS resource in chat tool channels** Check your z/OS job, data set, and USS files status directly in chat tool channels. You can also issue z/OS console commands directly in the chat tool. You can drill down on a specific job, data set, error code, and so on to get more details through button or drop-down menu that Zowe Chat provides.
- **Execute Zowe CLI commands in chat tool channels**

  You can also issue Zowe CLI commands to perform operations such as help and z/OS resource management including z/OS job, data set, USS file, error code, and console command. Theoretically, most of Zowe CLI commands are supported as long as it is executable with single-submit.
- **Extensibility**
</details>

Zowe Chat is extensible via plug-ins. You can extend Zowe Chat by developing plug-ins and contributing code to the base Zowe Chat or existing plug-ins.

- **Security:**

  Zowe Chat makes use of z/OS SAF calls and supports the three main security management products on z/OS (RACF, Top Secret, ACF2). You can log in to the chat client via enterprise standards, including two factor authentication if required. The first time you issue a command to the Zowe Chat installed in the chat workspace, it prompts you to log in with the mainframe ID using a one-time URL. Once authenticated against the mainframe security, Zowe Chat securely caches in memory the relationship between your Chat tool ID and the mainframe ID. Zowe Chat's Security Facility will generate credentials for downstream API requests.

- **Display alerts:**

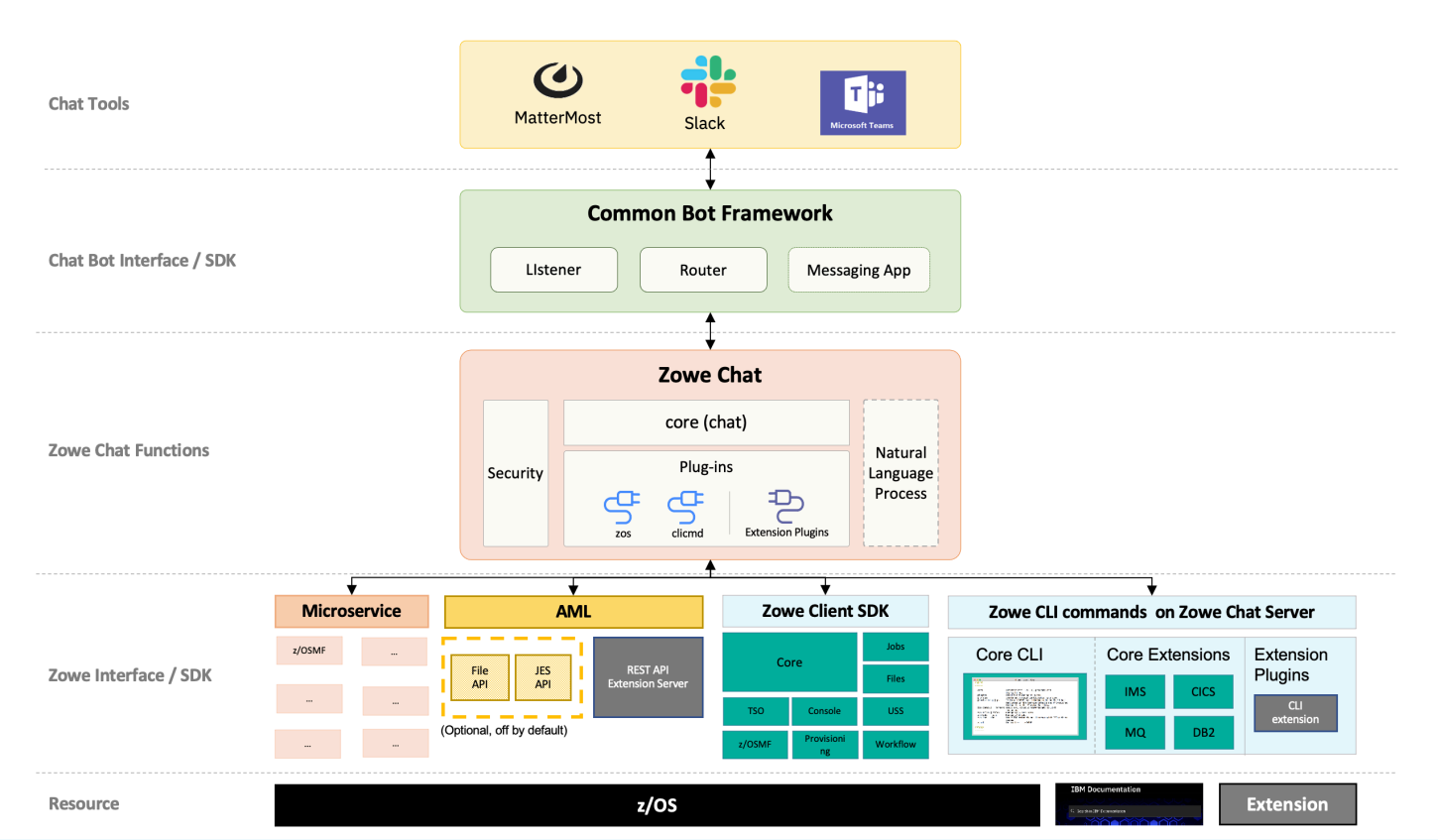
  Allows you to send alert or event to a channel in the chat tool in use. An event data model enables Zowe Chat extenders to send alerts to a channel in the chat through Zowe Chat.

Read the following blogs to learn more about Zowe Chat:

- Zowe Gets Chatty
- Zowe Chat can make you more productive: user scenarios

Zowe Chat architecture

Zowe Chat is based on the Common Bot framework, which is required for the chat platform Slack, Mattermost, and Microsoft Teams.



For more information, see Installing Zowe Chat and Using Zowe Chat.

ZEBRA (Zowe Embedded Browser for RMF/SMF and APIs) - Incubator

ZEBRA Provides re-usable and industry compliant JSON formatted RMF/SMF data records, so that many other ISV SW and users can exploit them using open-source SW for many ways.

For more information, see the ZEBRA documentation.

Zowe Explorer plug-in for IntelliJ IDEA

Zowe Explorer plug-in for IntelliJ IDEA is a smart and interactive mainframe code editing tool that allows you to browse, edit, and create data on z/OS via z/OSMF REST API.

The plug-in helps to:

- Start working with z/OS easily with no complex configurations
- Organize data sets on z/OS, files on USS into working sets
- Allocate data sets, create members, files and directories with different permissions
- Perform operations like renaming, copying and moving data in a modern way
- Edit data sets, files and members. Smart auto-save keeps your content both in the editor and on the mainframe in sync
- Create multiple connections to different z/OS systems
- Perform all available operations with jobs
- Work with TSO Console directly in the IDE

To learn more about the plug-in, you can start with Zowe Explorer plug-in for IntelliJ IDEA use cases.

Zowe Bill of Materials

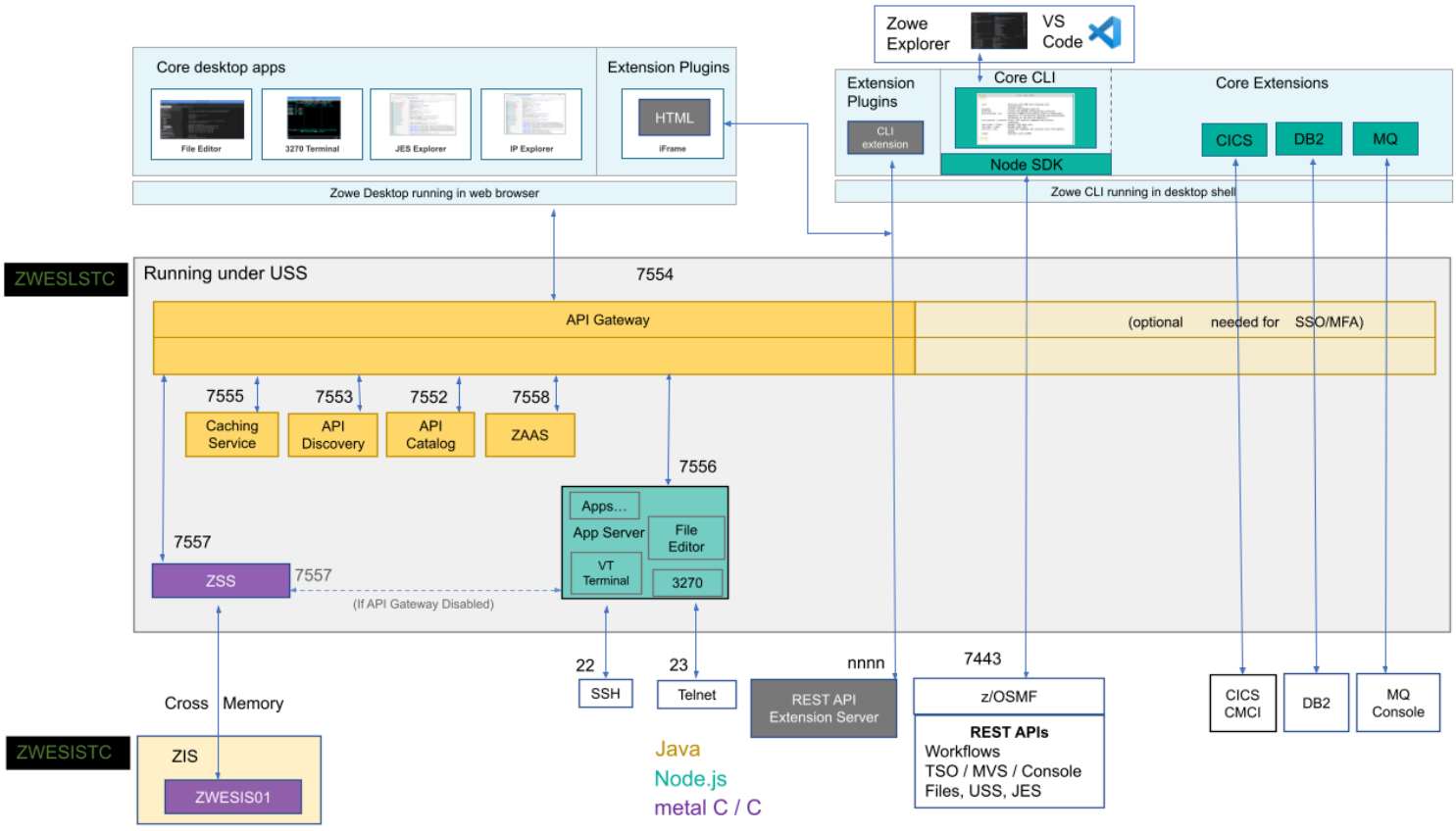
For information about the Zowe Bill of Materials (BOM), see this link to the appendix.

Version: v3.2.x LTS

Zowe architecture

Zowe™ is a collection of components that together form a framework that makes Z-based functionality accessible across an organization. Zowe functionality includes exposing Z-based components, such as z/OSMF, as REST APIs. The Zowe framework provides an environment where other components can be included and exposed to a broader non-Z based audience.

The following diagram illustrates the high-level Zowe architecture.



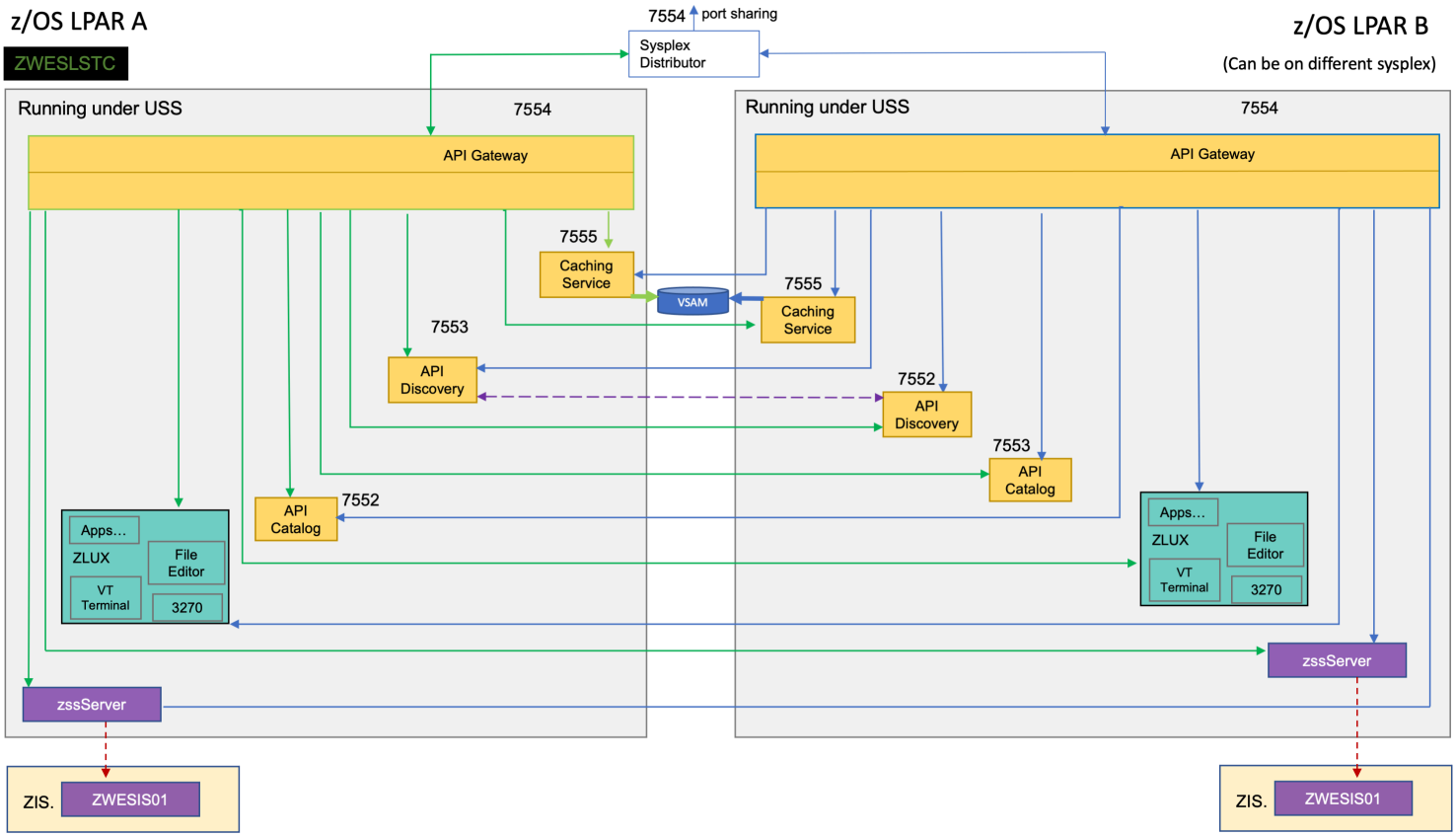
The diagram shows the default port numbers that are used by Zowe. These are dependent on each instance of Zowe and are held in the Zowe YAML configuration file.

Zowe components can be categorized by location: server or client. While the client is always an end-user tool such as a PC, browser, or mobile device, the server components can be further categorized by what machine they run on.

Zowe server components can be installed and run entirely on z/OS, but a subset of the components can alternatively run on Linux or z/Linux via Docker. While on z/OS, many of these components run under UNIX System Services (USS). The components that do not run under USS must remain on z/OS when using Docker in order to provide connectivity to the mainframe.

Zowe architecture with high availability enablement on Sysplex

The following diagram illustrates the difference in locations of Zowe components when deploying Zowe into a Sysplex with high availability enabled as opposed to running all components on a single z/OS system.



Zowe has a high availability feature built in. To enable this feature, you can define the `haInstances` section in your YAML configuration file.

The preceding diagram shows that `ZWESLSTC` has started two Zowe instances running on two separate LPARs that can be on the same or different sysplexes.

- Sysplex distributor port sharing enables the API Gateway 7554 ports to be shared so that incoming requests can be routed to either the Gateway on LPAR A or LPAR B.
- The discovery servers on each LPAR communicate with each other and share their registered instances, which allows the API Gateway on LPAR A to dispatch APIs to components either on its own LPAR, or alternatively to components on LPAR B. As indicated in the diagram, each component has two input lines: one from the API Gateway on its own LPAR and one from the Gateway on the other LPAR. When one of the LPARs goes down, the other LPAR remains operating within the Sysplex, thereby providing high availability to clients that connect through the shared port irrespective of which Zowe instance is serving the API requests.

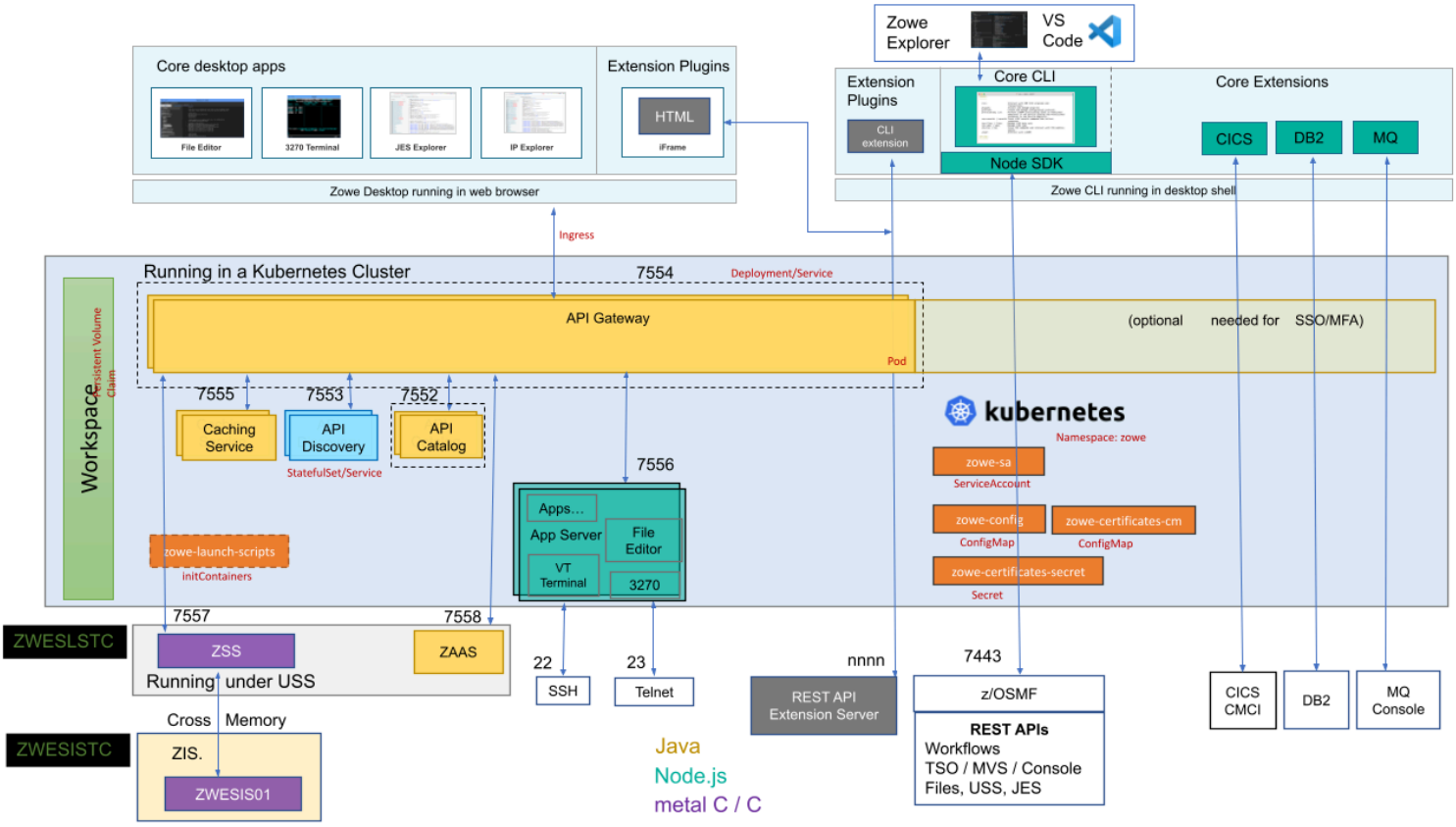
The `zowe.yaml` file can be configured to start Zowe instances on more than two LPARS, and also to start more than one Zowe instance on a single LPAR, thereby providing a grid cluster of Zowe components that can meet availability and scalability requirements.

The configuration entries of each LPAR in the `zowe.yaml` file control which components are started. This configuration mechanism makes it possible to start just the desktop and API Mediation Layer on the first LPAR, and start all of the Zowe components on the second LPAR. Because the desktop on the first LPAR is available to the Gateway of the second LPAR, all desktop traffic is routed there.

The caching services for each Zowe instance, whether on the same LPAR, or distributed across the sysplex, are connected to each other by the same shared VSAM data set. This arrangement allows state sharing so that each instance behaves similarly to the user irrespective of where their request is routed.

Zowe architecture when running in Kubernetes cluster

The following diagram illustrates the difference in locations of Zowe components when deploying Zowe into a Kubernetes cluster as opposed to running all components on a single z/OS system.

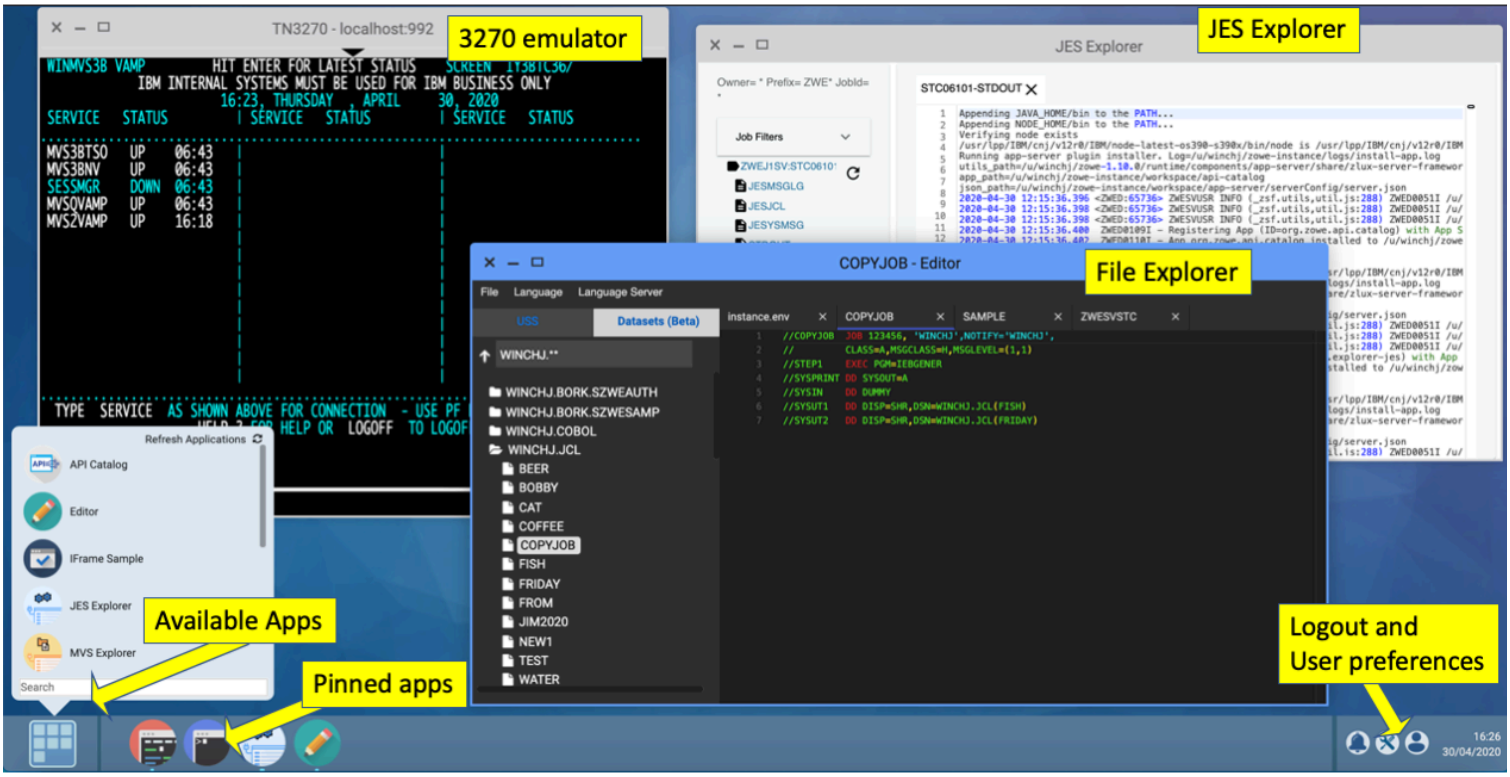


When deploying other server components into container orchestration software like Kubernetes, Zowe follows standard Kubernetes practices. The cluster can be monitored and managed with common Kubernetes administration methods.

- All Zowe workloads run on a dedicated namespace (`zowe` by default) to distinguish from other workloads in same Kubernetes cluster.
- Zowe has its own `ServiceAccount` to help with managing permissions.
- Server components use similar `zowe.yaml` on z/OS, which are stored in `ConfigMap` and `Secret`, to configure and start.
- Server components can be configured by using the same certificates used on z/OS components.
- Zowe claims its own `Persistent Volume` to share files across components.
- Each server component runs in separated containers.
- Components may register themselves to Discovery with their own `Pod` name within the cluster.
- Zowe workloads use the `zowe-launch-scripts` `initContainers` step to prepare required runtime directories.
- Only necessary components ports are exposed outside of Kubernetes with `Service`.

App Server

The App Server is a portable, extensible HTTPS server written in node.js. It can be extended with expressjs routers to add REST or Websocket APIs. This server is responsible for the Zowe Application Framework, including the Desktop which is described later in this page.



When the API Gateway is running, this server and the Desktop are accessible at `https://<ZOWE_HOST_IP>:7554/zlux/ui/v1/`. When the API Catalog is running, this server's API documentation is accessible at the API Catalog tile `Zowe Application Server`, which can be viewed at `https://<ZOWE_HOST_IP>:7554/apicatalog/ui/v1/#/tile/zlux/zlux`. When running on z/OS, this server uses the jobname suffix of DS1.

ZSS

Zowe System Services (ZSS) is a z/OS native, extensible HTTPS server which allows you to empower web programs with z/OS functionality due to ZSS' conveniences for writing REST and Websocket APIs around z/OS system calls. The Zowe desktop delegates a number of its services to the ZSS server.

When the API Gateway is running, this server is accessible at `https://<ZOWE_HOST_IP>:7554/zss/api/v1`. When the API Catalog is running, this server's API documentation is accessible at the API Catalog tile `Zowe System Services (ZSS)` which can be viewed at `https://<ZOWE_HOST_IP>:7554/apicatalog/ui/v1/#/tile/zss/zss` When running on z/OS, the server uses the jobname suffix of SZ.

ZIS

ZIS is a z/OS native, authorized cross-memory server that allows a secure and convenient way for Zowe programs, primarily ZSS, to build powerful APIs to handle z/OS data that would otherwise be unavailable or insecure to access from higher-level languages and software. As part of Zowe's security model, this server is not accessible over a network but rather empowers the less privileged servers. It runs as a separate STC, `ZWESISTC` to run the program `ZWESIS01` under its own user ID `ZWESIUSR`.

Unlike all of the servers described above which run under the `ZWESLSTC` started task as address spaces for USS processes, the Cross Memory server has its own separate started task `ZWESISTC` and its own user ID `ZWESIUSR` that runs the program `ZWESIS01`.

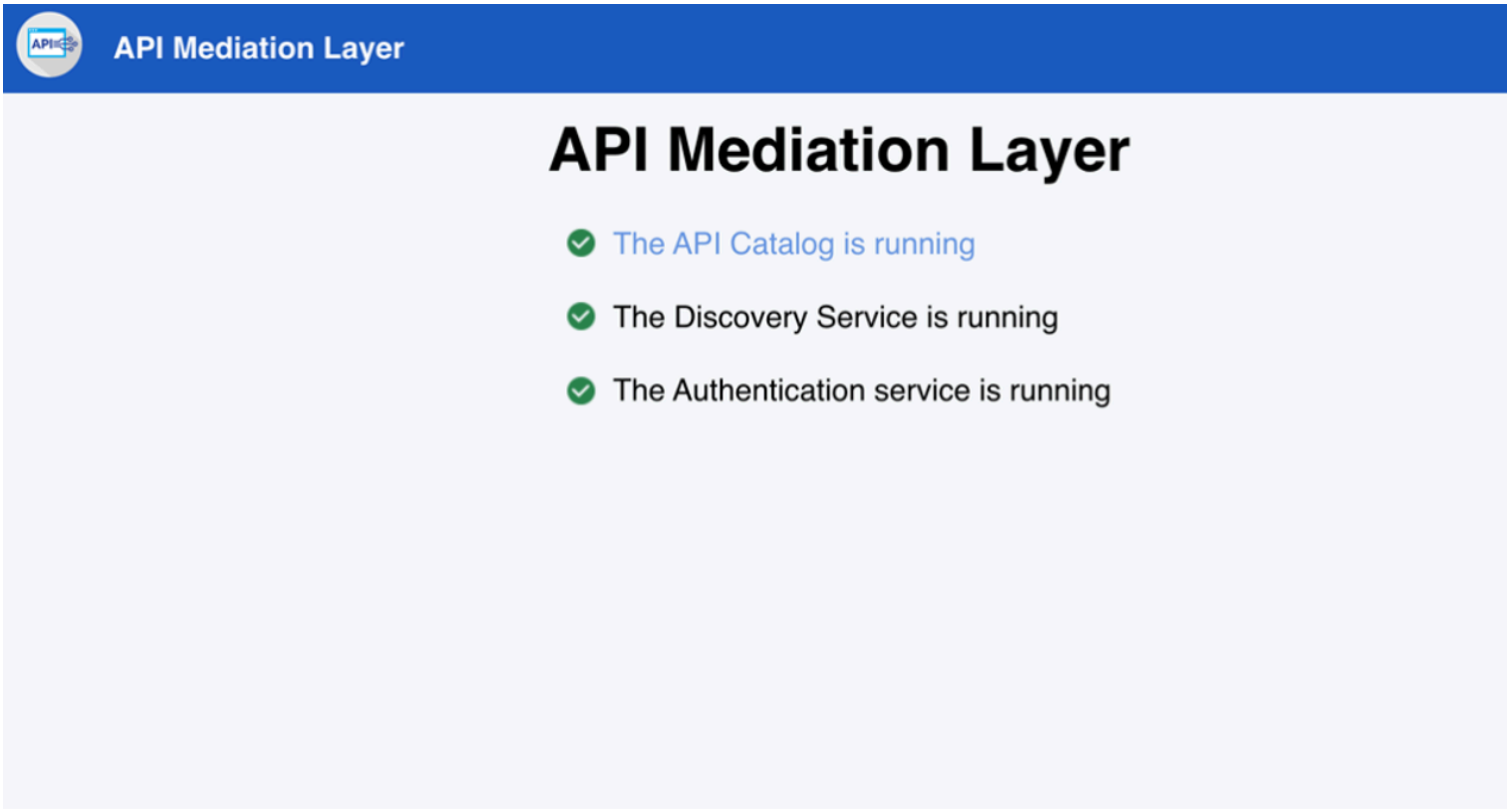
API Mediation Layer

The API Mediation Layer is a collection of services for management and administration of APIs, and is comprised of the following components that are described in detail below:

- API Gateway
- API Catalog
- API Discovery Service
- Caching Service
- ZAAS

API Gateway

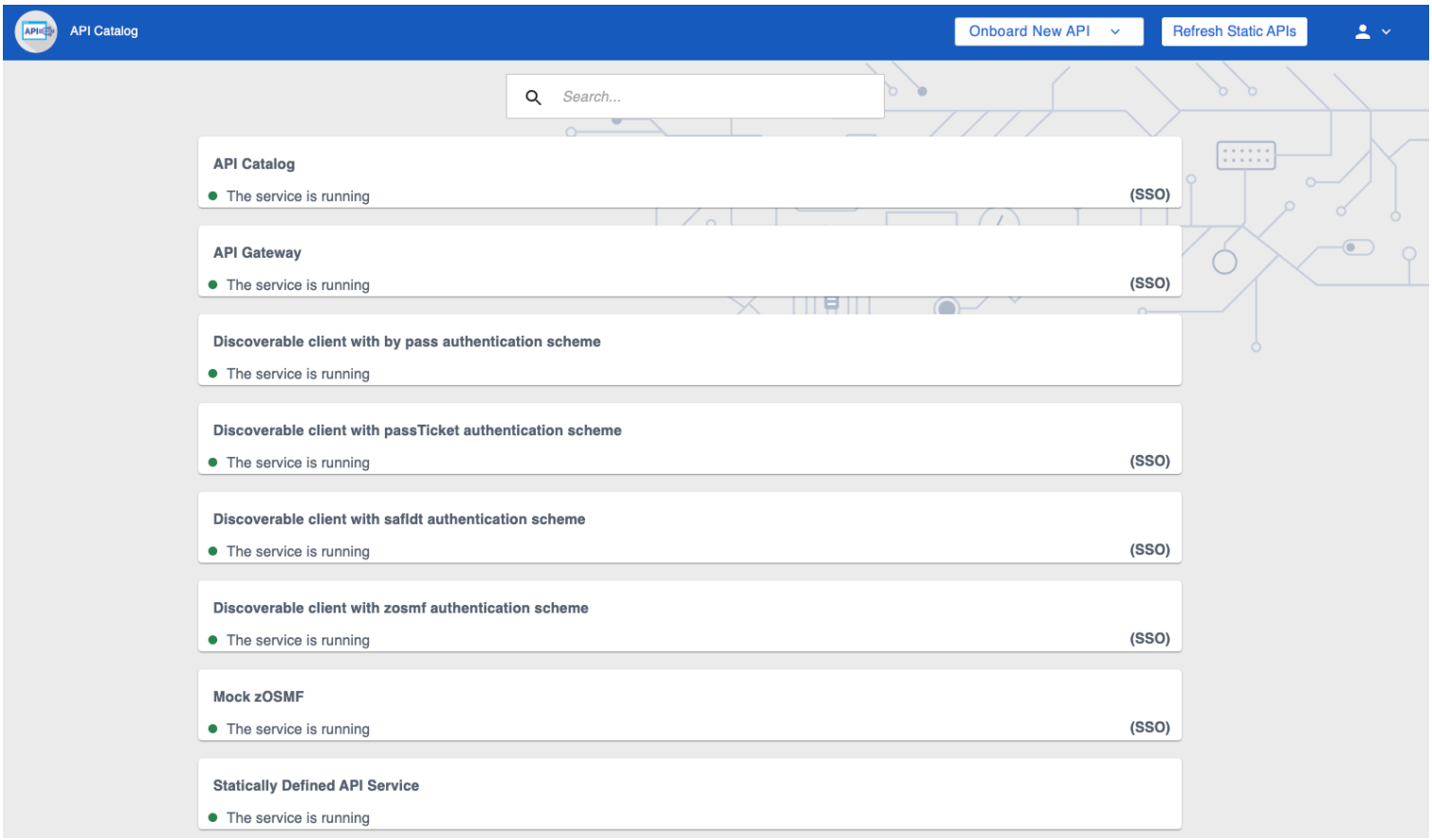
The API Gateway is a proxy server that routes requests from clients on its northbound or upstream edge, such as web browsers or the Zowe command line interface, to servers on its southbound (downstream) edge that are able to provide data to serve the request. The API Gateway is also responsible for generating the authentication token used to provide single sign-on (SSO) functionality. The API Gateway homepage is `https://<ZOWE_HOST_IP>:7554`. Following authentication, this URL enables users to navigate to the API Catalog.



When the API Gateway is running, this server is accessible at `https://<ZOWE_HOST_IP>:7554/`. When running on z/OS, the server uses the jobname suffix of AG.

API Catalog

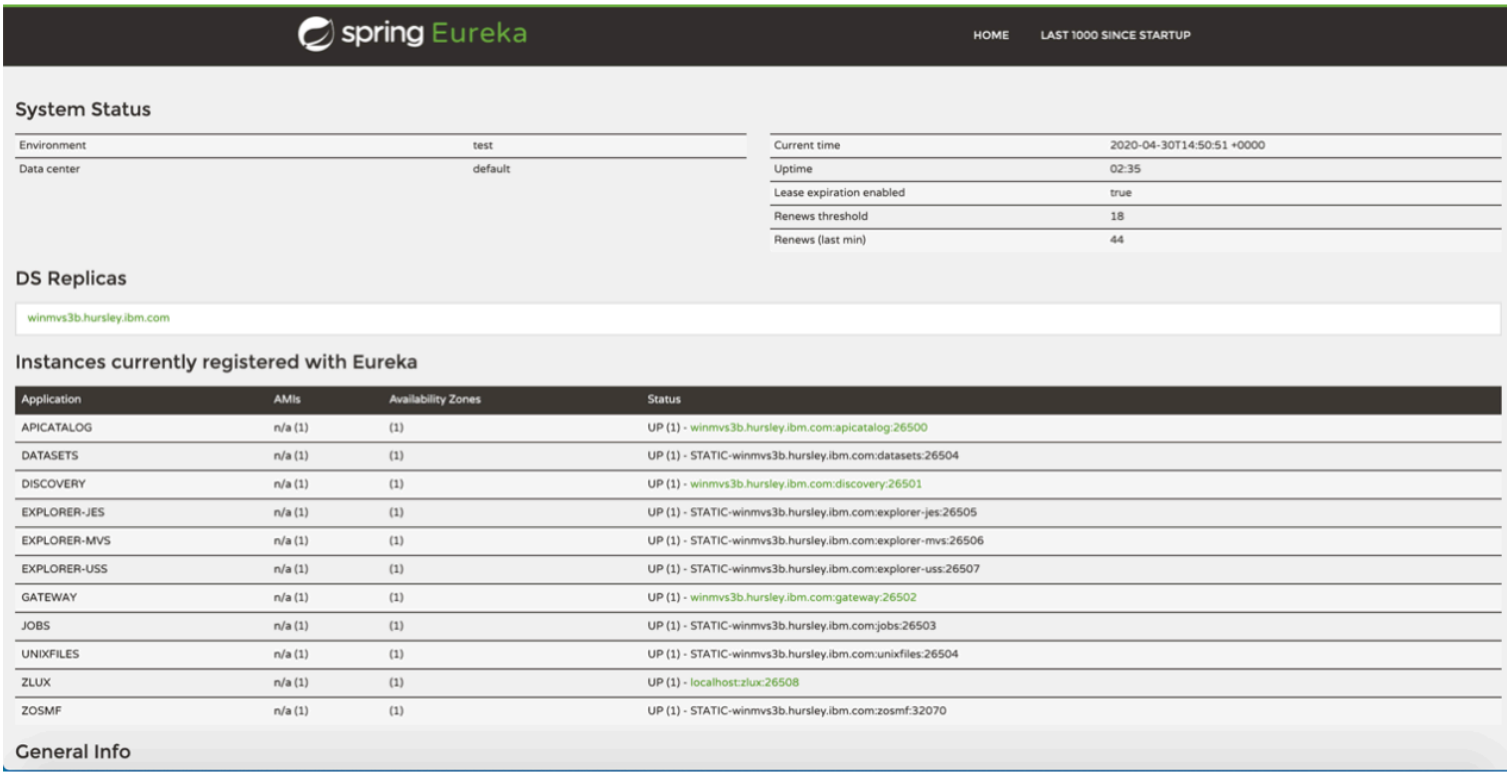
The API Catalog provides a list of the API services that have registered themselves as catalog tiles. These tiles make it possible to view the available APIs from Zowe's southbound (downstream) servers, as well as test REST API calls.



When the API Gateway is running, this server is accessible at `https://<ZOWE_HOST_IP>:7554/apicatalog/ui/v1`. When the API Catalog is running, the API documentation of this server is accessible at the API Catalog tile `Zowe Applications` which can be viewed at `https://<ZOWE_HOST_IP>:7554/apicatalog/ui/v1/#/tile/apimediationlayer/apicatalog` When running on z/OS, the server uses the jobname suffix of AC.

API Discovery Service

The API Discovery Service acts as the registration service broker between the API Gateway and its southbound (downstream) servers. This server can be accessed through the URL `https://<ZOWE_HOST_IP>:7552` making it possible to view a list of registered API services on the API discovery homepage.



When running on z/OS, the server uses the jobname suffix of AD.

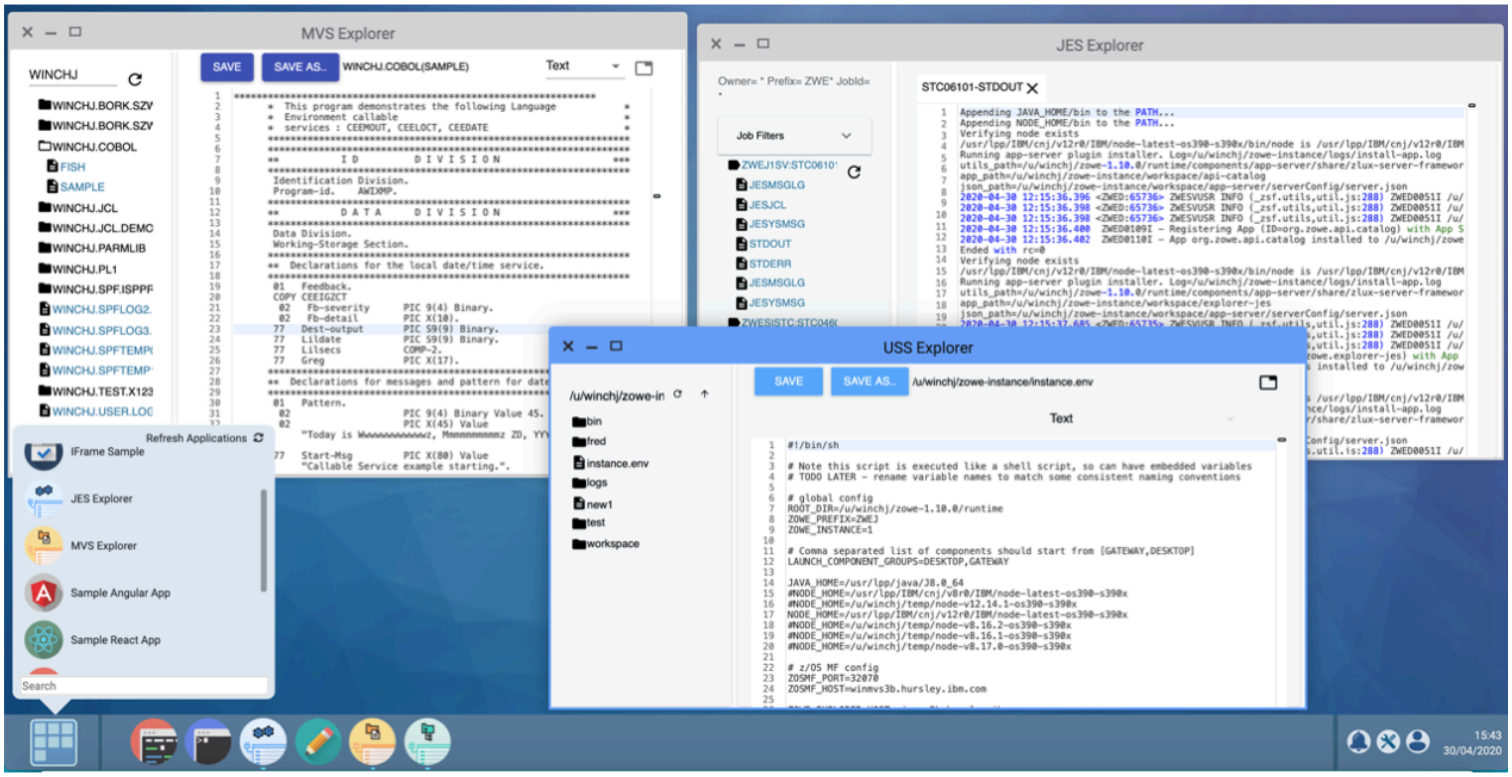
Caching Service

The Caching service aims to provide an API which offers the possibility to store, retrieve, and delete data associated with keys. The service is used only by internal Zowe applications and is not exposed to the internet. The Caching service URL is `https://<ZOWE_HOST_IP>:7555`. For more information about the Caching service, see Using the Caching Service.

When the API Gateway is running, this server is accessible at `https://<ZOWE_HOST_IP>:7554/cachingservice/api/v1`. When the API Catalog is running, the API documentation of this server is accessible at the API Catalog tile `Zowe Applications` which can be viewed at `https://<ZOWE_HOST_IP>:7554/apicatalog/ui/v1/#/tile/zowe/cachingservice`. When running on z/OS, the server uses the jobname suffix of CS.

Desktop Apps

Zowe provides a number of rich GUI web applications for working with z/OS. Such applications include the Editor for files and datasets, the JES Explorer for jobs, and the IP Explorer for the TCPIP stack. You can access them through the Zowe desktop.


MVS Explorer
WINCHJ
WINCHJ.BORK.SZV
WINCHJ.BORK.SZV
WINCHJ.COBOL
FISH
SAMPLE
WINCHJ.JCL
WINCHJ.JCL.DEMO
WINCHJ.PARMLIB
WINCHJ.PL1
WINCHJ.SPF.ISPPF
WINCHJ.SPFLOG2.
WINCHJ.SPFLOG3.
WINCHJ.SPFTEMP(
WINCHJ.SPFTEMP
WINCHJ.TEST.X123
WINCHJ.USER.LOG
SAVE
SAVE AS..
WINCHJ.COBOL(SAMPLE)
Text
Refresh Applications
IFrame Sample
JES Explorer
MVS Explorer
Sample Angular App
Sample React App
Search
JES Explorer
Owner= * Prefix= ZWE* JobId= *
Job Filters
ZWEJ1SV:STC0610
JESMSGLG
JESJCL
JESYSMSG
STDOUT
STDERR
JESMSGLG
JESYSMSG
STC06101-STDOUT
USS Explorer
/u/winchj/zowe-in
bin
fred
instance.env
logs
new1
test
workspace
SAVE
SAVE AS..
/u/winchj/zowe-instance/instance.env
Text
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Zowe Security Overview

Zowe implements comprehensive measures to secure mainframe services and data resources in transition and in rest:

- Digital certificates are used by Zowe to facilitate secure electronic communication and data exchange between people, systems, and devices online.
- User identity is authenticated through modern authentication methods such as OIDC/Oauth2, JWT, or Personal Access Token (PAT). Potentially with added Multi-Factor Authentication (MFA).
- User access is authorized by System Authorization Facility (SAF) / External Security Manager (ESM).

Before installation and use of Zowe server-side components, it is practical to first learn about the core security features built into the Zowe architecture.

This document provides an overview of the security technologies and features implemented by Zowe and links to Zowe practical guides on how to achieve specific tasks and goals.

Note: If you are familiar with security technologies and concepts such as digital certificates, authentication, authorization, and z/OS security, you may prefer to skip the introductory sections, and see the Additional resources section at the end of this article to jump directly to the security related technical guidance provided on how to Set up Zowe, Use Zowe or Extend Zowe.

Review the following sections to learn about how Zowe leverages modern security concepts and technologies:

- Zowe Security Overview
  - Digital certificates
    - Digital certificates usage
  - User Authentication
  - Access Authorization
    - SAF resource check
  - Additional resources

Digital certificates

A Digital Certificate is an electronic file that is tied to a cryptographic (public and private) key pair and authenticates the identity of a website, individual, organization, user, device or server. The de-facto standard is the x.509 family type of certificates, which are the foundation behind Public Key Infrastructure (PKI) security. An X.509 certificate binds an identity to a public key using a digital signature. A certificate contains an identity (a hostname, or an organization, or an individual) and a public key (RSA, DSA, ECDSA, ed25519, etc.).

A certificate can be self-signed or issued by a Certificate Authority (CA). A CA is a trusted organization which provides infrastructure for creation, validation and revocation of the certificates according to the contemporary security standards.

> **NOTE**
>
> For testing purposes of Zowe, it is acceptable to use certificates issued and signed either by the company's local Certificate Authority (CA), or even certificates issued by Zowe security tools and signed by generated CA specific for

the target technology platform. Use of certificates signed by generated CA, however, is not recommended for production environments.

TIP

Review digital certificates terminology in the Zowe security glossary before getting started with configuring certificates.

Digital certificates usage

Zowe uses digital certificates to secure the communication channel between Zowe components as well as between Zowe clients and Zowe services. Digital client certificates can also be used to validate that the identity of a client-user (the service user) is known to the mainframe security facility.

Next Steps:

- For more information about the mechanics of digital certificate, see Using certificates.
- To learn more about the various options for Zowe certificate configuration, see Zowe certificate configuration overview under the *Use* tab.

User Authentication

Zowe always authenticates the users accessing its interfaces and services.

Zowe API ML implements a Single-Sign-On feature which allows users to authenticate once, whereby users can access all mainframe resources that they are granted access rights to for the period in which the Zowe credentials remain valid.

API ML uses multiple authentication methods - Basic Auth (username-password), OIDC/OAuth2, Client certificates and Personal Access Tokens, with possibility of strengthening of the security by adding external Multi-Factor Authentication provider.

Next steps:

- For details about authentication methods used by Zowe, see Zowe User Authentication.

Access Authorization

Authorization is the mechanism by which a security system grants or rejects access to protected resources.

Zowe fully relies on the SAF/ESM for control on the user access to mainframe resources. Authorization is processed by SAF when a mainframe service attempts to access these services under the identity of the user authenticated by Zowe.

TIP

We recommend you review the core Authorization concepts by reading the related topics in the Zowe Security Glossary.

SAF resource check

In some cases Zowe API ML can check for the authorization of the user on certain endpoints even before the request is propagated to the target mainframe service. Access to a SAF resource is checked with the installed z/OS External Security Manager (ESM).

Next steps: For more information about the SAF resource check, see Configuring SAF resource checking.

Additional resources

For more information about getting started with certificates including determining your certificate configuration use case, importing certificates, generating certificates and using certificates, see the following resources:

- Certificate configuration scenarios
- Generating a certificate
- Importing and configuring a certificate
- Configuring certificates

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Glossary of Zowe Security terminology

Zowe implements a number of modern cyber-security concepts. Before getting started with configuring certificates, it is useful to familiarize yourself with the basic terminology. Read the following definitions for explanation of the security terms related to the core security technologies applied by Zowe:

- Certificate concepts
- Certificate verification
- Zowe certificate requirements
- Certificate setup types

Certificate concepts

- Keystore
- Truststore
- PKCS12
- z/OS Key Ring
- Server certificate
- Client certificate
- Self-signed certificates

Keystore

The keystore is the location where Zowe stores certificates that Zowe servers present to clients and other servers. In the simplest case, the keystore contains one private key and a certificate pair, which can then be used by each Zowe server.

When using a key ring, a single key ring can serve both as a keystore and as a truststore if desired.

Truststore

The truststore is used by Zowe to verify the authenticity of the certificates it encounters, whether communicating with another server, with one of Zowe own servers, or with a client that presents a certificate. A truststore is composed of Certificate Authority (CA) certificates which are compared against the CAs that an incoming certificate claims to be signed by. To ensure a certificate is authentic, Zowe must verify that the certificate's claims are correct. Certificate claims include that the certificate was sent by the host that the certificate was issued to, and that the cryptographic signature of the authorities the certificate claims to have been signed by match those signatures found within the truststore. This process helps to ensure that Zowe only communicates with hosts that are trusted and have been verified as authentic.

When using a key ring, a single key ring can be both a keystore and a truststore if desired.

PKCS12

PKCS12 is a file format that allows a Zowe user to hold many cryptographic objects in one encrypted, password-protected file. This file format is well-supported across platforms but because it is just a file, you may prefer to use z/OS key rings instead of PKCS12 certificates for ease of administration and maintenance.

z/OS Key Ring

z/OS provides an interface to manage cryptographic objects in "key rings". As opposed to PKCS12 files, using z/OS key rings allows the crypto objects of many different products to be managed in a uniform manner. z/OS key rings are still encrypted, but do not use passwords for access. Instead, SAF privileges are used to manage access. Java's key ring API requires that the password field for key ring access be set to "password", so despite not needing a password, you may see this keyword.

Use of a z/OS keystore is the recommended option for storing certificates if system programmers are already familiar with the certificate operation and usage. Creating a key ring and connecting the certificate key pair requires elevated permissions. When the TSO user ID does not have the authority to manipulate key rings and users want to create a Zowe sandbox environment or for testing purposes, the USS keystore is a good alternative.

Server certificate

Servers need a certificate to identify themselves to clients. Every time you go to an HTTPS website for example, your browser checks the server certificate and its CA chain to verify that the server you reached is authentic.

Client certificate

Clients do not always need certificates when communicating with servers, but sometimes client certificates can be used wherein the server verifies authenticity of the client similar to how the client verifies authenticity for the server. When client certificates are unique to a client, this can be used as a form of authentication to provide convenient yet secure login.

Self-signed certificates

A self-signed certificate is one that is not signed by a CA at all – neither private nor public. In this case, the certificate is signed with its own private key, instead of requesting verification from a public or a private CA. This arrangement, however, means there is no chain of trust to guarantee that the host with this certificate is the one you wanted to communicate with. Note that these certificates are not secure against other hosts masquerading as the one you want to access. As such, it is highly recommended that certificates be verified against the truststore for production environments.

Certificate verification

When you configure Zowe, it is necessary to decide whether Zowe will perform verification of certificates against its truststore. In the Zowe configuration YAML, the property `zowe.verifyCertificates` controls the verification behavior. It can be `DISABLED`, `NONSTRICT`, or `STRICT`.

You can set this property either before or after certificate setup, but **it is recommended to set `zowe.verifyCertificates` before certificate setup** because it affects the automation that Zowe can perform during certificate setup.

- DISABLED verification
- NON-STRICT verification
- STRICT verification

DISABLED verification

If you set `zowe.verifyCertificates` to `DISABLED`, certificate verification is not performed. This is not recommended for security reasons, but may be used for proof of concept or when certificates within your environment are self-signed.

If you set `DISABLED` before certificate setup, Zowe will not automate putting z/OSMF trust objects into the Zowe truststore. This can result in failure to communicate with z/OSMF if at a later time you enable verification. As such, it is recommended to either set verification on by default, or to re-initialize the keystore if you choose to turn verification on at a later point.

NON-STRICT verification

If you set `zowe.verifyCertificates` to `NONSTRICT`, certificate verification will be performed except for hostname validation. Using this setting, the certificate Common Name or Subject Alternate Name (SAN) is not checked. Skipping hostname validation facilitates deployment to environments where certificates are valid but do not contain a valid hostname. This configuration is for development purposes only and should not be used for production.

STRICT verification

`STRICT` is the recommended setting for `zowe.verifyCertificates`. This setting performs maximum verification on all certificates Zowe sees and uses a Zowe truststore.

Zowe certificate requirements

If you do not yet have certificates, Zowe can create self-signed certificates for you. This is not recommended for production. Note that the certificates must be valid for use with Zowe.

- Extended key usage
- Hostname validity
- z/OSMF access

Extended key usage

Zowe server certificates must either not have the `Extended Key Usage` (EKU) attribute, or have both the `TLS Web Server Authentication (1.3.6.1.5.5.7.3.1)` and `TLS Web Client Authentication (1.3.6.1.5.5.7.3.2)` values present within.

Some Zowe components act as a server, some as a client, and some as both - client and server. The component certificate usage for each of these cases is controlled by the Extended Key Usage (EKU) certificate attribute. Zowe components use a single certificate/the same certificate for client and server authentication. As such, it is necessary that this certificate is valid for the intended usage/s of the component - client, server, or both. The EKU certificate extension attribute is not required. If, however, the EKU certificate extension attribute is specified, it must be defined with the intended usage/s. Otherwise, connection requests will be rejected by the other party.

Hostname validity

The host communicating with a certificate should have its hostname match one of the values of the certificate's Common Name or Subject Alternate Name (SAN). If this condition is not true for at least one of the certificates seen by Zowe, then you may wish to set NON-STRICT verification within Zowe configuration.

z/OSMF access

The z/OSMF certificate is verified according to Zowe Certificate verification setting, as is the case with any certificate seen by Zowe. However, Zowe will also set up a trust relationship with z/OSMF within the Zowe truststore during certificate setup automation if the certificate setting is set to any value other than DISABLED.

Certificate setup types

Whether importing or letting Zowe generate certificates, the setup for Zowe certificate automation and the configuration to use an existing keystore and truststore depends upon the content format: file-based (`PKCS12`) or z/OS key ring-based.

- File-based (PKCS12) certificate setup
- z/OS key ring-based certificate setup

File-based (PKCS12) certificate setup

Zowe is able to use PKCS12 certificates that are stored in USS. Zowe uses a `keystore` directory to contain its certificates primarily in PKCS12 (`.p12`, `.pfx`) file format, but also in PEM (`.pem`) format. The truststore is in the `truststore` directory that holds the public keys and CA chain of servers which Zowe communicates with (for example z/OSMF).

z/OS key ring-based certificate setup

Zowe is able to work with certificates held in a **z/OS Key ring**.

The JCL member `.SZWESAMP(ZWEKRING)` contains security commands to create a SAF keyring. By default, this key ring is named `ZoweKeyring`. You can use the security commands in this JCL member to generate a Zowe certificate authority (CA) and sign the server certificate with this CA. The JCL contains commands for all three z/OS security managers: RACF, TopSecret, and ACF2.

There are two ways to configure and submit `ZWEKRING`:

- Copy the JCL `ZWEKRING` member and customize its values.
- Customize the `zowe.setup.certificate` section in `zowe.yaml` and use the `zwe init certificate` command.

  You can also use the `zwe init certificate` command to prepare a customized JCL member using `ZWEKRING` as a template.

A number of key ring scenarios are supported:

- Creation of a local certificate authority (CA) which is used to sign a locally generated certificate. Both the CA and the certificate are placed in the `ZoweKeyring`.
- Import of an existing certificate already held in z/OS to the `ZoweKeyring` for use by Zowe.
- Creation of a locally generated certificate and signed by an existing certificate authority. The certificate is placed in the key ring.

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Zowe Certificates overview

In order to leverage certificates in Zowe, it is useful to review the key concepts of digital certificates-based security and how Zowe implements this technology.

- Zowe Certificates overview
  - Digital certificates definition
  - Digital certificates usage
  - Public key infrastructure
  - Transport Layer Security
  - Digital certificates types
  - Certificates storage
    - Keystore and Truststore
      - Keystores
      - Truststores
    - SAF Keyring

Digital certificates definition

A Digital Certificate is an electronic file that is tied to a cryptographic (public and private) key pair and authenticates the identity of a website, individual, organization, user, device or server. The de facto standard is the x.509 family type of certificates, which are the foundation behind Public Key Infrastructure (PKI) security.

An X.509 certificate binds an identity to a public key using a digital signature. A certificate contains an identity (a hostname, or an organization, or an individual) and a public key (RSA, DSA, ECDSA, ed25519, etc.).

Certificates can be self-signed or issued by a Certificate Authority (CA). A CA is an organization which provides infrastructure for the creation, validation, and revocation of certificates according to contemporary security standards.

> **NOTE**
>
> For testing purposes of Zowe, it is acceptable to use certificates issued and signed either by a company local CA, or certificates that are signed by a CA created by Zowe security tools specific for the target technology platform. Use of self-signed certificates is **not recommended** for production environments.

Digital certificates usage

Digital certificates according to x.509 standard specification are the cornerstone for securing communication channels between clients and servers.

X.509 Digital certificates are primarly used to implement the following functions:

- Verification of the identity of a sender/receiver of an electronic message during TLS handshake.
- Encryption/Decryption of the messages between the sender and the receiver.
- Identification of client-service users.

Zowe uses digital certificates as a foundational element for both communication and for identity security. Additionally, Zowe provides a client identity validation functionality based on the ownership of the provided x.509 client certificate and the mainframe security authentication mechanism.

For more information about how Zowe leverages certificates, see Zowe certificate usage.

To review the various Zowe certificate configuration options, see the Zowe certificate configuration overview.

Public key infrastructure

Public Key Infrastructure (PKI) is a key element of internet security. PKI is both the technology and processes that make up the framework for encryption to protect and authenticate digital communications. PKI includes software, hardware, policies, and procedures that are used to create, distribute, manage, store, and revoke digital certificates and manage public-key encryption.

For detailed information about Public Key Infrastructure (PKI), see How Does PKI Work? in the *Keyfactor* documentation.

Visit the following link to learn more about PKI in the context of the z/OS Cryptographic Services.

Transport Layer Security

Transport Layer Security (TLS) is a networking cryptography protocol that provides authentication, privacy, and data integrity between two communicating computer applications. TLS is a successor to Secure Socket Layer (SSL), which was deprecated in 2015.

> **NOTE**
>
> While the transition from SSL 3.0 to TLS 1.0 occurred in 1999, the term SSL continues to be in common usage. At the time of this publication, this technology is still oftentimes referred to as SSL/TLS.

TLS defines a client-server handshake mechanism to establish an encrypted and secure connection, to ensure the authenticity of the communication between parties. During the handshake, the parties negotiate an exchange algorithm, cipher suites, and exchange key material to establish a stateful encrypted connection. The exact steps of the TLS handshake depend on the protocol version/s supported by the client and the server. The current version at the time of this publication is 1.3, while version 1.2 is widely supported.

Being familiar with the key concepts and terms describing TLS security helps to properly set up the Zowe servers network security and to troubleshoot configuration issues. The following list presents some of the key concepts and terms:

- Cipher Suite
- Key Exchange
- Symmetric Encryption
- Asymmetric Encryption
- Authentication
- Basic vs mutually-authenticated handshake

The following diagram illustrates the TLS handshake steps:

The architecture of Zowe strictly relies on Transport Layer Security (TLS) to secure communication channels between Zowe components, as well as between client applications and Zowe server components.

For more information, see the TLS requirements in Zowe API ML requirements.

> **NOTE**
>
> When installed on a mainframe system, Zowe is able to utilize AT-TLS implementation if supported by the corresponding z/OS version/installation. For more information, see Configuring AT-TLS for Zowe server.

Digital certificates types

Zowe's architecture also distinguishes several aspects of PKI artifacts and their usage. Based on these artifacts and use-cases, users can determine which certificate type to use. Some certificate types are specific for a given technology, while others are generic and applicable across a wider spectrum of platforms.

Certificates come in various file formats and can be stored in different certificates storage types.

Digital X.509 certificates can be issued in various file formats such as PEM, DER, PKCS#7 and PKCS#12. PEM and PKCS#7 formats use Base64 ASCII encoding, while DER and PKCS#12 use binary encoding.

The choice of certificate format depends on the technologies used in the implementation of the server components and on the certificate storage type. For example, Java servers can use JKS and JCEKS keystores, which are specific for the platform.

Zowe supports:

- **file-based PKCS12**
  PKCS12 certificates are the most general and widely deployed certificate format.
- **z/OS keyring-based keystore (JKS/JCEKS)**
  JKS/JCEKS certificates are specific types of certificates that depend on the Java environment.

> **NOTE**
>
> Java 9 and higher can also work with PKCS12 certificates.

Certificates storage

There are two options for the storage of certificates:

- Keystore and Truststore combination
- SAF Keyrings

Keystore and Truststore

Two key concepts to understand storage and verification of certificates are keystores and truststores.

- **Keystores** are used to store certificates and the verification of these certificates.
- **Truststores** are used to store the verification.

Zowe supports keystores and truststores that are either z/OS keyrings (when on z/OS) or PKCS12 files. By default, Zowe reads a PKCS12 keystore from `keystore` directory in zowe.yaml. This directory contains a server certificate, the Zowe generated certificate authority, and a `truststore` which holds intermediate certificates of servers that Zowe communicates with (for example z/OSMF).

Keystores

Zowe can use PKCS12 certificates stored in USS to encrypt TLS communication between Zowe clients and Zowe z/OS servers, as well as intra z/OS Zowe server to Zowe server communication. Zowe uses a `keystore` directory to contain its

external certificate, and a `truststore` directory to hold the public keys of servers which Zowe communicates with (for example z/OSMF).

Truststores

Truststores are essential to provide secure communication with external services. The truststore serves as a secure repository for storing certificates and trust anchors. In the context of Zowe, the truststore establishes the trust relationships with external services as well as manages the relationship between Zowe's components and the certificates presented by the external services.

In addition to utilizing the intra-address space of certificates, Zowe incorporates external services on z/OS to enhance the encryption of messages transmitted between its servers. These external services, such as z/OSMF or Zowe conformant extensions, have registered themselves with the API Mediation Layer.

API Mediation Layer, acting as an intermediary, validates these certificates. When API ML receives a certificate from an external service, it examines each certificate in the certificate chain and compares it to the certificates in the truststore.

By leveraging the truststore, Zowe ensures that only trusted and authorized external services can establish communication with its servers.

SAF Keyring

An alternative to certificate storage with keystores and trustores is to use a SAF Keyring. Use of a SAF Keyring is more secure than PKCS12 files. This SAF keyring method also makes it possible to import an existing certificate or generate new certificates with Top Secret, ACF2, and RACF.

For details about SAF Keyring, see the documentation API ML SAF Keyring in the article **Certificate management in Zowe API Mediation Layer**.

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Zowe User Authentication

The API Mediation Layer provides multiple methods which clients can use to authenticate.

- Zowe User Authentication
  - Authentication with JSON Web Tokens (JWT)
  - Authentication with client certificates
  - Authentication with Personal Access Token (PAT)
  - Multi-factor authentication (MFA)
  - Advanced Authentication Mainframe (AAM)

Authentication with JSON Web Tokens (JWT)

When the user successfully authenticates with API ML, the client receives a JWT in exchange. This token can be used by the client to access REST services behind the API ML Gateway and also for subsequent user authentication. The access JWT is signed with the private key that is configured in the Zowe Identity Provider's certificate store, regardless of whether the token is in a keystore or keyring.

To utilize Single-Sign-On (SSO), the Zowe API ML client needs to provide an access token to API services in the form of the cookie `apimlAuthenticationToken`, or in the `Authorization: Bearer` HTTP header as described in this authenticated request example.

Authentication with client certificates

If the keyring or a truststore contains at least one valid certificate authority (CA) other than the CA of API ML, it is possible to use client certificates issued by this CA to authenticate to API ML.

Authentication with Personal Access Token (PAT)

A Personal Access Token (PAT) is a specific scoped JWT with a configurable validity duration. The PAT authentication method is an alternative to using a client certificate for authentication. It is disabled by default. To enable this functionality, see Enabling single sign on for clients via personal access token configuration.

Benefits of PAT

- Long-lived. The maximum validity is 90 days.
- Scoped. Users are required to provide a scope. It is only valid for the specified services.
- Secure. If a security breech is suspected, the security administrator can invalidate all the tokens based on criteria as established by rules.

For more information about PAT, see Authenticating with a Personal Access Token documentation.

Multi-factor authentication (MFA)

Multi-factor authentication is provided by third-party products with which Zowe is compatible. The following are known to work with Zowe:

- Advanced Authentication Mainframe
- IBM Z Multi-Factor Authentication.

Additionally, Zowe API ML can be configured to accept OIDC/OAuth2 user authentication tokens. In this particular case, MFA support is built into the OIDC provider system. While mainframe MFA technology is not utilized in this case, an equal level of security is provided.

Advanced Authentication Mainframe (AAM)

To add a dynamic element to the authentication, you can configure the Advanced Authentication Mainframe to enable multi-factor authentication. For more information about AAM, see the Advanced Authentication Mainframe 2.0 documentation in *Broadcom Tech Docs*.

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High Availability

In order to deploy Zowe in high availability (HA) mode, it is necessary to set up a Parallel Sysplex® environment. A Parallel Sysplex is a cluster of z/OS® systems that cooperatively use certain hardware and software components to achieve a high-availability workload processing environment. A production instance with this High Availability setup is required to achieve the necessary availability.

Sysplex architecture and configuration

A Sysplex is required to make sure multiple Zowe instances can work together. For more configuration details, see Configuring Sysplex for high availability.

To enable high availability when Zowe runs in a Sysplex, it is necessary to meet the following requirements:

- The Zowe instance is installed on every LPAR.
- The API services are registered to each Zowe instance.
- A shared file system is created between LPARs in the Sysplex. For details, see How to share file systems in a Sysplex.
- z/OSMF High Availability mode is configured. For details, see Configuring z/OSMF high availability in Sysplex.
- The instance on every LPAR is started.

Configuration with high availability

The configuration for the specific instance is composed of the defaults in the main section and the overrides in the `haInstances` section of the `zowe.yaml` configuration file.

In this section, `ha-instance` represents any Zowe high availability instance ID. Every instance has an internal id and a section with overrides compared to the main configuration in the beginning of the `zowe.yaml` file. For more information, see Zowe YAML server configuration reference.

Caching service setup and configuration

Zowe uses the Caching Service to centralize the state data persistent in high availability (HA) mode. This service can be used to share information between services.

If you are running the Caching Service on z/OS, there are three storage methods with their own characteristics:

- Infinispan (*recommended*)
  - Part of the Caching service
  - Does not need separate processes
  - Highly performant
- VSAM (*deprecated*)
  - Familiar to z/OS engineers
  - Slow
- Redis
  - Needs to run in Distributed world separately

- Good for Kubernetes deployment

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Zowe FAQs

Check out the following FAQs to learn more about the purpose and function of Zowe™.

- Zowe FAQ
- Zowe CLI FAQ
- Zowe Explorer FAQ

Zowe FAQ

What is Zowe?

Click to hide answer

Zowe is an open source project within the Open Mainframe Project that is part of The Linux Foundation. The Zowe project provides modern software interfaces on IBM z/OS to address the needs of a variety of modern users. These interfaces include a new web graphical user interface, a script-able command-line interface, extensions to existing REST APIs, and new REST APIs on z/OS.

Who is the target audience for using Zowe?

Click to hide answer

Zowe technology can be used by a variety of mainframe IT and non-IT professionals. The target audience is primarily application developers and system programmers, but the Zowe Application Framework is the basis for developing web browser interactions with z/OS that can be used by anyone.

What language is Zowe written in?

Click to hide answer

Zowe consists of several components. The primary languages for API Mediation Layer are Java and JavaScript. Zowe CLI, Explorer for VSCode, and Desktop are written in TypeScript. Zowe Explorer plug-in for IntelliJ IDEA is written in Kotlin, ZSS is written in C, while the cross memory server is written in metal C.

What is the licensing for Zowe?

Click to hide answer

Zowe source code is licensed under EPL2.0. For license text click here and for additional information click here.

In the simplest terms (taken from the FAQs above) - "...if you have modified EPL-2.0 licensed source code and you distribute that code or binaries built from that code outside your company, you must make the source code available under the EPL-2.0."

Why is Zowe licensed using EPL2.0?

Click to hide answer

The Open Mainframe Project wants to encourage adoption and innovation, and also let the community share new source code across the Zowe ecosystem. The open source code can be used by anyone, provided that they adhere to the licensing terms.

What are some examples of how Zowe technology might be used by z/OS products and applications?

Click to hide answer

The Zowe Desktop (web user interface) can be used in many ways, such as to provide custom graphical dashboards that monitor data for z/OS products and applications.

Zowe CLI can also be used in many ways, such as for simple job submission, data set manipulation, or for writing complex scripts for use in mainframe-based DevOps pipelines.

The increased capabilities of RESTful APIs on z/OS allows APIs to be used in programmable ways to interact with z/OS services.

What is the best way to get started with Zowe?

Click to hide answer

Zowe provides a convenience build that includes the components released-to-date, as well as IP being considered for contribution, in an easy to install package on Zowe.org. The convenience build can be easily installed and the Zowe capabilities seen in action.

To install the complete Zowe solution, see Installing Zowe.

To get up and running with the Zowe CLI component quickly, see Zowe CLI quick start.

What are the prerequisites for Zowe?

Click to hide answer

Prerequisites vary by component used, but in most cases the primary prerequisites are Java and NodeJS on z/OS and the z/OS Management Facility enabled and configured. For a complete list of software requirements listed by

component, see System requirements for z/OS components and System requirements for Zowe CLI.

What's the difference between using Zowe with or without Docker?

Technical Preview

Click to hide answer

Docker is a download option for Zowe that allows you to run certain Zowe server components outside of z/OS. The Docker image contains the Zowe components that do not have the requirement of having to run on z/OS: The App server, API Mediation Layer, and the USS/MVS/JES Explorers.

Configurating components with Docker is similar to the procedures you would follow without Docker, however tasks such as installation and running with Docker are a bit different, as these tasks become Linux oriented, rather than utilizing Jobs and STCs.

> **NOTE**
>
> z/OS is still required when using the Docker image. Depending on which components of Zowe you use, you'll still need to set up z/OS Management Facility as well as Zowe's ZSS and Cross memory servers.

Is the Zowe CLI packaged within the Zowe Docker download?

Technical Preview

Click to hide answer

At this time, the Docker image referred to in this documentation contains only Zowe server components. It is possible to make a Docker image that contains the Zowe CLI, so additional Zowe content, such as the CLI, may have Docker as a distribution option later.

If you are interested in improvements such as this one, please be sure to express that interest to the Zowe community!

Does ZOWE support z/OS ZIIP processors?

Click to hide answer

Only the parts of Zowe that involve Java code are ZIIP enabled. The API Mediation Layer composed of the API Gateway, Discovery and Catalog servers along with any Java-based services that work with them such as the Jobs and Datasets servers are ZIIP enabled. Also, the CLI and VSCode Explorer make large use of z/OSMF, which is Java so they are ZIIP enabled as well. More details on portions of Zowe which are Java (ZIIP) enabled can be found here.

This leaves C and NodeJS code which are not ZIIP enabled, BUT, we have a tech preview available currently that allows execution of Java as well as NodeJS code, on Linux or zLinux via Docker. With the tech preview, only the C code remains on z/OS, which is not ZIIP enabled.

How is access security managed on z/OS?

Click to hide answer

Zowe components use typical z/OS System authorization facility (SAF) calls for security.

How is access to the Zowe open source managed?

Click to hide answer

The source code for Zowe is maintained on an Open Mainframe Project GitHub server. Everyone has read access. "Committers" on the project have authority to alter the source code to make fixes or enhancements. A list of Committers is documented in Committers to the Zowe project.

How do I get involved in the open source development?

Click to hide answer

The best way to get started is to join a Zowe Slack channel and/or email distribution list and begin learning about the current capabilities, then contribute to future development.

For more information about emailing lists, community calendar, meeting minutes, and more, see the Zowe Community GitHub repo.

For information and tutorials about extending Zowe with a new plug-in or application, see Extending on Zowe Docs.

Where can I submit an idea for a future enhancement to Zowe?

Click to hide answer

Go to the Zowe Community ReadMe file for information on requesting a bug fix or enhancement. Members of the Zowe community can then review your issue to post feedback or vote their support. Issues are continuously monitored by Zowe squads for improvement ideas.

When will Zowe be completed?

Click to hide answer

Zowe will continue to evolve in the coming years based on new ideas and new contributions from a growing community.

Can I try Zowe without a z/OS instance?

Click to hide answer

IBM has contributed a free hands-on tutorial for Zowe. Visit the Zowe Tutorial page to learn about adding new applications to the Zowe Desktop and and how to enable communication with other Zowe components.

The Zowe community is also currently working to provide a vendor-neutral site for an open z/OS build and sandbox environment.

Zowe is also compatible with IBM z/OSMF Lite for non-production use. For more information, see Configuring z/OSMF Lite on Zowe Docs.

Zowe CLI FAQ

Why might I use Zowe CLI versus a traditional ISPF interface to perform mainframe tasks?

Click to hide answer

For developers new to the mainframe, command-line interfaces might be more familiar than an ISPF interface. Zowe CLI lets developers be productive from day-one by using familiar tools. Zowe CLI also lets developers write scripts that automate a sequence of mainframe actions. The scripts can then be executed from off-platform automation tools such as Jenkins automation server, or manually during development.

With what tools is Zowe CLI compatible?

Click to hide answer

Zowe CLI is very flexible; developers can integrate with modern tools that work best for them. It can work in conjunction with popular build and testing tools such as Gulp, Gradle, Mocha, and Junit. Zowe CLI runs on a variety of operating systems, including Windows, macOS, and Linux. Zowe CLI scripts can be abstracted into automation tools such as Jenkins and TravisCI.

Where can I use the CLI?

Click to hide answer

Usage Scenario	Example
Interactive use, in a command prompt or bash terminal.	Perform one-off tasks such as submitting a batch job.
Interactive use, in an IDE terminal	Download a data set, make local changes in your editor, then upload the changed dataset back to the mainframe.
Scripting, to simplify repetitive tasks	Write a shell script that submits a job, waits for the job to complete, then returns the output.
Scripting, for use in automated pipelines	Add a script to your Jenkins (or other automation tool) pipeline to move artifacts from a mainframe development system to a test system.

Which method should I use to install Zowe CLI?

Click to hide answer

You can install Zowe CLI using the following methods:

- **Local package installation:** The local package method lets you install Zowe CLI from a zipped file that contains the core application and all plug-ins. When you use the local package method, you can install Zowe CLI in an offline environment. We recommend that you download the package and distribute it internally if your site does not have internet access.
- **Online NPM registry:** The online NPM (Node Package Manager) registry method unpacks all of the files that are necessary to install Zowe CLI using the command line. When you use the online registry method, you need an internet connection to install Zowe CLI

How can I get Zowe CLI to run faster?

Click to hide answer

- Zowe CLI runs significantly faster when you run it in daemon mode. Daemon mode significantly improves the performance of Zowe CLI commands by running Zowe CLI as a persistent background process. For more information, see Using daemon mode.

How can I manage profiles for my projects and teams?

Click to hide answer

- Zowe CLI V2 introduces **team** profiles. Using team profiles helps to improve the initial setup of Zowe CLI by making service connection details easier to share and easier to store within projects. For more information, see Using team profiles.

Does Zowe CLI support multi-factor authentication (MFA)?

Click to hide answer

Yes, Zowe CLI supports MFA through the API Mediation Layer. Without API ML, an MFA code can be used in place of a password for testing single requests, but storing the MFA code for future requests does not work because the code expires rapidly.

When mainframe services are routed through API ML, users can log in to the API ML gateway with an MFA code to obtain a long-lived API ML authentication token that can be stored for future requests.

How can I get help with using Zowe CLI?

Click to hide answer

- You can get help for any command, action, or option in Zowe CLI by issuing the command 'zowe --help'.
- For information about the available commands in Zowe CLI, see Command Groups.
- If you have questions, the Zowe Slack space is the place to ask our community!

How can I use Zowe CLI to automate mainframe actions?

Click to hide answer

- You can automate a sequence of Zowe CLI commands by writing bash scripts. You can then run your scripts in an automation server such as Jenkins. For example, you might write a script that moves your Cobol code to a mainframe test system before another script runs the automated tests.
- Zowe CLI lets you manipulate data sets, submit jobs, provision test environments, and interact with mainframe systems and source control management, all of which can help you develop robust continuous integration/delivery.

How can I contribute to Zowe CLI?

Click to hide answer

As a developer, you can extend Zowe CLI in the following ways:

- Build a plug-in for Zowe CLI
- Contribute code to the core Zowe CLI
- Fix bugs in Zowe CLI or plug-in code, submit enhancement requests via GitHub issues, and raise your ideas with the community in Slack.

  Note: For more information, see Developing for Zowe CLI.

Zowe Explorer FAQ

Why might I use Zowe Explorer versus a traditional ISPF interface to perform mainframe tasks?

Click to hide answer

The Zowe Explorer VSCode extension provides developers new to the mainframe with a modern UI, allowing you to access and work with the data set, USS, and job functionalities in a fast and streamlined manner. In addition, Zowe Explorer enables you to work with Zowe CLI profiles and issue TSO/MVS commands.

How can I get started with Zowe Explorer?

Click to hide answer

First of all, make sure you fulfill the following Zowe Explorer software requirements:

- Get access to z/OSMF.
- Install VSCode.
- Configure TSO/E address space services, z/OS data set, file REST interface, and z/OS jobs REST interface. For more information, see z/OS Requirements.
- For development, install Node.js v14.0 or later.

Once the software requirements are fulfilled, create a Zowe Explorer profile.

Follow these steps:

1. Navigate to the explorer tree.
2. Click the **+** button next to the **DATA SETS**, **USS**, or **JOBS** bar.
3. Select the **Create a New Connection to z/OS** option.
4. Follow the instructions, and enter all required information to complete the profile creation.

You can also watch Getting Started with Zowe Explorer to understand how to use the basic features of the extension.

Where can I use Zowe Explorer?

Click to hide answer

You can use Zowe Explorer either in VSCode or in Theia. For more information about Zowe Explorer in Theia, see Developing for Theia.

How do I get help with using Zowe Explorer?

Click to hide answer

- Use the Zowe Explorer channel in Slack to ask the Zowe Explorer community for help.
- Open a question or issue directly in the Zowe Explorer GitHub repository.

How can I use Secure Credential Storage for Zowe Explorer?

Click to hide answer

The Secure Credential Store Plug-in is no longer required for Zowe Explorer.

Secure credential storage functionality is now contained in the Zowe CLI core application, which stores credentials securely by default.

What if Secure Credential Storage does not work in my environment?

Click to hide answer

When an environment does not support Secure Credential Storage, it is possible to disable it. See Disabling Secure Credential Storage of credentials for more information.

What if I do not want Zowe Explorer to store my credentials?

Click to hide answer

Although not recommended in all cases, it is possible to disable Zowe Explorer's credential management functionality. See Preventing Zowe Explorer from storing credentials for more information.

What types of profiles can I create for Zowe Explorer?

Click to hide answer

Zowe Explorer V2 supports using Service Profiles, Base Profiles, and Team Profiles. For more information, see Using V1 profiles and Team configurations in the Using Zowe CLI section.

Does Zowe Explorer support multi-factor authentication (MFA)?

Click to hide answer

Yes, Zowe Explorer supports MFA through the API Mediation Layer. Without API ML, an MFA code can be used in place of a password for testing single requests, but storing the MFA code for future requests does not work because the code expires rapidly.

When mainframe services are routed through API ML, users can log in to the API ML gateway with an MFA code to obtain a long-lived API ML authentication token that can be stored for future requests.

Is it possible to change the detected language of a file or data set opened in Zowe Explorer?

Click to hide answer

Yes, you can configure Visual Studio Code to use a specific language for a particular file extension or data set qualifier. To set file associations, see Add a file extension to a language.

How can I use FTP as my back-end service for Zowe Explorer?

Click to hide answer

See the Zowe FTP extension README in GitHub for information about how to install FTP from the Visual Studio Code Marketplace and use it as your back-end service for working with UNIX files.

How can I contribute to Zowe Explorer?

Click to hide answer

As a developer, you may contribute to Zowe Explorer in the following ways:

- Build a Zowe Explorer extension.
- Contribute code to core Zowe Explorer.
- Fix bugs in Zowe Explorer, submit enhancement requests via GitHub issues, and raise your ideas with the community in Slack.

Note: For more information, see Extending Zowe Explorer.

Zowe Explorer plug-in for IntelliJ IDEA FAQ

Why would I use the plug-in versus a traditional ISPF interface to perform mainframe tasks?

Click to hide answer

Zowe Explorer plug-in for IntelliJ IDEA allows you to access and work with data sets, members and jobs directly from your IntelliJ-based IDE, such as IntelliJ IDEA, PyCharm, Android Studio, etc.

How can I get started with Zowe Explorer plug-in for IntelliJ IDEA?

Click to hide answer

Install the plug-in in your IntelliJ-based IDE directly from marketplace or download it from here.

Where can I use Zowe Explorer plug-in for IntelliJ IDEA?

Click to hide answer

You can use it in any IntelliJ-based IDE, such as IntelliJ IDEA, PyCharm, Android Studio, etc.

How do I get help with using Zowe Explorer plug-in for IntelliJ IDEA?

Click to hide answer

You can start with the Use cases section to learn about use cases and how to install and use the plug-in. Also, you can ask any questions in our Zowe Slack channel (#zowe-explorer-intellij).

How can I contribute to Zowe Explorer plug-in for IntelliJ IDEA?

Click to hide answer

If you have ideas on how to improve the plug-in, or have an issue/bug fix in mind, visit the contribution guide. Also, you can ask for help in our Zowe Slack channel (#zowe-explorer-intellij).

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Zowe glossary

This glossary is part of a growing list of terms and concepts used throughout the spectrum of Zowe projects, which includes both technical as well as organizational terms that are specific to Zowe.

If there is a term you are looking for that is not included in this glossary that you think should be included, please send a message to the Zowe Docs squad in the #zowe-doc Slack channel to discuss updating this glossary.

> **NOTE**
>
> Security is central to a wide range of functionalities in Zowe and includes numerous terms and concepts specific to security. As such, a separate glossary of Zowe Security terminology is available in the *Overview* section under *Zowe security*. For more information, see the **Glossary of Zowe Security teminology**.
>
> For an overview of security in Zowe, see the Zowe Security policy on zowe.org.

All Core Zowe Projects

Zowe API Mediation Layer (API ML)

Provides a reverse proxy and enables REST APIs by providing a single point of access for mainframe service REST APIs like MVS Data Sets, JES, as well as working with z/OSMF. API ML has dynamic discovery capability for these services and Gateway is also responsible for generating the authentication token used to provide single sign-on (SSO) functionality.

<details>
<summary>Click here for descriptions of the various components that form the API Mediation Layer.</summary>

API Catalog

Displays API services that have been discovered by the API Mediation Layer.

API Discovery Service

As the central repository of active services in the API Mediation Layer ecosystem, the API Discovery Service continuously collects and aggregates service information to provide status updates. This enables the discoverability of services.

API Gateway

A proxy server that routes requests from clients on its northbound edge (such as web browsers or Zowe CLI) to servers on its southbound edge that are able to provide data to serve the request.

Also responsible for generating the authentication token used to provide single sign-on (SSO) functionality.

Caching Service

Designed for Zowe components in a high availability (HA) configuration. The caching service supports the HA of all components within Zowe, allowing components to be stateless by providing a mechanism to offload their state to a location accessible by all instances of the service, including those which just started.
</details>

Zowe Application Framework

Modernizes and simplifies working on the mainframe via a web visual interface. Functionality is provided through apps and a desktop user experience called the Zowe Desktop. Base functionality includes apps to work with JES, MVS Data Sets, Unix System Services, as well as a 3270 Terminal, Virtual Terminal, and an Editor.

Zowe CLI

Provides a command-line interface that lets you interact with the mainframe remotely and use common tools such as Integrated Development Environments (IDEs), shell commands, bash scripts, and build tools for mainframe development. The core set of commands includes working with data sets, USS, JES, as well as issuing TSO and console commands. The Zowe CLI is incredibly popular in modern mainframe education.

Zowe client projects

Includes all the Zowe projects, or components, that are installed on the user's PC. Also known as *Zowe client-side projects* or *Zowe client-side components*.

Examples include Zowe CLI, Zowe Explorer for Visual Studio Code, Zowe Explorer for IntelliJ IDEA, and Zowe Client SDKs.

Zowe Client SDKs

Allow extenders to build applications on top of existing programmatic APIs such as z/OSMF. Currently supported client SDKs include Node.js (core), Kotlin, Python, Swift, and Java.

Zowe Explorer

A Visual Studio Code extension that modernizes the way developers and system administrators interact with z/OS mainframes. Zowe Explorer lets you interact with data sets, USS files, and jobs that are stored on z/OS. Zowe Explorer is incredibly popular in modern mainframe education.

Zowe server components

Includes all the Zowe components that are installed on z/OS. Also known as *Zowe z/OS components* or *Zowe server-side components*.

Zowe Systems Services Server (ZSS)

Working closely with ZIS, ZSS serves as one of the primary, authenticated back-ends that communicates with z/OS and provides Zowe with a number of APIs: z/OS Unix files and data sets, control of the plug-ins and services lifecycle, security management, etc. The Zowe Desktop especially delegates a number of its services to ZSS which it accesses through the default http port `7557`.

ZSS is written in C and uses native calls to z/OS to provide its services.

Architecture and other components

Configuration Manager

Works closely with the Zowe Launcher to manage the configuration of Zowe across its lifecycle. Interacted with primarily via `zwe` command

Core component

The definition of a core component is governed by the Technical Steering Committee (TSC). Typically a core component is a packaged, foundational piece that is part of base Zowe.

From the perspective of a conformant support provider, providing support for Zowe refers to providing support for each core component of Zowe (although providers may place their own limitations on what they support).

A core component is usually actively maintained by one or more squads. A component has a component manifest file that helps identify it with the rest of Zowe.

Explorer

When used by itself, ***Explorer*** often refers to the core Zowe component for Visual Studio Code, Zowe Explorer. However, the term "Explorer" is often also a part of multiple titles across Zowe.

Extension

Generally used to describe additional, non-default Zowe plug-ins or components. See plug-in for additional context.

Imperative CLI Framework

Also known as Imperative, the code framework that is used to build plug-ins for Zowe CLI.

Plug-in

A more general term used to describe a modular piece of some component. Depending on the component or squad context, a plug-in is sometimes referred to as an *app*, *extension*, *plug-in*, etc.

A component may have multiple plug-ins, sometimes working together to form a single purpose or user experience, but an individual plug-in belongs to a single component. See extension for additional context.

Secure credential store

Secret storage functionality embedded in core Zowe CLI and Zowe Explorer starting from Zowe V2.

The secure credential store securely stores configured private credentials in the secure vault available on your client operating system. Examples of such vaults include the Windows Credential Manager on Microsoft Windows, and Passwords and Keys on Ubuntu Linux.

Secure credential store can also refer to a separate plug-in of the same name used in Zowe V1 CLI.

Service

A service provides one or more APIs, and is identified by a service ID. Note that sometimes the term *service name* can be used to mean *service ID*.

The default service ID is provided by the service developer in the service configuration file. A system administrator can replace the service ID with the specific name of a deployment environment through the use of additional configuration that is external to the service deployment unit. Most often, this is configured in a JAR or WAR file.

Services are deployed using one or more service instances, which share the same service ID and implementation.

Team configuration

This method saves team-specific profiles in the `zowe.config.json` configuration file and user-specific profiles in the `zowe.config.user.json` configuration file. These profiles are stored locally in the user's client OS file system (for example, when using Zowe Explorer for Visual Studio Code or IntelliJ IDEA) and determine whether they are applied *globally* (to all projects) or *per project*. This configuration manages Zowe CLI and Explorer settings on the local client and does not store or affect z/OS configurations.

Web Explorers

A suite of web apps on the Zowe Desktop that are part of the Zowe Application Framework and the core Zowe server installation. They include JES, MVS, USS, and IP Explorers. Not related to Zowe Explorer.

Versions

Zowe is a collection of projects that, together, are released in iterative versions. While each Zowe project is developed for a particular version of Zowe (e.g. API ML V1 or API ML V2), each project can also have its own particular version series. For example, Zowe CLI v7.24.1 is part of Zowe v2.16.

The Zowe V1 suite of components is in maintenance state. The Zowe V2 suite of components is in active state, whereby new features are being actively added in every minor V2 release. Zowe V3 is scheduled for release on Sept. 30, 2024, at which time Zowe V1 reaches its End of Support phase.

To learn more about how versioning is applied in Zowe, see Understanding Zowe release versions.

ZIS (Zowe Interprocess Services)

An APF-authorized server application that provides privileged services to Zowe in a secure manner. For security reasons, it is not an HTTP server. Instead, this server has a trust relationship with ZSS.

Other Zowe components can work through ZSS in order to handle z/OS data that would otherwise be unavailable or insecure to access from higher-level languages and software.

zLUX (V1 only)

This is an older, no-longer-used name for the Zowe Application Framework. Note that unreasonable-to-change references still exist (such as GitHub repository names). Other synonyms/similar names include *MVD* (Mainframe Virtual Desktop) and *zlux*.

Zowe App Server

Refers to the Node.js-powered Application Server and is part of the Zowe Application Framework core project. The Zowe App Server hosts the web content of the Application Framework and provides the Zowe Desktop, which is accessible through a web browser.

Zowe Chat

An incubator focused on working with the mainframe from popular chat clients such as Mattermost®, Microsoft Teams®, and Slack®.

Zowe Component

Zowe is a collection of both *client* and *server* code. You can install only some of Zowe, or all of it, depending on your needs. Zowe splits the major sections of the code into *components*, with each serving an important purpose.

Server components are packaged in a standardized way to include all services and plug-ins in one deliverable. Extensions to Zowe can also be delivered as third-party server components. For more information about how these extensions can use a manifest file, see Zowe component manifest.

Zowe Desktop

Refers to the desktop UI that is part of the Zowe Application Framework core component. The Zowe Desktop includes a number of apps that run inside the App Framework, such as JES, MVS, and USS Explorers, as well as a 3270 Terminal, Virtual Terminal, and an Editor.

Zowe Embedded Browser for RMF/SMF and APIs (ZEBRA)

Provides re-usable and industry-compliant JSON-formatted RMF/SMF data records so that other ISV SW and users can exploit them using open-source SW for many ways. For more information, see the ZEBRA documentation or visit Real ZEBRA Use Cases in Large Production Systems in the Open Mainframe Project website.

Zowe install packaging

The set of programs (for example, `zwe` command) and utilities (for example, JCL, scripts) which manage the Zowe server configuration and components. The infrastructure standardizes the packaging of components and controls how they are started, stopped, and how configuration is provided to them.

Zowe Explorer plug-in for IntelliJ IDEA

Uses the IntelliJ IDEA platform IDEs to provide the ability to work with z/OS data sets, USS files, to explore and manage JES jobs and to work with TSO Console.

Zowe Launcher

A server-side program necessary for high availability/fault tolerance (HA/FT). It starts the Zowe server components and monitors their processes so that if a component fails to start or crashes, the launcher restarts the component. Component restart has limits to prevent loops in the event that a component that has uncorrectable problems.

Community

Open Mainframe Project (OMP)

An organization which hosts and promotes development of open source software for the benefit of the IBM z mainframe community, including but not limited to z/OS. Zowe(.org) is one of several programs in this project. See the Open Mainframe Project website for more information.

Squad

A group of people contributing and participating in the Zowe project. Such a group owns one or more projects.

Every squad is required to have a representative on the Technical Steering Committee (TSC), and participate in relevant working groups. For more information about active Zowe squads, see Current squads.

Technical Steering Committee (TSC)

The governing body that is responsible for the overall planning, development, and technical feedback assessment of Zowe. The TSC meets every Thursday to go over squad updates and discuss issues regarding the Zowe initiative. To receive notifications of upcoming meetings and agendas, join the TSC Slack channel.

Zowe Conformance Program

The Zowe Support Provider Conformance Program gives vendors the ability to showcase their Zowe support competencies via well-defined criteria. It is administered by the Linux Foundation and Open Mainframe Project.

Installation and configuration

Base profile

An object in a team configuration file that stores connection information for use with one or more services. Depending on your configuration file type, the base profile can be either a `global_base` or `project_base` profile. Your service profiles can pull information from base profiles as needed, to specify a common username and password only once, for example.

The base profile can optionally store tokens to connect to Zowe API Mediation Layer, which improves security by enabling Multi-Factor Authentication (MFA) and Single Sign-on (SSO).

Convenience build

The Zowe installation file for Zowe z/OS components that is distributed as a PAX file in z/OS Unix and contains the runtimes and scripts to install and launch the z/OS runtime. It is the most common method to install Zowe.

Extension directory

The standard z/OS Unix directory where Zowe extensions, or additional components, plug-ins, etc., outside the default install are stored. It is specified in the Zowe configuration file via `zowe.extensionDirectory`.

Log directory

The standard z/OS Unix directory where Zowe logs are stored. It is specified in the Zowe configuration file via `zowe.logDirectory`.

OMVS

Use of z/OS UNIX services requires a z/OS UNIX security context, referred to as an OMVS segment, for the user ID associated with any unit of work requesting these services. To learn more consult IBM Documentation.

Parent profile

An object in a team configuration file that groups service profiles together that share the same properties and values (for example, hostname or credentials). A parent profile makes it possible to define properties for its group of service profiles in one place rather than duplicating values throughout a configuration.

Runtime directory

The z/OS Unix directory for the Zowe runtime, specified in the Zowe configuration file via `zowe.runtimeDirectory`. Also the parent directory of the `zwe` command.

Service profile

An object in a team configuration file that stores connection information for a specific mainframe service, such as IBM z/OSMF. Plug-ins can introduce other service profile types, such as the CICS profile to connect to IBM CICS.

SMP/E

The Zowe installation for Zowe z/OS components that is distributed as an SMP/E package, identified by FMID, and contains the runtimes and the scripts to install and launch the z/OS runtime. First the initial package is installed, and then a PTF is applied. SMP/E is the second most common method to install Zowe.

SMP/E with z/OSMF workflow

A similar process as SMP/E, except this installation method is performed through the z/OSMF web interface as a Zowe SMP/E workflow. SMP/E with z/OSMF workflow is the third most common way to install Zowe.

Started task (STC)

A type of runnable/running program on z/OS and the primary way to run Zowe. For more information about when to use started tasks, see Determining whether to use a started task.

Zowe V2 has two started tasks:

- ZWESLSTC: The primary Zowe STC. In Zowe V1, it was just the HA/FT primary STC.
- ZWESISTC: The STC for the Zowe cross memory server (referred to as ZIS, formally XMEM)
- ZWESVSTC (outdated): V1 only

Workspace directory

The standard z/OS Unix directory where Zowe server component and extension configuration is stored. In V1, this directory was located within the instance directory. In V2 it is specified in the Zowe configuration file via `zowe.workspaceDirectory`.

Zowe configuration file

The Zowe V2 replacement for `instance.env` in V1. The Zowe configuration file is a YAML file that is required to configure the Zowe runtime. The zowe YAML file is used across every step in Zowe, from configuration to install to start.

Sometimes this configuration file is referred to as the *Zowe.yaml file*. For more information on various attributes, see Zowe YAML configuration file reference.

Zowe instance directory (V1 only)

Also known as `<INSTANCE_DIR>`, this directory contains information that is specific to a launch of Zowe. It contains configuration settings that determine how an instance of the Zowe server is started, such as ports that are used or paths to dependent Java and Node.js runtimes.

The instance directory also contains a log directory where different microservices write trace data for diagnosis, as well as a workspace and shell scripts to start and stop Zowe.

Zowe runtime

Refers to the full, unarchived set of binaries, executable files, scripts, and other elements that are run when Zowe is started.

Sample library

The cross memory server runtime artifacts, the JCL for the started tasks, the parmlib, and members containing sample configuration commands are found in the SZWESAMP PDS sample library. For more information, see PDS sample library and PDSE load library.

ZWEADMIN

A user group on the system that ZWESVUSR and ZWESIUSR should belong to. This user group requires a valid OMVS segment.

ZWESIUSR

A started task ID used to run the PROCLIB ZWESISTC that launches the cross memory server (also known as ZIS). It must have a valid OMVS segment. For more information, see ZWESIUSR requirements.

ZWESVUSR

A started task ID used to run the PROCLIB ZWESLSTC. The task starts a USS environment using BPXBATSL that executes server components such as the Application Framework, API ML, and ZSS. To work with USS, the user ID ZWESVUSR must have a valid OMVS segment. For more information, see ZWESVUSR requirements.

Plug-ins and extensions

API Mediation Layer

API Catalog

Displays API services that have been discovered by the API Mediation Layer.

Zowe Application Framework

3270 Terminal

An application in the Zowe Desktop that provides a user interface that emulates the basic functions of IBM 3270 family terminals.

File Tree

Formally known as the *File Explorer*, the FT refers to a re-usable widget existing in multiple apps across the Zowe Desktop to display z/OS Unix files and data sets.

IP Explorer

An application in the Zowe Desktop you can use to monitor the TCP/IP stacks, and view active connections and reserved ports.

JES Explorer

An application in the Zowe Desktop to interact with z/OS UNIX files.

MVS (Multiple Virtual Storage) Explorer

An application in the Zowe Desktop to interact with z/OS data sets. Though still supported, active development has been moved to the Zowe Editor.

USS Explorer

An application in the Zowe Desktop to interact with z/OS UNIX files. Though still supported, active development has been moved to the Zowe Editor.

Virtual (VT) Terminal

An application in the Zowe Desktop that provides a user interface that emulates the basic functions of DEC VT family terminals.

Zowe Editor

An application in the Zowe Desktop to interact with z/OS data sets and Unix files. It uses the File Tree.

Zowe CLI Extensions

IBM® CICS® Plug-in for Zowe CLI

Extends the Zowe CLI to interact with CICS programs and transactions.

IBM® Db2® Plug-in for Zowe CLI

Enables interaction with Db2 for z/OS to perform tasks through Zowe CLI and integrate with modern development tools.

Use and development

API Mediation Layer

Micronaut Enabler

A guide which helps to simplify the process of onboarding a REST service with API ML, using Micronaut and Gradle.

Node.js Enabler

An NPM package which helps to simplify the process of onboarding a REST service written in Node.js with API ML.

Plain Java Enabler (PJE)

A library which helps to simplify the process of onboarding a REST service with API ML, serving the needs of Java developers who are not using either Spring Boot, Spring Framework, or Spring Cloud Netflix.

Sprint Boot Enablers

A collection of enablers which help to simplify the process of onboarding a REST service with API ML using various versions of Spring framework.

Zowe Application Framework

Accessing the Desktop

The Zowe Desktop is accessed through the API ML. The Desktop URL uses the following format:

App2App

A feature of the Zowe environment where one application plug-in can communicate with another. The Zowe Application Framework provides constructs that facilitate this ability. For more information, see Application-to-application communication.

Config Service

A part of the Application Framework which allows plug-ins and the Framework itself to store user configuration as JSON or binary formats. The configuration is stored in a hierarchy in which company-wide and system-wide defaults can exist for all users. Users may override the defaults if policy allows it. What can be stored and what can be overridden depends on plug-in definition and administrative configuration.

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Zowe learning resources

Learn more about Zowe from these blog posts, videos, and other resources.

Blogs

- Zowe blogs on Medium
- Zowe blogs on Open Mainframe Project website

Want to contribute a blog? Details for how to contribute to the Zowe blogs on Medium site are at Zowe Blog Guidelines.

Videos

As well as Zowe videos owned and managed by the community, there are a number of external YouTubers who host Zowe related content.

- Zowe Demos playlist from Bill Pereira
- Mainframe Bytes channel from Jessielaine Punongbayan

Webinars

Find out what is happening with Zowe in the Zowe Quarterly Update Webinar Series.

- Zowe Quarterly Update Webinar: May 2024
- Zowe Quarterly Update Webinar: February 2024
- Zowe Quarterly Update Webinar: October 2021
- Zowe Quarterly Update Webinar: July 2021

- Zowe Quarterly Update Webinar: April 2021
- Zowe Quarterly Update Webinar: January 2021
- Zowe Quarterly Update Webinar: October 2020

The OMP Youtube channel also offers other webinars about Zowe.

- Treat Yourself to a Guided, Comprehensive Tour of Zowe Desktop Applications
- Zowe Webinar Feb. 22, 2019
- Open Mainframe Project Webinar: Zowe Virtual Hackathon

Community

Join us on Slack

- Slack invite link
- Introduction to Zowe Slack channels

Learn more about the community

- Zowe community GitHub repo

  Find out information about Zowe sub-projects, GitHub repos, mailing lists, community meeting minutes, contribution guidelines, and so on.

Connect with the community through meetings

- Zowe meeting calendar

  You can join one of the Zowe meetings to get latest Zowe updates and get involved in different squads and initiatives.

Training

Courses

- Zowe Fundamentals

  Interskill Learning offers a free training course that introduces the components that comprise Zowe and the benefits of using Zowe and how its capabilities can be extended.

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Important updates in Zowe V3

Zowe 3.0 brings a range of major changes in Zowe functionality, including *breaking changes*, or modifications that require updates to avoid disruptions in your applications.

Review this article for details about changes to various Zowe components that are introduced in Zowe V3, and any required actions you need to take.

API Mediation Layer (API ML)

Breaking changes

Change in Zowe V3	Required action
Authentication endpoints will not support the route `/api/v1/gateway`, and instead will support only `/gateway/api/v1`	If you use the endpoints directly, change the URLs to start with `/gateway/api/v1`. If you use ZAAS client to integrate with API Mediation Layer, no action is required as the change is handled in the ZAAS client code.
Spring Enabler will be updated to Spring Boot 3 and Spring 6. Spring Boot 2 and Spring 5 versions will no longer be supported	Upgrade extending services based on the Spring Enabler to Spring Boot 3 and Spring 6.
Datasets API will be archived	This service was disabled by default in Version 2. If you enable the service via `components.data-sets.enabled: true` and use the APIs documented in Data sets Swagger, it is necessary to move to the usage of the similar z/OSMF endpoints.
Jobs API will be archived	The service was disabled by default in Version 2. If you enable the service via `components.jobs.enabled: true` and use the APIs documented in Jobs Swagger, it is necessary to move to the usage of the similar z/OSMF endpoints.
Metrics service will be archived	The Metrics service was in Technical Preview. Currently, there is no replacement. In V3, the Open Telemetry standard will be implemented, which will serve as a replacement.
IMS API will be archived	The IMS API service was not fully supported. If you were using the API, please reach out to the IBM team for follow-up steps.
Java 17 will be required for the API	For V3, it is necessary to update z/OS to version 2.5 or later as this brings support of Java 17. It is necessary to install Java 17 and provide the path to Java 17 to Zowe Java

Change in Zowe V3	Required action
Mediation Layer to run	configuration.
z/OSMF in version V2R5 with APAR PH12143 applied (JWT setup)	If you are running a version of z/OS before 3.1, validate that the PH12143 APAR was applied to the z/OSMF installation used by Zowe. The value `auto` is no longer supported. For v3R1, validate that the JWT support is enabled. If you do not want to enable JWT support, make sure that you set the value of `components.gateway.apiml.security.auth.zosmf.jwtAutoconfiguration` to `ltpa`. The `ltpa` option cannot be used with hardware accelerated ICSF Keyrings. See example-zowe.yaml for new component values.
Configuration of keyrings will require transformation from `safkeyring:////` to `safkeyring://`	If your Zowe configuration contains `safkeyring:////`, change this part to `safkeyring://`.
Support access to z/OSMF only through `/ibmzosmf` route. V3 will not support access through the `/zosmf` route	If you use z/OSMF via `{apimlUrl}/zosmf/{zosmfEndpoint}` it is necessary to move to `{apimlUrl}/ibmzosmf/{zosmfEndpoint}.`

Important API ML updates

The current API Gateway contains the Authentication and Authorization Service. This service will be separated as a standalone service. The Authentication and Authorization Service is the only API ML service that directly requires z/OS.

Application Framework

Breaking changes

- Updated Angular to Version 18 from Version 12. Apps built upon Angular, excluding iframe apps, will need to be updated to be compatible with the V3 Desktop.

CLI

Breaking changes

Change in Zowe V3	Required action
Introducing a new format for error messages to improve clarity	Adjust Zowe CLI scripts that parse error messages to handle the new error format

Change in Zowe V3	Required action
Removing V1 profile support	Implement a team configuration or use Zowe CLI's built-in V1 profile conversion command: `zowe config convert`
Removing deprecated items - CLI and Imperative	Zowe CLI extenders or users of the Zowe Client Node.js SDK will need to review the breaking changes and adjust their code to account for removed/changed classes, functions, and constants

Pre-release availability

- V3 pre-release versions are available via npm under the 'next' tag

Application Framework

Breaking changes

- Updating Angular to Version 16 from Version 12
- Removing the core-js dependency
- Updating Webpack to version 5
- Updating Typescript to 4.9

Explorer for Intellij IDEA

Important updates

- Explorer for IntelliJ IDEA will be part of the Zowe Core
- Working with USS Files
- Working with Data Sets
- Working with JES Working Sets
- Interactive TSO Console

Explorer for Visual Studio Code

Breaking changes

Change in Zowe V3	Required action
Removing V1 profile support	Implement a team configuration or use Zowe Explorer's built-in V1 profile conversion functionality
Removing deprecated items - Explorer for VSCode	Zowe Explorer extenders or users of the Zowe Explorer APIs will need to review the breaking changes and adjust their code to account for removed/changed classes, functions, and constants

Change in Zowe V3	Required action
Storing extension settings in local storage	Settings and history previously stored in the .vscode settings folder will no longer be available. Users will have to adjust their Zowe Explorer settings after updating to V3

Important updates

- Storing persistent settings in local storage
- Comparing files in MVS view, the USS view, and across the two views

Pre-release availability

- V3 pre-release versions are available via GitHub releases or via the Open VSX Registry.

Installation and Packaging

Breaking changes

- Dropping the original V2 configuration management, `zowe.useConfigmgr=false`. (The Configuration Manager remains as the only supported method for configuring Zowe)

Important updates

- Removing the dependency on Node.js for configuration
- Introducing *ZEN*, a wizard to simplify configuration via the UI

ZSS

Breaking changes

- Run by default in 64 bit mode, `components.zss.agent.64bit=true`. 31-bit plugins cannot run in 64-bit ZSS, so you need to compile your plugins for the version of ZSS to be used. Note that only one version of ZSS can run at a time.

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Zowe V3 FAQs

Extender questions

API Mediation Layer

1. Do we need to move away from PassTickets as the method of authentication to the API Mediation Layer?

   No, we will continue to support PassTickets. However, PassTickets are deprecated in Zowe V3, and are no longer recommended due to the inefficiency of configuration wherein users must configure a PassTicket for every service that uses them.

2. With the introduction of the new cloud gateway, how is the configuration going to change?

   The cloud gateway configuration for V3 has moved to the currently used gateway configuration space (For example, `components.gateway`). The configuration that was Zuul specific has been removed and replaced with the Spring Cloud Gateway configuration.

3. How does client certificate authentication work in Zowe V3?

   Northbound authentication accepts client certificates. The API Mediation Layer then transforms the client certificate to another method of authentication (such as a JWT token, SAF IDT, or PassTicket). This new method is then accepted by southbound services. Currently, we do not plan to support authentication with client certificates to z/OSMF.

4. Will you identify deprecated functionality such as PassTickets?

   PassTickets will be deprecated in V3, but PassTickets will still be supported, possibly even through to Zowe V4.

   We plan to identify all deprecated functionality. We will announce how this functionality will be identified in the near future.

5. How do you intend to work with the the bypass scheme?

   The bypass scheme will remain. You can still claim conformance for services that only provide public endpoints that do not require authentication.

6. Do the dependency changes mean that I need Java 17 to run Zowe V3?

   Yes, Java 17 is required to run the API Mediation Layer in Zowe V3.

Zowe Explorer for Visual Studio Code

1. Will the functionality to convert Zowe V1 profiles to team configuration remain available for Zowe V3?

   Yes. However, users will not be able to use Zowe V1 profiles to connect to services on the mainframe.

2. Will the APIs that Zowe CLI provides for extenders remain the same?

In broad terms, yes. However, some of the functionality that was available in Zowe V2 has been changed (or removed). The changes are included in the Zowe CLI and Imperative lists of breaking changes.

Zowe Application Framework, ZSS

1. Is it possible to run 31-bit plug-ins at the same time as 64-bit plug-ins with ZSS?

   No. ZSS runs in either 31-bit or 64-bit mode, which means it can accommodate only one type of plug-in.

2. Have the versions of libraries used in the Desktop changed?

   In Zowe V3, the Application Framework uses Angular 18 with associated libraries such as webpack 5.

3. What *React* versions are supported by Zowe Desktop?

   Zowe v3's React compatibility has not changed. It is possible for Desktop extensions to use different versions of *React*. While the Desktop is not built on *React*, it is still compatible with extensions that import *React*.

Zowe System Installation and Configuration

1. Does Zowe provide a Software Bill of Materials (SBOM)?

   SBOMs are available in the SPDX format from the Bill of Materials page on Zowe Docs.

2. Is the Zowe Server Install Wizard application running on Zowe Desktop or on z/OS?

   The Zowe Server Install Wizard runs on a laptop/desktop and connects to z/OS via standard methods.

3. Is it possible to validate and change the `zowe.yaml` file and job definition within the Zowe Server Install Wizard?

   Yes.

User questions

Zowe API Mediation Layer

1. Does Zowe V3 API ML support clients with the V2 onboarding enabler?

   API ML in Zowe V3 supports clients with onboarding enablers from Zowe V2. It also works the other way around: The onboarding enablers from Zowe V3 continue to work with Zowe V2 API ML.

2. The jump to Java 17 means that we have to maintain two separate versions of our application, one with apiml-enabler V2 and one with V3, to support customers who want to stay with Java 8. Do you have a recommendation or a workaround for supporting both Java versions?

   The plain Java Enabler from Zowe V2 works in Zowe V3. You can keep this until Zowe V4.

   Zowe V4 will only support Spring Boot, which requires Java 17. We recommend building applications for Java 17 to ensure that applications continue to be compatible with API ML.

3. Can you speak about the migration from Zuul to Spring Cloud Gateway? Today there are two separate gateway services in API ML with separate configurations.

Spring Cloud Gateway is replacing Zuul as the technology to provide the API Gateway. The configuration for the API Gateway remains in the `components.gateway` namespace. If you were using Spring Cloud Gateway in V2 for the multi-tenancy scenario, you need to update the configuration for the Central Gateway (referred as Gateway from v3 onwards) and move this configuration from `components.cloud-gateway` to `components.gateway`.

4. If I have a legacy gateway deployed, how will I migrate to the new gateway? Will the old gateway be removed?

   The old gateway is removed in Zowe V3, but nothing should change from the point of view of the user. However, we may deliver a configuration utility to help with this transition if required.

5. How would a client-side end user find and obtain the correct API ML service instance ID for the desired instance of the user's service?

   In Zowe V2, clients can use the header instance ID to route communications to a specific instance. Clients can get instance IDs for specific services via an API on the Discovery service. We are planning to improve the method for finding service IDs in Zowe V3.

6. Will the LPAR ID be available for the clients to obtain?

   It is not currently available, but we are scheduled to work on this functionality in 2024.

7. API ML static onboarding locates templates that are then used to set variables in the api-defs directory. No manual user action is required. Will this automated process still be available in Zowe V3?

   Static onboarding will continue to be available. The recommendation for Zowe V3 is to move the api-defs directory out of the Zowe workspace. The `zowe.yaml` file contains a parameter called `components.discovery.alternativeStaticApiDefinitionsDirectories` that specifies where the directories for static definitions reside.

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Zowe V3 Office Hours

Zowe Office Hours are a chance for users and extenders to hear directly from Zowe developers about what to expect from the next major Zowe release.

Zowe squads go over their upcoming projects and answer your questions about Zowe V3.

Missed a session? Catch up here. Office hours are recorded and made available with videos posted to the Open Mainframe Project YouTube channel.

Date	Topic	Link to the recording	Links to the materials
10/18/2024 8AM - 9AM ET	Open Office Hours	Recording	Presentation
10/11/2024 8AM - 9AM ET	Systems, Install & Packaging	Recording	Presentation
10/04/2024 8AM - 9AM ET	Explorer (Intellij)	Recording	Presentation
09/27/2024 8AM - 9AM ET	Explorer (VS Code)	Recording	Presentation
09/20/2024 8AM - 9AM ET	Web UI	Recording	Presentation
09/13/2024 8AM - 9AM ET	Zowe CLI & Client Node SDK	Recording	CLI Presentation Node.js SDK Presentation
09/06/2024 8AM - 9AM ET	API Mediation Layer	Recording	Presentation

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Zowe V3 conformance criteria

The final version of Zowe V3 Conformance Criteria is published here.

See the link in each section for a PDF with the specific criteria for the corresponding project.

Zowe API Mediation Layer

Review the API Mediation Layer related conformance criteria.

Zowe CLI

Review the CLI related conformance criteria.

Zowe Explorer

Review the Explorer related conformance criteria.

Zowe Application Framework

Review the Application Framework related conformance criteria.

Support providers

Review the support providers related conformance criteria.

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Migrating from Zowe Vx to Zowe V3

Follow the procedure outlined in this article to migrate from Zowe v2 to Zowe v3, or Zowe v1 to Zowe v3. While the migration process is similar to a Zowe v2 minor release upgrade, there are several new and updated configuration parameters to consider. The workspace directory should be re-created only if you are using the app-server component. Follow the steps described in this article to ensure a smooth migration.

Upgrading to the latest version of Zowe v2 (v2.18)

Before upgrading to Zowe v3.0.0, first upgrade to Zowe v2.18, as the rest of the migration instructions are based upon Zowe v2.18. Please follow the instructions from the version of Zowe you have and newer in order to prepare to upgrade from Zowe v2 to v3.0.0.

Migrating from Zowe v2.16.0 or Lower

<details>
<summary>Click here for configuration details.</summary>

To migrate from Zowe **v2.16.0** or a lower version, perform the following tasks.

1. Ensure the following `zowe.network` section is added to your configuration:
2. Update your PROCLIB entries for Zowe, as enhancements and default parameters have changed throughout Zowe v2. This can be performed with the unix command `zwe init stc`, by running the job ZWEISTC, or by copying the SZWESAMP members ZWESLSTC, ZWESISTC, and ZWESASTC into your desired PROCLIB.
3. If you use keyrings, verify that Zowe YAML references to `safkeyring`. Use two forward slashes (`safkeyring://`). Do not use four forward slashes (`safkeyring:////`).

</details>

Migrating from Zowe v2.15.0 or Lower

<details>
<summary>Click here for configuration details.</summary>

To migrate from Zowe **v2.15.0** or a lower version, perform the following tasks.

If you are migrating from Zowe **v2.15.0** or a lower version, ensure that Zowe configurations using keyrings do not have the section `zowe.certificate.pem`. This section is no longer needed and can cause startup error in newer versions of Zowe.

</details>

Migrating from Zowe v2.10.0 or Lower

<details>
<summary>Click here for configuration details.</summary>

To migrate from Zowe **v2.10.0** or a lower version, perform the following tasks.
</details>

If you are migrating from Zowe **v2.10.0** or a lower version, consider taking advantage of the new **sysMessages** feature.

The `zowe.sysMessages` is a new array that allows you to select messages that, when found by the launcher, will be duplicated into the system's log.

Migrating from Zowe v2.9.0 or Lower

<details>
<summary>Click here for configuration details.</summary>

To migrate from Zowe **v2.9.0** or a lower version, perform the following tasks.

If you are migrating from Zowe **v2.9.0** or a lower version, it is recommended to delete the `<zowe.workspaceDirectory>/app-server/plugins` directory so that it can be regenerated on the next run of Zowe. In this version and prior there were old and no longer used Application Framework plugins and references to them will complicate logs with harmless errors.
</details>

Migrating from Zowe v2.3.0 or Lower

<details>
<summary>Click here for configuration details.</summary>

To migrate from Zowe **v2.3.0** or a lower version, perform the following tasks.

If you are running Zowe **v2.3.0** or a lower version, a **clean install** of Zowe v3 is highly recommended to avoid potential issues during the migration process.
</details>

Migrating from Zowe v1

<details>
<summary>Click here for configuration details.</summary>

To migrate from Zowe **v1** perform the following tasks.

If you are using v1, you must perform a clean install of Zowe rather than upgrading it as there is not a clear upgrade path from v1 to v2 or v3. Any extensions or products built upon Zowe v1 are unlikely to work in v2 or v3 without upgrading them. Refer to any product documentation on actions to take. More details

If you are using v1.27 or newer, you can retain your keyring or keystore with Zowe v2 and v3. During v2 or v3 installation, once your Zowe YAML configuration file is created, you can define a section `zowe.certificate` as follows to re-use your certificates.
</details>

V3 Prerequisite Changes

Before starting the migration, ensure the following system requirements are met:

- **z/OSMF**
  Version V2R5 or V3R1 is required. JWT support for z/OSMF is highly recommended. For more information, see Enabling JSON Web Token support in the IBM documentation. If you do not have JWT support in z/OSMF, make sure to set `components.gateway.apiml.security.auth.zosmf.jwtAutoconfiguration` to `ltpa`.
- **Java**
  Java 17 is required. The Zowe YAML parameter `java.home` value should be a **Java 17** home location. If an administrator uses `zwe init` to set up Zowe, ensure the `java` for that user is v17 by including it in the `PATH` environment variable.
- **Node.js**
  Ensure that the Zowe YAML parameter `node.home` value is **Node.js 18 or 20** home location. Node 16 and earlier versions are no longer supported.

System and Security Changes

- Existing SAF settings for Zowe do not need to be changed for v3. Install steps such as `zwe init security`, the job or workflow ZWESECUR, and the jobs ZWEIRAC, ZWEITSS, and ZWEIACF are not required to be re-run.
- Existing keyrings and keystores do not need to be changed for v3. Install steps such as `zwe init certificate`, the job or workflow ZWEKRING, or jobs starting with ZWEIKR* are not required to be re-run.
- The following network changes are needed for added or removed servers:

Component name	Change	Default Port	Default Jobname	Details
zaas	Added	7558	ZWE1AZ	This component is responsible for authentication and is now required when using the API Mediation Layer
metrics-service	Removed	7551	ZWE1MS	This service has been deprecated and removed. Currently, no replacement is available. The Open Telemetry standard will be implemented later, which will serve as a replacement
jobs-api	Removed	7558	ZWE1EJ	This component was deprecated in Zowe v2 and is now removed. Ensure that you switch to using equivalent z/OSMF endpoints
files-api	Removed	7559	ZWE1EF	This component was deprecated in Zowe v2 and is now removed. Ensure that you switch to using equivalent z/OSMF endpoints
cloud-gateway	Removed	7563	ZWE1CG	The cloud-gateway has been removed as a standalone component and merged into the gateway

Configuration changes

Review the following changes to configuration and updated configuration parameters.

New Configuration

components.zaas
Previously part of the `components.gateway` component, zaas in Zowe v3 is a separate component responsible for authentication.
If you do not explicitly configure this section, zaas will still be enabled by default and will use **port 7558**.

Updated Configuration Parameters

Keyrings

If you use keyrings, verify that Zowe YAML references to `safkeyring`. Use two forward slashes (`safkeyring://`). Do not use four forward slashes (`safkeyring:////`).

Gateway z/OSMF service configuration

The service ID for gateway zosmf has changed to **ibmzosmf**.
Set `jwtAutoconfiguration` to **jwt** (default) or **ltpa**. Note that **auto** is no longer supported.
If you are using zosmf as your auth service, ensure that you update this z/OSMF service configuration.

Caching Service

The Caching service now defaults to **Infinispan** mode instead of **VSAM**. While **VSAM** is still supported, this storage method is being deprecated and is not recommended. A new parameter for the key exchange port has been added to the default configuraion.

ZSS Server

The ZSS server now runs in **64-bit** mode by default.

Deprecated Settings

The following configuration parameters have been deprecated in Zowe v3. Ensure that these parameters are removed from your configuration.

zowe.useConfigmgr
The parameter `zowe.useConfigmgr=false` is no longer supported.

components.gateway.server.internal
The internal gateway server has been removed due to limited usage.

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Upgrade from Convenience Build to PSWI or SMP/E installation

Review the recommended procedure for upgrading an existing Zowe installation from a convenience build to a PSWI (Portable Software Instance) or SMP/E-based installation. The steps in this article outline the best practices for upgrading, and include all necessary tasks for reusing or updating configuration, managing runtime datasets, and maintaining service continuity.

Prerequisites before upgrade

Ensure you meet the following conditions before you start the upgrade process:

- Determine the current installed version of Zowe (e.g. v3.0).
- Determine if the upgrade target is the same version or a newer version (e.g. v3.1).
- Backup the following elements:
  - The existing zowe.yaml configuration file
  - Zowe runtime datasets
  - STC JCLs and PARMLIB members

Installing Zowe via PSWI or SMP/E

Choose your installation method, either PSWI or SMP/E, based on your preferences.

PSWI Installation (Portable Software Instance)

1. Download the Zowe PSWI package at zowe.org.
2. Install using z/OSMF workflows or standalone jobs provided.
3. Ensure the runtime libraries are correctly installed without errors by submitting jobs and reviewing the return codes from the JCL output for PSWI.

For more information about PSWI installation, see Installing Zowe from a Portable Software Instance.

SMP/E Installation

1. Acquire the Zowe SMP/E package at zowe.org
2. Execute SMP/E RECEIVE, APPLY, and ACCEPT jobs according to instructions in the documentation shipped with the PTF. For more information, see Installing Zowe via SMP/E instructions
3. Validate successful deployment of Zowe into target libraries. The following target libraries are created: `SZWEAUTH`, `SZWEEXEC`, `SZWESAMP`.
4. Utilize Zowe SAMPLIB for post-install configuration.

For more information about SMP/E installation, see Installing Zowe SMP/E overview.

Configuring to the same or newer version

When upgrading from the convenience build, you can either use PSWI or SMP/E to upgrade to the same version or to a higher version.

Upgrade to the same version

If the target PSWI or SMP/E version matches the currently installed convenience build, use the following outline of steps:

1. Reuse the existing zowe.yaml file.
2. Continue using the current runtime datasets, or for SMP/E, from the target library.
3. Update ZOWE STC (`ZWESISTC` and `ZWESLSTC`) and YAML to point to the new Zowe libraries from PROCLIB and YAML.

Upgrade to a newer version

To migrate to a newer version of Zowe, for example from v3.0 to v3.1, you can either use PSWI workflows, or alternatively, by configuring the SMP/E SAMPLIB.

- **Using PSWI Workflows**
  You can use z/OSMF workflows provided in the PSWI package to perform the following tasks:
  - Generate a new zowe.yaml configuration file
  - Allocate new runtime datasets
  - Configure system definitions (e.g. APF, PROCLIB)

For more information, see Installing Zowe SMP/E build with z/OSMF workflow.

- **Using SMP/E SAMPLIB**

  Use members from ZOWE SAMPLIB to perform the following tasks:

  - Allocate and define new runtime datasets
  - Create or customize a new zowe.yaml file
  - Configure system definitions (e.g. APF, PROCLIB)

> **TIP**
> Ensure all new configurations are validated for compatibility and correctness.

Switching between Zowe versions

Use the following step outline to switch between Zowe versions (e.g. v3.0 and v3.1):

1. Update STEPLIB in Zowe Started Task (STC) JCLs to reflect correct target libraries. Ensure that versions or HLQ are updated.
2. Modify PARMLIB member references accordingly in the PROCLIB STC job.
3. Restart all affected Zowe STCs. For more information, see Starting and stopping Zowe.

Validating after upgrade

Follow these steps to validate that you successfully upgraded your Zowe installation.

1. Start the following Zowe Started Tasks (STCs):

- **ZWESISTC**
  The Zowe cross memory server that runs as a started task to enable cross-memory communication between Zowe components on z/OS
- **ZWESLSTC**
  The Zowe launcher started task that initializes and manages the lifecycle of Zowe's core runtime services on z/OS

2. Monitor logs for any anomalies or errors.
3. Validate the following functionalities:

- Access to Zowe Desktop
- Confirm API services.

4. Review system and application logs for configuration or version mismatches.

   For more information about performing these steps, see Verifying Zowe installation on z/OS

> **TIP**
>
> Use the following guidelines to maintain rollback readiness in the event of unexpected issues during your Zowe upgrade:
>
> - Retain previous runtime datasets
> - Keep backup copies of all JCLs and configuration members
> - Be prepared to reassign STEPLIB/PARMLIB back to convenience build settings

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Important updates in Zowe V2

Zowe V2 is now in maintenance state. Only patch releases are planned until the Zowe V2 End of Service scheduled for early 2027.

Review enhancements introduced in previous releases:

- Zowe v2.18.0 (August 2024)
- Zowe v2.17.0 (July 2024)
- Zowe v2.16.0 (May 2024)
- Zowe v2.15.0 (March 2024)
- Zowe v2.14.0 (January 2024)
- Zowe v2.13.0 (December 2023)
- Zowe v2.12.0 (October 2023)
- Zowe v2.11.0 (September 2023)
- Zowe v2.10.0 (July 2023)
- Zowe v2.9.0 (June 2023)
- Zowe v2.8.0 (April 2023)
- Zowe v2.7.0 (March 2023)
- Zowe v2.6.1 (February 2023)
- Zowe v2.6.0 (January 2023)
- Zowe v2.5.0 (December 2022)
- Zowe v2.4.0 (October 2022)
- Zowe v2.3.1 (September 2022)
- Zowe v2.3.0 (September 2022)
- Zowe v2.2.0 (July 2022)
- Zowe v2.1.0 (June 2022)
- Zowe v2.0.0 (April 2022)

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Zowe V2 FAQs

Where can I find the V1 and V2 LTS conformance criteria?

The Zowe Squads have prepared XLS spreadsheets with conformance criteria for all Zowe extensions including: CLI, APIs, App Framework, and Explorer for VS Code. The spreadsheets clearly show the prior / V1 criteria alongside the new / V2 criteria. Please be aware, there are additions, deletions, and CHANGES to the criteria. In some cases, the change is simply that a BEST PRACTICE has been deemed REQUIRED. Use the included fill color key to identify new changes for V2, reworded changes, or changes from V1 removed in V2. See the Changes to the Conformance Criteria section at Zowe.org/vNext.

Whats the difference between "server.json" and "example-zowe.yaml"?

The previous Zowe V1.x config, "server.json", has been removed from V2 and has been replaced with a new yaml configuration file. The app server will no longer support instances/workspaces which only contain a "server.json" config file and will fallback to a default configuration. In addition to the app server, ZSS will no longer support "server.json".

The yaml Zowe configuration file contains configurations for the setup, install, and initialization of Zowe as well as for individual components. This file allows users to customize dataset names, security related configs, certificate setup/config, job name & job prefix, various runtime configs, high availability config, as well as individual component configurations.

For more information on Zowe setup and the yaml configuration, run the following command in the command line:

```
zwe init --help
```

What are the new default ports?

Four of the default Zowe ports have changed for the app server, and ZSS. The new default app server port is 7556 (previously 8544) and the new ZSS port is 7557 (previously 8542). The JES/USS/MVS Explorer UI servers have been removed, and thus no longer require port configurations.

How do I access Zowe through the API Mediation Layer in V2?

In previous V1.X versions of Zowe, the desktop could be accessed via the API Mediation Layer by navigating to `https://${zowe.externalDomains[0]}:{zowe.externalPort}//ui/v1/zlux`. In Zowe V2, the route to access the desktop has changed to `https://${zowe.externalDomains[0]}:{zowe.externalPort}/zlux/ui/v1`. Such routing structure is applicable to other clients connected to the API Gateway. For example, the API Catalog may be accessed via `https://${zowe.externalDomains[0]}:{zowe.externalPort}/apicatalog/ui/v1`.

What new frameworks are supported in V2?

The Zowe app framework now supports the more modern Angular 12, Corejs 3 and Typescript 4.

Why aren't the explorers appearing on my desktop anymore?

By default, the explorers will not longer appear on the desktop if the instance is not configured to use the API Mediation Layer.

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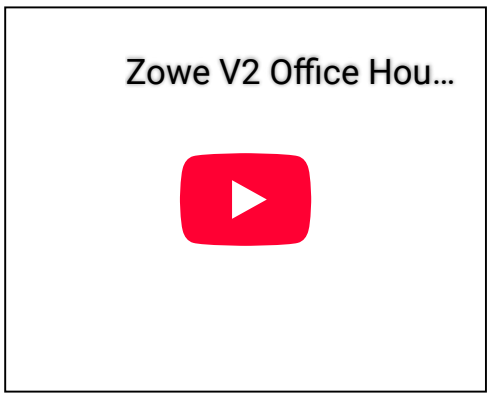
Zowe V2 Office Hours

Watch the series of Zowe office hours videos to learn more about the new features and enhancements in Zowe Version 2 release.

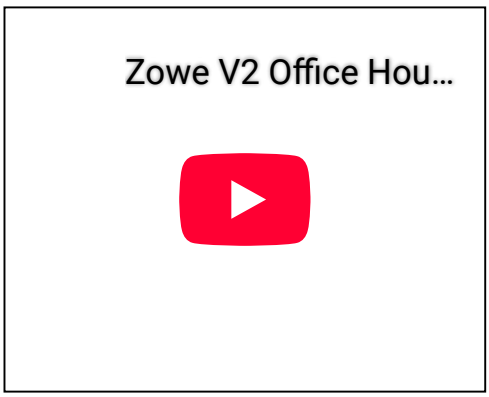
Office hours for Zowe extenders

The following videos walk you through Zowe V2 updates from an extender's perspective. You can start with general information and dive deeper in other sections for more details.

General information



General information



Updates for extenders

Wrap-up session

Zowe component updates

Zowe CLI

Zowe API Mediation Layer

Zowe Application Framework

Zowe Ex

Installation and V2 conformance

SSO and APIML SSO Conformance

Systems and installation

Office hours for Zowe consumers

The following office hours walk you through Zowe V2 updates from a consumer's perspective. Watch these videos to learn more about the enhancements that are introduced to each core component.

Zowe component updates

Zowe CLI

Zowe API Mediation Layer

Zowe Application Framework

Zowe Ex

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Migrating from Zowe V1 to Zowe V2

This doc guides you through migrating an existing Zowe server component from version 1 to version 2.

To make Zowe server component compatible with Zowe version 2, you must update the following configurations.

- Component manifest
- Lifecycle scripts
- Environment variables
- Packaging one component deliverable for both Zowe v1 and v2

Component manifest

In Zowe v2, the component must define a manifest file and package it into the extension's root directory. This manifest file is used by Zowe to understand how this component should be installed, configured, and started. For detailed information of this file, see Server Component Manifest File Reference.

Lifecycle scripts

In Zowe v2, lifecycle scripts can be located anywhere in your component directory. However, you must explicitly define them in the `commands` section of the component manifest file.

Environment variables

Zowe v1 and v2 environment variables are not exact match. There are the following differences:

- Some variables in Zowe v1 are removed in v2.
- Some are separated into two or more variables.
- Zowe v2 defines more configuration options than v1.

Review the following table for a detailed mapping of Zowe v1 and v2 variables.

Zowe v1 Variable	Zowe v2 YAML Configuration
`APIML_ALLOW_ENCODED_SLASHES`	`components.gateway.apiml.service.allowEncodedSlashes`
`APIML_CORS_ENABLED`	`components.gateway.apiml.service.corsEnabled`
`APIML_DEBUG_MODE_ENABLED`	`components.gateway.debug`, etc
`APIML_ENABLE_SSO`	Removed in v2

Zowe v1 Variable	Zowe v2 YAML Configuration
`APIML_GATEWAY_EXTERNAL_MAPPER`	`components.gateway.apiml.security.x509.externalMapperUrl`
`APIML_GATEWAY_INTERNAL_HOST`	Not configurable in v2
`APIML_GATEWAY_INTERNAL_PORT`	`components.gateway.server.internal.port`
`APIML_GATEWAY_TIMEOUT_MILLIS`	`components.gateway.apiml.gateway.timeoutMillis`
`APIML_MAX_CONNECTIONS_PER_ROUTE`	`components.gateway.server.maxConnectionsPerRoute`
`APIML_MAX_TOTAL_CONNECTIONS`	`components.gateway.server.maxTotalConnections`
`APIML_PREFER_IP_ADDRESS`	Removed in v2
`APIML_SECURITY_AUTH_PROVIDER`	`components.gateway.apiml.security.auth.provider`
`APIML_SECURITY_AUTHORIZATION_ENDPOINT_URL`	`components.gateway.apiml.security.authorization.endpoint.url`
`APIML_SECURITY_X509_ENABLED`	`components.gateway.apiml.security.x509.enabled`
`APIML_SECURITY_ZOSMF_APPLID`	`zOSMF.applId`
`CATALOG_PORT`	`components.api-catalog.port`
`DISCOVERY_PORT`	`components.discovery.port`
`EXTERNAL_CERTIFICATE_AUTHORITIES`	`zowe.certificate.pem.certificateAuthorities`
`EXTERNAL_COMPONENTS`	Removed in v2
`GATEWAY_PORT`	`components.gateway.port`
`INSTANCE_DIR`	Removed in v2
`JAVA_HOME`	`java.home`
`JES_EXPLORER_UI_PORT`	Removed in v2
`KEY_ALIAS`	`zowe.certificate.keystore.alias`

Zowe v1 Variable	Zowe v2 YAML Configuration
`KEYSTORE_CERTIFICATE_AUTHORITY`	`zowe.certificate.pem.certificateAuthorities`
`KEYSTORE_CERTIFICATE`	`zowe.certificate.pem.certificate`
`KEYSTORE_DIRECTORY`	`zowe.setup.certificate.pkcs12.directory`
`KEYSTORE_KEY`	`zowe.certificate.pem.key`
`KEYSTORE_PASSWORD`	`zowe.certificate.keystore.password` and `zowe.certificate.truststore.password`
`KEYSTORE_TYPE`	`zowe.certificate.keystore.type` and `zowe.certificate.truststore.type`
`KEYSTORE`	`zowe.certificate.keystore.file`
`LAUNCH_COMPONENT_GROUPS`	Removed in v2
`MVS_EXPLORER_UI_PORT`	Removed in v2
`PKCS11_TOKEN_LABEL`	Removed in v2
`PKCS11_TOKEN_NAME`	Removed in v2
`ROOT_DIR`	`zowe.runtimeDirectory`
`SKIP_NODE`	Removed in v2
`STATIC_DEF_CONFIG_DIR`	-
`TRUSTSTORE`	`zowe.certificate.truststore.file`
`USS_EXPLORER_UI_PORT`	Removed in v2

Zowe v1 Variable	Zowe v2 YAML Configuration
`ZOSMF_HOST`	`zOSMF.host`
`ZOSMF_PORT`	`zOSMF.port`
`ZOWE_APIM_NONSTRICT_VERIFY_CERTIFICATES`	`zowe.verifyCertificates`
`ZOWE_APIM_VERIFY_CERTIFICATES`	`zowe.verifyCertificates`
`ZOWE_EXPLORER_FRAME_ANCESTORS`	Removed in v2
`ZOWE_EXPLORER_HOST`	`zowe.externalDomains` or `haInstances.<ha-instance>.hostname`
`ZOWE_INSTANCE`	Removed in v2
`ZOWE_IP_ADDRESS`	Removed in v2
`ZOWE_PREFIX`	`zowe.job.prefix`
`ZOWE_ZLUX_SECURITY_TYPE`	-
`ZOWE_ZLUX_SERVER_HTTPS_PORT`	-
`ZOWE_ZLUX_SSH_PORT`	-
`ZOWE_ZLUX_TELNET_PORT`	-
`ZOWE_ZSS_SERVER_PORT`	-

Zowe v1 Variable	Zowe v2 YAML Configuration
`ZOWE_ZSS_SERVER_TLS`	-
`ZOWE_ZSS_XMEM_SERVER_NAME`	-
`ZWE_CACHING_EVICTION_STRATEGY`	`components.caching-service.storage.evictionStrategy`
`ZWE_CACHING_SERVICE_PERSISTENT`	`components.caching-service.storage.mode`
`ZWE_CACHING_SERVICE_PORT`	`components.caching-service.port`
`ZWE_CACHING_SERVICE_VSAM_DATASET`	`components.caching-service.storage.vsam.name`
`ZWE_CACHING_STORAGE_SIZE`	`components.caching-service.storage.size`
`ZWE_DISCOVERY_SERVICES_LIST`	-
`ZWE_DISCOVERY_SERVICES_REPLICAS`	`components.discovery.replicas`
`ZWE_EXTENSION_DIR`	`zowe.extensionDirectory`
`ZWE_EXTERNAL_HOSTS`	`zowe.externalDomains`
`ZWE_EXTERNAL_PORT`	`zowe.externalPort`
`ZWE_LAUNCH_COMPONENTS`	Combined information of `components.<component>.enabled` with value of `true`
`ZWE_LOG_LEVEL_ZWELS`	`zowe.launchScript.logLevel`
`ZWEAD_EXTERNAL_STATIC_DEF_DIRECTORIES`	Removed in v2
`ZWES_ZIS_LOADLIB`	`zowe.setup.dataset.authLoadlib`
`ZWES_ZIS_PARMLIB_MEMBER`	-
`ZWES_ZIS_PARMLIB`	`zowe.setup.dataset.parmlib`
`ZWES_ZIS_PLUGINLIB`	`zowe.setup.dataset.authPluginLib`

Packaging one component deliverable for both Zowe v1 and v2

It is recommended that you create a dedicated package of extensions for Zowe v2, which is the most straight-forward way to address all of the breaking changes introduced in v2. We understand that this method presents the challenge of maintaining two sets of packages. If you prefer not to maintain two sets of packages, it's still possible to maintain one version of an extension which works for both Zowe v1 and v2. However, the lifecycle code will be complicated and in this case, comprehensive testing should be performed.

> **⚠ CAUTION**
>
> The Zowe v2 App Framework desktop is upgraded from Angular version 6 to angular version 12 for support and security - websites have a "1 version of a library" limitation. This means that plug-ins dependent upon Angular must be coded for either v6 or v12 [not both] thus the single version approach is not applicable.

If the lifecycle scripts are the main concern, the following steps outline requirements and recommendations for the single version approach:

- Packaging `manifest.yaml` is required. This is a hard requirement for Zowe v2. If you define lifecycle scripts with default names, for example, use `bin/start.sh` as `commands.start`, it should work for v1.
- Revisit all environment variables used in the lifecycle scripts and apply fallback variables. For example, if you use `$ROOT_DIR` in Zowe v1, this should be changed to `${ZWE_zowe_runtimeDirectory:-${ROOT_DIR}}` to make it compatible with both versions. Other variables like `$EXPLORER_HOST` should be changed to `${ZWE_haInstance_hostname:-${EXPLORER_HOST}}` or `${ZWE_externalDomains_0:-${EXPLORER_HOST}}` based on purpose.
- In Zowe v2, we recommend you to define extension configurations in the manifest.yaml `configs` section and use `${ZWE_configs_*}` variables to access them. This feature does not exist in Zowe v1. So if you use `${ZWE_configs_*}` variables, it should fall back to the matching environment variable used in v1.
- In Zowe v2, we recommend you to define a `commands.install` lifecycle script to handle extension installation. This lifecycle script will be executed by `zwe components install`. In v1, this also exists if you use the `zowe-install-components.sh` utility to install a Zowe extension. So if you want one extension package to work for both Zowe v1 and v2, this install lifecycle script should also be compatible with both v1 and v2.
- A new v2 variable `${ZWE_VERSION}` may help you determine the Zowe version number. This variable does not exist in Zowe v1. By knowing the Zowe version, the lifecycle scripts can implement logic to source v1 or v2 dedicated scripts to avoid handling fallbacks in the same script. This could help avoid complicated compatibility version checks, and it could be easier in the future if you decide to drop Zowe v1.

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Zowe conformance and release compatibility

Backward compatibility

Zowe V2 conformant extensions/plug-ins are not guaranteed to be compatible with Zowe V3 and therefore may not be operable. In general, plug-ins/extensions which leverage V3 APIs that have known breaking changes are at high risk of incompatibility and unpredictable results.

> **RECOMMENDATION**
>
> All V2 extenders test with Zowe V3, identify any issues, and disclose results to consumers to clearly indicate backward compatibility status in the extension documentation. Testing limitations should be clearly documented.

Forward compatibility

Zowe V3 conformant (planning to earn conformance) extensions/plug-ins are not guaranteed to be compatible with Zowe V2 LTS. In general, plug-ins/extensions with no known dependency on any newly introduced Zowe V2 functions are at minimum risk.

> **RECOMMENDATION**
>
> All V3 extenders test with Zowe V2 LTS, identify any issues, and disclose results to consumers to clearly indicate forward compatibility status in the extension documentation. Any testing limitations should be clearly documented.

Conformance compatibility

Zowe V2 conformant extensions/plug-ins are likely to require changes to meet Zowe V3 conformance criteria. All extensions (regardless of V2 conformance status) must apply for V3 conformance and satisfy all required V3 testing criteria. For more information about V3 Conformance Criteria, see the Zowe Support Provider Conformance Guide.

> **RECOMMENDATION**
>
> Extenders interested in earning V3 conformance should review the V3 conformance criteria, determine if technical changes are necessary, make appropriate modifications, and then prepare to apply for V3 conformance.

Need help?

For assistance with reviewing or completing the Zowe Conformance Zowe V3 application, reach out to members of the Zowe Onboarding Squad on Slack at https://slack.openmainframeproject.org in the **#zowe-onboarding** channel.

Version: v3.2.x LTS

Zowe CLI quick start

The content from this page has been removed while Zowe Docs gathers feedback from the Zowe community.

Please let us know your thoughts.

Do you regularly refer to the quick start content and would like to see it displayed again here? Do you find the quick start documentation unnecessary? Do you prefer the Installing Zowe CLI documentation?

Please let us know with a message in the Zowe Doc Slack or by filing an issue in our GitHub repository.

To read the content that was previously here, please see the Zowe 3.1 version of Zowe CLI quick start.

Version: v3.2.x LTS

Installing Zowe

The installation of Zowe™ consists of the following processes:

- Installation of the Zowe server-side components.

  You can install the components either on z/OS only or you can install the components both on z/OS and on Docker.

- Installation of Zowe client-side components.

  You can install Zowe CLI or Zowe Explorer, a Visual Studio Code extension powered by Zowe CLI.

The Zowe server components provide a web desktop that runs a number of applications such as API Mediation Layer that includes the Single Sign-on (SSO) capability, organization of the multiple Zowe servers under a single website, and other useful features for z/OS developers.

Because Zowe is a set of components, before installing Zowe, use this guide to determine which components you want to install and where you want to install them.

Consider the following scenarios:

- If you plan to use Zowe CLI on PC only, you may not need to install the Zowe server components.

  Note: Some CLI plug-ins require the installation of components on z/OS. If you plan to use core Zowe CLI groups from your PC, the z/OS you connect to does not require any components of Zowe to be installed on z/OS, unless you want to take advantage of advanced authentication methods such as single sign-on or multi-factor authentication.

- If you use the Docker technical preview to run the Linux parts of Zowe in a container, you only need to configure the Zowe z/OS component to start the ZSS server.

Version: v3.2.x LTS

Zowe server-side installation overview

Installation of Zowe™ server-side components on z/OS, consists of the following two parts:

- Zowe runtime
- Zowe Cross Memory Server (ZIS)

Zowe runtime

The Zowe runtime consists of the following three components:

- **Zowe Application Framework**
  Zowe Application Framework modernizes and simplifies working on the mainframe via a web visual interface. Functionality is provided through apps and a desktop user experience, which is referred to as the Zowe Desktop. Base functionality includes apps to work with JES, MVS Data Sets, Unix System Services, as well as a 3270 Terminal, Virtual Terminal, and an Editor.

- **Zowe API Mediation Layer (API ML)**
  Zowe API ML provides a reverse proxy and enables REST APIs by providing a single point of access for mainframe service REST APIs like MVS Data Sets, JES, as well as working with z/OSMF. Zowe API ML has dynamic discovery capability for these services and Gateway is also responsible for generating the authentication token used to provide single sign-on (SSO) functionality.

- **Z System Services Server (ZSS)**
  ZSS serves as one of the primary, authenticated backends that communicates with z/OS and works closely with the Zowe Cross Memory Server (ZIS). ZSS provides Zowe with a number of APIs including z/OS Unix files and data sets, control of the plug-ins and services lifecycle, security management, and other APIs. The Zowe Desktop delegates a number of services to ZSS which can then be accessed through the default http port `7557`. ZSS is written in C and uses native calls to z/OS to provide its services.

The Zowe Cross Memory Server (ZIS)

The Zowe Cross Memory Server, also referred to as Zowe Interprocess Services (ZIS) is an APF authorized server application that provides privileged services to Zowe in a secure manner. For security reasons, ZIS is not an HTTP server. Instead, this server has a trust relationship with ZSS.

Other Zowe components can work through ZSS to handle z/OS data that would otherwise be unavailable or where access to these data could be vulnerable to security breaches.

Roles and responsibilities for server-side component installation

To avoid interuptions in the installation of Zowe™ server-side components, it is useful to be aware of the roles required to perform various tasks in the installation and configuration process.

Security administrator

To configure Zowe security for production environments, it is likely that your organization's security administrator will be required to perform specific tasks. For more information, see Addressing security requirements.

Storage administrator

Before starting installation, notify your storage administrator to reserve the required space for USS, directory storage space, and any other storage requrements to install Zowe. For more information, see Addressing storage requirements.

Network administrator

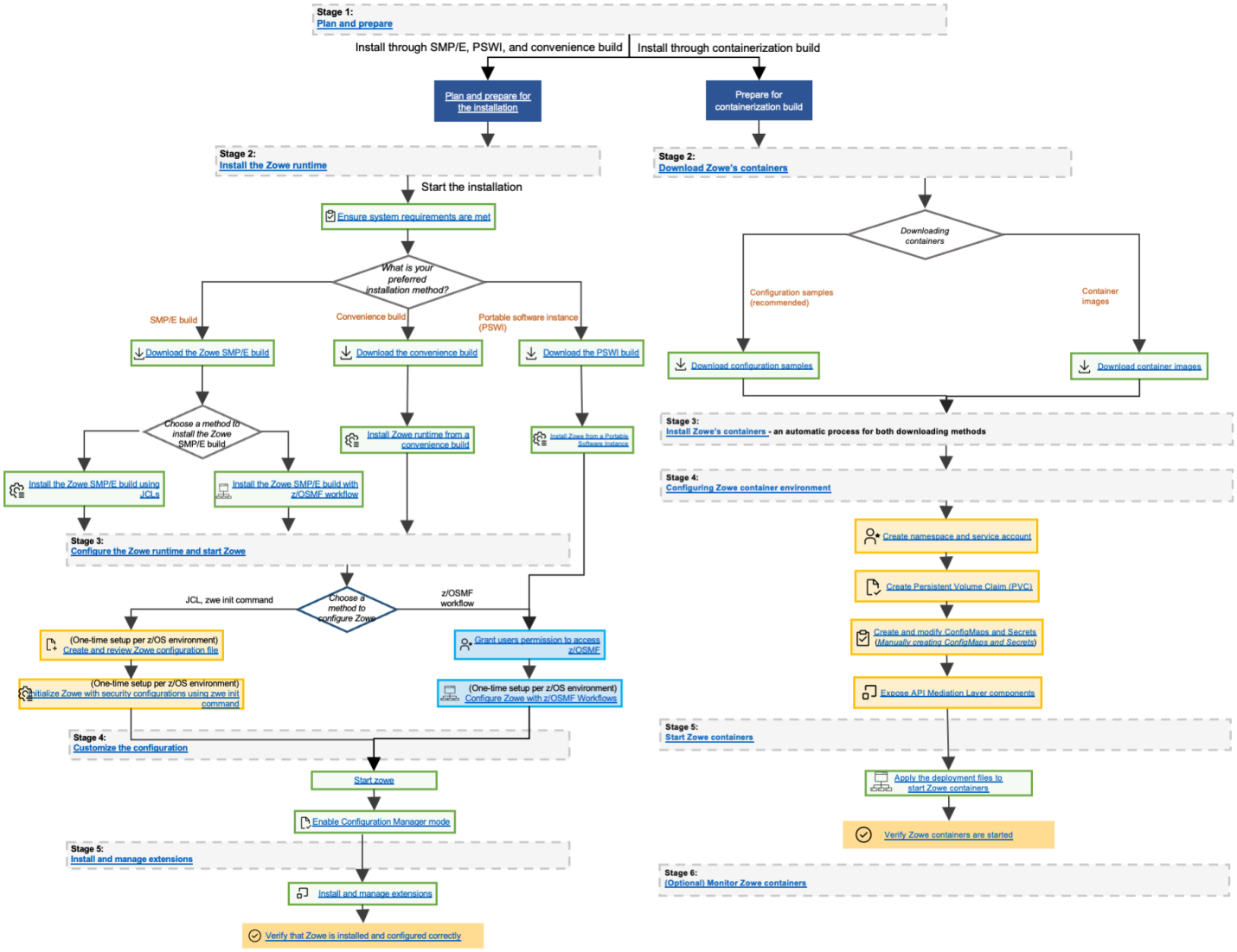
Notify your organization's network administrator to assign port numbers, reserve these port numbers, and arrange them for you. For more information about network setup, see Addressing network requirements.

System programmer

In most cases, the system programmer performs the Zowe installation and configuration, and starts Zowe. Ensure that your system programmers have general knowledge about SMP/E, z/OSMF workflows, and regular maintanance procedures. In many cases, the system programmer also prepares jobs for other administrators.

End-to-end installation

The following diagram illustrates the full ecosystem for installing Zowe server-side components for z/OS.

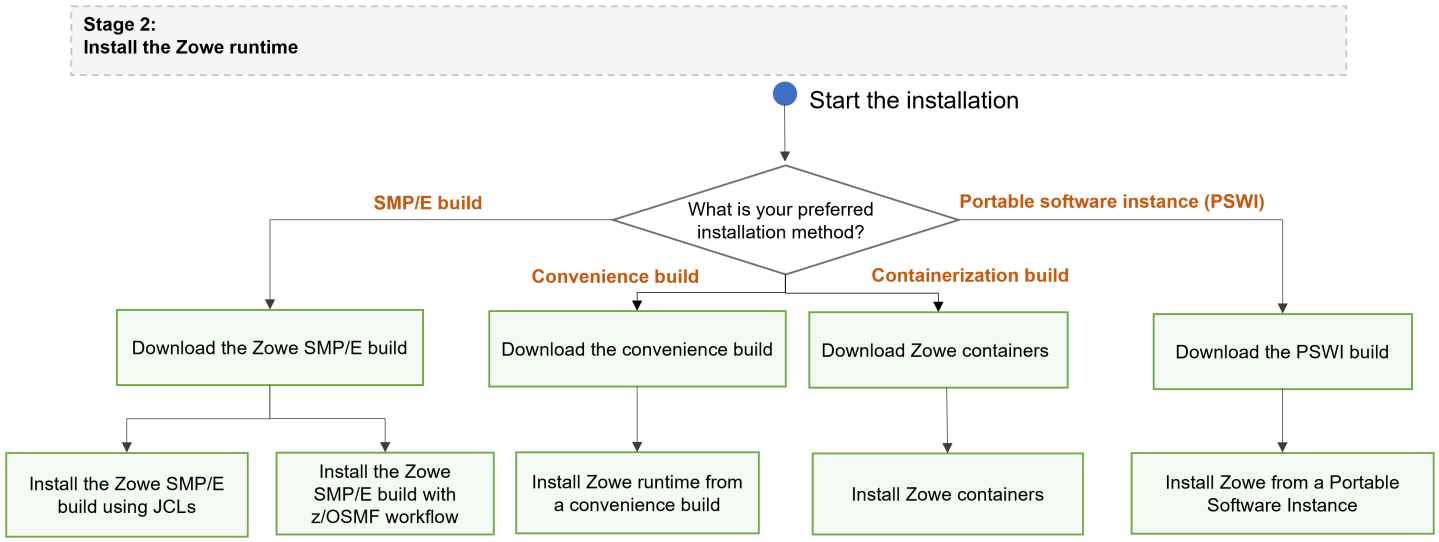


Stage 1: Prepare for installation

Begin the installation process by familiarizing yourself with the following topics which are covered in the section Preparing for installation:

- Zowe's hardware and software requirements
- The `zwe` utility used for installing, configuring, and managing Zowe
- The configuration file used for Zowe, `zowe.yaml`

Stage 2: Installing the Zowe z/OS runtime



1. Ensure that the software requirements described in Preparing for installation are met.

2. Choose your method for installing Zowe on z/OS.

   Each method to perform Zowe server-side component installation contains the same contents. Choose the method based on your needs. The Zowe z/OS binaries are distributed in the following formats:

   - **Convenience build**
     The Zowe z/OS binaries are packaged as a PAX file which is a full product install. Transfer these binaries to a USS directory and expand the contents. Use the zwe command `zwe install` to extract a number of PDS members which contain load modules, JCL scripts, and PARMLIB entries.

   - **SMP/E build**
     Zowe z/OS binaries are packaged as the following files that you can download. You install this build through SMP/E.

     - A pax.Z file, which contains an archive (compressed copy) of the FMIDs to be installed.
     - A readme file, which contains a sample job to decompress the pax.Z file, transform this file into a format that SMP/E can process, and invoke SMP/E to extract and expand the compressed SMP/E input data sets.

   - **Portable Software Instance (PSWI)**
     You can acquire and install the Zowe z/OS PAX file as a portable software instance (PSWI) using z/OSMF.

> **NOTE**
>
> While the procedures to obtain and install the convenience build, SMP/E build or PSWI are different, the procedure to configure a Zowe runtime is the same, and does not depend on how the build is obtained and installed.

1. Obtain and install the Zowe build.

   - For more information about how to obtain and install the convenience build, see Installing Zowe runtime from a convenience build.
   - For more information about how to obtain and install the SMP/E build, see Installing Zowe SMP/E overview.

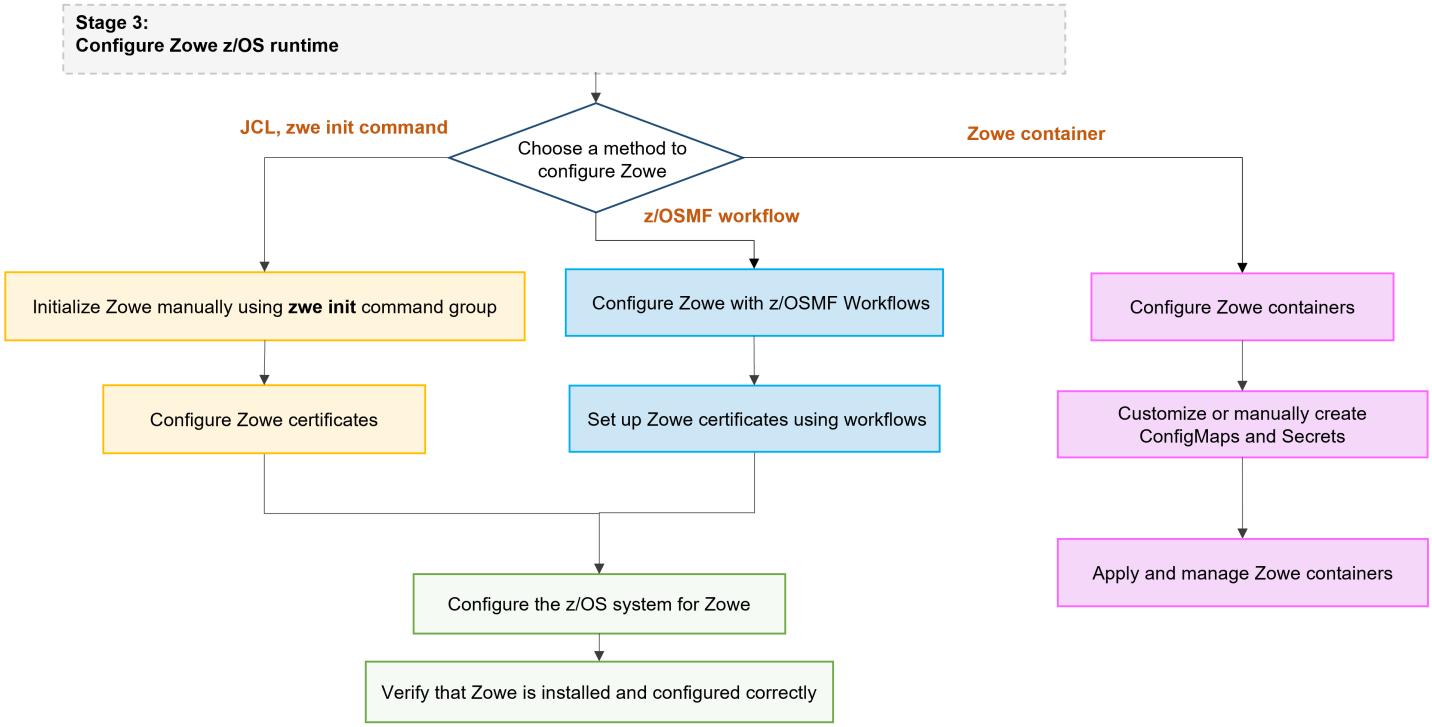
- For more information about how to obtain and install the PSWI, see Installing Zowe from a Portable Software Instance.

Successful installation of either a convenience build or an SMP/E build creates a zFS folder that contains the following artifacts:

- The unconfigured Zowe runtime directory
- The utility library `SZWEEXEC` that contains utilities
- The SAMPLIB library `SZWESAMP` that contains sample members
- The load library `SZWEAUTH` that contains load modules

The steps to prepare the z/OS environment to launch Zowe are the same for all installation methods.

Stage 3: Configuring the Zowe z/OS runtime



Choose from the following methods to configure the Zowe runtime:

- Use a combination of JCL and the zwe command `zwe init`
- Use Zowe z/OSMF Workflows
- Use API ML optimized z/OSMF Workflows

> **TIP**
>
> We recommend you open the links to this configuration procedure in new tabs.

The steps to initialize the system are the same independent of whether you obtained Zowe from a .pax convenience build, or an SMP/E distribution.

> **NOTE**
>
> The `zwe init` command runs the subcommands in sequence automatically. You can choose to run the subcommands one by one to define each step based on your need. If you encounter any failures with `zwe init` command, you can pick up the failed subcommands step specifically and rerun this subcommand.

The following procedure outlines the steps to configure the Zowe z/OS runtime, and the corresponding `zwe init` subcommands.

1. Prepare the zowe.yaml configuration file if the file does not already exist.
2. Prepare the custom MVS data sets. Copy the data sets provided with Zowe to custom data sets.
   (Uses the command `zwe init mvs`)
3. Initialize Zowe security configurations. Create the user IDs and security manager settings.
   (Uses the command `zwe init security`)

> **NOTE**
>
> If Zowe has already been launched on a z/OS system from a previous release of Zowe v2, you can skip this security configuration step unless told otherwise in the release documentation.

4. Perform APF authorization of load libraries. These load libraries contain the modules required to perform z/OS priviledged security calls.
   (Uses the command `zwe init apfauth`)
5. Configure Zowe to use TLS certificates
   (Uses the command `zwe init certificate`)
6. Create the VSAM data sets used by the Zowe API Mediation Layer caching service. Note that this step is only required if you are configuring Zowe for cross LPAR sysplex high availability.
   (Uses the command `zwe init vsam`)
7. Install Zowe main started tasks.
   (Uses command `zwe init stc`)

Once you complete the Zowe z/OS runtime, you can verify the installation to determine that Zowe is installed correctly on z/OS.

> **TIP**
>
> - For testing purposes, it is not necessary to set up certificates when configuring the API Mediation Layer. You can configure Zowe without certificate setup and run Zowe with `verifyCertificates: DISABLED`.
> - For production environments, certificates are required. Ensure that certificates for each of the following services are issued by the Certificate Authority (CA) and that all keyrings contain the public part of the certificate for the relevant CA.
>   - z/OSMF
>   - Zowe
>   - The service that is onboarded to Zowe

Stage 4: (Optional) Customizing the configuration

Now that you have the permissions, certificates, files, and datasets necessary to run Zowe, you may wish to customize your Zowe configuration. Customization can be performed to change various attributes including the following:

- Enabling or disabling components so you only run what you need
- Changing the network ports Zowe runs on to suit your environment
- Customizing the behavior of a component, such as turning on optional features or logging
- Splitting, templating, and placing your configuration into PARMLIBs with the Zowe Configuration Manager

> **TIP**
>
> See the Zowe YAML configuration file reference for other customization options.

Stage 5: (Optional) Installing and managing extensions

Before installing extensions, we recommend you start zowe.

After Zowe is customized according to your needs, you can leverage more Zowe functionalities by installing extensions. These extensions can be optional components from the Zowe project or from other vendors.

For more information about installing and managing extensions, see Zowe server component and extension management.

How to troubleshoot problems with the installation

If you encounter unexpected behavior when installing or verifying the Zowe runtime on z/OS, see the Troubleshooting section for tips.

For more information on `zwe`, refer to the zwe appendix.

For more information on the server configuration file, see the Zowe YAML configuration file reference.

Next step

Before starting the installation process, first review the article Preparing for installation and the address the requirements outlined in the sub-articles in this section.

Version: v3.2.x LTS

Preparing for installation

Review this overview article to familiarize yourself with key concepts used in the Zowe server-side installation process. After you get familiar with these key concepts, review the articles in this section to prepare your system for installation.

REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR, STORAGE ADMINISTRATOR

To prepare for Zowe server-side installation, we recommend that your installation team review the installation and configuration tasks and the indicated required roles to perform specific procedures. Doing so can help you complete the process without encountering delays waiting for tasks to be completed at the last minute.

Key concepts in Zowe server-side installation

Before you begin the installation process, it is useful to understand the following key concepts and features used to perform the installation.

z/OS UNIX System Services (USS)

zFS is a UNIX file system where Zowe runtime files and folders are installed. Zowe uses a zFS directory to contain its northbound certificate keys as well as a truststore for its southbound keys if the administrator chooses to use PKCS#12 keystore for certificate storage.

For more information about USS, see Addressing UNIX System Servies (USS) Requirements.

TIP

Zowe runs in USS and makes heavy use of shell scripts and TCP/IP sockets, which creates temporary files and ENQUEUES within the /tmp directory. It is not likely that the increased volume of temporary files and ENQUEUES will impact your system, as this volume is on the scale of a few thousand temporary files and ENQUEUES, which are subsequently freed after configuration and startup.

If, in your specific case, this increase in the /tmp directory results in impacts to your system, or you are concerned about the possible impact of this increased volume in the /tmp directory, we recommend you update the following property in the zowe.yaml to move the created files and ENQUEUES to different directory:

Runtime directory

The runtime directory contains the binaries, executable files, scripts, and other elements that are run when Zowe is started. Creating a Zowe runtime directory involves setting up the necessary environment for Zowe to run on your system.

You can create a runtime directory in one of the following ways:

- Create a directory and extract Zowe convenience build into this directory.
- Install the Zowe SMP/E FMID AZWE002 using the JCL members in the REL4 member.

- Execute the z/OSMF workflow script ZWERF01 contained in the SMP/E FMID AZWE002.

During execution of Zowe, the runtime directory contents are not modified. Maintenance or Zowe APAR releases replaces the contents of the runtime directory.

> **NOTE**
>
> - Multiple instances of Zowe can be started from the same Zowe z/OS runtime. Each launch of Zowe has its own configuration, usually mentioned as Zowe YAML configuration file or zowe.yaml, and zFS directory that is known as a workspace directory.

Example of a runtime directory:

- For Zowe in a high availability configuration, there will be only one workspace directory which must be created on a shared file system (zFS directory) where all LPARs in a Sysplex can access.

- (If not using containerization) Zowe optionally uses a zFS directory to contain its northbound certificate keys as well as a truststore for its southbound keys if the administrator chooses to use PKCS#12 keystore for certificate storage. Northbound keys are one presented to clients of the Zowe desktop or Zowe API Gateway, and southbound keys are for servers that the Zowe API gateway connects to. The certificate directory is not part of the Zowe runtime so that it can be shared between multiple Zowe runtimes and have its permissions secured independently.

- Zowe has the following started tasks:

  - `ZWESISTC` is a cross memory server that the Zowe desktop uses to perform APF-authorized code. More details on the cross memory server are described in Configuring the Zowe cross memory server.

  - `ZWESASTC` is a cross memory Auxiliary server that is used under some situations in support of a Zowe extension. Auxiliary server is started, controlled, and stopped by the cross memory server, so no need to start it manually. More details are described in Zowe auxiliary service

  - `ZWESLSTC` brings up other parts of the Zowe runtime on z/OS as requested. This may include Desktop, API mediation layer, ZSS, and more, but when using containerization likely only ZSS will be used here. It can be used for a single Zowe instance deployment and can also be used for Zowe high availability deployment in Sysplex. It brings up and stops Zowe instances, or specific Zowe components without restarting the entire Zowe instances.

    In order for above started tasks to run correctly, security manager configuration needs to be performed. This is documented in Configuring the z/OS system for Zowe and a sample JCL member `ZWESECUR` is shipped with Zowe that contains commands for RACF, TopSecret, and ACF2 security managers.

  Notes:

  - To start the API Mediation Layer as a standalone component, see API Mediation Layer as a standalone component.

  - If you plan to use only API ML components and you will not be using x509 client-side certificate authentication, you do not need to run or set up ZWESISTC and ZWESASTC. Only ZWESLSTC will be used.

Topology of the Zowe z/OS launch process

Runtime directory

The runtime directory contains the binaries and executable files. You can create a runtime directory in one of the following ways:

- Create a directory and extract Zowe convenience build into it.
- Installing the Zowe SMP/E FMID AZWE002 using the JCL members in the REL4 member.
- Executing the z/OSMF worklow script `ZWERF01` contained in the SMP/E FMID AZWE002.

During execution of Zowe, the runtime directory contents are not modified. Maintenance or APAR release for Zowe replaces the contents of the runtime directory and are rollup PTFs.

A typical Zowe runtime directory looks like this:

`zwe` command

The `zwe` command is provided in the `<RUNTIME_DIR>/bin` directory.

The zwe init command is a combination of the following subcommands. Each subcommand defines a configuration.

- **mvs**
  Copies the data sets provided with Zowe to custom data sets.
- **security**
  Creates the user IDs and security manager settings.
- **apfauth**
  APF authorizes the LOADLIB containing the modules that need to perform z/OS privileged security calls.
- **certificate**
  Configures Zowe to use TLS certificates.
- **vsam**
  Configures the VSAM files needed to run the Zowe caching service used for high availability (HA)
- **stc**
  Configures the system to launch the Zowe started task.

In combination, these commands initialize Zowe, manage Zowe instances, and perform common tasks.

> **TIPS:**
>
> - The `zwe` command has built in help that can be retrieved with the `-h` suffix. Use `zwe -h` to see all supported `zwe` commands.
>
> For more information about `zwe` see zwe in the appendix.
>
> - If you expect to have only one copy of the Zowe runtime on your system, it is convenient to be able to access a copy of `zwe` from your user at any location within USS. Add this Zowe bin directory to your `PATH` environment variable to execute the `zwe` command without having to fully qualify its location. To update your PATH, run the following command:
>
> This command updates the `PATH` for the current shell. To make this update persistent, you can add the line to your `~/.profile` file, or the `~/.bash_profile` file if you are using a bash shell. To make this update system wide, update the `/etc/.profile` file. Once the PATH is updated, you can execute the `zwe` command from any

USS directory. For the remainder of the documentation when `zwe` command is referenced, it is assumed that it has been added to your `PATH`.

You may not want to add `zwe` to your PATH if you have multiple copies of the Zowe runtime, as this can confuse which one you are utilizing.

Zowe started tasks

Zowe has the following started tasks:

- **`ZWESISTC`**
  This started task corresponds to a cross memory server that the Zowe desktop uses to perform APF-authorized code. For more information about the cross memory server, and the cross memory auxiliary server `ZWESASTC` see Configuring the Zowe cross memory server.
- **`ZWESASTC`**
  This started task corresponds to a cross memory auxiliary server that is used under some situations in support of a Zowe extension. The auxiliary server is started, controlled, and stopped by the cross memory server, and does not need to be started manually.
- **`ZWESLSTC`**
  This started task brings up other features of the Zowe runtime on z/OS upon request. Features may include Desktop, API Mediation Layer, ZSS, and more. When using containerization, it is likely that the only feature will be ZSS. This task can be used for a single Zowe instance deployment, and can also be used for Zowe high availability deployment in Sysplex. This task brings up and stops Zowe instances, or specific Zowe components without restarting the entire Zowe instances.

IMPORTANT

- In order for the above started tasks to run correctly, the security administrator permissions are required. For more information, see Configuring the z/OS system for Zowe.
- Note that the sample JCL member `ZWESECUR` is shipped with Zowe and contains commands for RACF, TopSecret, and ACF2 security managers.

z/OS Data sets used by Zowe

After Zowe is properly installed, the following data sets are created on z/OS under the prefix you defined:

- **`<prefix>.SZWEAUTH`**
  This data set contains authorized binaries used by Zowe components. In particular, ZIS needs this data set to run.
- **`<prefix>.SZWELOAD`**
  This data set contains binaries that do not need authorization. In particular, this data set contains a version of configuration manager that can be accessed within REXX.
- **`<prefix>.SZWEEXEC`**
  This data set contains few utility executables will be used by Zowe.
- **`<prefix>.SZWESAMP`**
  This data set contains sample JCLs to help you configure or start Zowe.

If you install Zowe with the convenience build, these data sets are created by `zwe install` command. If you install Zowe with SMP/E or equivalent methods, these data sets are created during installation and you are not required to run

the `zwe install` command. Note that the aforementioned data sets are overwritten during the upgrade process.

Zowe configuration and runtime also use other data sets to store customization. These data sets are not overwritten during upgrade.

- **`zowe.setup.datasets.parmlib`**
  This data set defined in Zowe configuration contains user customized PARMLIB members.
- **`zowe.setup.datasets.jcllib`**
  This data set defined in Zowe configuration contains user customized JCLs or JCLs generated by `zwe init` command.
- **`zowe.setup.datasets.authLoadlib`**
  This data set defined in Zowe configuration is optional. If the user chooses to copy out load libraries from `<prefix>.SZWEAUTH`, these libraries are placed here. With this option, you have better control on what will be APF authorized other than authorize whole `<prefix>.SZWEAUTH`.
- **`zowe.setup.datasets.authPluginLib`**
  This data set defined in Zowe configuration contains extra load libraries used by ZIS plugins.
- **`zowe.setup.datasets.loadlib`**
  This data set defined in Zowe configuration contains load libraries that do not need authorization, such as a version of the configuration manager that can be used within REXX.

Zowe configuration file (`zowe.yaml`)

Zowe uses a YAML format configuration. If you store the configuration on USS, this file is usually referred as `zowe.yaml`.

This configuration file has the following requirements:

- The Zowe runtime user, usually referred as `ZWESVUSR`, must have read permission to this file.
- If you plan to run Zowe in Sysplex, all Zowe high availability instances must share the same configuration file. As such, this configuration file should be placed in a shared file system (zFS directory) where all LPARs in a Sysplex can access.
- The Zowe configuration file may contain sensitive configuration information so it should be protected against malicious access.

To create this configuration, you can copy from `example-zowe.yaml` located in Zowe runtime directory. Note that the `zowe.runtimeDirectory` definition in the configuration file should match the Zowe runtime directory mentioned previously.

To learn more about this Zowe configuration file, see the Zowe YAML configuration file reference.

> **ZOWE.YAML CONFIGURATION TIPS:**
>
> When you execute the `zwe` command, the `--config` or `-c` argument is used to pass the location of a `zowe.yaml` file.
>
> - To avoid passing `--config` or `-c` to every `zwe` command, you can define `ZWE_CLI_PARAMETER_CONFIG` environment variable points to the location of zowe.yaml.
>
> For example, after defining `export ZWE_CLI_PARAMETER_CONFIG=/path/to/my/zowe.yaml`, you can simply type `zwe start` instead of the full command `zwe start -c /path/to/my/zowe.yaml`.

- If you are new to the `example-zowe.yaml` configuration file, you can start with entries that are marked with `COMMONLY_CUSTOMIZED`. It highlights most of the common configurations, such as directories, host and domain name, service ports, certificate setup, and z/OSMF, which are critical for standing a new Zowe instance.

Workspace directory

The workspace directory is required to launch Zowe. It is automatically created when you start Zowe. More than one workspace directory can be created and used to launch multiple instances of Zowe sharing the same runtime directory. It is not recommended to create workspace directory manually in order to avoid permission conflicts.

Zowe instances are started by running the server command `zwe start`. This creates a started task with the PROCLIB member `ZWESLSTC` that is provided with the samplib `SZWESAMP` created during the installation of Zowe. The JCL member `ZWESLSTC` starts Zowe launcher under which it launches Zowe components address spaces.

Zowe enables read and write permission to both Zowe runtime user (`ZWESVUSR` by default) and Zowe admin group (`ZWEADMIN` by default) for Zowe workspace directory.

If you plan to run Zowe in Sysplex, all Zowe high availability instances must share the same workspace directory, which means it should be placed in a shared file system (zFS directory) where all LPARs in a Sysplex can access.

The workspace directory should be defined in your Zowe configuration file as `zowe.workspaceDirectory`.

Log directory

Some Zowe components write logs to a file system. The directory is created automatically when you start Zowe and the content is automatically managed by Zowe components. It is not recommended to create a log directory manually in order to avoid permission conflicts.

Multiple Zowe instances can define different log directories. It is not necessary that these log directories be shared in Sysplex deployment like the workspace directory.

The log directory should be defined in your Zowe configuration file as `zowe.logDirectory`.

Keystore directory

Zowe uses certificates to enable transport layer security. The system administrator can choose to use z/OS Keyring or PKCS#12 keystore for certificate storage. A keystore directory is created and used if PKCS#12 keystore is chosen.

Example of a PKCS#12 keystore directory:

To generate a keystore directory, you need proper `zowe.setup.certificate` configuration defined in the Zowe configuration file. Execute the server command `zwe init certificate`. To learn more about this command, see the Reference of zwe init certificate in the appendix.

Extension directory

Zowe allows server extensions to expand Zowe core functionalities. The extensions are required to be installed in a central location so Zowe runtime can find and recognize them.

Similar to Zowe runtime directory, this extension directory should be created by the administrators perform Zowe installation and configuration task. Zowe runtime user, typically `ZWESVUSR` requires read-only permission to this directory.

The extension directory should be created by system administrator and defined in your Zowe configuration file as `zowe.extensionDirectory`.

Zowe uses `zwe components install` command to install Zowe server extensions. This command creates sub-directories or symbolic links under the extension directory.

Next step

Review and address the specific requirements in the Prepare for Installation section before beginning installation of Zowe server-side components for z/OS.

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Zowe z/OS components installation checklist

Use this checklist to guide you through the installation and configuration of Zowe server-side components for z/OS.

Preparing for installation

Task	Results	Time Estimate
Review the Zowe server-side installation overview	Knowledge about the basic installation stages and the roles and responsibilities to perform the installation	25 minutes
Prepare for installation	Knowledge about the key-concepts in server-side installation	25 minutes
Address pre-installation requirements	The following pre-installation requirements are addressed: * z/OS * Node.js * security * USS * storage * network * z/OSMF (recommended for full functionality) * z/OSMF HA (required for production)	1 day

Installing the Zowe z/OS runtime

Choose from the following installation options to install Zowe server-side components for z/OS.

Task	Results	Time Estimate
Option 1: Install Zowe with SMP/E (Optionally install via Server Install Wizard) **Option 2: Install Zowe with z/OSMF from a portable software instance** **Option 3: Install Zowe SMP/E build with z/OSMF workflow** **Option 4: Install Zowe via a convenience build**	Executables and binaries are unpaxed on the mainframe	1 hour

Task	Results	Time Estimate
(PAX file) (Optionally install via Server Install Wizard)		

Configuring Zowe z/OS Components

Choose the following options to initialize Zowe z/OS runtime:

Task	Results	Time Estimate
Option 1: Configure Zowe with zwe init **Option 2: Configure Zowe with z/OSMF workflows** **Option 3: Configure Zowe with JCL**	* All datasets are created and populated. * Started tasks are copied to system libraries. **Important:** Security administrator permissions are required for some zwe init sub-commands to pass.	1 hour

Configuring security

Configure Zowe and your z/OS system to run Zowe with z/OS.

Task	Results	Time Estimate
Review Configuring security	Knowledge about which tasks need to be performed by the security administrator.	10 minutes
Initialize Zowe security configurations	The JCL member to configure the z/OS system is created.	10 minutes
Perform APF authorization of load libraries	APF authorization is granted to load libraries.	10 minutes
Customize z/OS system security	Your z/OS and security product are configured.	2 hours
Assign security permissions to users	Zowe user is created and is assigned all required permissions.	30 minutes

Configuring certificates

Zowe is able to use PKCS12 certificates or certificates held in a z/OS Keyring.

Task	Results	Time Estimate
Read the article Zowe certificate configuration overview. Then use one of the following options: **Option 1: Choose the certificate configuration scenario** that best applies to your use case, and follow the configuration procedure and scenario template. **Option 2: Set up Zowe certificates using workflows**	Your certificates are configured and stored securely.	2 hours

Configuring the Zowe cross memory server (ZIS)

The Zowe cross memory server (ZIS) provides privileged cross-memory services to the Zowe Desktop and runs as an APF-authorized program.

> **NOTE**
>
> To start Zowe without the desktop (for example to launch just the API Mediation Layer), you do not need to install and configure the cross memory server and can skip this step.

Task	Results	Time Estimate
Configure the Zowe cross memory server (ZIS)	* JCL member `ZWESISTC` is copied from `SZWESAMP` installation PDS to a PDS on the JES concatenation path. * The PDSE Load Library `SZWEAUTH` is APF-authorized, or the load module `ZWESIS01` is copied to an existing APF Auth LoadLib. * The JCL member `ZWESISTC DD` statements are updated to point to the location of `ZWESIS01` and `ZWESIP00`.	30 minutes

Configuring High Availability (optional)

You can configure your system to enable HA. This configuration is not required to run a single instance of Zowe.

Task	Results	Time Estimate
Configure Sysplex for high availability	The Parallel Sysplex environment is set up.	30 minutes
Configure z/OSMF for high availability in Sysplex	The z/OSMF server is set up to provide continuous availability of REST services.	30 minutes

Task	Results	Time Estimate
Configure the Caching Service for HA	State data persistent in HA mode is centralized.	30 minutes
Define the `haInstances` section in your zowe.yaml	A dedicated section for `haInstances` is created in your zowe.yaml file.	30 minutes

Starting and Stopping Zowe

Start/Stop Step	Task	Results	Time Estimate
Start and stop the cross memory server `ZWESISTC` on z/OS	The `ZWESISTC` task starts and stops the `ZWESASTC` task as needed	The cross memory server is run as a started task from the JCL in the PROCLIB member `ZWESISTC`	5 minutes
Start and stop the Zowe main server `ZWESLSTC` on z/OS	**Option 1: Use zwe to start and stop the main Zowe server** **Option 2: Manually start and stop the Zowe main server `ZWESLSTC`**	You started or stopped Zowe main server `ZWESLSTC` on z/OS with `zwe` or manually	20 minutes

Verifying Zowe installation on z/OS

Verification Step	Task	Results	Time Estimate
Verify Zowe Application Framework installation	Open the Zowe Desktop from a supported browser	You should be able to open the Zowe Desktop from a supported browser.	20 minutes
Verify API Mediation installation	Use a REST API client to review the value of the status variable of the API Catalog service routed through the API Gateway	See the example presented in Verify API Mediation installation	15 minutes
Verify z/OS Services installation	Zowe z/OS services usually are registered with Zowe APIML Discovery	You should see JSON format data of all jobs running on the system	15 minutes

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Addressing z/OS requirements

Before installing Zowe™ z/OS components, ensure that your z/OS environment meets the prerequisites. The prerequisites you need to install depend on what Zowe z/OS components you want to use and how you want to install and configure Zowe on z/OS. Assess your installation scenario and install the prerequisites that meet your needs.

> **REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR**

All Zowe server components can be installed on a z/OS environment, while some can alternatively be installed on Linux or zLinux via Docker. The components provide a number of services that are accessed through a web browser such as an API catalog and a web desktop.

z/OS system requirements

Be sure your z/OS system meets the following prerequisites:

z/OS

- z/OS version is in active support, such as Version 2.5, and 3.1

  > **NOTES:**
  >
  > - z/OS V2.4 reached end of support on 30 September, 2024.
  > - z/OS V2.3 reached end of support on 30 September, 2022. For more information, see the z/OS v2.3 lifecycle details.

- zFS volume has at least 1200 MB of free space for Zowe server components, the corresponding keystore, instance configuration files and logs, and third-party plug-ins.

- (Optional, recommended) System Display and Search Facility (SDSF)

  SDSF is used for a few management tasks of Zowe, though there are alternative ways to accomplish the same tasks.

Task	Command utilizing SDSF	Alternatives
Certificate setup	`zwe init certificate`	z/OSMF workflow "ZWEKRING", or the JCL samples "ZWEKRING" and those that begin with "ZWEIKR" can be used to create keyrings.
Starting Zowe	`zwe start`	Products that can issue the MVS START command upon Zowe's STC such as Sysview or EJES can be used instead.
Stopping Zowe	`zwe stop`	Products that can issue the MVS STOP command upon Zowe's STC such as Sysview or EJES can be used instead.

  Not having SDSF installed may result in the following error message:

```
IRX0043I Error running /Zowe/bin/utils/opercmd.rex, line 130: Routine not found
```

For more information about SDSF, see the *Abstract for z/OS SDSF Operation and Customization* in the IBM documentation.

- (Optional, recommended) z/OS OpenSSH

  Some features of Zowe require SSH, such as the SSH terminal of the Desktop. Install and manage Zowe via SSH, as an alternative to OMVS over TN3270.

- (Optional) Parallel Sysplex.

  To deploy Zowe for high availability, a Parallel Sysplex environment is recommended. For more information, see Configuring Sysplex for high availability.

Mainframe Resources Consumption

During Zowe startup, there is high resource consumption in order for Zowe to be operational as soon as possible. Subsequent resource consumption depends on the processing load of Zowe services. When Zowe is idle, resource consumption is relatively lower.

Resource consumption during Zowe startup

- **CPU consumption**
  Zowe consumes approximately 300 CPU seconds on the z15 T01 processor during startup. Approximately 50 percent of CPU consumption is zIIP eligible.

- **I/O**
  Zowe performs approximately 5,000,000 I/O operations during startup.

Resource consumption when Zowe is idling

- **CPU consumption**
  Zowe consumes approximately 90 CPU seconds on the z15 T01 processor during 1 hour of operation when no external load is processed. Approximately 60 percent of CPU consumption is zIIP eligible.

- **I/O**
  Zowe performs approximately 17,000 I/O operations during 1 hour of operation when no external load is processed.

> **NOTE**
>
> Zowe consumption reference data were measured with the default Zowe configuration. The following components were enabled:
>
> - Gateway
> - Discovery Service
> - API Catalog
> - Caching Service
> - ZSS
> - Zowe Desktop

Node.js

- The app-server component requires one of the following Node.js versions:

  - v18.x
  - v20.x
  - v22.x

  Node is not included with z/OS so must be installed separately. To install Node.js on z/OS, follow the instructions in Addressing Node.js requirements.

  > **TIP**
  >
  > If you are a software vendor building extensions for Zowe, we recommend you tag your plug-ins. For more information, see Tagging on z/OS.

Java

- IBM® Semeru Runtime Certified Edition for z/OS® version 17

z/OSMF (Optional)

- (Optional, recommended) IBM z/OS Management Facility (z/OSMF) Version 2.5, or Version 3.1.

  z/OSMF is included with z/OS so does not need to be separately installed. If z/OSMF is present, Zowe detects z/OSMF during configuration and uses z/OSMF for the following purposes:

  - Authenticating TSO users and generating a single sign-on JSON Web Token (JWT). Ensure that the z/OSMF JWT Support is available via APAR and associated PTFs and that JWT generation is enabled. For more information see Enabling JSON Web Token support in the IBM documentation.

  - REST API services for Files (Data Sets and USS), JES, and z/OSMF workflows. These are used by some Zowe applications such as the Zowe Explorers in the Zowe Desktop. If z/OSMF REST APIs are not present, other Zowe desktop application, such as the File Editor that provides access to USS directories and files as well as MVS data sets and members, will work through the Zowe Z Secure Services (ZSS) component to access z/OS resources.

  > **RECOMMENDATIONS**
  >
  > - For production use of Zowe, we recommend configuring z/OSMF to leverage Zowe functionalities that require z/OSMF. For more information, see Configuring z/OSMF.
  > - For non-production use of Zowe (such as development, proof-of-concept, demo), you can customize the configuration of z/OSMF to create ***z/OS MF Lite*** to simplify your setup of z/OSMF. z/OS MF Lite only supports selected REST services (JES, DataSet/File, TSO and Workflow), resulting in considerable improvements in startup time as well as a reduction in steps to set up z/OSMF. For information about how to set up z/OSMF Lite, see Configuring z/OSMF Lite (non-production environment).

> **NOTE**

> For specific z/OS security configuration options that apply to the specific Zowe server-side components in your configuration, see Security customization of your z/OS system.

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Addressing Node.js requirements

Before you install Zowe™ on z/OS, you must install IBM SDK for Node.js on the same z/OS server that hosts the Zowe Application Server and z/OS Explorer Services. Review the information in this topic to obtain and install Node.js.

REQUIRED ROLE: SYSTEM PROGRAMMER

NOTE

Node.js is required when installing the Zowe servers on z/OS. Node.js is not required if using Docker instead of z/OS, or if running Zowe without the app-server enabled.

Supported Node.js versions

The following Node.js versions are supported to run Zowe. See the Hardware and software prerequisites section for the prerequisites that are required by Zowe.

The corresponding IBM SDK for Node.js - z/OS documentation lists all the prerequisites for Node.js. Some software packages, which might be listed as prerequisites there, are **NOT** required by Zowe. Specifically, you do **NOT** need to install Python, Make, Perl, or C/C++ runtime or compiler. If you can run `node --version` successfully, you have installed the prerequisites required by Zowe.

NOTE

IBM SDK for Node.js withdrew v16 from marketing on September 4, 2023. The v14 service ended on September 30, 2022.

- v18.x
  - z/OS V2R4: PTFs UI78913, UI81096, UI78103, UI80155, UI83490
  - z/OS V2R5: PTFs UI78912, UI81095, UI80156, UI83424
- V20.x
  - z/OS V2R4: PTFs UI80106, UI81096, UI78103, UI80155, UI83490
  - z/OS V2R5: PTFs UI78912, UI81095, UI80156, UI83424
  - z/OS V3R1: No PTFs needed.
- V22.x
  - z/OS V2R5: PTFs UI78912, UI81095, UI80156, UI83424
  - z/OS V3R1: No PTFs needed.

How to obtain IBM SDK for Node.js - z/OS

You can obtain IBM SDK for Node.js - z/OS for free in one of the following ways:

- Order the SMP/E edition through your IBM representative if that is your standard way to order IBM software.
- Order the SMP/E edition through IBM Shopz with optional paid support available.
- Download PAX file format at ibm.com/products/sdk-nodejs-compiler-zos. IBM defect Support is not available for this format.

For more information, see the blog "Options on how to obtain IBM Open Enterprise SDK for Node.js".

Hardware and software prerequisites

To install Node.js for Zowe, the following requirements must be met.

The corresponding IBM SDK for Node.js - z/OS documentation lists all the prerequisites for Node.js. Some software packages, which might be listed as prerequisites there, are **NOT** required by Zowe. Specifically, you do **NOT** need to install Python, Make, Perl, or C/C++ runtime or compiler.

If you run `node --version` successfully, you installed the Node.js prerequisites required by Zowe.

Hardware:

IBM zEnterprise® 196 (z196) or newer

Software:

- z/OS UNIX System Services enabled
- Integrated Cryptographic Service Facility (ICSF) configured and started

  ICSF is required for Node.js to operate successfully on z/OS. If you have not configured your z/OS environment for ICSF, see Cryptographic Services ICSF: System Programmer's Guide. To verify that ICSF started, check that the started task `ICSF` or `CSF` is active.

Installing the PAX edition of Node.js - z/OS

Follow these steps to install the PAX edition of Node.js - z/OS to run Zowe.

1. Download the pax.Z file to a z/OS machine.
2. Extract the pax.Z file inside an installation directory of your choice.
   For example:

   `pax -rf <path_to_pax.Z_file> -x pax`
3. Add the full path of your installation directory to your PATH environment variable:
4. Run the following command from the command line to verify the installation.

   If Node.js is installed correctly, the version of Node.js is displayed. If it is intalled correctly, you will see the version information on your device.
5. After you install Node.js, set the `NODE_HOME` environment variable to the directory where Node.js is installed. For example, `NODE_HOME=/proj/mvd/node/installs/node-v18.18.2-os390-s390x`.

Installing the SMP/E edition of Node.js - z/OS

To install the SMP/E edition of Node.js, see the documentation for IBM SDK for Node.js - z/OS. Remember that the software packages Perl, Python, Make, or C/C++ runtime or compiler that the Node.js documentation might mention are **NOT** needed by Zowe.

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Addressing security requirements

ROLES REQUIRED: SECURITY ADMINISTRATOR

During configuration of server-side components, it is necessary to configure various system security settings. Your organization may require your security administrator to complete steps to configure Zowe security. As a system administrator/programmer, first consult with your security administrator before you start the installation process.

NOTE

This article addresses configuring Zowe security during the Zowe z/OS components installation process, and does not address security configuration to extend Zowe. For more information about security configuration to extend Zowe, see the following articles:

- Digital certificates
- User Authentication
- Access Authorization

Tasks performed by your security administrator

To configure Zowe security, your organization's security administrator is required to perform various tasks. Some of the tasks apply to general Zowe configuration, while other tasks are required during installation if you plan to use specific Zowe components or features.

The following required configuration tasks are performed by your organization's security administrator during the post-installation configuration:

- Initialize Zowe security configurations
- Perform APF authorization of load libraries
- Configure the z/OS system for Zowe
- Configure address space job naming
- Assign security permissions to users

If your Zowe server-side installation includes the features listed in the following table, consult your security administrator to perform the associated security tasks after installation:

Feature of a Zowe server-side component	Configuration Task
If using Top Secret as your security manager **Note:** No specific configuration is necessary for security managers other than Top Secret.	Configuring multi-user address space (for TSS only)
High Availability	Configuring ZWESLSTC to run Zowe high availability instances under ZWESVUSR user ID

Feature of a Zowe server-side component	Configuration Task
z/OSMF authentication or onboarding of z/OSMF service	Granting users permission to access z/OSMF
ZSS component enabled (required for API ML certificate and identity mapping)	Configuring an ICSF cryptographic services environment and Configuring security environment switching
API Mediation Layer certificate mapping	Configuring main Zowe server to use client certificate identity mapping
API Mediation Layer identity mapping	Configuring main Zowe server to use distributed identity mapping
API Mediation Layer Identity Tokens (IDT)	Configuring signed SAF Identity tokens (IDT)
Cross memory server (ZIS)	Configuring the cross memory server for SAF and Configuring cross memory server load module and Configuring cross-memory server SAF configuration

Assign security permissions to users

As a security administrator, assign users (`ZWESVUSR` and `ZWESIUSR`) and the `ZWEADMIN` security group permissions required to perform specific tasks.

For more information about assigning these permissions, see Assigning security permissions to users.

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(Recommended) Addressing authentication requirements

The following features are not required, but are recommended with additional prerequisites.

> **ROLES REQUIRED: SECURITY ADMINISTRATOR**

Multi-Factor Authentication (MFA)

Multi-factor authentication (MFA) is supported for several Zowe components, including the Zowe Desktop, API Mediation Layer, and Zowe Application Framework. Multi-factor authentication is provided by third-party products with which Zowe is compatible. The following MFA products are known to work with Zowe:

- Advanced Authentication Mainframe 2.0
- IBM Z Multi-Factor Authentication.

To support the multi-factor authentication, it is necessary to apply z/OSMF APAR PH39582.

> **IMPORTANT**
>
> Multi-factor authentication requires configuration with Single-Sign-On (SSO). Ensure that SSO is configured before you use MFA in Zowe.

Single Sign On (SSO)

Zowe has an SSO scheme with the goal that each time you use multiple Zowe components you should only be prompted to login once.

Requirements:

- IBM z/OS Management Facility (z/OSMF)

> **NOTES:**
>
> - For more information about single sign on (SSO) for users, see Zowe API Mediation Layer Single Sign On Overview.
> - For more information about single sign on (SSO) for extenders, see Single Sign On Integration for Extenders.

API Mediation Layer OIDC Authentication

Zowe requires **ACF2 APAR LU01316** to be applied when using the ACF2 security manager.

For more information about OIDC authentication, see Zowe API Mediation Layer OIDC Authentication.

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Addressing UNIX System Services (USS) Requirements

The Zowe z/OS component runtime requires UNIX System Services (USS) to be configured. As shown in the Zowe architecture, a number of servers run under UNIX System Services (USS) on z/OS. Review this topic for knowledge and considerations about USS when you install and configure Zowe.

REQUIRED ROLE: SECURITY ADMINISTRATOR

What is USS?

The UNIX System Services element of z/OS® is a UNIX operating environment, which is implemented within the z/OS operating system. It is also known as z/OS UNIX. z/OS UNIX files are organized in a hierarchy, as in a UNIX system. All files are members of a directory, and each directory in turn is a member of another directory at a higher level in the hierarchy. The highest level of the hierarchy is the *root* directory. The z/OS UNIX files system is also known as zFS. This zFS directory is the location where the Zowe runtime files and folders are installed.

For more information on USS, see the Introduction to z/OS UNIX

Setting up USS for the first time

If you have not enabled USS for your z/OS environment before, the SMP/E distribution of Zowe provides a number of JCL jobs to assist with this purpose. You can consult with your USS administrator if you need more information such as the USS file system.

Language environment

The following Language Environment options should be set for Zowe.

Name	Value	Description
HEAP64	HEAP64(4M,4M,KEEP,1M,1M,KEEP,0K,0K,FREE)	You need to have HEAP64 large enough that Zowe has enough memory allocated to run.
HEAPPOOLS	HEAPPOOLS(OFF)	Some parts of Zowe cannot run when HEAPPOOLS is enabled.
HEAPPOOLS64	HEAPPOOLS64(OFF)	Some parts of Zowe cannot run when HEAPPOOLS64 is enabled.

OMVS segment

An OMVS segment is required for users (`ZWESVUSR` or `ZWESIUSR`) who install Zowe to run Zowe scripts.

> **TIP**
>
> For information about OMVS segments, see the article *The OMVS segment in user profiles* in the IBM documentation.

If the user profile does not have an OMVS segment, the following messages can occur:

- When you access USS through TSO OMVS, the following message is thrown:
- When you access USS through SSH, the following message is thrown:

Address space region size

Java as a prerequisite for Zowe requires a suitable z/OS region size to operate successfully while you install and configure Zowe. It is suggested that you do not restrict the region size, but allow Java to use what is necessary. Restricting the region size might cause failures with storage-related error messages such as the following one:

You can fix the storage-related issue by making one of the following changes:

- **ASSIZEMAX** parameter
  The ASSIZEMAX parameter is the maximum size of the process's virtual memory (address space) in bytes.

  To specify the JVM maximum address space size on a per-user basis, set the `ASSIZEMAX` configuration parameter to the value `2147483647`.

  > **NOTE**
  >
  > Running a shell script via TSO OMVS will run the shell in the TSO address space, unless you specify `_BPX_SHAREAS=NO` when invoking OMVS. If you are using TSO OMVS to install Zowe, you will need `export _BPX_SHAREAS=NO` to make the ASSIZEMAX change effective.

- **SIZE** parameter of TSO segment
  Set `SIZE` operand of TSO segment to the value `2096128`.

  > **NOTE**
  >
  > If you set `export _BPX_SHAREAS=YES` in your shell setup as recommended, Java will run in the TSO address space and the SIZE change will work.

- **ulimit -A**
  The maximum address space size for the process should be at least 250 M, in units of 1024 bytes. For example, `ulimit -A 250000`.

  > **NOTE**
  >
  > Running `ulimit -a` displays the current process limits.

Temporary files management

Zowe server components require the use of temporary files. By default, these temporary files are written to the global `/tmp` directory in the USS file system. This section describes options to customize the destination directory for all Zowe server components.

How to customize temporary files

Three environment variables control the directory used to place these temporary files:

- **`TMPDIR`**
  This is the main environment variable, it controls the directory used for most USS operations.
- **`TEMP_DIR`**
  This variable controls some installation specific files, such as the location to perform transformations on zowe.yaml.
- **`CATALINA_TMPDIR`**
  This variable controls the destination directory of Tomcat java servers used in some core components.

Customizing temporary files in STC

Global environment variables can be customized directly in the Zowe STC, `zowe.setup.security.stcs.zowe` in the `zowe.yaml`. The default started task name value is `ZWESLSTC`.

To add environment variables, follow these steps:

1. Open the STC.
2. Find `STDENV DD` inline statements.
3. Add a new line for each environment variable.
   Example:

Customizing temporary files in zowe.yaml

Edit your installation `zowe.yaml` file and add values under property `zowe.environments`.

Example:

> **NOTE**
>
> If the variable is defined in both the `zowe.yaml` and the STC member, the definition from `zowe.yaml` has priority.

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Addressing storage requirements

> **ROLES REQUIRED: STORAGE ADMINISTRATOR, SYSTEM PROGRAMMER**

Ensure that you have sufficient storage depending on the installation method. Review the storage requirements according to your installation method as presented in this article.

Installing Zowe Server Runtime

Before installing Zowe, review the reference for Zowe's server datasets

Installing with SMP/E

Additionally, when installing Zowe with SMP/E, review the DASD storage requirements.

Memory requirements for API Mediation Layer

Before placing limits on available system memory to Zowe API ML, it is necessary to consider resource consumption. The memory consumption depends on specific use cases and network traffic.

The main type of memory used by Java applications, including Zowe API ML components, is heap memory. Heap memory is defined by the initial and maximum memory size. Each Zowe API ML service uses a default minimum of 32 MB and a maximum of 512 MB. When a service requires more memory, the service allocates additional memory in increments of the same size as the initial memory. When the system has limited resources, it is a good practice to set a fixed minimum and maximum memory size. Memory is then allocated during startup, preventing the memory from exceeding the specified limit.

The following table shows the expected heap memory requirements for core Zowe API ML services:

Component name	Memory usage
Gateway Service	512MB
ZAAS	128MB
Discovery Service	128MB
API Catalog	128MB
Caching Service	256MB

JVM Memory

Different memory types are used by JVM services: native, threads, direct memory buffers, and JIT (just-in-time compilation).

Direct memory buffers are limited to the same size as heap memory. By default, in the case of large network traffic, the JVM can allocate up to the same memory allocation as applied to heap memory.

Similarly, threads responsible for processing incoming requests are prepared during JVM start-up. By default, 20 threads are available to process incoming requests. Additional threads can be created on demand (up to 200 threads by default). When the system has limited address space, it is recommended to use fixed-size thread pools, initializing all threads at the beginning.

As a general rule, total memory consumption should be 150% of the heap size.

Customizing memory limits in Zowe API Mediation Layer

Setting memory limits strictly depends on the use case, such as the kind and volume of data that is typically transferred, how many users can be active simultaneously, and the number and type of onboarded services.

If limits need to be set, it is recommended to verify your environment with the following procedure:

1. Run the API ML without a memory limit.
2. Start the services you wish to start and wait approximately an hour or until you have the expected level of traffic to the service.
3. Assess the memory usage during a typical workload.

Setting a direct memory buffer limit

To set a direct memory buffer limit, set the following property: `zowe.environments.JAVA_OPTS`: `-XX:MaxDirectMemorySize=<value><k|K|m|M|g|G>`

- **`<value><k|K|m|M|g|G>`**
  Specifies the limit size and unit.
  Example: `64M` is a 64 Megabyte limit.

Establishing a fixed thread pool

To establish a fixed thread pool, set the following properties to the same value:

- **`zowe.environments.SERVER_TOMCAT_THREADS_MIN_SPARE`**
  The initial number of threads
  Default: 20 threads to process incoming requests.
- **`zowe.environments.SERVER_TOMCAT_THREADS_MAX`**
  The maximum number of threads
  Default: Up to 200 threads

Note: Updating these environment values impacts all Java-based services running as part of the Zowe Server.

The following example shows the configuration of all applicable parameters:

Example:

> **TIP**

It is recommended to set `REGION=0M` in the STC, which is the default setting. Setting a `MEMLIMIT` is not recommended as doing so prevents issues caused by insufficient memory.

For more details about specifying the region size, see the following links:

- Specifying Region Size in the IBM documenation
- Address space region size in Zowe Docs
- Resources in the article *Installing Product Software Using z/OSMF Deployments* in Zowe Docs

When setting a memory limit, consider all running Zowe services, the typical workload, and a buffer to the memory requirement.

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Addressing network requirements

Review the following table during installation of Zowe server-side components to determine which TCP ports are required. Values presented in the table are default values. You can change the values by updating variable values in the `zowe.yaml` file.

REQUIRED ROLES: NETWORK ADMINISTRATOR, SYSTEM PROGRAMMER

For more information about variable names in the following table, see the Zowe YAML configuration file reference in the References section.

Component Ports

Most Components of Zowe are HTTPS servers. The ports of each and their default jobnames are listed below. The ports can be customized for each component by editing the value of `components.<component-name>.port` within the Zowe YAML file. Each Jobname has a default prefix of ZWE1, but that can be customized via the `zowe.job.prefix` value in the Zowe YAML file.

Port number	Category	Component	Default Jobname	Log Suffix	Purpose
7552	API Mediation Layer	api-catalog	ZWE1**AC**	AAC	Used to view API swagger / openAPI specifications for registered API services in the API Catalog.
7553	API Mediation Layer	discovery	ZWE1**AD**	ADS	Discovery server port which dynamic API services can issue APIs to register or unregister themselves.
7554	API Mediation Layer	gateway	ZWE1**AG**	AGW	The northbound edge of the API Gateway used to accept client requests before routing them to registered API services. This port must be exposed outside the z/OS network so clients (web browsers, VS Code, processes running the Zowe CLI) can reach the gateway.
7555	API Mediation Layer	Caching Service	ZWE1**CS**	ACS	Port of the Caching Service that is used to share state between different Zowe instances in a high availability topology.
7556	App Framework	app-server	ZWE1**DS** & ZWE1SV	D	The Zowe Desktop (also known as ZLUX) port used to log in through web browsers.
7557	App Framework	zss	ZWE1**SZ**	SZ	Z Secure Services (ZSS) provides REST API services to ZLUX, used by the File Editor

Port number	Category	Component	Default Jobname	Log Suffix	Purpose
					application and other ZLUX applications in the Zowe Desktop.
7558	API Mediation Layer	zaas	ZWE1**AZ**	AZ	

Application Server Jobname for Port

The jobnames associated with the component "app-server" varies depending on whether cluster mode is enabled or not (default: enabled).

Cluster mode	Jobname for listener port	Jobname for worker processes
Enabled (Default)	Name of STC (default: ZWE1SV)	`zowe.job.prefix` + DS (default: ZWE1**DS**)
Disabled	`zowe.job.prefix` + DS (default: ZWE1**DS**)	Not Applicable

To enable or disable cluster mode, see the Advanced Application Framework Configuration Guide.

Caching Service Infinispan ports

The Caching Service will use these additional ports if enabled (`components.caching-service.enabled: true`) and set to use infinispan (the default, `components.caching-service.storage.mode: infinispan`).

Port number	zowe.yaml variable name	Purpose
7601	zowe.components.caching-service.storage.infinispan.jgroups.keyExchange.port	The port at which the key server in Infinispan is listening. If the port is not available, the next port is probed, up to port+5. Used by the key server (server) to create an SSLServerSocket and by clients to connect to the key server.
7600	zowe.components.caching-service.storage.infinispan.jgroups.port	Bind port for the socket that is used to form an Infinispan cluster.

IP Addresses

Zowe's servers by default use the TCP IP address `0.0.0.0` which assigns the servers to be available on all network interfaces available to the jobs.

If this default is not desired, it is recommended to use TCPIP port assignment statements to restrict the IP & ports of each server by their jobnames. The jobnames of each Zowe component is derived from the property `zowe.job.prefix` and `<component-suffix>` as shown in the table prior.

When `zowe.job.prefix` is `ZWE1`, an example of port reservations with a fixed IP of `10.11.12.13` could be:

> ⓘ **THIS TCP IP SETTING IS VALID FOR THE ZOWE SERVER STARTED WITH `JOBNAME=ZWE1SV` OPTION, FOR EXAMPLE `S ZWESLSTC,JOBNAME=ZWE1SV`. :::**

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Addressing browser requirements

Review the following browser requirements to avoid browser-specific issues when running particular server-side components.

REQUIRED ROLE: SYSTEM PROGRAMMER

Zowe Desktop requirements (client PC)

The Zowe Desktop is powered by the Application Framework which has server prereqs depending on where it is installed.

The Zowe Desktop runs inside of a browser. No browser extensions or plugins are required. The Zowe Desktop supports Google Chrome, Mozilla Firefox, Apple Safari, and Microsoft Edge releases that are at most 1 year old, except when the newest release is older. For Firefox, both the regular and Extended Support Release (ESR) versions are supported under this rule.

If you do not see your browser listed here, please contact the Zowe community so that it can be validated and included.

Browser limitations in API Catalog

It is recommended to use Google Chrome when accessing the API Catalog of API Mediation Layer. Errors might occur if you access API Catalog with Firefox.

Version: v3.2.x LTS

Installing Zowe via Zowe Server Install Wizard

The Zowe Server Install Wizard version 1.1.0 is an installation wizard for Zowe server-side components available on Microsoft Windows, macOS, and Linux systems. Performing Zowe installation via the Wizard streamlines the installation process and is an alternative to performing manual Zowe server-side component installation. Review this article for details about installing Zowe server-side components via the Wizard, setting up the Wizard connection to z/OS, and details including sample JCLs for the Install Wizard initialization steps. There is also a troubleshooting section in case you encounter issues when installing Zowe via the Install Wizard.

> **NOTES**
>
> - To use Zowe v2.18 and later versions, ensure that you use the latest version of the Zowe Server Install Wizard.
> - The Zowe Server Install Wizard is currently available only as a technical preview. This preview includes some of the installation options. Future releases will include more options including validation and discovery properties that can assist with Zowe server installation.
>
> This technical preview includes the following features:
>
> - Install a PAX or SMP/E edition of Zowe (including offline PAX upload)
> - Apply `zwe init` to perform configuration. JCL preview and z/OSMF Workflows support is currently not available in this technical preview.
> - Use of certificates (PKCS12 or Keyring formats) generated by Zowe. The use of your organizations certificate without requiring manual edits to the zowe.yaml file is currently not supported.
>
> Future Wizard releases will include post-install configuration tasks including customizing the behavior of individual Zowe components, and the enablement of tracing. Currently, these tasks must be performed manually in the zowe.yaml file.

> **TIP**
>
> To review open issues, ask questions, find solutions, and report bugs, see Issues in the Zowe Server Install Wizard GitHub repository.

- Benefits of Wizard Installation
- Prerequisites of the Wizard
- Downloading the Wizard
- Installing Zowe server-side components
  - Connecting the Wizard to z/OS
  - Setting z/OSMF Attributes
- Choosing the Server Installation Type
- Configuring the Zowe Server
- Final Review

> **NOTE**

> If you encounter problems during installation of the Zowe Server Install Wizard, see Troubleshooting Zowe Server Install Wizard.

Benefits of Wizard installation

- Reduces the need for YAML editing in z/OS Unix by handling these operations for you based on inputs to the prompts presented in the Wizard UI.
- Inputs to the prompts are validated, so that invalid input or typos entered in most commands are prevented.
- The separation of duties for steps to be performed by a security administrator is made easier, whereby a system programmer or system administrator can skip particular steps where elevated user permissions are required, whereupon security administrators can perform such steps outside of the Wizard.
- Results for each step and the YAML configuration output can be reviewed for reference alongside activites performed outside of the Wizard, or for future use.

Prerequisites of the Wizard

- Zowe version 2.16.0 or above for SMP/E as well as .PAX
- Microsoft Windows, Apple macOS, or a Linux with an X11 or Wayland server display, which can install programs from .rpm or .deb formats
- An FTP or FTPS connection to z/OS for Zowe installation
- An account on z/OS that has access to z/OS UNIX for Zowe installation
- A security administrator to configure required permissions in z/OS and z/OSMF
- A security administrator to generate certificates for Zowe
- A network administrator to open ports used by Zowe

Downloading the Wizard

To download the latest version of the Wizard, visit Zowe.org. Ensure that you download the appropriate file extension type according to your operating system:

Operating System	File Extension Type
Microsoft Windows	.exe
Apple macOS	.dmg
Linux (debian-based)	.deb
Linux (RedHat or SuSE-based)	.rpm

> **NOTE**
>
> If you are using macOS you might encounter the following error message:

> To resolve this error, open the terminal and run the following command:
>
> This command enables you to use the .dmg file on macOS.

Installing Zowe server-side components

Once the Wizard is installed, use the procedure as presented in the Wizard. The following steps outline the procedure and provide additional details.

1. On the landing page of the Zowe Server Installation Wizard, select from the two presented options:

- **New Zowe Installation**
  This option directs you to the Connection window. Provide details as presented in the following table: **Connecting the Wizard to z/OS**.
- **Zowe Installation Dry Run**
  This option allows you to follow the installation steps without running the installation.

Connecting the Wizard to z/OS

2. Set the following fields according to your environment:

Field name	Description
Host	Value for the target z/OS system for Zowe Installation. For example, `mainframe.yourcompany.com`
FTP Port	The FTP Port number for internal use. The default port is 21. If not specified, the Wizard uses the default port.
User Name	Your z/OS username.
Password	Your z/OS password.

3. Select **Use FTP with TLS**. This is the recommended option. Provide details as described in the following table:

Field name	Description
Min TLS	Select the minimum TLS version to accept the certificate from the server.
Max TLS	Select the maximum TLS version to accept the certificate from the server.

4. (Optional) You can select **Accept all certificates**. Note that selecting all certificiates disables certificate verification. Checking this option is not recommended.
5. Click **VALIDATE CREDENTIALS**.
6. Click **Continue**.
7. In the **Before you start** window, review the instructions. Customize the job statement, or use the default.
8. In the **Job statement** field, customize the job statement as necessary and click **SAVE AND VALIDATE**.

9. Further down the *Planning* page, provide details for z/OS Unix locations (including Node and Java), identifiers, and z/OSMF details.

Setting z/OSMF Attributes

Provide details for z/OSMF.

1. After specifying all the mandatory details, click **VALIDATE LOCATIONS**.

   You will see green check marks next to the Java Home Directory and Node.js Home Directory fields as confirmation that the locations are validated successfully.

2. Click **Continue to Installation Options**.

Choosing the Server Installation Type

1. In the **Installation Type** window, select one of the following three installation types in the Wizard:

   <details>
   <summary>Download Zowe convenience build PAX from internet</summary>

   Download the latest Zowe convenience build in .PAX format from zowe.org using the Wizard without visiting the website.

   i. Click **License Agreement**.
   ii. On the *End User License Agreement for Zowe* page, click **AGREE**.
   iii. In Download Zowe Pax, click **UNPAX** and **BEGIN DOWNLOAD**. Ensure that all statuses finish before continuing to the next step.
   </details>

   <details>
   <summary>Upload Zowe PAX for offline install</summary>

   Use this option to upload a local (already downloaded) Zowe .PAX file.

   i. Click **UPLOAD PAX**.
   ii. Select **downloaded PAX file**, and click **Open**.
   </details>

   <details>
   <summary>SMP/E</summary>

   Use this option to install Zowe through a SMP/E build outside the wizard.

   i. Provide the location of the Runtime Directory.
   ii. Click **VALIDATE LOCATION**.
   Note: When using SMP/E installation, in the Initialization window, under the **Installation** tab, confirm the dataset names used during installation.
   </details>

iii. Click **Save**.

2. Click **Continue to Component Installation**.

Configuring the Zowe Server

Perform Zowe server configuration in the Wizard by providing inputs to the prompts for configuration values. Some steps may require an administrator with sufficient privileges to complete the step.

The following actions can be performed during Wizard configuration:

- **View/Edit Yaml**
  This option lets you preview or adjust the YAML configuration that is used by Zowe. The prompts of the Wizard are used to automatically generate the YAML contents, but you also have the options to review, edit, or import and export contents of the YAML file. This option also allows you to copy the YAML in its current state, which can than be sent to an administrator that is authorized to perform the task. Copying the YAML also includes a relevant JCL sample and explanation for the particular step.

- **View Job Output**
  This option presents the results of the jobs that were submitted. Details are provided if a job fails or returns a warning. This option allows you to collect the job content which can be provide to an administrator without submitting it. Each value entered is validated against the schema.

- **Skip**
  This option makes it possible to skip an installation step that you cannot perform such as an administrative security action that you cannot perform yourself. This option makes it possible to complete an action external to the Wizard.

The following table presents the steps in the installation, detailed descriptions of the steps, and corresponding sample JCLs:

Install Wizard Initalization Step	Description	Sample JCL
Installation	**Purpose:** Create datasets for Zowe's PARMLIB content and non-ZFS extension content for a given Zowe Instance **Action:** 1. Allocate the PDSE FB80 dataset with at least 15 tracks named from Zowe parameter `zowe.setup.dataset.parmlib` 2. Allocate the PDSE FB80 dataset with at least 30 tracks named from Zowe parameter `zowe.setup.dataset.authPluginLib` 3. Copy the ZWESIP00 member from `zowe.setup.dataset.prefix`.SZWESAMP into `zowe.setup.dataset.parmlib`	ZWEIMVS

Install Wizard Initalization Step	Description	Sample JCL
APF Auth	**Purpose:** Zowe contains one privileged component, ZIS, which enables the security model. The majority of Zowe is unprivileged and in key 8. The load library for the ZIS component and its extension library must be set as APF authorized and run in key 4. This enables ZIS and components that depend on ZIS. **Action:** 1. APF authorize the datasets defined at `zowe.setup.dataset.authLoadlib` and `zowe.setup.dataset.authPluginLib`. 2. Define PPT entries for the members ZWESIS01 and ZWESAUX as Key 4, NOSWAP in the SCHEDxx member of the system PARMLIB.	ZWEIAPF
Security	**Purpose:** The STC accounts for Zowe need permissions for operating servers, and users need permissions for interacting with the servers. **Action:** Set SAF permissions for accounts	RACF: ZWEIRAC TSS: ZWEITSS ACF2: ZWEIACF
Security	(z/OS v2.4 ONLY) Create Zowe SAF Resource Class	This is not needed on z/OS v2.5+. On z/OS v2.4, the SAF resource class for Zowe is not included, and must be created. See these samples for examples: RACF: ZWEIRACZ TSS: ZWEITSSZ ACF2: ZWEIACFZ
Certificates Option 1	Zowe creates a keyring and populates it with a newly generated certificate and certificate authority. The certificate would be seen as "self-signed" by clients unless import of the CA to clients is performed.	RACF: ZWEIKRR1 TSS: ZWEIKRT1 ACF2: ZWEIKRA1
Certificates Option 2	Zowe creates a keyring and populates the keyring by connecting pre-existing certificates and CAs that you specify.	RACF: ZWEIKRR2 TSS: ZWEIKRT2

Install Wizard Initalization Step	Description	Sample JCL
		ACF2: ZWEIKRA2
Certificates Option 3	Zowe creates a keyring and populates the keyring by importing PKCS12 content from a dataset that you specify.	RACF: ZWEIKRR3 TSS: ZWEIKRT3 ACF2: ZWEIKRA3
STC	**Purpose**: ZWESLSTC is the job for running Zowe's webservers. ZWESISTC runs the APF authorized cross-memory server. The ZWESASTC job is started by ZWESISTC on an as-needed basis. **Action**: Copy the members ZWESLSTC, ZWESISTC, and ZWESASTC into your desired PROCLIB. If the job names are customized, modify the job name YAML values in `zowe.setup.security.stcs`	ZWEISTC
(Optional) VSAM for Caching Service (NYI)	**Purpose:** To use VSAM as your storage method for the Caching Service. Note that Infinispan is the recommended storage method. For more information, see Using VSAM as a storage solution through the Caching service. **Action:** Create a RLM or NONRLM dataset for the Caching service, and set the name as the value for `components.caching-service.storage.vsam.name`	ZWECSVSM

Final Review

After completing the steps presented in the Wizard, a summary is provided indicating which steps were completed, skipped, or have errors. Errors are stored and can be reviewed in **View Job Output**. You can revisit any step to retry performing the step. You also have the option to export the final generated YAML file.

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Troubleshooting Zowe Server Install Wizard

As a user of the Zowe Server Install Wizard, you may encounter problems during installation of the Wizard. This article presents known Zowe Server Install Wizard issues and their solutions.

Failure to establish a TLS connection

When attempting to establish a TLS connection, you may encounter the following message:

If you receive this message, go back to the *Connection* page and attempt to re-establish the connection. If the connection cannot be established, restart the Wizard.

Unable to continue with Wizard installation

If you encounter strange behavior that prohibits you from continuing with Wizard installation, we recommend you follow this procedure:

1. View the Job output within the Wizard.
2. If the error is not clear from the Job output, view the output of the log file according to your platform:

   For Windows

   `%USERPROFILE%\AppData\Roaming{app name}\logs\main.log`

   For macOS

   `~/Library/Logs/{app name}/main.log`

   For Linux

   `~/.config/{app name}/logs/main.log`

If you are still unsure how to proceed, you can optionally make a backup of these log files, and then use the following procedure to remove the Wizard's cache.

1. Close the Wizard.
2. Follow the steps according to your operating system:

   For Windows

i. Open File Explorer. In the address bar type `%APPDATA%`. This takes you to the directory where your app data is stored. The typical directory path is `C:\Users[Your User Name]\AppData\Roaming`.

ii. Locate the folder corresponding to `zowe-install-wizard`.

For macOS

i. Open Finder. In the menu bar select **Go > Go to Folder**.

ii. Type `~/Library/Application Support/` and press **Enter**.

iii. Locate the folder corresponding to `zowe-install-wizard`

For Linux

i. Open a terminal or file manager.

ii. Navigate to `~/.config/`, which is where most apps store their configuration data.

iii. In the terminal, enter the following command: `cd ~/.config/`.

iv. Locate the folder corresponding to `zowe-install-wizard`.

3. Delete this folder to remove all stored data.

4. Restart the Wizard.

Unable to save setting to zowe.yaml via the Wizard's UI or editor

The accurate updating & saving to `YAML` in the UI may not always work as intended. If you have issues saving a specific setting to the `Zowe configuration YAML` via the Wizard's UI or editor (or an advanced setting is not available to be edited), it is recommended to make a manual edit to the configuration `YAML` file in `z/OS Unix` & then proceed with the Wizard as intended.

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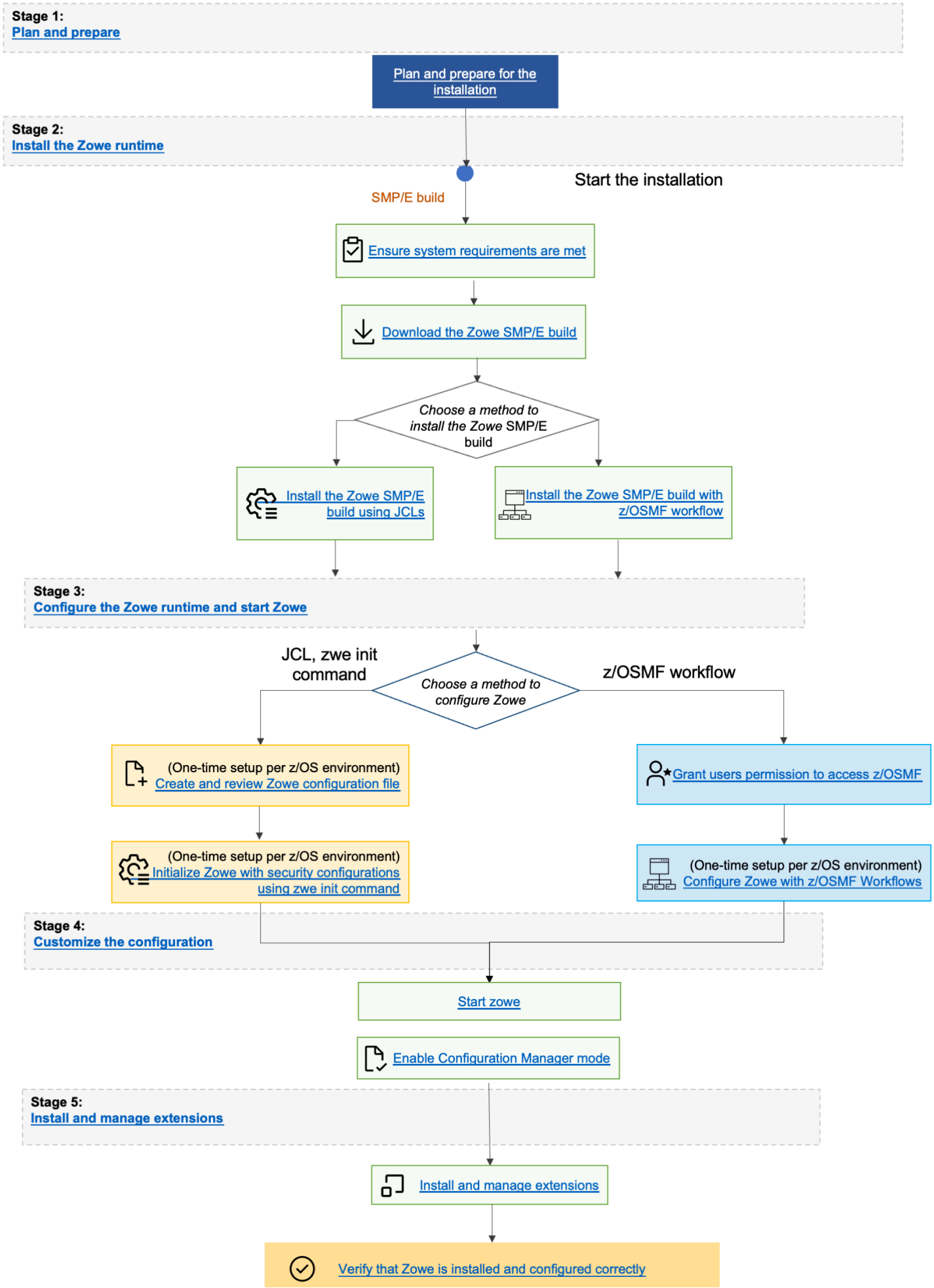
Installing Zowe SMP/E overview

This program directory is intended for system programmers who are responsible for program installation and maintenance. It contains information about the material and procedures associated with the installation of Zowe Open Source Project (Base). This publication refers to Zowe Open Source Project (Base) as Zowe.

End-to-end installation diagram


Stage 1:
Plan and prepare
Plan and prepare for the installation
Stage 2:
Install the Zowe runtime
Start the installation
SMP/E build
Ensure system requirements are met
Download the Zowe SMP/E build
Choose a method to install the Zowe SMP/E build
Install the Zowe SMP/E build using JCLs
Install the Zowe SMP/E build with z/OSMF workflow
Stage 3:
Configure the Zowe runtime and start Zowe
JCL, zwe init command
Choose a method to configure Zowe
z/OSMF workflow
(One-time setup per z/OS environment)
Create and review Zowe configuration file
Grant users permission to access z/OSMF
(One-time setup per z/OS environment)
Initialize Zowe with security configurations using zwe init command
(One-time setup per z/OS environment)
Configure Zowe with z/OSMF Workflows
Stage 4:
Customize the configuration
Start zowe
Enable Configuration Manager mode
Stage 5:
Install and manage extensions
Install and manage extensions
Verify that Zowe is installed and configured correctly

Zowe FMIDs

Zowe consists of the following FMIDs:

- AZWE003

Program materials

Basic Machine-Readable Materials are materials that are supplied under the base license and are required for the use of the product.

Basic machine-readable material

The distribution medium for this program is via downloadable files. This program is in SMP/E RELFILE format and is installed using SMP/E. See Installation instructions for more information about how to install the program.

Program source materials

No program source materials or viewable program listings are provided for Zowe in the SMP/E installation package. However, program source materials can be downloaded from the Zowe GitHub repositories at https://github.com/zowe/.

Publications useful during installation

Publications listed below are helpful during the installation of Zowe.

Publication Title	Form Number
IBM SMP/E for z/OS User's Guide	SA23-2277
IBM SMP/E for z/OS Commands	SA23-2275
IBM SMP/E for z/OS Reference	SA23-2276
IBM SMP/E for z/OS Messages, Codes, and Diagnosis	GA32-0883

These and other publications can be obtained from IBM Publications Center.

Program support

This section describes the support available for Zowe.

Support is available through the Zowe community and Zowe Conformant Support Providers. See Zowe Support Overview for details. Slack is the preferred interaction channel.

Additional support may be available through other entities outside of the Open Mainframe Project and Linux Foundation which offers no warranty and provides the package under the terms of the EPL v2.0 license.

Statement of support procedures

Report any problems which you feel might be an error in the product materials to the Zowe community via the Zowe GitHub community repo at https://github.com/zowe/community/issues/new/choose. You may be asked to gather and submit additional diagnostics to assist the Zowe Community for analysis and resolution.

Program and service level information

This section identifies the program and relevant service levels of Zowe. The program level refers to the APAR fixes that have been incorporated into the program. The service level refers to the PTFs that have been incorporated into the program.

Program level information

All issues of previous releases of Zowe that were resolved before October 2024 have been incorporated into this packaging of Zowe.

Service level information

The Zowe SMP/E package is a distribution of Zowe version 3.0.0 with an FMID of AZWE003.

Subsequent releases of the Zowe z/OS components are delivered as rollup PTFs on zowe.org.

Installation requirements and considerations

The following sections identify the system requirements for installing and activating Zowe. The following terminology is used:

- *Driving System:* the system on which SMP/E is executed to install the program.
- *Target system:* the system on which the program is configured and run.

Use separate driving and target systems in the following situations:

- When you install a new level of a product that is already installed, the new level of the product will replace the old one. By installing the new level onto a separate target system, you can test the new level and keep the old one in production at the same time.
- When you install a product that shares libraries or load modules with other products, the installation can disrupt the other products. By installing the product onto a separate target system, you can assess these impacts without disrupting your production system.

Driving system requirements

This section describes the environment of the driving system required to install Zowe.

Driving system machine requirements

The driving system can be run in any hardware environment that supports the required software.

Driving system programming requirements

Program Number	Product Name	Minimum VRM	Minimum Service Level will satisfy these APARs	Included in the shipped product?
5650-ZOS	z/OS	V2.5.0 or later	N/A	No

NOTES:

- SMP/E is a requirement for Installation and is an element of z/OS but can also be ordered as a separate product, 5655-G44, minimally V03.06.00.
- Installation might require migration to a new z/OS release to be service supported. See https://www.ibm.com/support/pages/lifecycle/.

Zowe is installed into a file system, either HFS or zFS. Before installing Zowe, you must ensure that the target system file system data sets are available for processing on the driving system. OMVS must be active on the driving system and the target system file data sets must be mounted on the driving system.

Zowe is installed into a zFS file system. Before installing Zowe, you must ensure that the target system file system data sets are available for processing on the driving system. OMVS must be active on the driving system and the target system file data sets must be mounted on the driving system.

Target system requirements

This section describes the environment of the target system required to install and use Zowe.

Zowe installs in the z/OS (Z038) SREL.

Target system machine requirements

The target system can run in any hardware environment that supports the required software.

Target system programming requirements

Installation requisites

Installation requisites identify products that are required and must be present on the system or products that are not required but should be present on the system for the successful installation of Zowe.

Mandatory installation requisites identify products that are required on the system for the successful installation of Zowe. These products are specified as PREs or REQs.

Zowe has no mandatory installation requisites.

Conditional installation requisites identify products that are not required for successful installation of Zowe but can resolve such things as certain warning messages at installation time. These products are specified as IF REQs.

Zowe has no conditional installation requisites.

Operational requisites

Operational requisites are products that are required and must be present on the system, or, products that are not required but should be present on the system for Zowe to operate all or part of its functions.

Mandatory operational requisites identify products that are required for this product to operate its basic functions. The following table lists the target system mandatory operational requisites for Zowe.

Program Number	Product Name and Minimum VRM/Service Level
5650-ZOS	IBM z/OS Management Facility V2.5.0 or higher
5655-NOS	IBM Open Enterprise SDK for Node.js 20.0
5655-UA1	IBM Semeru Runtime Certified Edition for z/OS 17.0.0

NOTES:

- The minimum product version is either what is listed in the table, or the currently minimum supported version, whichever is the most recent.
- The pre-requistes for Node.js itself are not required, nor is any configuration of Node.js required. The only requirement is the presence of the Node.js executable code.

Conditional operational requisites identify products that are not required for Zowe to operate its basic functions but are required at run time for Zowe to operate specific functions. These products are specified as IF REQs. Zowe has no conditional operational requisites.

Toleration/coexistence requisites

Toleration/coexistence requisites identify products that must be present on sharing systems. These systems can be other systems in a multi-system environment (not necessarily Parallel Sysplex™), a shared DASD environment (such as test and production), or systems that reuse the same DASD environment at different time intervals.

Zowe has no toleration/coexistence requisites.

Incompatibility (negative) requisites

Negative requisites identify products that must *not* be installed on the same system as Zowe.

Zowe has no negative requisites.

DASD storage requirements

Zowe libraries can reside on all supported DASD types.

Total DASD space required by Zowe

Library Type	Total Space Required in 3390 Trks	Description
Target	300 Tracks	/

Library Type	Total Space Required in 3390 Trks	Description
Distribution	13165 Tracks	/
File System(s)	27900 Tracks	/
Web Download	45810 Tracks	These are temporary data sets, which can be removed after the SMP/E install.

Notes:

1. For non-RECFM U data sets, we recommend using system-determined block sizes for efficient DASD utilization. For RECFM U data sets, we recommend using a block size of 32760, which is most efficient from the performance and DASD utilization perspective.

2. Abbreviations used for data set types are shown as follows.

   - **U** - Unique data set, allocated by this product and used by only this product. This table provides all the required information to determine the correct storage for this data set. You do not need to refer to other tables or program directories for the data set size.
   - **S** - Shared data set, allocated by this product and used by this product and other products. To determine the correct storage needed for this data set, add the storage size given in this table to those given in other tables (perhaps in other program directories). If the data set already exists, it must have enough free space to accommodate the storage size given in this table.
   - **E** - Existing shared data set, used by this product and other products. This data set is not allocated by this product. To determine the correct storage for this data set, add the storage size given in this table to those given in other tables (perhaps in other program directories). If the data set already exists, it must have enough free space to accommodate the storage size given in this table.

   If you currently have a previous release of Zowe installed in these libraries, the installation of this release will delete the old release and reclaim the space that was used by the old release and any service that had been installed. You can determine whether these libraries have enough space by deleting the old release with a dummy function, compressing the libraries, and comparing the space requirements with the free space in the libraries.

   For more information about the names and sizes of the required data sets, see Allocate SMP/E target and distribution libraries.

3. Abbreviations used for the file system path type are as follows.

   - **N** - New path, created by this product.
   - **X** - Path created by this product, but might already exist from a previous release.
   - **P** - Previously existing path, created by another product.

4. All target and distribution libraries listed have the following attributes:

   - The default name of the data set can be changed.
   - The default block size of the data set can be changed.
   - The data set can be merged with another data set that has equivalent characteristics.

- The data set can be either a PDS or a PDSE, with some exceptions. If the value in the "ORG" column specifies "PDS", the data set must be a PDS. If the value in "DIR Blks" column specifies "N/A", the data set must be a PDSE.

5. All target libraries listed have the following attributes:

   - These data sets can be SMS-managed, but they are not required to be SMS-managed.
   - These data sets are not required to reside on the IPL volume.
   - The values in the "Member Type" column are not necessarily the actual SMP/E element types that are identified in the SMPMCS.

6. All target libraries that are listed and contain load modules have the following attributes:

   - These data sets cannot be in the LPA, with some exceptions. If the value in the "Member Type" column specifies "LPA", it is advised to place the data set in the LPA.
   - These data sets can be in the LNKLST.
   - These data sets are not required to be APF-authorized, with some exceptions. If the value in the "Member Type" column specifies "APF", the data set must be APF-authorized.

Storage requirements for SMP/E work data sets

Library DDNAME	TYPE	ORG	RECFM	LRECL	No. of 3390 Trks	No. of DIR Blks
SMPWRK6	S	PDS	FB	80	(5250,525)	50
SYSUT1	U	SEQ	--	--	(5250,525)	0

In the table above, (20,200) specifies a primary allocation of 20 tracks, and a secondary allocation of 200 tracks.

Storage requirements for SMP/E data sets

Library DDNAME	TYPE	ORG	RECFM	LRECL	No. of 3390 Trks	No. of DIR Blks
SMPPTS	S	PDSE	FB	80	(12000,3000)	50

The following figures describe the target and distribution libraries and file system paths required to install Zowe. The storage requirements of Zowe must be added to the storage required by other programs that have data in the same library or path.

> **NOTE**
>
> Use the data in these tables to determine which libraries can be merged into common data sets. In addition, since some ALIAS names may not be unique, ensure that no naming conflicts will be introduced before merging libraries.

Storage requirements for Zowe target libraries

Review the list of Zowe's runtime datasets in the Server Dataset Appendix.

Zowe file system paths

DDNAME	TYPE	Path Name
SZWEZFS	X	/usr/lpp/zowe/SMPE

Storage requirements for Zowe distribution libraries

Library DDNAME	TYPE	ORG	RECFM	LRECL	No. of 3390 Trks	No. of DIR Blks
AZWEAUTH	U	PDSE	U	0	240	N/A
AZWESAMP	U	PDSE	FB	80	25	5
AZWEZFS	U	PDSE	VB	6995	12900	30

Storage requirements for Zowe SMP/E input libraries

The following figures list data sets that are not used by Zowe, but are required as input for SMP/E.

Data Set Name	TYPE	ORG	RECFM	LRECL	No. of 3390 Trks	No. of DIR Blks
hlq.ZOWE.AZWE003.F1	U	PDSE	FB	80	9	N/A
hlq.ZOWE.AZWE003.F2	U	PDSE	FB	80	28	N/A
hlq.ZOWE.AZWE003.F3	U	PDSE	U	0	275	N/A
hlq.ZOWE.AZWE003.F4	U	PDSE	VB	6995	14100	N/A
hlq.ZOWE.AZWE003.SMPMCS	U	SEQ	FB	80	3	N/A
z/OS UNIX file system	U	zFS	N/A	N/A	31395	N/A

> **NOTE**
>
> These are temporary data sets, which can be removed after the SMP/E installation.

FMIDs deleted

Installing Zowe might result in the deletion of other FMIDs.

To see which FMIDs will be deleted, examine the `++VER` statement in the SMPMCS of the product. If you do not want to delete these FMIDs now, install Zowe into separate SMP/E target and distribution zones.

> **NOTE**
>
> These FMIDs are not automatically deleted from the Global Zone. If you want to delete these FMIDs from the Global Zone, use the SMP/E REJECT NOFMID DELETEFMID command. See the SMP/E Commands book for details.

Special considerations

Zowe has no special considerations for the target system.

For details about installing Zowe SMP/E, see Installing Zowe via SMP/E instructions.

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Installing Zowe via SMP/E instructions

Review this article and the procedures to install and activate the functions of Zowe server-side components using SMP/E.

REQUIRED ROLES: SYSTEM PROGRAMMER

NOTES:

- To install Zowe into its own SMP/E environment, consult the SMP/E manuals for instructions on creating and initializing the SMPCSI and SMP/E control data sets.
- You can use the sample jobs that are provided to perform part or all of the installation tasks. The SMP/E jobs assume that all DDDEF entries that are required for SMP/E execution have been defined in appropriate zones.
- You can use the SMP/E dialogs instead of the sample jobs to accomplish the SMP/E installation steps.

TIP

You can now perform Zowe installation via the Zowe Server Install Wizard. Using the wizard streamlines the installation process and is an alternative to performing manual Zowe server-side component installation. For more information about the wizard, see Installing Zowe via Zowe Server Install Wizard.

SMP/E considerations for installing Zowe

Use the SMP/E **RECEIVE**, **APPLY**, and **ACCEPT** commands to install this release of Zowe.

SMP/E options subentry values

The recommended values for certain SMP/E CSI subentries are shown in the following table. Using values lower than the recommended values can result in failures in the installation. `DSSPACE` is a subentry in the GLOBAL options entry. `PEMAX` is a subentry of the GENERAL entry in the GLOBAL options entry. See the SMP/E manuals for instructions on updating the global zone.

Subentry	Value	Comment
DSSPACE	(1200,1200,1400)	Space allocation
PEMAX	SMP/E Default	IBM recommends using the SMP/E default for PEMAX.

Overview of the installation steps

Follow these high-level steps to download and install Zowe Open Source Project (Base).

1. Download and unzip the Zowe SMP/E package.
2. Allocate the file system to hold the download package.
3. Upload the download package to the host

4. Extract and expand the compress SMPMCS and RELFILEs
5. Customize sample installation jobs
6. Create SMP/E environment (optional)
7. Perform SMP/E RECEIVE
8. Allocate SMP/E target and distribution libraries
9. Allocate, create and mount ZSF files (Optional)
10. Allocate z/OS UNIX paths
11. Create DDDEF Entries
12. Perform SMP/E APPLY
13. Perform SMP/E ACCEPT
14. Run REPORT CROSSZONE
15. Cleaning up obsolete data sets, paths, and DDDEFs

Download and unzip the Zowe SMP/E package

To download the Zowe SMP/E package, open your web browser and go to the Zowe Download website. Click the option **Zowe SMP/E FMID AZWE003** to save the file to a folder on your desktop.

A ZIP package is sent to your desktop. Extract the following files from the package. You may need to use the `unzip` command at a terminal rather than an unzip utility. For example, run `unzip zowe-smpe-package-3.0.0.zip` in your terminal.

- **AZWE003.pax.Z (binary)**

  The SMP/E input data sets to install Zowe are provided as compressed files in AZWE003.pax.Z. This pax archive file holds the SMP/E MCS and RELFILEs.

- **AZWE003.readme.txt (text)**

  The README file AZWE003.readme.txt is a single JCL file containing a job with the job steps you need to begin the installation, including comprehensive comments on how to tailor them. There is a sample job step that executes the z/OS UNIX System Services pax command to extract package archives. This job also executes the GIMUNZIP program to expand the package archives so that the data sets can be processed by SMP/E.

- **AZWE003.htm (text)**

  The Program Directory for the Zowe Open Source Project.

Allocate the file system to hold the download package

You can either create a new z/OS UNIX file system (zFS) or create a new directory in an existing file system to place AZWE003.pax.Z. The directory that will contain the download package must reside on the z/OS system where the function will be installed.

To create a new file system, and directory, for the download package, you can use the following sample JCL (FILESYS).

Copy and paste the sample JCL into a separate data set, uncomment the job, and modify the job to update required parameters before submitting the job.

EXPECTED RESULTS

You will receive a return code of `0` if this job runs correctly.

Upload the download package to the host

Upload the `AZWE003.readme.txt` file in text format and the `AZWE003.pax.Z` file in binary format from your workstation to the z/OS UNIX file system. The instructions in this section are also in the `AZWE003.readme.txt` file that you downloaded.

IMPORTANT

Ensure you download the pax file in a different file system than where you put Zowe runtime.

There are many ways to transfer the files or make these files available to the z/OS system where the package will be installed. The following sample dialog uses FTP from a Microsoft Windows command line to perform the transfer. This method is applicable when the z/OS host is configured as an FTP host/server and the workstation is an FTP client. Commands or other customizations entered by the user are in bold, and the following values are assumed.

NOTE

If you are not sure which protocol or port to use to transfer the files, or for other access requirements, consult with your network administrator.

User enters:	Values
mvsaddr	TCP/IP address or hostname of the z/OS system
tsouid	Your TSO user ID
tsopw	Your TSO password
d:	Location of the downloaded files
@zfs_path@	z/OS UNIX path where to store the files. This matches the @zfs_path@ variable you specified in the previous step.

IMPORTANT

The `AZWE003.pax.Z` file must be uploaded to the z/OS driving system in binary format. Not using binary format causes the subsequent UNPAX step to fail.

NOTE

This file tranfer can take a long time to run, depending on the capacity of your system, and on what other jobs are running.

Sample FTP upload scenario:

> **TIP**
>
> If you are unable to connect with ftp and only able to use sftp, use *sftp* at the command prompt instead of *ftp*
>
> As *sftp* only supports binary file transfer, the ***ascii*** and ***binary*** commands should be omitted. After you transfer the `AZWE003.readme.txt` file, this file will be in an ASCII codepage so you need to convert the file to `EBCDIC` before it can be used. To convert `AZWE003.readme.txt` to `EBCDIC`, log in to the distribution system using ssh and run the **ICONV** command.

Extract and expand the compressed SMPMCS and RELFILEs

The `AZWE003.readme.txt` file uploaded in the previous step holds a sample JCL to expand the compressed SMPMCS and RELFILEs from the uploaded `AZWE003.pax.Z` file into data sets for use by the SMP/E RECEIVE job. The JCL is repeated here for your convenience.

- *@zfs_path@* matches the variable that you specified in the previous step.
- If the `oshell` command gets a RC=256 and message "pax: checksum error on tape (got ee2e, expected 0)", then the archive file was not uploaded to the host in binary format.
- GIMUNZIP allocates data sets to match the definitions of the original data sets. You might encounter errors if your SMS ACS routines alter the attributes used by GIMUNZIP. If this occurs, specify a non-SMS managed volume for the GINUMZIP allocation of the data sets. For example:
- Normally, your Automatic Class Selection (ACS) routines decide which volumes to use. Depending on your ACS configuration, and whether your system has constraints on disk space, units, or volumes, some supplied SMP/E jobs might fail due to volume allocation errors. See GIMUNZIP for more details.

GIMUNZIP

The GIMUNZIP job may issue allocation error messages for SYSUT1 similar to these:

The job will end with RC=12. If this happens, add a TEMPDS control statement to the existing SYSIN as shown below:

- **&VOLSER**
  Specifies the DISK volume with sufficient free space to hold temporary copies of the RELFILES. As a guide, this may require 1,000 cylinders, or approximately 650 MB.

Customize sample installation jobs

The following sample installation jobs are provided in `hlq.ZOWE.AZWE003.F1`, or equivalent, as part of the project to help you install Zowe:

Job Name	Job Type	Description	RELFILE
ZWE1SMPE	SMP/E	(Optional) Sample job to create an SMP/E environment	ZOWE.AZWE003.F1
ZWE2RCVE	RECEIVE	Sample SMP/E RECEIVE job	ZOWE.AZWE003.F1

Job Name	Job Type	Description	RELFILE
ZWE3ALOC	ALLOCATE	Sample job to allocate target and distribution libraries	ZOWE.AZWE003.F1
ZWE4ZFS	ALLOMZFS	(Optional) Sample job to allocate, create mountpoint, and mount zFS data sets	ZOWE.AZWE003.F1
ZWE5MKD	MKDIR	Sample job to invoke the supplied ZWEMKDIR EXEC to allocate file system paths	ZOWE.AZWE003.F1
ZWE6DDEF	DDDEF	Sample job to define SMP/E DDDEFs	ZOWE.AZWE003.F1
ZWE7APLY	APPLY	Sample SMP/E APPLY job	ZOWE.AZWE003.F1
ZWE8ACPT	ACCEPT	Sample SMP/E ACCEPT job	ZOWE.AZWE003.F1

> **NOTE**
>
> When Zowe is downloaded from the web, the RELFILE data set name is prefixed by your chosen high-level qualifier, as documented in the Extract and expand the compressed SMPMCS and RELFILEs section.

Follow these steps to access the sample installation jobs.

1. Performing an SMP/E RECEIVE. See Perform SMP/E RECEIVE.
2. Copy the jobs from the RELFILES to a working data set for editing and submission.

Alteratively, you can copy the sample installation jobs from the product files by submitting the job in the following example.

Before you submit the job, add a job statement and change the lowercase parameters to uppercase values to meet the requirements of your site.

Example:

Customize the statements is this job statement with the following values:

- IN:
  - **filevol**
    Specifies the volume serial of the DASD device where the downloaded files reside.
- OUT:
  - **jcl-library-name**
    Specifies the name of the output data set where the sample jobs are stored.
  - **dasdvol**
    Specifies the volume serial of the DASD device where the output data set resides. Uncomment the statement is a volume serial must be provided.

The following supplied jobs might fail due to disk space allocation errors for GIMUNZIP. Review the following sections for example error and actions that you can take to resolve the error.

- ZWE2RCVE
- ZWE1SMPE and ZWE4ZFS
- ZWEMKDIR, ZWE1SMPE, ZWE2RCVE, ZWE3ALOC, ZWE4ZFS and ZWE5MKD

ZWE2RCVE

Add space and directory allocations to this `SMPCNTL` statement in the preceding ZWE1SMPE job:

Result:

ZWE1SMPE and ZWE4ZFS

Example error:

Action
Uncomment the `VOLUMES(...)` control statements and refer to the comments at the start of the JCL job for related necessary changes.

ZWEMKDIR, ZWE1SMPE, ZWE2RCVE, ZWE3ALOC, ZWE4ZFS and ZWE5MKD

Example error:

Action
Uncomment the `VOL=SER=&...` control statements and refer to the comments at the start of the JCL job for related necessary changes.

Create SMP/E environment (Optional)

A sample job ZWE1SMPE is provided or you may choose to use your own JCL. If you are using an existing CSI, do not run the sample job ZWE1SMPE. If you choose to use the sample job provided, edit and submit ZWE1SMPE. Consult the instructions in the sample job for more information.

> **NOTE**
>
> To use the default of letting your Automatic Class Selection (ACS) routines decide which volume to use, comment out the following line in the sample job `ZWE1SMPE`.
>
> `// SET CSIVOL=#csivol`

> **EXPECTED RESULTS**
>
> You will receive a return code of `0` if this job runs correctly.

Perform SMP/E RECEIVE

Edit and submit sample job ZWE2RCVE to perform the SMP/E RECEIVE for Zowe. Consult the instructions in the sample job for more information.

EXPECTED RESULTS

You will receive a return code of 0 if this job runs correctly.

Allocate SMP/E target and distributions libraries

Edit and submit sample job ZWE3ALOC to allocate the SMP/E target and distribution libraries for Zowe. Consult the instructions in the sample job for more information.

EXPECTED RESULTS

You will receive a return code of `0` if this job runs correctly.

Allocate, create and mount ZSF files (Optional)

This job allocates, creates a mountpoint, and mounts zFS data sets.

If you plan to install Zowe into a new z/OS UNIX file system, you can edit and submit the optional ZWE4ZFS job to perform the following tasks. Consult the instructions in the sample job for more information.

- Create the z/OS UNIX file system
- Create a mountpoint
- Mount the z/OS UNIX file system on the mountpoint

The recommended z/OS UNIX file system type is zFS. The recommended mountpoint is `_/usr/lpp/zowe`._

Before running the sample job to create the z/OS UNIX file system, ensure that OMVS is active on the driving system. zFS must be active on the driving system if you are installing Zowe into a file system that is zFS.

If you create a new file system for this product, consider updating the BPXPRMxx PARMLIB member to mount the new file system at IPL time. This action can be helpful if an IPL occurs before the installation is completed.

Customize the statements is this job statement with the following values:

- **#dsn**
  Specifies the name of the data set holding the z/OS UNIX file system.
- ***/usr/lpp/zowe***
  Specifies the name of the mountpoint where the z/OS UNIX file system will be mounted.

EXPECTED RESULTS

You will receive a return code of `0` if this job runs correctly.

Allocate z/OS UNIX paths

The target system HFS or zFS data set must be mounted on the driving system when running the sample ZWE5MKD job since the job will create paths in the HFS or zFS.

Before running the sample job to create the paths in the file system, ensure that OMVS is active on the driving system and that the target system's HFS, or zFS file system is mounted on the driving system. zFS must be active on the driving system if you are installing Zowe into a file system that is zFS.

If you plan to install Zowe into a new HFS or zFS file system, you must create the mountpoint and mount the new file system on the driving system for Zowe.

The recommended mountpoint is `/usr/lpp/zowe.`

Edit and submit sample job ZWE5MKD to allocate the HFS or zFS paths for Zowe. Consult the instructions in the sample job for more information.

If you create a new file system for this product, consider updating the BPXPRMxx PARMLIB member to mount the new file system at IPL time. This action can be helpful if an IPL occurs before the installation is completed.

> **EXPECTED RESULTS**
>
> You will receive a return code of 0 if this job runs correctly.

Create DDDEF entries

Edit and submit sample job ZWE6DDEF to create DDDEF entries for the SMP/E target and distribution libraries for Zowe. Consult the instructions in the sample job for more information.

> **EXPECTED RESULTS**
>
> You will receive a return code of `0` if this job runs correctly.

Perform SMP/E APPLY

In this step, you run the sample job ZWE7APLY to apply Zowe. This step can take a long time to run, depending on the capacity of your system, and on what other jobs are running.

Follow these steps

1. Ensure that you have the latest HOLDDATA; then edit and submit sample job ZWE7APLY to perform an SMP/E APPLY CHECK for Zowe. Consult the instructions in the sample job for more information.

The latest HOLDDATA is available through several different portals, and may identify HIPER and FIXCAT APARs for the FMIDs you will be installing. Use the **APPLY CHECK** command to assist you to determine whether any HIPER or FIXCAT APARs are applicable to the FMIDs you are installing.

If there are any applicable HIPER of FIXCAT APARs, the **APPLY CHECK** also identifies fixing PTFs that will resolve the APARs, if a fixing PTF is available.

You should install the FMIDs regardless of the status of unresolved HIPER or FIXCAT APARs. However, do not deploy the software until the unresolved HIPER and FIXCAT APARs have been analyzed to determine their applicability. Before deploying the software either ensure fixing PTFs are applied to resolve all HIPER or FIXCAT APARs, or ensure the problems reported by all HIPER or FIXCAT APARs are not applicable to your environment.

> **TIP**
>
> To receive the full benefit of the SMP/E Causer SYSMOD Summary Report, do *not* bypass the PRE, ID, REQ, and IFREQ on the APPLY CHECK. The SMP/E root cause analysis identifies the cause only of *errors* and not of *warnings* (SMP/E treats bypassed PRE, ID, REQ, and IFREQ conditions as warnings, instead of errors).

Sample APPLY commands

Review the following sample **APPLY** commands:

- **APPLY CHECK**
  To ensure that all recommended and critical services are installed with the FMIDs, receive the latest HOLDDATA and use the **APPLY CHECK**.

Example:

> **NOTE**
>
> - Some HIPER APARs might not have fixing PTFs available yet. You should analyze the symptom flags for the unresolved HIPER APARs to determine if the reported problem is applicable to your environment and if you should bypass the specific ERROR HOLDs in order to continue the installation of the FMIDs.
> - This method requires more initial research, but can provide resolution for all HPERs that have fixing PTFs available and not in a PE chain. Unresolved PEs or HIPERs might still exist and require the use of BYPASS.

- **APPLY CHECK with operand**
  To install the FMIDs without regard for unresolved HIPER APARs, add the `BYPASS(HOLDCLASS(HIPER))` operand to the **APPLY CHECK** command. Using this command and operand enables you to install FMIDs, even though one or more unresolved HIPER APARs exist. After the FMIDs are installed, use the SMP/E **REPORT ERRSYSMODS** command to identify unresolved HIPER APARs and any fixing PTFs.

> **NOTES:**
>
> - This method is quicker, but requires subsequent review of the Exception SYSMOD report produced by the REPORT ERRSYSMODS command to investigate any unresolved HIPERs. If you have received the latest HOLDDATA, you can also choose to use the REPORT MISSINGFIX command and specify Fix Category IBM.PRODUCTINSTALL-REQUIREDSERVICE to investigate missing recommended service.
> - If you bypass HOLDs during the installation of the FMIDs because fixing PTFs are not yet available, you can be notified when the fixing PTFs are available by using the APAR Status Tracking (AST) function of the ServiceLink or the APAR Tracking function of Resource Link.

2. After you take actions that are indicated by the **APPLY CHECK**, remove the `CHECK` operand and run the job again to perform the APPLY.

> **NOTE**
>
> The GROUPEXTENDED operand indicates the SMP/E applies all requisite SYSMODs. The requisite SYSMODS might be applicable to other functions.

> **TIP**

- Expected results from **APPLY CHECK** You will receive a return code of `0` if this job runs correctly.
- Expected results from **APPLY** You will receive a return code of `0` if the job runs correctly.

Perform SMP/E ACCEPT

Edit and submit sample job ZWE8ACPT to perform an SMP/E ACCEPT CHECK for Zowe. Consult the instructions in the sample job for more information.

To receive the full benefit of the SMP/E Causer SYSMOD Summary Report, do not bypass the PRE, ID, REQ, and IFREQ on the ACCEPT CHECK. The SMP/E root cause analysis identifies the cause of errors but not warnings (SMP/E treats bypassed PRE, ID, REQ, and IFREQ conditions as warnings rather than errors).

Before you use SMP/E to load new distribution libraries, it is recommended that you set the ACCJCLIN indicator in the distribution zone. In this way, you can save the entries that are produced from JCLIN in the distribution zone whenever a SYSMOD that contains inline JCLIN is accepted. For more information about the ACCJCLIN indicator, see the description of inline JCLIN in the SMP/E Commands book for details.

After you take actions that are indicated by **ACCEPT CHECK**, remove the `CHECK` operand and run the job again to perform the **ACCEPT**.

> **NOTE**
>
> The GROUPEXTEND operand indicates that SMP/E accepts all requisite SYSMODs. The requisite SYSMODS might be applicable to other functions.

EXPECTED RESULTS FROM ACCEPT CHECK

You will receive a return code of `0` if this job runs correctly.

If PTFs that contain replacement modules are accepted, SMP/E ACCEPT processing will link-edit or bind the modules into the distribution libraries. During this processing, the Linkage Editor or Binder might issue messages that indicate unresolved external references, which will result in a return code of 4 during the ACCEPT phase. You can ignore these messages, because the distribution libraries are not executable and the unresolved external references do not affect the executable system libraries.

EXPECTED RESULTS FROM ACCEPT

You will receive a return code of `0` if this job runs correctly.

Run REPORT CROSSZONE

The SMP/E REPORT CROSSZONE command identifies requisites for products that are installed in separate zones. This command also creates **APPLY** and **ACCEPT** commands in the `SMPPUNCH` data set. You can use the **APPLY** and **ACCEPT** commands to install those cross-zone requisites that the SMP/E REPORT CROSSZONE command identifies.

After you install Zowe, it is recommended that you run **REPORT CROSSZONE** against the new or updated target and distribution zones. **REPORT CROSSZONE** requires a global zone with ZONEINDEX entries that describe all the target and distribution libraries to be reported on.

For more information about **REPORT CROSSZONE**, see the SMP/E manuals.

Cleaning up obsolete data sets, paths, and DDDEFs

The web download data sets listed in DASD storage requirements are temporary data sets. You can delete these data sets after you complete the SMP/E installation.

Activating Zowe

File system execution

If you mount the file system in which you have installed Zowe in read-only mode during execution, then you do not have to take further actions to activate Zowe.

Zowe customization

You can find the necessary information about customizing and using Zowe on the Zowe doc site.

- For more information about how to customize Zowe, see Configuring Overview.
- For more information about how to use Zowe, see Using Zowe.

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Installing Zowe via z/OSMF from PSWI and SMP/E workflow

The following information contains procedures and tips for meeting z/OSMF requirements. For complete information, go to IBM Documentation and read the following documents.

- IBM z/OS Management Facility Configuration Guide
- IBM z/OS Management Facility Help

z/OS requirements for z/OSMF configuration

Ensure that the z/OS system meets the following requirements:

Requirements	Description	Resources in IBM Knowledge Center
AXR (System REXX)	z/OS uses AXR (System REXX) component to perform Incident Log tasks. The component enables REXX executable files to run outside of conventional TSO and batch environments.	System REXX
Common Event Adapter (CEA) server	The CEA server, which is a co-requisite of the Common Information Model (CIM) server, enables the ability for z/OSMF to deliver z/OS events to C-language clients.	Customizing for CEA
Common Information Model (CIM) server	z/OSMF uses the CIM server to perform capacity-provisioning and workload-management tasks. Start the CIM server before you start z/OSMF (the IZU* started tasks).	Reviewing your CIM server setup
CONSOLE and CONSPROF commands	The CONSOLE and CONSPROF commands must exist in the authorized command table.	Customizing the CONSOLE and CONSPROF commands
Java level	IBM® 64-bit SDK for z/OS®, Java Technology Edition V8 or later is required.	Software prerequisites for z/OSMF
TSO region size	To prevent **exceeds maximum region size** errors, verify that the TSO maximum region size is a minimum of 65536 KB for the z/OS system.	N/A
User IDs	User IDs require a TSO segment (access) and an OMVS segment. During workflow processing and REST API requests, z/OSMF might start one or more TSO address spaces under the following job names: userid; substr(userid, 1, 6) CN (Console).	N/A

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Addressing z/OSMF requirements

Before you install Zowe using IBM z/OSMF, address the following installation and security requirements. Your systems programmers and security administrators can complete these tasks in parallel.

Configure z/OSMF

> **ROLES REQUIRED: SYSTEMS PROGRAMMER, SECURITY ADMINISTRATOR, DOMAIN ADMINISTRATOR**

The IBM z/OS Management Facility Configuration Guide is your primary source of information about how to configure z/OSMF. You can open the IBM documentation in a separate browser tab for reference during installation of your products using z/OSMF Deployments. To prevent configuration errors and to enable z/OSMF Software Update for maintenance, apply all z/OSMF related maintenance before you begin the installation process.

Configure z/OSMF security

> **ROLES REQUIRED: SECURITY ADMINISTRATOR**

Configure z/OSMF security for ACF2, Top Secret, or IBM RACF as applicable to authorize users and resources. To prevent SSL handshake failures when importing product information into z/OSMF, make sure that you have added the Digicert Intermediate CA certificate to the z/OSMF keyring. For information, see Import Product Information into z/OSMF.

Confirm that the installer has read, create, update, and execute privileges in z/OS

> **ROLES REQUIRED: SECURITY ADMINISTRATOR**

- **Write** access is also required to the USS directories that are used for the installation process.
- To deploy a product that has USS components, the installer's user ID must have access to the appropriate resource profiles in the `UNIXPRIV` class and access to the `BPX.SUPERUSER` resource profile in the `FACILITY` class, or `UID(0)`.
- For `UNIXPRIV` class, **read** access is required to `SUPERUSER.FILESYS.CHOWN`, `SUPERUSER.FILESYS.CHGRP`, and `SUPERUSER.FILESYS.MOUNT`.

Address USS requirements

> **ROLES REQUIRED: SECURITY ADMINISTRATOR, SYSTEM PROGRAMMER**

- Create a USS directory to receive the z/OSMF pax file and to perform the unpack steps.
- Confirm that you have write authority to the USS directories that are used for the z/OSMF pax installation process.

- Confirm that you have available USS file space. To download and unpack the pax file, you need free space that is approximately 3.5 times the pax file size in the file system that contains the pax directories. For example, to download and unpack a 14-MB pax file, you need approximately 49 MB of free space in the file system hosting your pax directory. If you do not have sufficient free space, error messages like EZA1490I Error writing to data set or EZA2606W File I/O error 133 can occur.

Configure SMP/E Internet Service Retrieval

> **ROLES REQUIRED: SECURITY ADMINISTRATOR, SYSTEM PROGRAMMER**

Configure SMP/E Internet Service Retrieval to receive and download maintenance on a regular cadence or build custom maintenance packages (order PTFs, APARs, critical, recommended, all, or just HOLDDATA). This step is our recommended best practice when installing maintenance and is required to use the z/OSMF Software Update. For configuration details, see the Mainframe Common Maintenance Procedures documentation.

After these requirements have been addressed, you are ready to acquire a z/OSMF Portable Software Instance or Configure Zowe with z/OSMF Workflows or Configuring API ML with z/OSMF Workflows.

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Configuring z/OSMF

Follow these steps described in this article to configure z/OSMF.

> **REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR, DOMAIN ADMINISTRATOR**

1. From the console, issue the following command to verify the version of z/OS:

Expected results:
Part of the output contains the release, for example, `RELEASE z/OS 02.02.00`.

2. Configure z/OSMF.

   z/OSMF is a base element of z/OS, so it is already installed. However, z/OSMF might not be configured and running on every z/OS system.

   To configure an instance of z/OSMF, run the IBM-supplied jobs `IZUSEC` and `IZUMKFS`, and then start the z/OSMF server. The z/OSMF configuration process occurs in three stages, and in the following order:

   - Stage 1 - Security setup
   - Stage 2 - Configuration
   - Stage 3 - Server initialization

   This stage sequence is critical to a successful configuration. For complete information about how to configure z/OSMF, see Configuring z/OSMF for the first time if you use z/OS V2.2 or Setting up z/OSMF for the first time if V2.3.

> **NOTE**
>
> The base element z/OSMF is started by default at system initial program load (IPL). Therefore, z/OSMF is available for use as soon as you set up the system. If you prefer not to start z/OSMF automatically, disable the autostart function by checking for `START` commands for the z/OSMF started procedures in the *COMMNDxx parmlib* member.
>
> The z/OS Operator Consoles task is new in Version 2.3. Applications that depend on access to the operator console such as Zowe™ CLI's RestConsoles API require Version 2.3 or newer.

1. Verify that the z/OSMF server and angel processes are running. From the command line, issue the following command:

   If jobs `IZUANG1` and `IZUSVR1` are not active, issue the following command to start the angel process:

Expected results:
You will see the message `CWWKB0056I INITIALIZATION COMPLETE FOR ANGEL`.

To start the server, issue the following command:

Expected results:
It might take a few minutes to initialize. The z/OSMF server is available when the message `CWWKF0011I: The server zosmfServer is ready to run a smarter planet.` is displayed.

4. To find the startup messages in the SDSF log of the z/OSMF server, issue the following command:

   Expected results:
   You will see a message that indicates the port number, for example, `IZUG349I: The z/OSMF STANDALONE Server home page can be accessed at https://mvs.hursley.ibm.com:443/zosmf after the z/OSMF server is started on your system.` In this example, the port number is `443`. You will need this port number later.

5. Point your browser at the nominated z/OSMF STANDALONE Server home page. You should see its Welcome Page where you can log in.

> **NOTE**
>
> If your implementation uses an external security manager other than RACF (for example, Top Secret for z/OS or ACF2 for z/OS), provide equivalent commands for your environment. For more information, see the following product documentation:
>
> - Configure z/OS Management Facility for Top Secret
> - Configure z/OS Management Facility for ACF2

z/OSMF REST services for Zowe clients

Zowe clients use z/OSMF Representational State Transfer (REST) APIs to work with system resources and extract system data. Ensure that the following REST services are configured and available.

z/OSMF REST services	Requirements	Resources in IBM knowledge Center
Cloud provisioning services	Cloud provisioning services are required for the Zowe CLI CICS and Db2 command groups. Endpoints begin with `/zosmf/provisioning/`	Cloud provisioning services
TSO/E address space services	TSO/E address space services are required to issue TSO commands in the Zowe CLI. Endpoints begin with `/zosmf/tsoApp`	TSO/E address space services
z/OS console services	z/OS console services are required to issue console commands in the Zowe CLI. Endpoints begin with `/zosmf/restconsoles/`	z/OS console services
z/OS data set and file REST interface	z/OS data set and file REST interface is required to work with mainframe data sets and UNIX System Services files in the Zowe CLI. Endpoints begin with `/zosmf/restfiles/`	z/OS data set and file REST interface
z/OS jobs REST interface	z/OS jobs REST interface is required to use the zos-jobs command group in the Zowe CLI. Endpoints begin with `/zosmf/restjobs/`	z/OS jobs REST interface
z/OSMF workflow services	z/OSMF workflow services is required to create and manage z/OSMF workflows on a z/OS system. Endpoints begin with `/zosmf/workflow/`	z/OSMF workflow services

Zowe uses symbolic links to the z/OSMF `bootstrap.properties`, `jvm.security.override.properties`, and `ltpa.keys` files. Zowe reuses SAF, SSL, and LTPA configurations; therefore, they must be valid and complete.

For more information, see Using the z/OSMF REST services in IBM z/OSMF documentation.

To verify that z/OSMF REST services are configured correctly in your environment, enter the REST endpoint into your browser. For example: `https://mvs.ibm.com:443/zosmf/restjobs/jobs`

> **NOTES**
>
> - Browsing z/OSMF endpoints requests your user ID and password for defaultRealm; these are your TSO user credentials.
> - The browser returns the status code 200 and a list of all jobs on the z/OS system. The list is in raw JSON format.

Configuring z/OSMF to properly work with API ML

There is an issue observed in z/OSMF which leads to a stuck JSON web token(JWT). It manifests as the endpoint `/zosmf/services/authenticate` issuing a JWT with success RC that is not valid for API calls, resulting in 401 response status code. This is a persistent condition. To get the token unstuck, perform a logout with the LTPA token from the login request. This causes logins to start serving unique JWTs again.

Until this issue is properly fixed in z/OSMF, we propose the possible temporary workaround:

Disable Cache in z/OSMF

To disable the cache in z/OSMF, update the `server_override.xml` file in the z/OSMF installation with the following parameter with the value `false`:

This parameter setting results in the generation of a new JWT from each authentication call.

Version: v3.2.x LTS

Configuring z/OSMF Lite (for non-production use)

This section provides information about requirements for z/OSMF Lite configuration.

Disclaimer: z/OSMF Lite can be used in a non-production environment such as development, proof-of-concept, demo and so on. It is not for use in a production environment. To use z/OSMF in a production environment, see Configuring z/OSMF.

Introduction

IBM® z/OS® Management Facility (z/OSMF) provides extensive system management functions in a task-oriented, web browser-based user interface with integrated user assistance, so that you can more easily manage the day-to-day operations and administration of your mainframe z/OS systems.

By following the steps in this guide, you can quickly enable z/OSMF on your z/OS system. This simplified approach to set-up, known as "z/OSMF Lite", requires only a minimal amount of z/OS customization, but provides the key functions that are required by many exploiters, such as the open mainframe project (Zowe™).

A z/OSMF Lite configuration is applicable to any future expansions you make to z/OSMF, such as adding more optional services and plug-ins.

It takes 2-3 hours to set up z/OSMF Lite. Some steps might require the assistance of your security administrator.

For detailed information about various aspects of z/OSMF configuration such as enabling the optional plug-ins and services, see the IBM publication *z/OSMF Configuration Guide*.

Assumptions

This document is intended for a first time z/OSMF setup. If z/OSMF is already configured on your system, you do not need to create a z/OSMF Lite configuration.

This document is designed for use with a single z/OS system, not a z/OS sysplex. If you plan to run z/OSMF in a sysplex, see *z/OSMF Configuration Guide* for multi-system considerations.

It is assumed that a basic level of security for z/OSMF is sufficient on the z/OS system. IBM provides a program, IZUNUSEC, to help you set up basic security for a z/OSMF Lite configuration.

System defaults are used for the z/OSMF environmental settings. Wherever possible, it is recommended that you use the default values. If necessary, however, you can override the defaults by supplying an IZUPRMxx member, as described in Appendix A. Creating an IZUPRMxx parmlib member.

It is recommended that you use the following procedures as provided by IBM:

- Started procedures IZUSVR1 and IZUANG1
- Logon procedure IZUFPROC

Information about installing these procedures is provided in Copying the IBM procedures into JES PROCLIB.

Software Requirements

Setting up z/OSMF Lite requires that you have access to a z/OS V2R2 system or later. Also, your z/OS system must meet the following minimum software requirements:

- Minimum Java level
- WebSphere® Liberty profile (z/OSMF V2R3 and later)
- System settings
- Web browser

Minimum Java level

Java™ must be installed and operational on your z/OS system, at the required minimum level. See the table that follows for the minimum level and default location. If you installed Java in another location, you must specify the JAVA_HOME statement in your IZUPRMxx parmlib member, as described in Appendix A. Creating an IZUPRMxx parmlib member.

z/OS Version	Minimum level of Java™	Recommended level of Java	Default location
z/OS V2R2	IBM® 64-bit SDK for z/OS®, Java Technology Edition V7.1 (SR3), with the PTFs for APAR PI71018 and APAR PI71019 applied **OR** IBM® 64-bit SDK for z/OS®, Java Technology Edition V8, with the PTF for APAR PI72601 applied.	IBM® 64-bit SDK for z/OS®, Java™ Technology Edition, V8 SR6 (5655-DGH)	`/usr/lpp/java/J7.1_64`
z/OS V2R3	IBM® 64-bit SDK for z/OS®, Java™ Technology Edition, V8 SR4 FP10 (5655-DGH)	IBM® 64-bit SDK for z/OS®, Java™ Technology Edition, V8 SR6 (5655-DGH)	`/usr/lpp/java/J8.0_64`

WebSphere® Liberty profile (z/OSMF V2R3 and later)

z/OSMF V2R3 uses the Liberty Profile that is supplied with z/OS, rather than its own copy of Liberty. The WebSphere Liberty profile must be mounted on your z/OS system. The default mount point is: `/usr/lpp/liberty_zos`. To determine whether WebSphere® Liberty profile is mounted, check for the existence of the mount point directory on your z/OS system.

If WebSphere® Liberty profile is mounted at a non-default location, you need to specify the location in the IZUSVR1 started procedure on the keyword **WLPDIR=**. For details, see Appendix B. Modifying IZUSVR1 settings.

Note: Whenever you apply PTFs for z/OSMF, you might be prompted to install outstanding WebSphere Liberty service. It is recommended that you do so to maintain z/OSMF functionality.

System settings

Ensure that the z/OS host system meets the following requirements:

- Port 443 (default port) is available for use.
- The system host name is unique and maps to the system on which z/OSMF Lite will be configured.

Otherwise, you might encounter errors later in the process. If you encounter errors, see Troubleshooting problems for the corrective actions to take.

Web browser

For best results with z/OSMF, use one of the web browsers supported by z/OSMF.

To check your web browser's level, click **About** in the web browser.

Creating a z/OSMF nucleus on your system

The following system changes are described in this chapter:

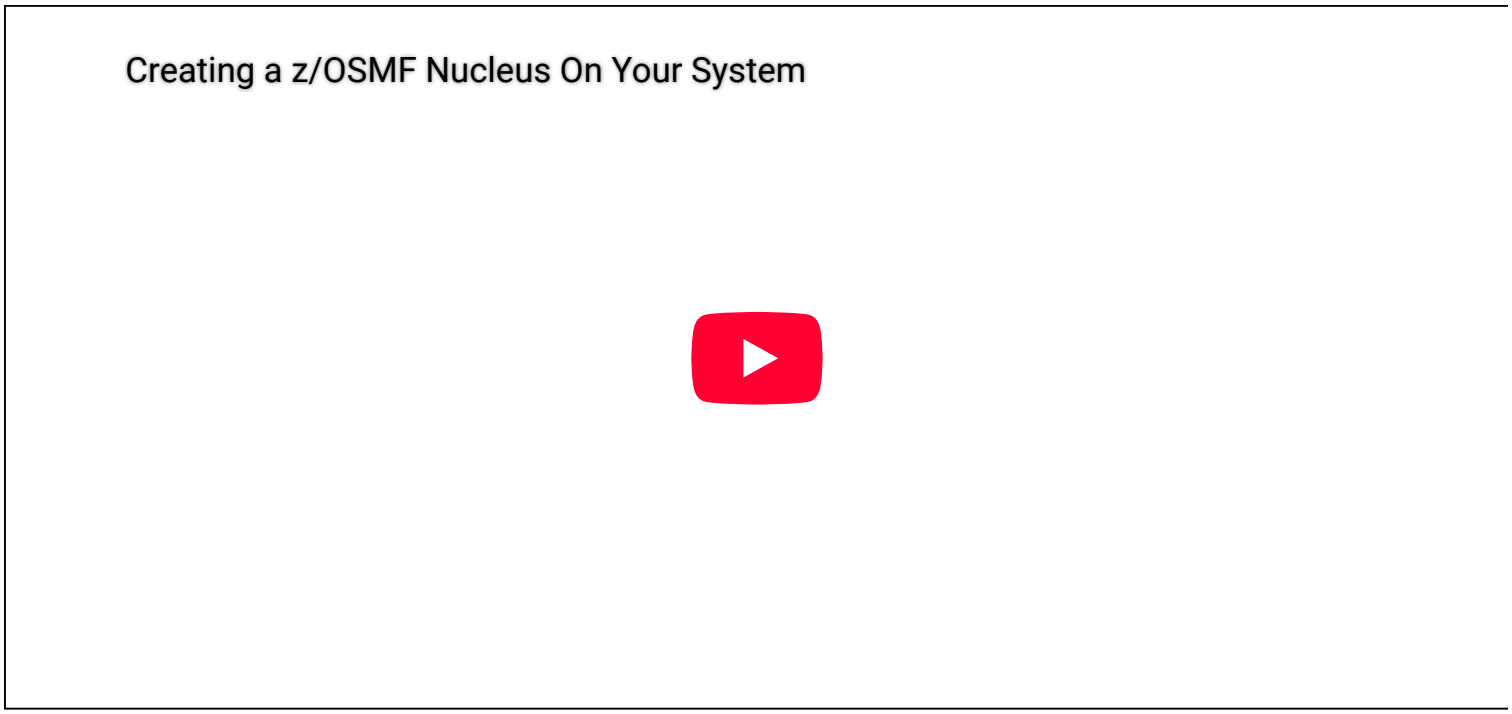
- Running job IZUNUSEC to create security
- Running job IZUMKFS to create the z/OSMF user file system
- Copying the IBM procedures into JES PROCLIB
- Starting the z/OSMF server
- Accessing the z/OSMF Welcome page
- Mounting the z/OSMF user file system at IPL time

The following sample jobs that you might use are included in the package and available for download:

- IZUAUTH
- IZUICSEC
- IZUNUSEC_V2R2
- IZUNUSEC_V2R3
- IZUPRM00
- IZURFSEC
- IZUTSSEC
- IZUWFSEC

Download sample jobs

Check out the video for a demo of the process:



Running job IZUNUSEC to create security

The security job IZUNUSEC contains a minimal set of RACF® commands for creating security profiles for the z/OSMF nucleus. The profiles are used to protect the resources that are used by the z/OSMF server, and to grant users access to the z/OSMF core functions. IZUNUSEC is a simplified version of the sample job IZUSEC, which is intended for a more complete installation of z/OSMF.

Note: If your implementation uses an external security manager other than RACF (for example, Top Secret or ACF2), provide equivalent commands for your environment. For more information, see the following product documentation:

- Configure z/OS Management Facility for Top Secret
- Configure z/OS Management Facility for ACF2

Before you begin

In most cases, you can run the IZUNUSEC security job without modification. To verify that the job is okay to run as is, ask your security administrator to review the job and modify it as necessary for your security environment. If security is not a concern for the host system, you can run the job without modification.

Procedure

1. If you run z/OS V2R2 or V2R3, download job IZUNUSEC in the sample jobs package and upload this job to z/OS. If you run z/OS V2R4, locate job IZUNUSEC at SYS1.SAMPLIB.
2. Review and edit the job, if necessary.
3. Submit IZUNUSEC as a batch job on your z/OS system.
4. Connect your user ID to IZUADMIN group.
    i. Download job IZUAUTH in the sample jobs package and customize it.
    ii. Replace the 'userid' with your z/OSMF user ID.
    iii. Submit the job on your z/OS system.

Results

Ensure the IZUNUSEC job completes with return code `0000`.

To verify, check the results of the job execution in the job log. For example, you can use SDSF to examine the job log:

1. In the SDSF primary option menu, select Option ST.
2. On the SDSF Status Display, enter **S** next to the job that you submitted.
3. Check the return code of the job. The job succeeds if '0000' is returned.

Common errors

Review the following messages and the corresponding resolutions as needed:

Symptom	Cause	Resolution
Message IKJ56702I: INVALID data is issued	The job is submitted more than once.	You can ignore this message.
Job fails with an authorization error.	Your user ID lacks superuser authority.	Contact your security admin to run IZUNUSEC. If you are using RACF®, select a user ID with SPECIAL attribute which can issue all RACF® commands.
Job fails with an authorization error.	Your installation uses the RACF PROTECT-ALL option.	See Troubleshooting problems.
ADDGROUP and ADDUSER commands are not executed.	The automatic GID and UID assignment is required.	Define SHARED.IDS and BPX.NEXT.USER profiles to enable the use of AUTOUID and AUTOGID.

Running job IZUMKFS to create the z/OSMF user file system

The job IZUMKFS initializes the z/OSMF user file system, which contains configuration settings and persistence information for z/OSMF.

The job mounts the file system. On a z/OS V2R3 system with the PTF for APAR PI92211 installed, the job uses mount point `/global/zosmf`. Otherwise, for an earlier system, the job mounts the file system at mount point `/var/zosmf`.

Before you begin

To perform this step, you need a user ID with "superuser" authority on the z/OS host system. For more information about how to define a user with superuser authority, see the publication *z/OS UNIX System Services*.

Procedure

1. In the system library `SYS1.SAMPLIB`, locate job IZUMKFS.
2. Copy the job.

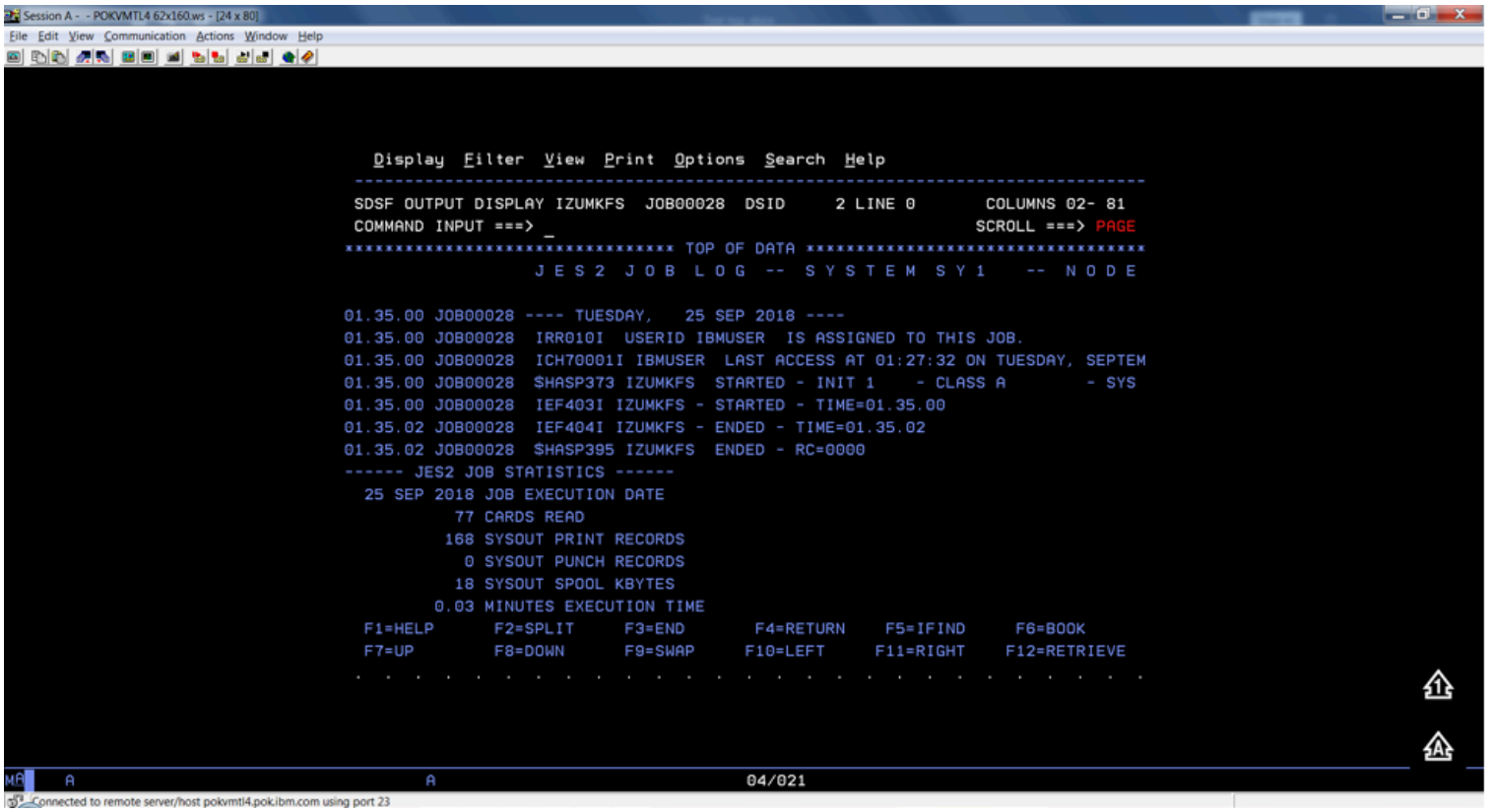
3. Review and edit the job:
    - Modify the job information so that the job can run on your system.
    - You must specify a volume serial (VOLSER) to be used for allocating a data set for the z/OSMF data directory.
4. Submit IZUMKFS as a batch job on your z/OS system.

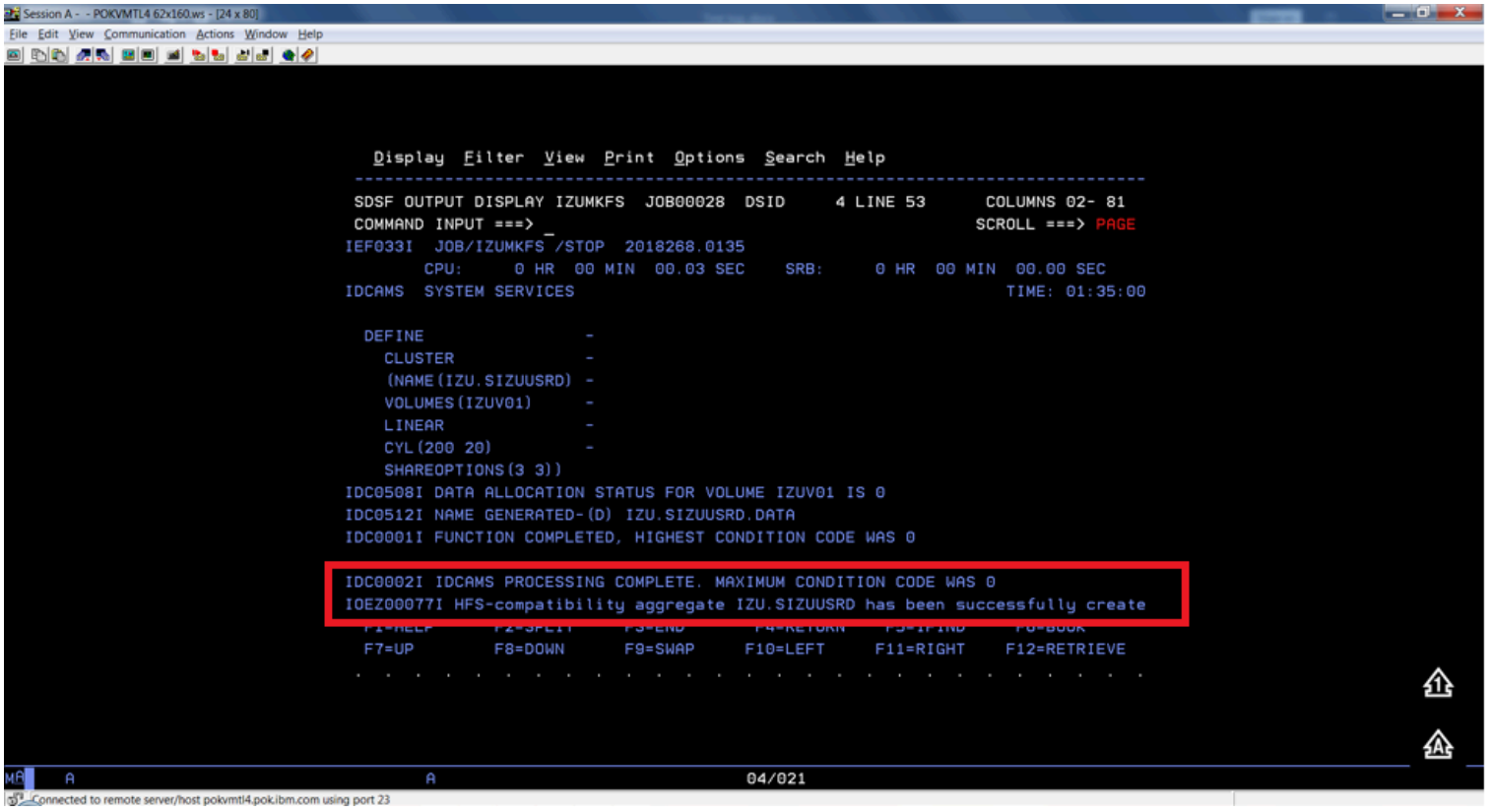
Results

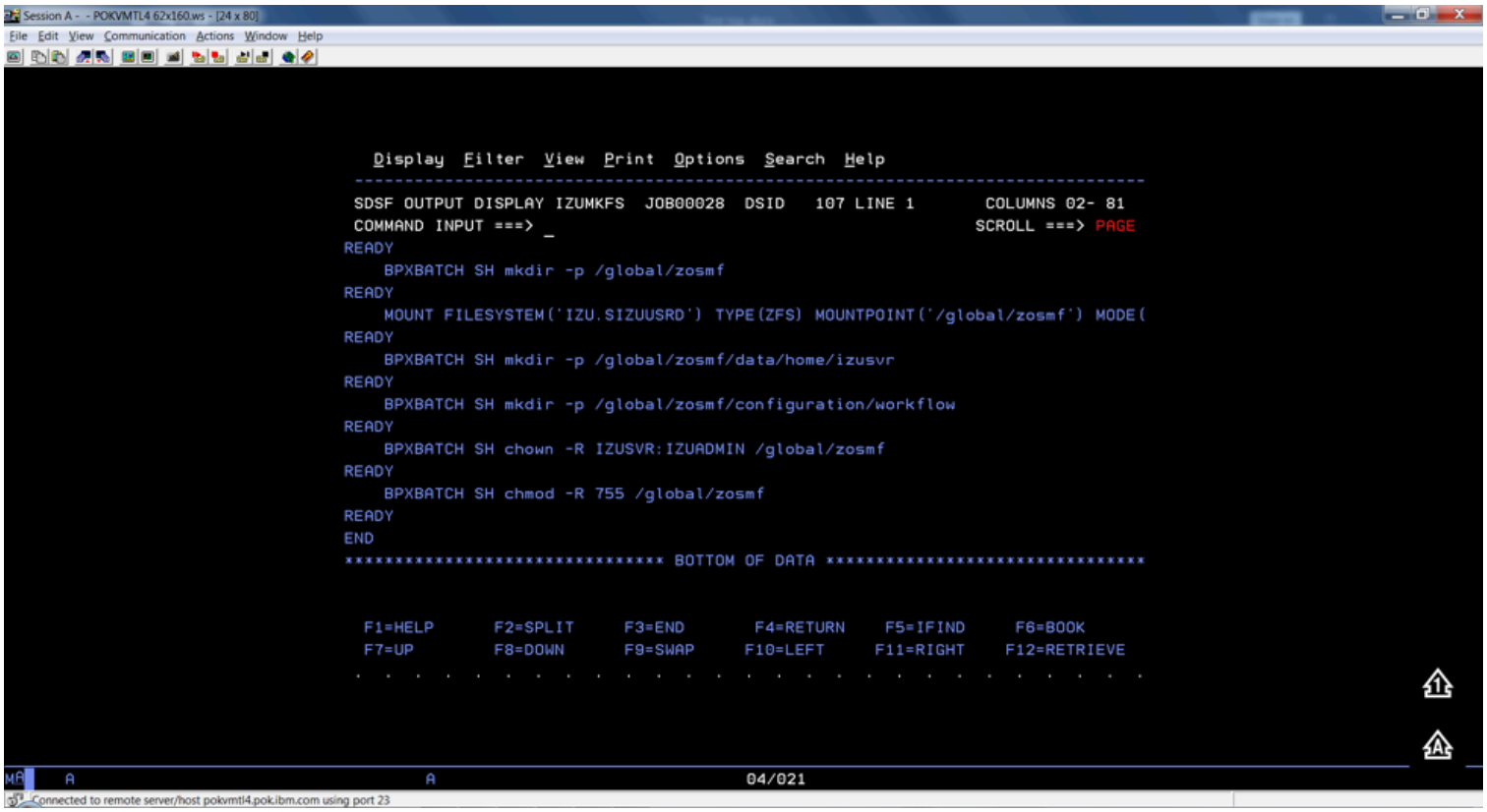
The z/OSMF file system is allocated, formatted, and mounted, and the necessary directories are created.

To verify if the file system is allocated, formatted, locate the following messages in IZUMKFS job output.

Sample output:







Common errors

Review the following messages and the corresponding resolutions as needed

Symptom	Cause	Resolution
Job fails with FSM error.	Your user ID lacks superuser authority.	For more information about how to define a user with superuser authority, see the publication *z/OS UNIX System Services*.
Job fails with an authorization error.	Job statement errors.	See Troubleshooting problems.

Copying the IBM procedures into JES PROCLIB

Copy the z/OSMF started procedures and logon procedure from SYS1.PROCLIB into your JES concatenation. Use `$D PROCLIB` command to display your JES2 PROCLIB definitions.

Before you begin

Locate the IBM procedures. IBM supplies procedures for z/OSMF in your z/OS order:

- ServerPac and CustomPac orders: IBM supplies the z/OSMF procedures in the SMP/E managed proclib data set. In ServerPac and SystemPac, the default name for the data set is SYS1.IBM.PROCLIB.
- CBPDO orders: For a CBPDO order, the SMP/E-managed proclib data set is named as SYS1.PROCLIB.
- Application Development CD.

Procedure

Use ISPF option 3.3 or 3.4 to copy the procedures from SYS1.PROCLIB into your JES concatenation.

- IZUSVR1
- IZUANG1
- IZUFPROC

Results

The procedures now reside in your JES PROCLIB.

Common errors

Review the following messages and the corresponding resolutions as needed

Symptom	Cause	Resolution
Not authorized to copy into PROCLIB.	Your user ID doesn't have the permission to modify PROCLIB.	Contact your security administrator.
Abend code B37 or E37.	The data set runs out of space.	Use IEBCOPY utility to compress PROCLIB dataset before you copy it.

Starting the z/OSMF server

z/OSMF processing is managed through the z/OSMF server, which runs as the started tasks IZUANG1 and IZUSVR1. z/OSMF is started with the START command.

Before you begin

Ensure that you have access to the operations console and can enter the START command.

Procedure

In the operations console, enter the START commands sequentially:

Note: The z/OSMF angel (IZUANG1) must be started before the z/OSMF server (IZUSVR1).

You must enter these commands manually at subsequent IPLs. If necessary, you can stop z/OSMF processing by entering the STOP command for each of the started tasks IZUANG1 and IZUSVR1.

Note: z/OSMF offers an autostart function, which you can configure to have the z/OSMF server started automatically. For more information about the autostart capability, see *z/OSMF Configuration Guide*.

Results

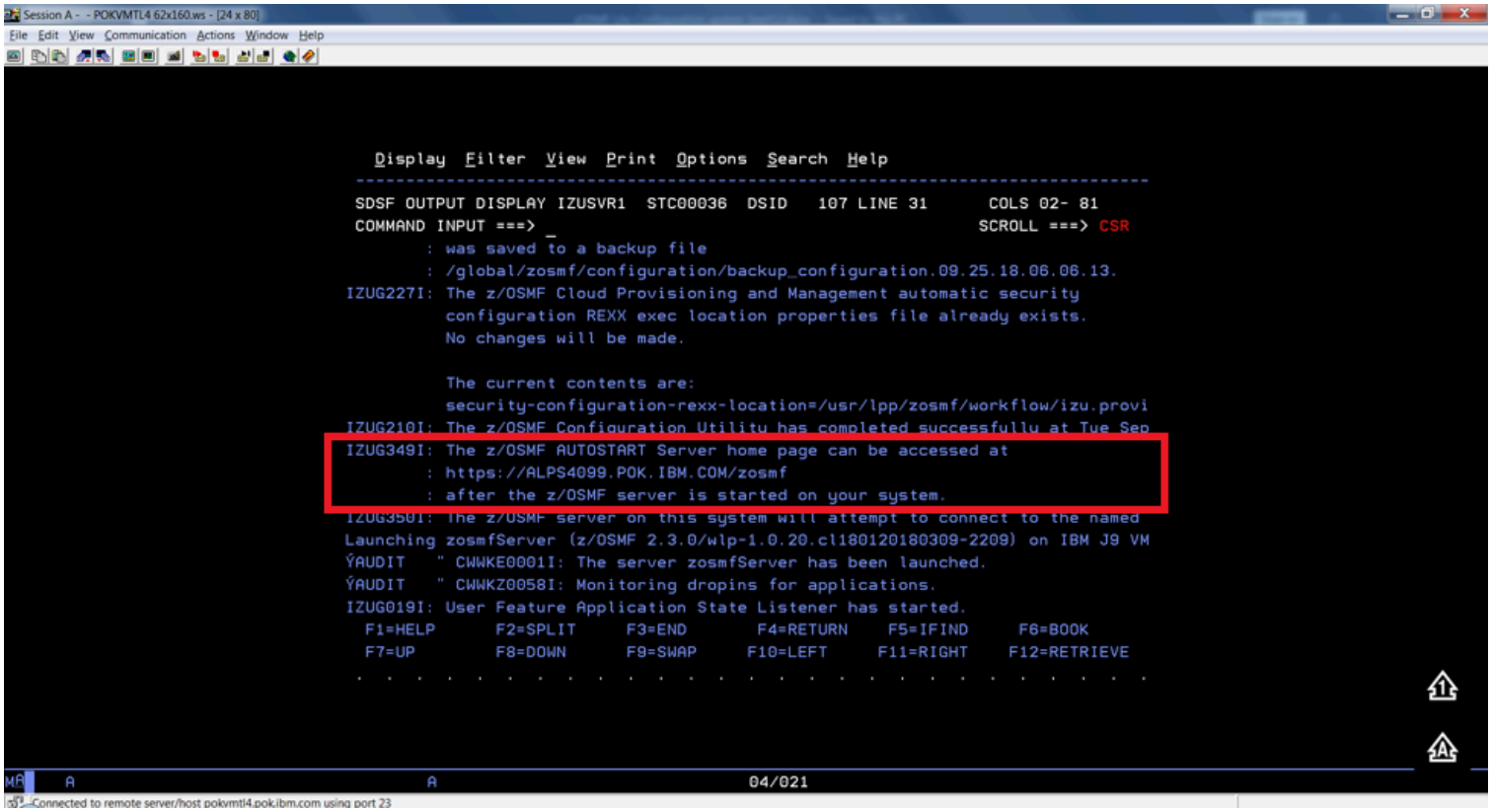
When the z/OSMF server is initialized, you can see the following messages displayed in the operations console:

Accessing the z/OSMF Welcome page

At the end of the z/OSMF configuration process, you can verify the results of your work by opening a web browser to the Welcome page.

Before you begin

To find the URL of the Welcome page, look for message IZUG349I in the z/OSMF server job log.



Procedure

1. Open a web browser to the z/OSMF Welcome page. The URL for the Welcome page has the following format: `https://hostname:port/zosmf/`

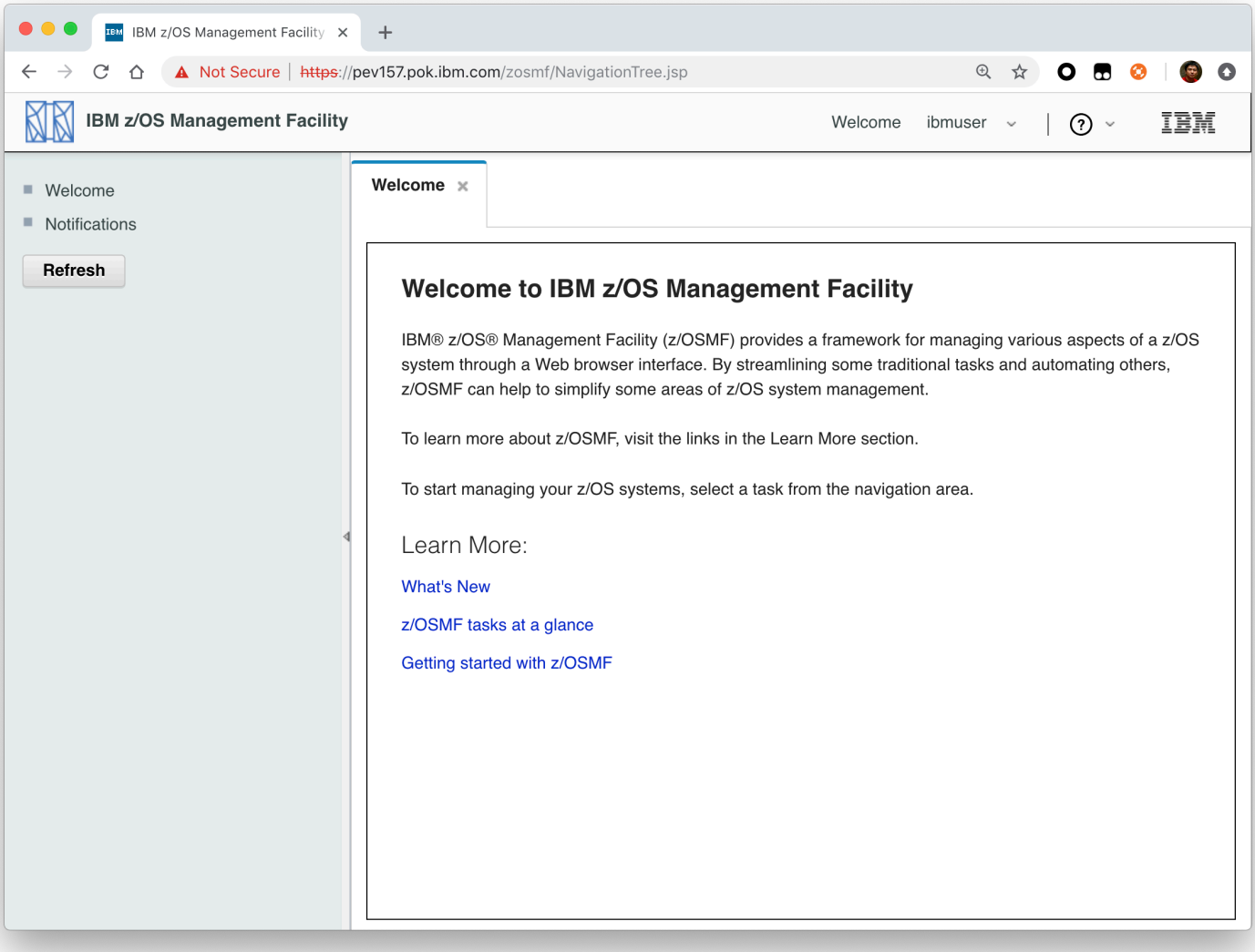
   Where:

   - *hostname* is the host name or IP address of the system in which z/OSMF is installed.
   - *port* is the secure port for the z/OSMF configuration. If you specified a secure port for SSL encrypted traffic during the configuration process through parmlib statement HTTP_SSL_PORT, port is required to log in. Otherwise, it is assumed that you use the default port 443.

2. In the z/OS USER ID field on the Welcome page, enter the z/OS user ID that you use to configure z/OSMF.
3. In the z/OS PASSWORD field, enter the password or pass phrase that is associated with the z/OS user ID.
4. Select the style of UI for z/OSMF. To use the desktop interface, select this option. Otherwise, leave this option unselected to use the tree view UI.
5. Click **Log In**.

Results

If the user ID and password or pass phrase are valid, you are authenticated to z/OSMF. The Welcome page of IBM z/OS Management Facility tab opens in the main area. At the top right of the screen, Welcome `<your_user_ID>` is displayed. In the UI, only the options you are allowed to use are displayed.



You have successfully configured the z/OSMF nucleus.

Common errors

The following errors might occur during this step:

Symptom	Cause	Resolution
z/OSMF welcome page does not load in your web browser.	The SSL handshake was not successful. This problem can be related to the browser certificate.	See Certificate error in the Mozilla Firefox browser.
To log into z/OSMF, enter a valid z/OS user ID and password. Your account might be locked after too many incorrect log-in attempts.	The user ID is not connected to the IZUADMIN group.	Connect your user ID to the IZUADMIN group.
To log into z/OSMF, enter a valid z/OS user ID and password. Your account	The password is expired.	Log on to TSO using your z/OS User ID and password, you will be asked

Symptom	Cause	Resolution
might be locked after too many incorrect log-in attempts.		to change your password if it's expired.

Mounting the z/OSMF user file system at IPL time

Previously, in Running job IZUMKFS to create the z/OSMF user file system, you ran job IZUMKFS to create and mount the z/OSMF user file system. Now you should ensure that the z/OSMF user file system is mounted automatically for subsequent IPLs. To do so, update the BPXPRMxx parmlib member on your z/OS system.

Before you begin

By default, the z/OSMF file system uses the name IZU.SIZUUSRD, and is mounted in read/write mode. It is recommended that this file system is mounted automatically at IPL time.

If you do not know which BPXPRMxx member is active, follow these steps to find out:

1. In the operations console, enter the following command to see which parmlib members are included in the parmlib concatenation on your system:

   ```
   D PARMLIB
   ```

2. Make a note of the BPXPRMxx member suffixes that you see.

3. To determine which BPXPRMxx member takes precedence, enter the following command:

   ```
   D OMVS
   ```

The output of this command should be similar to the following:

In this example, the member BPXPRMST takes precedence. If BPXPRMST is not present in the concatenation, member BPXPRM3T is used.

Procedure

Add a MOUNT command for the z/OSMF user file system to your currently active BPXPRMxx parmlib member. For example:

On a z/OS V2R3 system with the PTF for APAR PI92211 installed:

On a z/OS V2R2 or V2R3 system without PTF for APAR PI92211 installed:

Results

The BPXPRMxx member is updated. At the next system IPL, the following message is issued to indicate that the z/OSMF file system is mounted automatically.

Adding the required REST services

You must enable a set of z/OSMF REST services for the Zowe framework.

The following system changes are described in this topic:

- Enabling the z/OSMF JOB REST services
- Enabling the TSO REST services
- Enabling the z/OSMF data set and file REST services
- Enabling the z/OSMF Workflow REST services and Workflows task UI

Enabling the z/OSMF JOB REST services

The Zowe framework requires that you enable the z/OSMF JOB REST services, as described in this topic.

Procedure

None

Results

To verify if the z/OSMF JOB REST services are enabled, open a web browser to our z/OS system (host name and port) and add the following REST call to the URL:

```
GET /zosmf/restjobs/jobs
```

The result is a list of the jobs that are owned by your user ID. For more information about the z/OSMF JOB REST services, see *z/OSMF Programming Guide*.

Common errors

Review the following messages and the corresponding resolutions as needed:

Symptom 1

401 Unauthorized

Cause

The user ID is not connected to IZUADMIN or IZUUSER.

Resolution

Connect your user ID to IZUADMIN or IZUUSER.

Symptom 2

HTTP/1.1 500 Internal Server Error

Cause

For JES2, you may have performed one of the following "Modify" operations: Hold a job, Release a job, Change the job class, Cancel a job, Delete a job (Cancel a job and purge its output), or you are running JES3 without configuring CIM Server.

Resolution

If you are running JES2, you can use *synchronous support for job modify operations* which does not required CIM. If you are running JES3, follow the *CIM setup instructions* to configure CIM on your system.

Enabling the TSO REST services

The Zowe framework requires that you enable the TSO REST services, as described in this topic.

Before you begin

Ensure that the common event adapter component (CEA) of z/OS is running in full function mode.

1. To check if the CEA address space is active, enter the following command:

```
D A,CEA
```

2. If not, start CEA in full function mode. For detailed instructions, see *System prerequisites for the CEA TSO/E address space services*.

3. To verify that CEA is running in full function mode, enter the following command:

```
F CEA,D
```

The output should look like the following:

Procedure

1. If you run z/OS V2R2 and V2R3, download job IZUTSSEC in the sample jobs package and upload this Job to z/OS. If you run z/OS V2R4, locate job IZUTSSEC at `SYS1.SAMPLIB`.
2. Review and edit job IZUTSSEC before you submit. You can review the IZUTSSEC section below for more details.
3. Submit IZUTSSEC as a batch job on your z/OS system.

IZUTSSEC

IBM provides a set of jobs in `SYS1.SAMPLIB` with sample RACF commands to help with your z/OSMF configuration and its prerequisites. The IZUTSSEC job represents the authorizations that are needed for the z/OSMF TSO/E address space service. Your security administrator can edit and run the job. Generally, your z/OSMF user ID requires the same authorizations for using the TSO/E address space services as when you perform these operations through a TSO/E session on the z/OS system. For example, to start an application in a TSO/E address space requires that your user ID be authorized to operate that application. In addition, to use TSO/E address space services, you must have:

- READ access to the account resource in class ACCTNUM, where account is the value specified in the COMMON_TSO ACCT option in parmlib.
- READ access to the CEA.CEATSO.TSOREQUEST resource in class SERVAUTH.
- READ access to the proc resource in class TSOPROC, where proc is the value specified with the COMMON_TSO PROC option in parmlib.
- READ access to the `<SAF_PREFIX>.*.izuUsers` profile in the EJBROLE class. Or, at a minimum, READ access to the `<SAF_PREFIX>.IzuManagementFacilityTsoServices.izuUsers` resource name in the EJBROLE class. You must also ensure that the z/OSMF started task user ID, which is IZUSVR by default, has READ access to the CEA.CEATSO.TSOREQUEST resource in class SERVAUTH. To create a TSO/E address space on a remote system, you require the following authorizations:

- You must be authorized to the SAF resource profile that controls the ability to send data to the remote system (systemname), as indicated: CEA.CEATSO.FLOW.systemname
- To flow data between different systems in the sysplex, you must be authorized to do so by your external security manager, such as a RACF database with sysplex-wide scope. For example, to flow data between System A and System B, you must be permitted to the following resource profiles:
  - CEA.CEATSO.FLOW.SYSTEMA
  - CEA.CEATSO.FLOW.SYSTEMB

Results

The IZUTSSEC job should complete with return code 0000.

Enabling the z/OSMF data set and file REST services

The Zowe framework requires that you enable the z/OSMF data set and file REST services.

Before you begin

1. Ensure that the message queue size is set to a large enough value. It is recommended that you specify an IPCMSGQBYTES value of at least 20971520 (20M) in BPXPRMxx.

   Issue command `D OMVS,O` to see the current value of IPCMSGQBYTES, if it is not large enough, use the `SETOMVS` command to set a large value. To set this value dynamically, you can enter the following operator command:

   ```
   SETOMVS IPCMSGQBYTES=20971520
   ```

2. Ensure that the TSO REST services are enabled.

3. Ensure that IZUFPROC is in your JES concatenation.

4. Ensure that your user ID has a TSO segment defined. To do so, enter the following command from TSO/E command prompt:

   ```
   LU userid TSO
   ```

Where *userid* is your z/OS user ID.

The output from this command must include the section called **TSO information**, as shown in the following example:

Procedure

1. If you run z/OS V2R2 and V2R3, download job IZURFSEC in the sample jobs package and upload it to z/OS. If you run z/OS V2R4, locate job IZURFSEC at `SYS1.SAMPLIB`.
2. Copy the job.
3. Examine the contents of the job.
4. Modify the contents as needed so that the job will run on your system.
5. From the TSO/E command line, run the IZURFSEC job.

Results

Ensure that the IZURFSEC job completes with return code `0000`.

To verify if this setup is complete, try issuing a REST service. See the example in *List data sets* in the z/OSMF programming guide.

Common errors

Review the following messages and the corresponding resolutions as needed:

Symptom	Cause	Resolution
REST API doesn't return expected data with rc=12, rsn=3, message: message queue size "SIZE" is less than minimum: 20M	The message queue size for CEA is too small.	Ensure that the message queue size is set to a large enough value. It is recommended that you specify an IPCMSGQBYTES value of at least 20971520 (20M) in BPXPRMx.

Enabling the z/OSMF Workflow REST services and Workflows task UI

The Zowe framework requires that you enable the z/OSMF Workflow REST services and Workflows task UI.

Before you begin

1. Ensure that the JOB REST services are enabled.
2. Ensure that the TSO REST services are enabled.
3. Ensure that the dataset and file REST services are enabled.

Procedure

1. If you run z/OS V2R2 and V2R3, download job IZUWFSEC in the sample jobs package and upload this job to z/OS. If you run z/OS V2R4, locate job IZUWFSEC at `SYS1.SAMPLIB`.
2. Copy the job.
3. Examine the contents of the job.
4. Modify the contents as needed so that the job will run on your system.
5. From the TSO/E command line, run the IZUWFSEC job.

Results

Ensure the IZUWFSEC job completes with return code `0000`.

To verify, log on to z/OSMF (or refresh it) and verify that the Workflows task appears in the z/OSMF UI.

At this point, you have completed the setup of z/OSMF Lite.

Optionally, you can add more users to z/OSMF, as described in Appendix C. Adding more users to z/OSMF.

Troubleshooting problems

This section provides tips and techniques for troubleshooting problems you might encounter when creating a z/OSMF Lite configuration. For other types of problems that might occur, see *z/OSMF Configuration Guide*.

Common problems and scenarios

This section discusses troubleshooting topics, procedures, and tools for recovering from a set of known issues.

System setup requirements not met

This document assumes that the following is true of the z/OS host system:

- Port 443 is available for use. To check this, issue either TSO command `NETSTAT SOCKET` or TSO command `NETSTAT BYTE` to determine if the port is being used.
- The system host name is unique and maps to the system on which z/OSMF Lite is being installed. To retrieve this value, enter either "hostname" z/OS UNIX command or TSO command "HOMETEST". If your system uses another method of assigning the system name, such as a multi-home stack, dynamic VIPA, or System Director, see *z/OSMF Configuration Guide*.
- The global mount point exists. On a z/OS 2.3 system, the system includes this directory by default. On a z/OS 2.2 system, you must create the global directory at the following location: `/global/zosmf/`.

If you find that a different value is used on your z/OS system, you can edit the IZUPRMxx parmlib member to specify the correct setting. For details, see Appendix A. Creating an IZUPRMxx parmlib member.

Tools and techniques for troubleshooting

For information about working with z/OSMF log files, see *z/OSMF Configuration Guide*.

Common messages

If you see above error messages, check if your IZUANG0 procedure is up to date.

For descriptions of all the z/OSMF messages, see *z/OSMF messages* in IBM Knowledge Center.

Appendix A. Creating an IZUPRMxx parmlib member

If z/OSMF requires customization, you can modify the applicable settings by using the IZUPRMxx parmlib member. To see a sample member, locate the IZUPRM00 member in the SYS1.SAMPLIB data set. IZUPRM00 contains settings that match the z/OSMF defaults.

Using IZUPRM00 as a model, you can create a customized IZUPRMxx parmlib member for your environment and copy it to SYS1.PARMLIB to override the defaults.

The following IZUPRMxx settings are required for the z/OSMF nucleus:

- HOSTNAME
- HTTP_SSL_PORT
- JAVA_HOME.

The following setting is needed for the TSO/E REST services:

- COMMON_TSO ACCT(IZUACCT) REGION(50000) PROC(IZUFPROC)

Descriptions of these settings are provided in the table below. For complete details about the IZUPRMxx settings and the proper syntax for updating the member, see *z/OSMF Configuration Guide*.

If you change values in the IZUPRMxx member, you might need to customize the started procedure IZUSVR1, accordingly. For details, see Appendix B. Modifying IZUSVR1 settings.

To create an IZUPRMxx parmlib member, follow these steps:

1. Copy the sample parmlib member into the desired parmlib data set with the desired suffix.
2. Update the parmlib member as needed.
3. Specify the IZUPRMxx parmlib member or members that you want the system to use on the IZU parameter of IEASYSxx. Or, code a value for IZUPRM= in the IZUSVR1 started procedure. If you specify both IZU= in IEASYSxx and IZUPARM= in IZUSVR1, the system uses the IZUPRM= value you specify in the started procedure.

Setting	Purpose	Rules	Default
HOSTNAME(*hostname*)	Specifies the host name, as defined by DNS, where the z/OSMF server is located. To use the local host name, enter asterisk (*), which is equivalent to @HOSTNAME from previous releases. If you plan to use z/OSMF in a multisystem sysplex, IBM recommends using a dynamic virtual IP address (DVIPA) that resolves to the correct IP address if the z/OSMF server is moved to a different system.	Must be a valid TCP/IP HOSTNAME or an asterisk (*).	Default: *
HTTP_SSL_PORT(nnn)	Identifies the port number that is associated with the z/OSMF server. This port is used for SSL encrypted traffic from your z/OSMF configuration. The default value, 443, follows the Internet Engineering Task Force (IETF) standard. **Note:** By default, the z/OSMF server uses the SSL protocol SSL_TLSv2 for secure TCP/IP communications. As a result, the server can accept incoming connections that use SSL V3.0 and the TLS 1.0, 1.1 and 1.2 protocols.	Must be a valid TCP/IP port number. Value range: 1 - 65535 (up to 5 digits)	Default: 443
COMMON_TSO ACCT(*account-number*) REGION(*region-size*) PROC(*proc-name*)	Specifies values for the TSO/E logon procedure that is used internally for various z/OSMF activities and by the Workflows task.	The valid ranges for each value are described in *z/OSMF Configuration Guide*.	Default: 443 ACCT(IZUACCT) REGION(50000) PROC(IZUFPROC)
USER_DIR=*filepath*	z/OSMF data directory path. By default, the z/OSMF data directory is located in	Must be a valid z/OS UNIX path	Default: `/global/zosmf/`

Setting	Purpose	Rules	Default
	`/global/zosmf`. If you want to use a different path for the z/OSMF data directory, specify that value here, for example: USER_DIR=`/the/new/config/dir`.	name.	

Appendix B. Modifying IZUSVR1 settings

You might need to customize the started procedure IZUSVR1 for z/OSMF Lite.

To modify the IZUSVR1 settings, follow these steps:

1. Make a copy
2. Apply your changes
3. Store your copy in PROCLIB.

Setting	Purpose	Rules	Default
WLPDIR='directory-path'	WebSphere Liberty server code path.	The directory path must: Be a valid z/OS UNIX path name Be a full or absolute path name Be enclosed in quotation marks Begin with a forward slash ('/').	Default: `/usr/lpp/zosmf/liberty`
USER_DIR=*filepath*	z/OSMF data directory path. By default, the z/OSMF data directory is located in /global/zosmf. If you want to use a different path for the z/OSMF data directory, specify that value here, for example: USER_DIR=`/the/new/config/dir`.	Must be a valid z/OS UNIX path name.	Default: `/global/zosmf/`

Appendix C. Adding more users to z/OSMF

Your security administrator can authorize more users to z/OSMF. Simply connect the required user IDs to the z/OSMF administrator group (IZUADMIN). This group is permitted to a default set of z/OSMF resources (tasks and services). For the specific group permissions, see Appendix A in *z/OSMF Configuration Guide*.

You can create more user groups as needed, for example, one group per z/OSMF task.

Before you Begin

Collect the z/OS user IDs that you want to add.

Procedure

1. On an RACF system, enter the CONNECT command for the user IDs to be granted authorization to z/OSMF resources:

```
CONNECT userid GROUP(IZUADMIN)
```

Results

The user IDs can now access z/OSMF.

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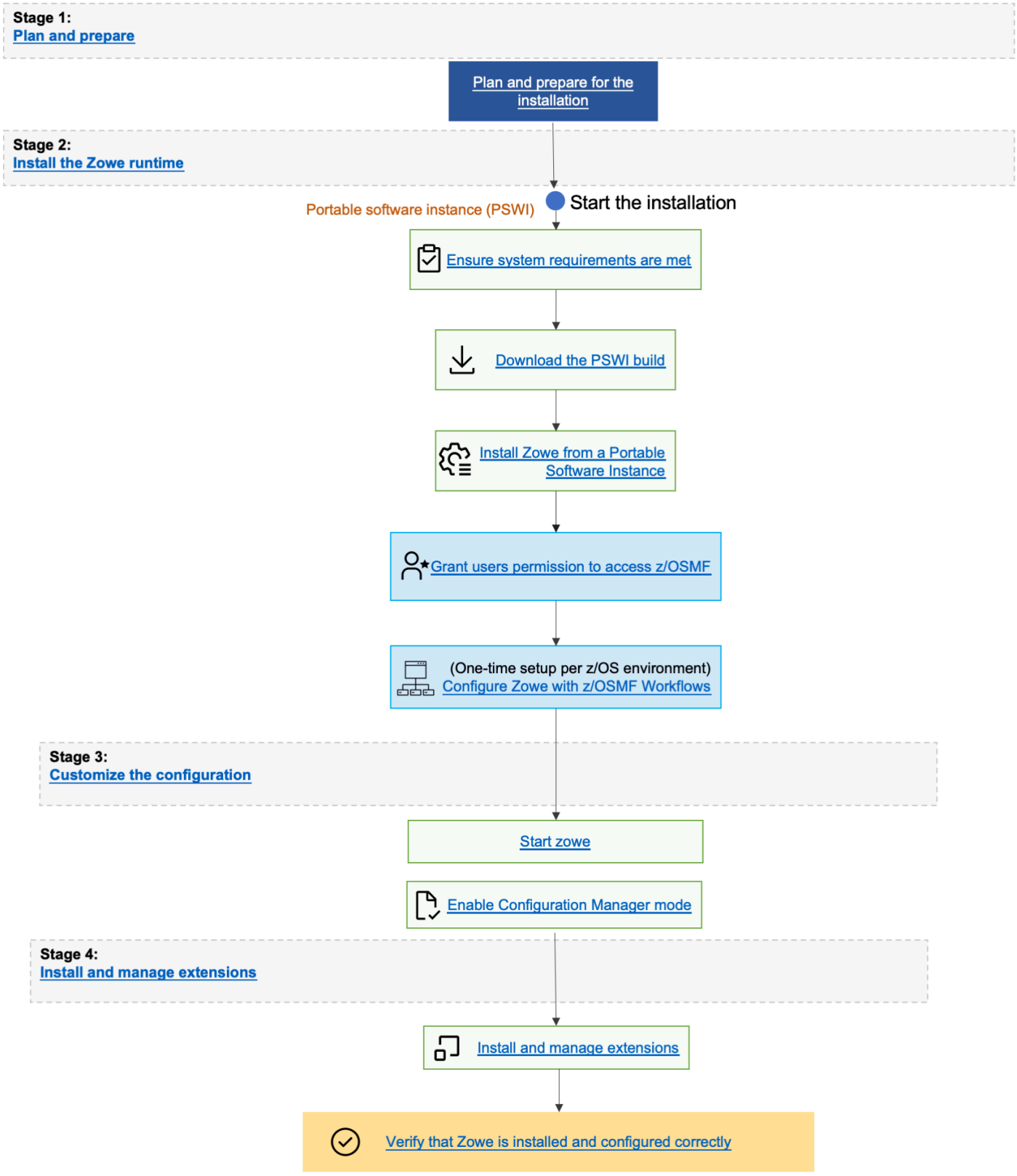
Installing Zowe from a Portable Software Instance

As a systems programmer, your responsibilities include acquiring, installing, maintaining, and configuring mainframe products on your systems. z/OSMF lets you perform these tasks. z/OSMF lets you manage software on your z/OS systems through a browser at any time, from any location. By streamlining some traditional tasks and automating others, z/OSMF can simplify some areas of system management and also reduce the level of expertise that is required for managing system activities. Experienced users can view, define, and update policies that affect system behavior, monitor system performance, and manage their z/OS software. As products and vendors adopt z/OSMF services, you can install and maintain all your mainframe products in a common way according to industry best practices. After configuration is complete, you can execute the product and easily provision new software instances for use on other systems throughout your environment.

End-to-end installation diagram



Prerequisites

To install Zowe using z/OSMF, ensure that you meet the following requirements:

- z/OSMF 2.5 or higher
- 1.2GB of free space

- READ access to data set names with the HLQ **ZWE** on the user ID you use to deploy the portable package

Procedure

Refer to the following subpages to guide you through the installation procedure using z/OSMF.

- Address z/OSMF Requirements
  Provides information about z/OSMF general configuration and security requirements.

- Acquire a z/OSMF Portable Software Instance
  Provides the steps to acquire the product software by downloading the z/OSMF portable software instance to the z/OSMF host. You must then register the portable software instance in z/OSMF.

- Install Product Software Using z/OSMF Deployments
  Provides the steps to install (deploy) the portable software instance to an LPAR using z/OSMF Deployments. This step creates the SMP/E environment and runs the RECEIVE, APPLY, and ACCEPT steps to prepare the software instance for SMP/E operations. This step also:

  - Customizes the data set names that are defined to SMP/E.
  - Mounts required USS files if necessary.
  - Performs workflow execution to customize the deployed runtime environment for use on a specific z/OS system.

When these tasks are completed, you are ready to install preventive maintenance.

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Acquiring a z/OSMF Portable Software Instance

As a systems programmer, you can acquire an IBM z/OSMF portable package for your product and then add the portable software instance to z/OSMF. The product SMP/E environments are pre-built, backed up, and made available for download as a z/OSMF portable software instance. After you acquire the portable software instance, you can use z/OSMF Deployments to perform the installation and z/OSMF workflows to perform post-install configuration.

When you complete the acquisition process, the product software is ready for installation using z/OSMF Deployments.

> **NOTE**
>
> Before you begin the acquisition process, ensure that you address the z/OSMF requirements.

The z/OSMF product acquisition process consists of 2 tasks.

1. Download the portable software instance from Zowe downloads and transfer the instance to the mainframe.
2. Register the portable software instance in z/OSMF.

Download the Portable Software Instance from Zowe Downloads

The portable software instance is a portable form of a software instance, including the SMP/E CSI data sets, all associated SMP/E-managed target and distribution libraries, non-SMP/E-managed data sets, and meta-data that is required to describe the product software instance.

To acquire the portable software instance, you can download it from the Zowe Downloads page and transfer the instance to a local z/OSMF host using a file transfer utility, such as FTP.

1. Go to Zowe Downloads and find **Zowe - Portable Software Instance**.
2. Download the latest version of the package to your workstation.
3. Use a file transfer utility such as an FTP client to transfer the single pax file to the mainframe.
4. Execute the JCL to unpack the installation file and restore the individual pax files.

Sample JCL:

5. Customize the sample JCL as follows and then submit for execution:

    i. Update a `JOB` statement if needed.
    ii. Update the USS directory `yourUSSpaxdirectory` with the path where the pax file is located.
    iii. Update `yourpaxfilename` with the name of the pax file that you want to restore.

> **EXPECTED RESULTS:**
>
> USSBATCH can take several minutes to execute. You will receive a return code of `0` if this job runs correctly.

After successful execution, the individual pax files are restored and ready for use. The next step is to register the Portable Software Instance in z/OSMF.

Register Portable Software Instance in z/OSMF

After you have acquired and downloaded the portable software instance to a local z/OSMF host system, it is necessary to log in to z/OSMF to register the product software and define the portable software instance to z/OSMF as shown in the following procedure. When you complete these steps, the portable software instance is registered in z/OSMF and ready for installation (deployment).

1. Log in to the z/OSMF web interface and select your user ID in the top or bottom right-hand corner to switch between the Desktop Interface and Classic Interface.
2. Complete **either** of the following steps to display the Software Management page:
    i. In the Desktop Interface, select **Software Management**.
    ii. In the Classic Interface, select **Software**, **Software Management**.
3. Select **Portable Software Instances** to define your portable software instance to z/OSMF.
4. Select **Add** from the Actions menu and select **From z/OSMF System**. The *Add Portable Software Instance* page should display.
5. Select or type the system name (destination LPAR) and UNIX directory (destination USS directory) where the portable software instance files reside and select **Retrieve**.
6. Enter a name for the new portable software instance. You can also enter an optional description and assign one or more categories that display existing packages.
7. Select **OK**.

The new portable software instance is now defined to z/OSMF, and the portable software instance is registered in z/OSMF and ready to install (deploy).

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Installing Product Software Using z/OSMF Deployments

> **SYSTEM PROGRAMMER**

After the portable software instance or software instance is registered in z/OSMF, you can use z/OSMF Deployments to install the product software and create the product data sets (global, CSI, target libraries, and distribution libraries) for the new software instance. The deployment jobs create a copy of the source product data sets to create the product target runtime environment. Creating a copy of the SMP/E target data sets keeps the SMP/E environment clean and separates the product runtime environment for maintenance activities. You can also perform z/OSMF workflows to customize the SMP/E data sets, mount UNIX System Services (USS) files if necessary, and configure the new software instance on the target system.

Prerequisite - Define a new deployment

To install Zowe PSWI using z/OSMF and make the product software available for use on a system by users and other programs, you first need to define a new deployment. This step defines the SMP/E environment name and the prefix of the CSI data set in z/OSMF. Specify data set allocation parameters for all SMP/E data sets, target libraries, and distribution libraries.

To define a new deployment, complete the deployment checklist as specified in Deploying software in the IBM documentation. Specify the following configuration elements:

- UNIX System Services path (USS path)
- Data Set Name (DNS)
- Volume Serial Numbers (VOLSERs)

Then submit the deployment jobs through the z/OSMF user interface. When the deployment is complete, you have a source and target copy of the software.

Subsequent product maintenance activities update the SMP/E environment without affecting your active product runtime environments. You can decide when to redeploy the maintenance-updated SMP/E target data sets to each of the product runtime environments.

Before installing, ensure the z/OSMF requirements are met.

Installing process

1. Display the Deployments table in z/OSMF (**Software ManagementU**, **Deployments**).
2. Define a new deployment by selecting **New** from the Actions menu. The deployment checklist displays where you can also modify, view, copy, cancel, or remove existing deployments.
3. Complete the deployment checklist items as described in *Defining new deployments* in the IBM documentation. As you complete the deployment checklist, be sure to make the following selections:

    i. Specify the properties for this deployment (name, description, and optional category).

ii. Select the software to deploy. Select **Portable Software Instance** and select your package.

iii. Select the objective for this deployment to indicate where and how you want to install the selected portable software instance. Indicate that you want to create a software instance and specify the global zone CSI and the system where the target software instance will reside.

iv. Check for missing SYSMODs and view missing SYSMOD reports. Deselect the following report options:

- Requisite SYSMODs and Fix Categories reports
- Regressed SYSMODs and HOLDDATA Delta reports

v. Configure this deployment to define the target software instance.

- For **DLIBs**, specify **Yes** to copy the distribution zones and libraries that are associated with the source software. You can customize the names and the storage class or volumes of the new data sets.
- For **Model**, indicate **The source software** to use as a model. z/OSMF uses the data sets, volumes, mount points, catalogs, and SMP/E zones that are associated with the model to specify default values for the target software instance.
- For **SMP/E Zones**, the DLIB and TLIB names do not typically need to be changed.
- For **Data sets**, change the target data set name prefix to the one that you want to use for your deployment. Specify a volume or storage class to identify where to create the target data sets.
- For **Catalogs**, no action is required assuming that your target data set prefix is defined in a user catalog.
- For **Volumes and Storage Classes**, no action is required. A summary is presented of the target data sets to be created and how much space is required.
- For **Mount Points**, review the mount points for the UNIX file system data sets that are included in the target software instance. When specifying a new target mount point, retain the static path extension in the path name to prevent failures in the configuration workflow
  Example: `_targetpathname_**/staticpathextension**`.
  Note: If your product does not include USS directories, ignore this instruction.

vi. Define the job settings to generate the JCL to install the software and view the deployment summary. Update the JOB statement as needed.

Note: If the target system for the deployment is in a JES Multi-Access Spool (MAS) and the mount point is only accessible from the target system, add a System Affinity (SYSAFF) to the job card to ensure execution on the system where the zFS resides.

vii. Submit the deployment jobs in sequential order. Wait for each job to complete, and then select **Refresh** to register job completion in z/OSMF.

> **EXPECTED RESULTS:**
> You will receive a return code of `0` if this job runs correctly. When all deployment jobs are executed successfully, you have unzipped, renamed and copied the product data sets, updated the CSI data set, and specified the properties for the target software instance.

viii. Complete **Mount Workflow** to mount the Zowe zFS. Complete both steps in the workflow. Perform the following steps to execute each step individually:

a. Click the title of the step.

b. Select the **Perform** tab.

c. Review the step contents and update the JCL if needed.

d. Select **Next**.

e. Repeat the previous two steps to complete all items until the **Finish** option is available.

ix. (Optional) To configure your Zowe instance, follow the procedure in Configuring Zowe with z/OSMF Workflows. To configure your Zowe instance specifically for API Mediation Layer, see Configuring API ML with z/OSMF Workflows.

x. Specify the name and description of the new target software instance.

> **NOTES**
>
> - All workflows that are mentioned in the previous steps are part of the PSWI.
> - You do not have to execute all workflows during PSWI provisioning in z/OSMF immediately.

The deployment process is complete. The new software instance is defined to z/OSMF. You are now ready to Import Product Information into z/OSMF before you install product maintenance.

Recommendations

Cleanup

If there is a need to update the deployment settings such as the HLQ after a previous run, note that the deployment process does not perform a full cleanup of the datasets. Before attempting job execution again, make sure the following datasets are deleted to avoid write conflicts:

For Zowe v2

For Zowe v3

If deployment options must be modified and the JCL recreated, first check the original JCL for the temporary ZFS dataset name.

Example: `<user>.SWDEPL.<random_id>.ZFS`

Delete this name manually.

> **NOTE**
>
> Note that the deployment job is unable to clean this data set name once the data set is recreated because the value for `random_id` will change.

Resources

It is recommended to update the job card to run with `REGION=0M`, particularly for job `IZUD01DZ` which unpaxes the contents.

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Installing Zowe SMP/E build with z/OSMF workflow

z/OSMF workflow simplifies the procedure to create an SMP/E environment for Zowe. Register and execute the Zowe SMP/E workflow to create SMP/E environment in the z/OSMF web interface. Perform the following steps to register and execute the Zowe workflow in the z/OSMF web interface:

1. Log in to the z/OSMF web interface.
2. Select **Workflows** from the navigation tree.
3. Select **Create Workflow** from the **Actions** menu.
4. Enter the complete path to the workflow definition file in the **Workflow Definition filed**.

   The workflow is located in the `ZWEWRF01` member of the `hlq.ZOWE.AZWE002.F4` data set.
5. (Optional) Enter the path to the customized variable input file that you prepared in advance.

   The variable input file is located in `ZWEYML01` member of the `hlq.ZOWE.AZWE002` data set.

   Create a copy of the variable input file. Modify the file as necessary according to the built-in comments. Set the field to the path where the new file is located. When you execute the workflow, the values from the variable input file override the workflow variables default values.
6. Select the system where you want to execute the workflow.
7. Select **Next**.
8. Specify the unique workflow name.
9. Select or enter an **Owner Use ID** and select **Assign all steps to owner user ID**.
10. Select **Finish**.

    The workflow is registered in z/OSMF and ready to execute.
11. Select the workflow that you registered from the workflow list.
12. Execute the steps in order.
13. Perform the following steps to execute each step individually:

    i. Double-click the title of the step.

    ii. Select the **Perform** tab.

    iii. Review the step contents and update the input values as required.

    iv. Select **Next**.

v. Repeat the previous two steps to complete all items until the option **Finish** is available.

vi. Select **Finish**.

After you execute each step, the step is marked as **Complete**. The workflow is executed.

After you complete executing all the steps individually, the Zowe SMP/E is created.

Activating Zowe

File system execution

If you mount the file system in which you have installed Zowe in read-only mode during execution, then you do not have to take further actions to activate Zowe.

Zowe customization

You can find the necessary information about customizing and using Zowe on the Zowe doc site.

- For more information about how to customize Zowe, see Configuring Zowe after installation.
- For more information about how to use Zowe, see Using Zowe.

Version: v3.2.x LTS

Installing the z/OS Build via Convenience Build (PAX file)

You can install the Zowe™ convenience build by obtaining a PAX file which is used to create the Zowe runtime environment.

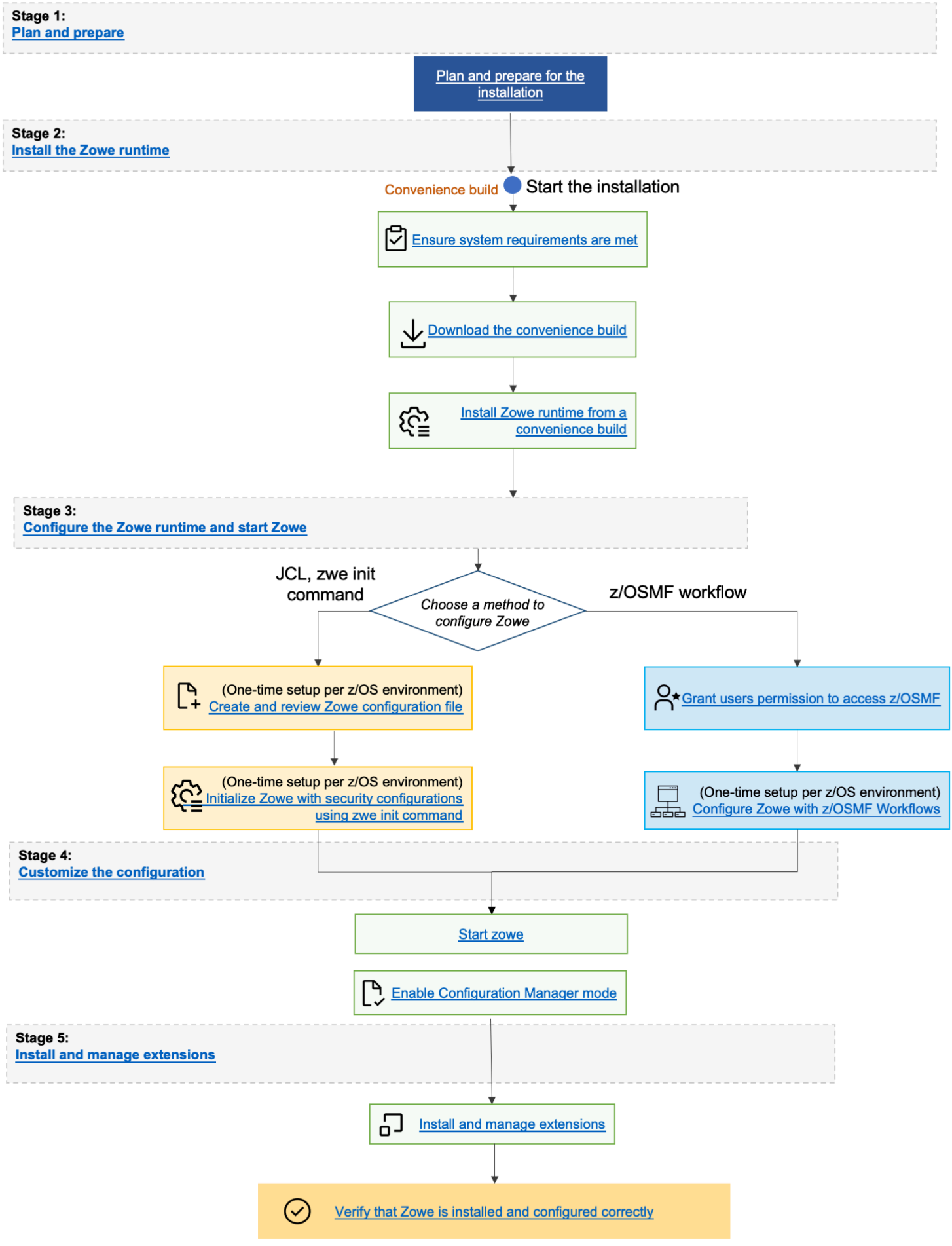
Introduction

The Zowe installation file for Zowe z/OS components is distributed as a PAX file that contains the runtimes and the scripts to install and launch the z/OS runtime. You must first obtain the PAX file and transfer this file to z/OS. To install, configure, and start Zowe, use the `zwe` command. This command defines help messages, logging options, and more. For details about how to use this command, see the ZWE Server Command Reference.

The configuration data that is read by the `zwe` command are stored in a YAML configuration file named `zowe.yaml`. Modify the `zowe.yaml` file based on your environment.

Complete the following steps to install the Zowe runtime.

End-to-end installation diagram


Stage 1:
Plan and prepare
Plan and prepare for the installation
Stage 2:
Install the Zowe runtime
Convenience build
Start the installation
Ensure system requirements are met
Download the convenience build
Install Zowe runtime from a convenience build
Stage 3:
Configure the Zowe runtime and start Zowe
JCL, zwe init command
Choose a method to configure Zowe
z/OSMF workflow
(One-time setup per z/OS environment)
Create and review Zowe configuration file
(One-time setup per z/OS environment)
Initialize Zowe with security configurations using zwe init command
Grant users permission to access z/OSMF
(One-time setup per z/OS environment)
Configure Zowe with z/OSMF Workflows
Stage 4:
Customize the configuration
Start zowe
Enable Configuration Manager mode
Stage 5:
Install and manage extensions
Install and manage extensions
Verify that Zowe is installed and configured correctly

Step 1: Obtain the convenience build

1. To download the PAX file, open your web browser on the Zowe Download website.
2. Navigate to **Zowe V3** -> **Zowe 3.v.p z/OS Convenience build** section, and select download the v3 convenience build.

Step 2: Transfer the convenience build to USS and expand it

After you download the PAX file, transfer the file to z/OS and expand the file contents.

1. Open a terminal in Mac OS or Linux, or command prompt in Windows OS, and navigate to the directory where you downloaded the Zowe PAX file.

2. Connect to z/OS using SFTP. Issue the following command:

   If SFTP is not available or if you prefer to use FTP, you can issue the following command instead:

3. Navigate to the target directory that you want to transfer the Zowe PAX file into on z/OS.

   Note: After you connect to z/OS and enter your password, enter the UNIX file system. The following commands are useful:

   - To see what directory you are in, type `pwd`.
   - To switch directory, type `cd`.
   - To list the contents of a directory, type `ls`.
   - To create a directory, type `mkdir`.

4. When you are in the directory you want to transfer the Zowe PAX file into, issue the following command:

   - `zowe-V.v.p`
     Specifies the name of the PAX file you downloaded.

   Note: When your terminal is connected to z/OS through FTP or SFTP, you can prepend commands with `l` to have them issued against your desktop. To list the contents of a directory on your desktop, type `lls` where `ls` lists contents of a directory on z/OS.

   > **TIP**
   > You can simplify `sftp` usage for the existing directory with the following command:

   After the PAX file successfully transfers, exit your `sftp` or `ftp` session.

5. Use `cd` to move into the high level directory where you want the code to be installed.

   Note: The directory may be `/usr/lpp/zowe`

6. Open a USS shell to expand the PAX file. THe command environment can be any of the following options:

- ssh terminal
- OMVS

- iShell
- Any other z/OS USS command environment.

7. Expand the PAX file by issuing the following command in the USS shell.

    - `zowe-V.v.p`
      Specifies the name of the PAX file you downloaded. When extracting the Zowe convenience build, ensure that you include the `-ppx` argument that preserves the extended attributes.

This command expands to a file structure similar to the following example:

This directory is the Zowe runtime directory, and is referred to as `<RUNTIME_DIR>` throughout this documentation.

Note: In Zowe v2, and Zowe v3 the contents of the expanded Zowe PAX file are the Zowe runtime directory.

Step 3: (Optional) Add the `zwe` command to your PATH

The `zwe` command is provided in the `<RUNTIME_DIR>/bin` directory. You can optionally add this Zowe bin directory to your `PATH` environment variable so you can execute the `zwe` command without having to fully qualify its location. To update your `PATH`, run the following command:

Replace `<RUNTIME_DIR>` with your Zowe runtime directory path. This replacement updates the `PATH` for the current shell. To make this update persistent, add the line to your `~/.profile` file, or the `~/.bashProfile` file if you are using a bash shell. To make this update system wide, update the `/etc/.profile` file. Once the `PATH` is updated, you can execute the `zwe` command from any USS directory.

Note: For the remainder of the documentation, references to the `zwe` command assumes this update to your `PATH`.

> **TIP**
> The `zwe` command has built-in help that can be retrieved with the `-h` option. For example, type `zwe -h` to display all of the supported commands. These are broken down into a number of sub-commands:

Step 4: Copy the zowe.yaml configuration file to preferred location

Copy the template file `<RUNTIME_DIR>/example-zowe.yaml` file to a new location, such as `/var/lpp/zowe/zowe.yaml` or your home directory `~/.zowe.yaml`. This file is your configuration file that contains data used by the `zwe` command throughout the lifecycle of configuring and starting Zowe. Modify the `zowe.yaml` file based on your environment.

When you execute the `zwe` command, the `-c` argument is used to pass the location of the `zowe.yaml` file.

> **TIP**
> To avoid passing `--config` or `-c` to every `zwe` commands, you can define the `ZWE_CLI_PARAMETER_CONFIG` environment variable pointing to the location of `zowe.yaml`.
>
> **Example of defining the path:**

> Once the path is defined, it is possible to enter `zwe install` as a substitute for the full command `zwe install -c /path/to/my/zowe.yaml`.

Step 5: Install the MVS data sets

After you extract the Zowe convenience build, run the `zwe install` command to install MVS data sets.

About the MVS data sets

Review the list of datasets and members in a Zowe installation in the Server Datasets Appendix.

Procedure

The high level qualifer (or HLQ) for these data sets is specified in the `zowe.yaml` section below. Ensure that you update the `zowe.setup.dataset.prefix` value to match your system.

To create and install the MVS data sets, use the command `zwe install`.

1. In a USS shell, execute the command `zwe install -c /path/to/zowe.yaml`. This creates the data sets and copies the data set content.
2. If the data sets already exist, specify `--allow-overwritten`.
3. To see the full list of parameters, execute the command `zwe install -h`.

The following example illustrates a sample run of the command using default values.

Example:

Next steps

You successfully installed Zowe from the convenience build. However, before you start Zowe, it is necessary to complete several required configurations. The next step is Initializing Zowe z/OS runtime.

Version: v3.2.x LTS

Installing Zowe via a containerization build (PAX file)

You can download Zowe (server) containers as an alternative to running Zowe servers on z/OS through the Zowe convenience and SMP/E builds. Choose the appropriate installation type for your use case.

REQUIRED ROLES: SYSTEM PROGRAMMER

Using containers for installation has the following advantages:

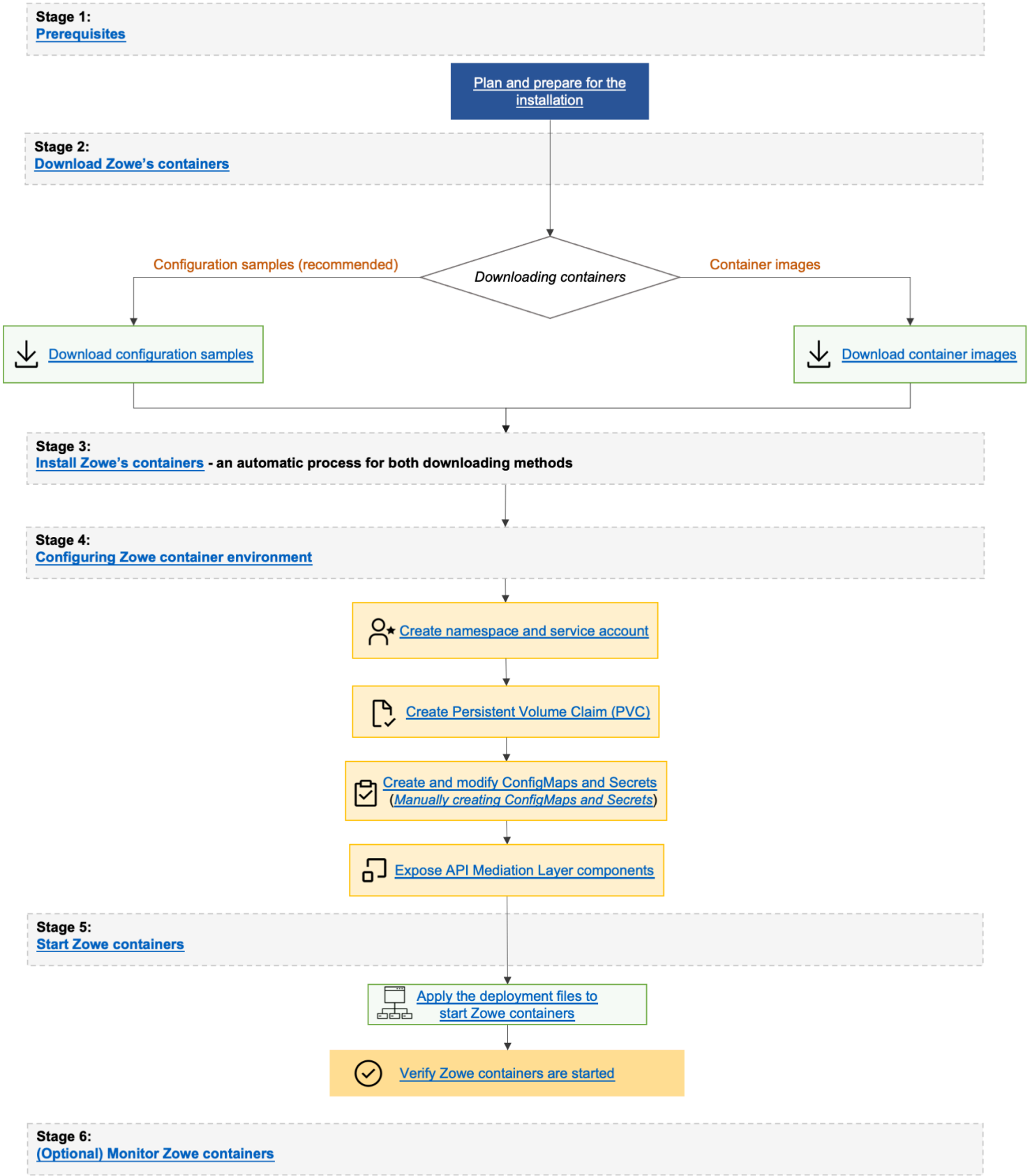
- You can run Zowe servers on other platforms including Linux on Z and your PC.
- You can run Zowe servers locally on your system for rapid development.
- You can run redundant copies of servers for scaling capacity to meet workload requirements.
- You can leverage container monitoring tools.

For more information about containers, see the Kubernetes website to learn about key concepts.

TIP

You can now perform Zowe installation via the Zowe Server Install Wizard. Using the wizard streamlines the installation process and is an alternative to performing manual Zowe server-side component installation. For more information about the wizard, see Installing Zowe via Zowe Server Install Wizard.

End-to-end container installation



Zowe containers are designed to run together with extensions and Zowe utilities, and therefore are built for orchestration software that can manage the relationship and lifecycle of the containers. The following topics guide you to set up and use Zowe's containers with the Kubernetes orchestration software.

Stage 1: Plan and prepare for the installation

Stage 1 ensures that your software and hardware are prepared for installation. For more information, see Preparing for Zowe server containers installation.

Stage 2: Download Zowe containers

In Stage 2, you download the Zowe containers. Choose from the following download methods:

- Download Configuration samples.(This is the recommended method)
- Download container images.

Stage 3 & 4: Install and configure Zowe containers

In Stage 3, you do not need to install the Zowe containers if you use Zowe's Kubernetes configuration samples. If you download container images, installation is achieved when the images are findable by Kubernetes. For more information, see the Installing section of ***Downloading and installing containers***.

In Stage 4, you can configure the Zowe container environment.
Follow these steps:

1. Create namespace and service account
2. Create Persistent Volume Claim (PVC)
3. Create and modify ConfigMaps and Secrets (Manually creating ConfigMaps and Secrets)
4. Expose API Mediation Layer components

Stage 5: Start Zowe containers

In Stage 5, you can start Zowe containers.

Follow these steps:

1. Apply the deployment files to start Zowe containers.
2. After you start Zowe containers, verify that Zowe containers are started.

(Optional) Stage 6: Monitor Zowe containers

In Stage 6, monitor your containers to verify that the containers are functioning properly.

Known limitations

- You may encounter an issue that some plugins do not appear in Zowe Desktop. We recommnend you try the **Refresh Applications** icon that appears in the Desktop start menu.
- You may encounter an issue that some services do not appear in Zowe API Catalog. We recommend you try the **Refresh Static APIs** option that appears in the upper-right corner of API Catalog web page.
- `useConfigmgr` is disabled within containers. As such yaml schema validation is not currently supported.

Version: v3.2.x LTS

Preparing for Zowe server containers installation

Before you install the Zowe server container, make sure that you have the required software and environments.

- Zowe installed on z/OS for users of ZSS and ZIS (default when you use the Zowe Application Framework `app-server`, the Zowe Desktop, or products that are based on them)
- z/OSMF installed on z/OS for users of it (default when you use `gateway`, API Mediation Layer, Web Explorers, or products that are based on them)
- A container runtime, such as:
  - Docker
  - CRI-O
  - containerd
- Kubernetes Cluster software
- kubectl, for initial setup and management of the cluster

Note: This documentation uses container terminology that may be explained within the Kubernetes Glossary.

Kubernetes cluster

The Zowe containerization solution is compatible with Kubernetes v1.19+ or OpenShift v4.6+.

You can prepare a Kubernetes cluster based on your requirements in many different ways.

- For development purposes, you can set up a Kubernetes cluster on your local computer in one of the following ways:
  - Enable Kubernetes shipped with Docker Desktop
  - Set up minikube

  Attention! You must make sure that the Kubernetes cluster you have created has a minimum RAM of 3GB in order for Zowe to start.
- For production purposes, you can set up a Kubernetes cluster in one of the following ways:
  - Bootstrap your own cluster by following instructions in Installing Kubernetes with deployment tools in the Kubernetes documentation.
  - Provision a Kubernetes cluster from popular Cloud vendors:
    - Amazon Elastic Kubernetes Service
    - Microsoft Azure Kubernetes Service
    - IBM Cloud Kubernetes Service
    - Google Cloud Kubernetes Engine

`kubectl` tool

You need `kubectl` CLI tool installed on your local computer where you want to manage the Kubernetes cluster. For instructions on how to install the kubectl tool, see Install Tools in the Kubernetes documentation.

Version: v3.2.x LTS

Downloading and installing Zowe containers

Learn how to download and install Zowe's containers.

Downloading

You can download Zowe's containers in one of the following ways:

- Downloading configuration samples
- Downloading container images

Downloading configuration samples

The easiest way to install and run Zowe's containers is by using the configuration samples that are provided on Zowe's website. If you don't already have these samples, you can download them by completing the following tasks:

1. Download Zowe containerization build from zowe.org.
2. Extract the compressed file to the system where you will run the Zowe containers.
3. Find the samples within the extracted folder `kubernetes`.

Downloading container images

Downloading Zowe's container images manually is not required because this can be done automatically when applying a Kubernetes deployment configuration.

If wanted, you can download Zowe's container images manually by using the `docker pull` commands. This allows you to get an image from a registry or attach an image that you have downloaded directly. You can find Zowe's container images in https://zowe.jfrog.io/ui/repos/tree/General/docker-release%2Fompzowe:

- **Registry**: zowe-docker-release.jfrog.io
- **Organization**: ompzowe

Full image addresses include,

- `zowe-docker-release.jfrog.io/ompzowe/gateway-service:latest-ubuntu`
- `zowe-docker-release.jfrog.io/ompzowe/app-server:latest-ubuntu`
- `zowe-docker-release.jfrog.io/ompzowe/explorer-jes:latest-ubuntu`

Therefore, you can download these manually with the `docker pull` commands. For example,

`docker pull zowe-docker-release.jfrog.io/ompzowe/app-server:latest-ubuntu`

Installing

You do not need to install the Zowe containers if you use Zowe's Kubernetes configuration samples. By default, these sample configurations will pull Zowe component images from the public Zowe docker release registry `zowe-docker-`

`release.jfrog.io` directly and then start them. Your Kubernetes nodes require an Internet connection that can reach this registry.

An image could be considered "installed" when it is findable by Kubernetes. Just like downloading, this is done automatically by Kubernetes but commands such as `docker pull` or `docker load` accomplishes the same task.

Upgrading

Upgrade is an automatic process when you apply Kubernetes deployment configuration. The configuration files tell Kubernetes to automatically download the latest version of Zowe. Here, `latest` is the keyword for constantly updated version. For example `zowe-docker-release.jfrog.io/ompzowe/gateway-service:latest-ubuntu`.

Note: Automatic upgrades can fail if you have changed the workload configuration files to use a specific Zowe version. In that case, you must enter the latest version manually in the configuration file such as `zowe-docker-release.jfrog.io/ompzowe/gateway-service:2.0.0-ubuntu`.

If your Kubernetes nodes do not have an Internet connection, you can follow the instruction of the previous step to manually pull all images into all your Kubernetes nodes. After you have done this, you need to modify all occurrences of `imagePullPolicy: Always` in the sample configurations and replace them with `imagePullPolicy: Never` before applying them.

Version: v3.2.x LTS

Configuring Zowe containers

Zowe provides sample configurations that make it easy for you to run Zowe in Kubernetes. You can use them directly or as a reference.

You can customize the configuration or make your own. If you do so, note the following objects that are expected by the container deployments:

Kind	Name	Note
Namespace	zowe	
ServiceAccount	zowe-sa	
ConfigMap	zowe-certificates-cm	Contains `zowe-certificates.env` with the same format as seen on z/OS keystore
Secret	zowe-certificates-secret	Contains the base64 PEM and P12 data for keystore and truststore
Ingress	discovery-ingress	Used for external access to the Discovery service
Ingress	gateway-ingress	Used for external access to the Gateway service
Route	discovery	Used for external access to the Discovery service
Route	gateway	Used for external access to the Gateway service
Service	discovery-service	Used for internal or external access to the Discovery service
Service	gateway-service	Used for external access to the Gateway service
Service	catalog-service	Used for access to the Catalog service
PersistentVolumeClaim	zowe-workspace-pvc	
HorizontalPodAutoscaler	*	Autoscalers exist for the various pods
PodDisruptionBudget	*	Disruption budgets exist for the various pods

To configure the Zowe container environment, complete the following procedure.

1. Create namespace and service account

Run the following commands to create Zowe's Namespace `zowe` with Service Account `zowe-sa`.

Note that by default, `zowe-sa` service account has `automountServiceAccountToken` disabled for security purposes.

Verification

To verify, check the following configurations.

- `kubectl get namespaces` should show a Namespace `zowe`.

  This displays the default Namespace zowe, if not set.

- `kubectl get serviceaccounts --namespace zowe` should show a ServiceAccount `zowe-sa`.

  This displays the default ServiceAccount zowe-sa, if not set.

2. Create Persistent Volume Claim (PVC)

Zowe's PVC has a default StorageClass value that may not apply to all Kubernetes clusters. Check and customize the `storageClassName` value of `samples/workspace-pvc.yaml` as needed. You can use `kubectl get sc` to confirm which StorageClass you can use.

After you customize the `storageClassName` value, apply the result by issuing the following commands:

Verification

To verify, run the following commands and check if the `STATUS` of line item `zowe-workspace-pvc` shows as `Bound`.

> **IMPORTANT:**
>
> `zowe-workspace-pvc` `PersistentVolumeClaim` must be declared in access mode `ReadWriteMany` to allow the workspace be shared by all Zowe components.

In some Kubernetes environment, you may need to define `PeristentVolume` and define `volumeName` in `PersistentVolumeClaim` instead of defining `storageClassName`. Please consult your Kubernetes administrator to confirm the appropriate way for your environment. This is an example to configure `PersistentVolumeClaim` with pre-configured `zowe-workspace-pv` `PeristentVolume`.

3. Create and modify ConfigMaps and Secrets

Similarly, to run Zowe services on z/OS, you can use the Zowe `zowe.yaml` configuration file to customize Zowe in Kubernetes.

You can modify `samples/config-cm.yaml` and `samples/certificates-secret.yaml` directly. Or more conveniently, if you have Zowe ZSS/ZIS running on z/OS, the Kubernetes environment can reuse instance and keystore configuration from that installation. Ensure that the verify certificate setting of your existing keystore configuration is set to `STRICT` mode. Otherwise, update your `zowe.yaml` configuration file to change the setting to `STRICT` mode and generate a new set of certificates.

If you want to manually create, or later customize the ConfigMaps and Secrets, see Customizing or manually creating ConfigMaps and Secrets for details.

To create and modify ConfigMaps and Secrets by using the migrate configuration script, complete the following steps:

a. To make Zowe v2 certificates work in Kubernetes, in your `zowe.yaml` (in runtime directory), you need to:

- set `zowe.verifyCertificate` to `STRICT` mode.
- set `zowe.setup.certificate.pkcs12.caAlias`. Default alias is `local_ca`.
- set `zowe.setup.certificate.pkcs12.caPassword`. Default CA password is `local_ca_password`.
- make sure the certificate that you are using have defined the following domains in certificate Subject Alt Name (SAN):
  - your external domains to access Zowe APIML Gateway Service running in Kubernetes cluster
  - `*.<k8s-namespace>.svc.<k8s-cluster-name>`
  - `*.discovery-service.<k8s-namespace>.svc.<k8s-cluster-name>`
  - `*.gateway-service.<k8s-namespace>.svc.<k8s-cluster-name>`
  - `*.<k8s-namespace>.pod.<k8s-cluster-name>`

  where,

  - `<k8s-namespace>` is the Kubernetes Namespace you installed Zowe into
  - `<k8s-cluster-name>` is the Kubernetes cluster name, which usually should be `cluster.local`. Note that the following command will automatically add the k8s internal domain into SAN.

Next, on z/OS, run the following command:

For more detailed explaination of zwe migrate command parameters, see zwe migrate for kubernetes.

As a result, it displays ConfigMaps `zowe-config` and Secrets (`zowe-certificates-secret`) Kubernetes objects which are based on the Zowe instance and keystore used. The content looks similar to `samples/config-cm.yaml` and `samples/certificates-secret.yaml` but with real values.

b. Follow the instructions in the script output to copy the output and save it as a YAML file `configs.yaml` on your computer where you manage Kubernetes.

c. Apply the file into Kubernetes:

d. Remove the previously saved `configs.yaml` file from all systems for security.

Verification

To verify, run the following commands and check the results.

- `kubectl get configmaps --namespace zowe`

  This command must display the two ConfigMaps `zowe-config` and `zowe-certificates-cm`.

- `kubectl get secrets --namespace zowe`

  This command must display a Secret `zowe-certificates-secret`.

4. Expose API Mediation Layer components

This step makes Zowe's Gateway, Discovery, and API Catalog servers available over a network.

The Gateway is always required to be externally accessible, and depending upon your environment the Discovery service may also need to be externally accessible.

The actions you need to take in this step vary depending upon your Kubernetes cluster configuration. If you are uncertain about this section, please contact your Kubernetes administrator or the Zowe community.

4a. Create service

You can set up either a `LoadBalancer` or `NodePort` type Service.

Note: Because `NodePort` cannot be used together with `NetworkPolicies`, `LoadBalancer` and `Ingress` is preferred configuration option.

Review the following table for steps you may take depending on the Kubernetes provider you use. If you don't need additional setups, you can skip steps 4b, 4c and jump directly to the Apply zowe section.

Kubernetes provider	Service	Additional setups required
minikube	LoadBalancer or NodePort	Port Forward (on next section Starting, stopping, and monitoring)
docker-desktop	LoadBalancer	none
bare-metal	LoadBalancer or NodePort	Create Ingress
cloud-vendors	LoadBalancer	none
OpenShift	LoadBalancer or NodePort	Create Route

Defining api-catalog service

`api-catalog-service` is required by Zowe, but not necessarily exposed to external users. Therefore, `api-catalog-service` is defined as type `ClusterIP`.

To define this service, run the command:

To verify, You should see the following output:

Then, you can proceed with creating the Gateway and Discovery services according to your environment.

Applying Gateway Service

If using `LoadBalancer`, run the command:

Or if using `NodePort` instead, first check `spec.ports[0].nodePort` as this will be the port to be exposed to external. In this case, the default gateway port is not 7554 but 32554. You will need to use `https://<your-k8s-node>:32554/` to access APIML Gateway. To apply `NodePort` type `gateway-service`, run the following command:

To verify either case, run the following command and check that the command displays the service `gateway-service`.

Applying Discovery service

Exposing the Discovery service is only required when there is a Zowe service or extension which needs to be registered to the API Mediation Layer but is running outside of Kubernetes, such as on z/OS. Otherwise, the discovery service can remain accessible only within the Kubernetes environment.

Optional: To set up the discovery service without exposing it externally, edit `samples/discovery-service-lb.yaml` if using `LoadBalancer` type services, or `samples/discovery-service-np.yaml` if using `NodePort` type services. In either file, specify `ClusterIP` as the type, replacing the `NodePort` or `LoadBalancer` value.

To enable the service externally when using `LoadBalancer` services, run the command:

Or if using `NodePort` instead, first check `spec.ports[0].nodePort` as this will be the port to be exposed to external. In this case, the default discovery port is not 7553 but 32553. And you will need to use `https://<your-k8s-node>:32553/` to access APIML Discovery. To apply `NodePort` type `discovery-service`, run the following command:

To verify either case, run the following command and check that this command displays the service `discovery-service`:

```
kubectl get services --namespace zowe
```

Upon completion of all the preceding steps in this 4a. Create service section, you may need to run additional setups. Refer to "Additional setups required" in the table. If you don't need additional setups, you can skip 4b, 4c, 4d, and jump directly to Apply Zowe section.

4b. Create Ingress (Bare-metal)

An Ingress gives Services externally-reachable URLs and may provide other abilities such as traffic load balancing.

To create Ingress, perform the following steps:

a. Edit `samples/gateway-ingress.yaml` and `samples/discovery-ingress.yaml` before applying them, by uncommenting the lines (19 and 20) for defining `spec.rules[0].host` and `http:`, and then commenting out the line below, `- http:`

b. Run the following commands:

To verify, run the following commands:

```
kubectl get ingresses --namespace zowe
```

This command must display two Ingresses `gateway-ingress` and `discovery-ingress`.

Upon completion, you can finish the setup by applying zowe and starting it.

4c. Create Route (OpenShift)

If you are using OpenShift and choose to use `LoadBalancer` services, you may already have an external IP for the service. You can use that external IP to access Zowe APIML Gateway. To verify your service external IP, run:

If you see an IP in the `EXTERNAL-IP` column, that means your OpenShift is properly configured and can provision external IP for you. If you see `<pending>` and it does not change after waiting for a while, that means you may not be able to use `LoadBalancer` services with your current configuration. Try `ClusterIP` services and define `Route`. A Route is a way to expose a service by giving it an externally reachable hostname.

To create a route, perform the following steps:

a. Check and set the value of `spec.port.targetPort` in `samples/gateway-route.yaml` and `samples/discovery-route.yaml` before applying the changes.

b. Run the following commands:

To verify, run the following commands:

```
oc get routes --namespace zowe
```

This command must display the two Services `gateway` and `discovery`.

Upon completion, you can finish the setup by applying zowe and starting it.

Customizing or manually creating ConfigMaps and Secrets

The z/OS to k8s convert tool can automatically create a config map and secret. However, if you want to customize or create your own, review the instructions in this section.

To make certificates work in Kubernetes, make sure the certificate you are using have defined the following domains in certificate Subject Alt Name (SAN):

- your external domains to access Zowe APIML Gateway Service running in Kubernetes cluster
- `*.<k8s-namespace>.svc.<k8s-cluster-name>`
- `*.discovery-service.<k8s-namespace>.svc.<k8s-cluster-name>`
- `*.gateway-service.<k8s-namespace>.svc.<k8s-cluster-name>`
- `*.<k8s-namespace>.pod.<k8s-cluster-name>`

`<k8s-namespace>` is the Kubernetes Namespace you installed Zowe into. And `<k8s-cluster-name>` is the Kubernetes cluster name, which usually should be `cluster.local`.

Without the additional domains in SAN, you may see warnings/errors related to certificate validation.

> **⚠ CAUTION**
>
> It's not recommended to disable `zowe.verifyCertificates`.

Notes: When the following conditions are true, this migration script will regenerate a new set of certificates for you with proper domain names listed above.

- You use `zwe init` command to initialize Zowe

- You use `PKCS#12` format keystore by defining `zowe.setup.certificate.type: PKCS12`
- You did not define `zowe.setup.certificate.pkcs12.import.keystore` and let `zwe` command to generate PKCS12 keystore for you
- You enabled `STRICT` mode `zowe.verifyCertificates`

To manually create the ConfigMaps and Secrets used by Zowe containers, you must create the following objects:

1. A ConfigMap, with values based upon a Zowe configuration `zowe.yaml` and similar to the example `samples/config-cm.yaml` with the following differences to the values seen on a z/OS installation:

   - `zowe.setup` and `haInstances` are not needed for Zowe running in Kubernetes and will be ignored. You can remove them.
   - `java.home` and `node.home` are not usually needed if you are using Zowe base images.
   - `zowe.runtimeDirectory` must be set to `/home/zowe/runtime`.
   - `zowe.externalDomains` is suggested to define as a list of domains you are using to access your Kubernetes cluster.
   - `zowe.externalPort` must be the port you expose to end-user. This value is optional if it's same as default APIML Gateway service port `7554`. With default settings,
     - if you choose `LoadBalancer` `gateway-service`, this value is optional, or set to `7554`,
     - if you choose `NodePort` `gateway-service` and access the service directly, this value should be same as `spec.ports[0].nodePort` with default value `32554`,
     - if you choose `NodePort` `gateway-service` and access the service through port forwarding, the value should be the forwarded port you set.
   - `components.discovery.replicas` should be set to same value of `spec.replicas` defined in `workloads/discovery-statefulset.yaml`.
   - All components running in Kubernetes should use default ports:
     - `components.api-catalog.port` is `7552`,
     - `components.discovery.port` is `7553`,
     - `components.gateway.port` is `7554`,
     - `components.caching-service.port` is `7555`,
     - `components.app-server.port` is `7556`.
   - `components.caching-service.storage.mode` should NOT be set to `VSAM`. `redis` is suggested. Follow Redis configuration documentation to customize other Redis related variables. Leave the value to empty for debugging purposes.
   - Must append and customize these 2 values into `zowe.environments` section:
     - `ZWED_agent_host=<ZOWE_ZOS_HOST>`
     - `ZWED_agent_https_port=<ZOWE_ZSS_SERVER_PORT>`

2. A Secret, with values based upon a Zowe keystore's files, and similar to the example `samples/certificates-secret.yaml`.

   You need 2 entries under the `data` section:

   - `keystore.p12`: which is base64 encoded PKCS#12 keystore,
   - `truststore.p12`: which is base64 encoded PKCS#12 truststore.

   And 3 entries under `stringData` section:

- `keystore.key`: is the PEM format of certificate private key,
- `keystore.cer`: is the PEM format of the certificate,
- `ca.cer`: is the PEM format of the certificate authority.

`PodDisruptionBudget`

Zowe provides optional `PodDisruptionBudget` which can provide high availability during upgrade. By default, Zowe defines `minAvailable` to be `1` for all deployments. This configuration is optional but recommended. To apply `PodDisruptionBudget`, run this command:

To verify this step, run:

This should show you a list of `PodDisruptionBudget` like this:

`HorizontalPodAutoscaler`

Zowe provides optional `HorizontalPodAutoscaler` which can automatically scale Zowe components based on resource usage. By default, each workload has a minimum of 1 replica and a maximum of 3 to 5 replicas based on CPU usage. This configuration is optional but recommended. `HorizontalPodAutoscaler` relies on Kubernetes Metrics server monitoring to provide metrics through the Metrics API. To learn how to deploy the metrics-server, see the metrics-server documentation. Please adjust the `HorizontalPodAutoscaler` definitions based on your cluster resources, then run this command to apply them to your cluster:

To verify this step, run:

This should show you a list of `HorizontalPodAutoscaler` like this:

Kubernetes v1.21+

If you have Kubernetes v1.21+, several optional changes are recommended based on Deprecated API Migration Guide.

- Kind `CronJob`: change `apiVersion: batch/v1beta1` to `apiVersion: batch/v1` on `workloads/zowe-yaml/cleanup-static-definitions-cronjob.yaml` and `workloads/instance-env/cleanup-static-definitions-cronjob.yaml`. `apiVersion: batch/v1beta1` will stop working on Kubernetes v1.25.
- Kind `PodDisruptionBudget`: change `apiVersion: policy/v1beta1` to `apiVersion: policy/v1` on all files in `samples/pod-disruption-budget/`. `apiVersion: policy/v1beta1` will stop working on Kubernetes v1.25.

Version: v3.2.x LTS

Starting, stopping, and monitoring Zowe containers

After Zowe's containers are installed and configured, you can refer to the following topics that help you manage your installation.

Starting Zowe containers

The Kubernetes cluster will automatically start as many containers as needed per service according to the Deployment configuration.

To apply the deployment files, run this command:

Port forwarding (for minikube only)

Kubectl port-forward allows you to access and interact with internal Kubernetes cluster processes from your localhost. For debugging or development, you might want to port forward to make Zowe gateway or discovery service available externally quickly.

Before issuing port forward commands, make sure that gateway and discovery services pods are running. You can run `kubectl get pods -n zowe` and check if the `STATUS` of both `discovery-*` and `gateway-*` is `RUNNING`. If not, you may have to wait.

Once both `STATUS` shows `RUNNING`, run the following command to port forward:

The `&` sign at the command will run the command as a background process. Otherwise, the port forward process will occupy the terminal indefinitely until canceled as a foreground service.

Verifying Zowe containers

The containers will start soon after applying the deployments.

To verify:

1. `kubectl get deployments --namespace zowe`

   This command must show you a list of deployments including `explorer-jes`, `gateway-service`, `app-server`, etc. Each deployment should show `1/1` in `READY` column. It could take a moment before all deployments say `1/1`.

2. `kubectl get statefulsets --namespace zowe`

   This command must show you a StatefulSet `discovery` which `READY` column should be `1/1`.

3. `kubectl get cronjobs --namespace zowe`

   This command must show you a CronJob `cleanup-static-definitions` which `SUSPEND` should be `False`.

Monitoring Zowe containers

You can monitor Zowe containers using a UI or CLI.

Monitoring Zowe containers via UI

Kubernetes provides a container that allows you to manage your cluster through a web browser. When using Docker Desktop, it is already installed in the namespace `kubernetes-dashboard`. See the Kubernetes website for install instructions.

Metrics Server is also recommended and is required if you want to define Horizontal Pod Autoscaler. Check if you have `metrics-server` `Service` in `kube-system` namespace with this command `kubectl get services --namespace kube-system`. If you don't have it, you can follow this Installation instruction to install it.

Monitoring Zowe containers via CLI

`kubectl` allows you to see the status of any kind of object with the `get` command. This applies to the table in the Configuring article but also for the pods that run the Zowe containers.

Here are a few commands you can use to monitor your environment:

- `kubectl get pods -n zowe` lists the status of the components of Zowe.
- `kubectl describe pods -n zowe <podid>` can see more details about each pod.
- `kubectl logs -n zowe <podid>` will show you the terminal output of a particular pod, with `-f` allowing you to keep the logs open as new messages are added.
- `kubectl get nodes -n zowe -owide` will tell you more about the environment you're running.

Stopping, pausing or removing Zowe containers

To temporarily stop a component, locate the `Deployment` component and scale down to `0`. For example, if you want to stop the `api-catalog` container, run this command:

You can later re-enable a component by scaling the component back to 1 or more.

If you want to permanently remove a component, you can delete the component `Deployment`. To use `api-catalog` as an example, run this command:

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Configuring Overview

Review this article for an overview of the procedures that must be performed to configure Zowe z/OS components and the z/OS system. More details about the individual procedures are provided in the articles in this section.

> **REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR**

Configuring Zowe z/OS components consists of the following four main steps:

1. Configure Zowe runtime
2. Configure the z/OS system for Zowe
3. Assign security permissions
4. Configure the Zowe cross memory server (ZIS)

> **NOTE**
>
> Successful completion of steps 2, 3, and 4 may require elevated security permissions. We recommend you consult with your security administrator to assist with performing these steps.

Configuring Zowe runtime

To cofigure Zowe runtime, choose from the following options:

- **Option 1: Configure Zowe manually using the `zwe init` command group**
  To run the `zwe init` command, it is necessary to create a Zowe configuration file. For more information about this file, see the Runtime directory which details all of the started tasks in the article *Preparing for installation*.

  Once your configuration file is prepared, see Configuring Zowe with zwe init, for more information about using the `zwe init` command group.

- **Option 2: Configure Zowe via JCL** You can configure Zowe by directly customizing JCLs. The Zowe Runtime Dataset `SZWESAMP` contains JCL samples that have templates referencing `zowe.yaml` parameters. These samples should not be submitted without modification.

  For more information, see Configuring Zowe via JCL

- **Option 3: Configure Zowe with z/OSMF workflows**
  You can execute the Zowe configuration workflow either from a PSWI during deployment, or later from a created software instance in z/OSMF. Alternatively, you can execute the configuration workflow z/OSMF during the workflow registration process.

  For more information about configuring all Zowe server-side components, see Configuring Zowe with z/OSMF Workflows.

  To simplify configuration for Zowe API Mediation Layer, see Configuring API ML with z/OSMF Workflows.

Configuring the z/OS system for Zowe

Configuration of the z/OS system is dependent on the specific Zowe features and functionalities you would like to employ with your Zowe installation.

> **TIP**
>
> Note that configuring the z/OS system requires elevated permissions. We recommend you consult with your security administrator to perform the reqired steps to configure the z/OS system.

For more information, see Configuring the z/OS system for Zowe.

Assigning security permissions

Specific user IDs with sufficient permissions are required to run or access Zowe. Your organization's security administrator is responsible to assign user IDs during Zowe z/OS component configuration.

In addition, each TSO user ID that logs on to Zowe services that require z/OSMF must have permissions to access these z/OSMF services. This user ID should be added to either `IZUUSER` or `IZUADMIN` (default).

> **TIP**
>
> Granting users permissions requires elevated permissions. We recommend you consult with your security administrator to grant these user permissions.

For more information about granting the user permissions, see Assigning security permissions to users.

Configuring the Zowe cross memory server (ZWESISTC)

The Zowe cross memory server (ZIS), provides privileged cross-memory services to the Zowe Desktop and runs as an APF-authorized program. The same cross memory server can be used by multiple Zowe desktops. The cross memory server is needed to be able to log on to the Zowe desktop and operate its apps such as the Code Editor.

For more information, see Configuring the Zowe cross memory server (ZIS).

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Initializing Zowe z/OS runtime

Begin configuration of your installation of Zowe z/OS components by initializing Zowe z/OS runtime.

> **REQUIRED ROLES: SYSTEM PROGRAMMER**

Use one of the following options to initialize Zowe z/OS runtime:

- Initialize Zowe maunually using zwe init command group
- Configure Zowe with z/OSMF workflows

Initialize Zowe manually using zwe init command group

After your installation of Zowe runtime, you can run the `zwe init` command to perform the following configurations:

- Initialize Zowe with copies of data sets provided with Zowe
- Create user IDs and security manager settings (Security Admin)
- Provide APF authorize load libraries (Security Admin)
- Configure Zowe to use TLS certificates (Security Admin)
- Configure VSAM files to run the Zowe caching service used for high availability (HA)
- Configure the system to launch the Zowe started task

For more information about this z/OS runtime initialization method, see Configuring Zowe with zwe init

Configure Zowe with z/OSMF workflows

Another option to initialize Zowe z/OS runtime is to configure Zowe with z/OSMF workflows. This method also performs the initization using the `zwe init` command group. You can use z/OSMF workflows to perform the following configurations:

- Configure the Zowe instance directory
- Enable the API ML gateway
- Enable the API catalog
- Enable automatic discovery
- Enable a caching service
- Enable an application server
- Enable the ZSS component
- Enable JES Explorer
- Enable MVS Explorer
- Enable USS Explorer

You can execute the Zowe configuration workflow either from a PSWI during deployment, or later from a created software instance in z/OSMF. Alternatively, you can execute the configuration z/OSMF workflow during the workflow registration process.

For more information about this z/OS runtime initialization method, see Configuring Zowe with z/OSMF Workflows.

For details about API ML optimized initialization, see Configuring API ML with z/OSMF Workflows.

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Configuring Zowe with zwe init

Once you complete the installation of the Zowe runtime, begin configuration by initializing Zowe with proper security configurations. To simplify this configuration process, one option is to run the `zwe init` command. This step is common for installing and configuring Zowe from either a convenience build or from an SMP/E build.

> **REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR**

About the `zwe init` command

The `zwe init` command is a combination of the following subcommands. Each subcommand defines a configuration.

- **mvs** Copies the data sets provided with Zowe to custom data sets.
- **security** Creates the user IDs and security manager settings.
- **apfauth** APF authorizes the LOADLIB containing the modules that need to perform z/OS privileged security calls.
- **certificate** Configures Zowe to use TLS certificates.
- **stc** Configures the system to launch the Zowe started task.
- (Deprecated) **vsam** Configures the VSAM files needed if the Caching service is set to VSAM mode. This is not required nor the default, and exists for compatibility.

> **RECOMMENDATION:**
>
> We recommend you to run these sub commands one by one to clearly see the output of each step. To successfully run `zwe init security`, `zwe init apfauth`, and `zwe init certificate`, it is likely that your organization requires elevated permissions. We recommend you consult with your security administrator to run these commands. For more information about tasks for the security administrator, and details about the `zwe init security` command, see the section Configuring security in this configuration documentation

> **TIP**
>
> Enter `zwe init --help` to learn more about the command or see the `zwe init` command reference for detailed explanation, examples, and parameters.

zwe init arguments

The following `zwe init` arguments can assist you with the initization process:

- **--update-config**
  This argument allows the init process to update your configuration file based on automatic detection and your `zowe.setup` settings. For example, if `java.home` and `node.home` are not defined, they can be updated based on the information that is collected on the system. `zowe.certificate` section can also be updated automatically based on your `zowe.setup.certificate` settings.

- **--allow-overwrite**
  This argument allows you to rerun the `zwe init` command repeatedly regardless of whether some data sets are already created.
- **-v** or **--verbose**
  This argument provides execution details of the `zwe` command. You can use it for troubleshooting purposes if the error message is not clear enough.
- **-vv** or **--trace**
  This argument provides you more execution details than the `--verbose` mode for troubleshooting purposes.

Zowe initilization command

The `zwe init` command runs the subcommands in sequence automatically. If you have the Zowe configuration file preparted and have security administrator privileges, or security and certificates setup was already completed on the system, you can run the following command:

> **NOTE**
>
> For more information about the individual `zwe init` subcommands, see zwe init subcommand overview.

> **VALIDATE SUCCESSFUL INITIALIZATION**
>
> Output from the execution of this command indicates the command ran successfully. However, to determine if each of the subcommands ran successfully, check the full output log. Failed execution of some subcommands may be the result of insufficient user permissions. Consult with your security administrator to find out if elevated permissions are required to successfully execute some of the `zwe init` subcommands.
>
> For more information about security administrator tasks, see:
>
> - Addressing security requirements
> - Configuring security
> - Configuring certificates

Next steps

For detailed information about individual `zwe init` subcommands, see zwe init subcommand overview.

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zwe init subcommand overview

Review this article to learn about the individual subcommands executed in `zwe init`. Based on your use case, you may choose to run the subcommands of `zwe init` individually rather than running all of these commands together. Review this article to get started with using `zwe init` subcommands.

> **IMPORTANT**
>
> Some of the following `zwe init` subcommands require elevated permissions. See the required roles associated with each of these commands.

- Initializing Zowe custom data sets (`zwe init mvs`)
  - Procedure to initialize Zowe custom data sets
- Initializing Zowe security configurations (`zwe init security`)
- Performing APF authorization of load libraries (`zwe init apfauth`)
- Configuring Zowe to use TLS certificates (`zwe init certificate`)
- Installing Zowe main started tasks (`zwe init stc`)

Initializing Zowe custom data sets (`zwe init mvs`)

Use the `zwe init mvs` command to intialize Zowe custom MVS data sets.

> **REQUIRED ROLE: SYSTEM PROGRAMMER**

During the installation of Zowe, the following three data sets are created and populated with members copied across from the Zowe installation files:

- `SZWEAUTH`
- `SZWESAMP`
- `SZWEEXEC`

The contents of these data sets represent the original files that were provided as part of the Zowe installation and are not meant to be modified.

For modification and execution, it is necessary to create custom data sets by using the `zwe init mvs` command. For detailed information about this command, see the `zwe init mvs` command reference.

The following `zowe.yaml` section contains the parameters for the data set names:

Review the following table for storage requirements for the three data sets:

Library DDNAME	Member Type	zowe.yaml	Target Volume	Type	Org	RECFM	LRECL	No 33 Tr
CUST.PARMLIB	PARM Library Members	zowe.setup.dataset.parmlib	ANY	U	PDSE	FB	80	15
CUST.JCLLIB	JCL Members	zowe.setup.dataset.jcllib	ANY	U	PDSE	FB	80	15
CUST.ZWESAPL	CLIST copy utilities	zowe.setup.dataset.authPluginLib	ANY	U	PDSE	U	0	15

Procedure to initialize Zowe custom data sets

To initialize Zowe custom data sets, run the following command:

The following output is an example of running `zwe init mvs`.

Example:

Successful execution of `zwe init mvs` has the following results:

- In the `zowe.yaml` file, three custom data sets are created that have matching values with the following libraries:
  - `zowe.setup.dataset.parmlib`
  - `zowe.setup.dataset.jcllib`
  - `zowe.setup.dataset.authPluginLib`.
- The member `ZWESIP00` is contained in `CUST.PARMLIB`. `JCLLIB` and `ZWESAPL` are empty.
- The PDS `SZWEAUTH` is created. If `SZWEAUTH` already exists, the following error is thrown:

  You can ignore this message, or you can use the `--allow-overwritten` option on the command. For example, `zwe init mvs -c zowe.yaml --allow-overwritten`.

Initializing Zowe security configurations (`zwe init security`)

This subcommand creates the user IDs and security manager settings.

> **REQUIRED ROLE: SECURITY ADMINISTRATOR**

If Zowe has already been launched on a z/OS system from a previous release of Zowe v2 or later, you can skip this security configuration step unless told otherwise in the release documentation.

The JCL member `.SZWESAMP(ZWESECUR)` is provided to assist with the security configuration. Before submitting the `ZWESECUR` JCL member, customize this member to match site security rules. For script driven scenarios, you can run the command `zwe init security` which uses `ZWESECUR` as a template to create a customized member in `.CUST.JCLLIB`. This member contains the commands required to perform the security configuration.

For more information about `zwe init security`, see:

- *Configure with `zwe init security` command* in Configuring security.
- `zwe init security` in the Reference section.

> **TIP**
>
> To avoid having to run the `init security` command, you can specify the flag `--security-dry-run`. This flag enables you to construct a JCL member containing the security commmands without running the member. This is useful for previewing commands and can also be used to copy and paste commands into a TSO command prompt for step by step manual execution.
>
> **Example:**
>
> For production environments, inform your security administrator to re-submit the `init security` command with proper authorization.

Performing APF authorization of load libraries (`zwe init apfauth`)

Zowe contains load modules that require access to make privileged z/OS security manager calls. These load modules are held in two load libraries which must be APF authorized.

> **REQUIRED ROLES: SECURITY ADMINISTRATOR**

The command `zwe init apfauth` reads the PDS names for the following load libraries from zowe.yaml and performs the APF authority commands.

- **zowe.setup.dataset.authLoadLib**
  Specifies the user custom load library, containing the ZWELNCH, ZWESIS01 and ZWESAUX load modules. These are the Zowe launcher, the ZIS cross memory server and the auxiliary server.
- **zowe.setup.dataset.authPluginLib**
  References the load library for ZIS plugins.

For more information about `zwe init apfauth` see:

- Performing APF authorization of load libraries.
- `zwe init apfauth` in the Reference section.

> **TIP**
>
> To avoid having to run the `init apfauth` command, you can specify the flag `--security-dry-run` as in the following example.

Example:

For production environments, inform your security administrator to re-submit the `init apfauth` command with proper authorization.

Configuring Zowe to use TLS certificates (`zwe init certificate`)

Zowe uses digital certificates for secure, encrypted network communication over Secure Sockets Layer/Transport Layer Security (SSL/TLS) and HTTPS protocols.

REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR

Zowe supports using either file-based (PKCS12) or z/OS key ring-based (when on z/OS) keystores and truststores, and can reuse compatible stores. You can use the `zwe init certificate` command to create keystores and truststores by either generating certificates or by allowing users to import their own compatible certificates.

For more information about `init certificate`, see:

- Configuring certificates.
- `zwe init certificate` in the Reference section.

Installing Zowe main started tasks (`zwe init stc`)

Execute the subcommand `zwe init stc` to install Zowe main started tasks.

Installation of Zowe main started tasks requires that JCL members for each of Zowe's started tasks be present on the JES proclib concatenation path.

Once you have completed security configuration, you can install the Zowe main started tasks.

REQUIRED ROLE: SYSTEM PROGRAMMER

The JCL members for each of Zowe's started tasks need to be present on the JES proclib concatenation path. The command `zwe init stc` copies these members from the install source location `.SZWESAMP` to the targted PDS specified in the `zowe.setup.dataset.proclib` value `USER.PROCLIB`. The three proclib member names are specified in `zowe.yaml` arguments.

The `zwe init stc` command uses the `CUST.JCL` LIB data sets as a staging area to contain intermediatory JCL which are transformed version of the originals that are shiped in `.SZWESAMP` with paths, PDS locations, and other runtime data updated. If you wish to just generate the `CUST.JCLLIB` members without having them copied to `USER.PROCLIB`, specify `--security-dry-run`. If the JCL members are already in the target PROCLIB, specify `--allow-overwritten`.

Example:

(Deprecated) Creating VSAM caching service datasets (`zwe init vsam`)

This command is no longer required as the Caching service by default uses Infinispan instead. You only need to run this command if you wish the Caching service to use VSAM for its storage medium.

Zowe can work in a high availability (HA) configuration where multiple instances of the Zowe launcher are started, either on the same LPAR or different LPARs connected through sysplex distributor. If you are only running a single Zowe instance on a single LPAR you do not need to create a caching service so you may skip this step.

> **REQUIRED ROLES: SYSTEM PROGRAMMER**

The command `zwe init vsam` uses the template JCL in `SZWESAMP(ZWECSVSM)` to copy the source template member from `zowe.setup.mvs.hlq.SZWESAMP(ZWECVCSM)` and creates a target JCL member in `zowe.setup.mvs.jcllib(ZWECVSCM)` with values extracted from the `zowe.yaml` file.

For more information about `zwe init vsam`, see Creating VSAM caching service datasets

Next steps

After each of the `zwe init` subcommands run successfully, the next step is to complete configuring security.

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Configuring Zowe via JCL

One option to configure Zowe is by directly customizing JCLs. The Zowe Runtime Dataset `SZWESAMP` contains JCL samples that have templates referencing Zowe YAML parameters. These samples should not be submitted without modification. Samples that are submitted without modification will end unsuccessfully with a JCL ERROR status.

Edit and submit the job `SZWESAMP(ZWEGENER)` to validate the contents of your `zowe.yaml` before resolving the `JCL templates` and placing the resulting JCL into a separate data set created by the job `ZWEGENER`. The location is specified in `zowe.setup.dataset.jcllib`.

> **NOTE**
>
> `zowe.setup.dataset.jcllib` is deleted and created each time the job `SZWESAMP(ZWEGENER)` is submitted.

When the JCL is prepared, the following jobs can be submitted to perform the following instance configuration actions. In addition to core JCL samples, you can also customize JCL samples for various keyring setup options according to your security manager.

- For sample JCLs corresponding to core tasks, see the table Core Tasks.
- For sample JCLs corresponding to keyring tasks, see the section Keyring Tasks later in this article.
- For JCL samples if you are using VSAM as your storage solution for the Caching service, see the table corresponding to (Deprecated) Caching Service VSAM Task.

Core Tasks

Task	Description	Sample JCL
Create Instance Datasets	**Purpose:** Create datasets for Zowe's PARMLIB content and non-ZFS extension content for a given Zowe Instance **Action:** 1) Allocate the PDSE FB80 dataset with at least 15 tracks named from Zowe parameter `zowe.setup.dataset.parmlib` 2) Allocate the PDSE FB80 dataset with at least 30 tracks named from Zowe parameter `zowe.setup.dataset.authPluginLib` 3) Copy the member `ZWESIP00` from `zowe.setup.dataset.prefix.SZWESAMP` into `zowe.setup.dataset.parmlib`	ZWEIMVS
APF Authorize privileged content	**Purpose:** The majority of Zowe is unprivileged code running in Key 8. Zowe relies on a single component called ZIS to own all of the privileged code logic. The load library for the ZIS component and its extension library must be set as APF authorized and run in Key 4 to use ZIS and components that depend upon it.	ZWEIAPF

Task	Description	Sample JCL
	Action: 1) APF authorize the datasets defined at `zowe.setup.dataset.authLoadlib` and `zowe.setup.dataset.authPluginLib`. 2) Define PPT entries for the members `ZWESIS01` and `ZWESAUX` as Key 4, NOSWAP in the `SCHEDxx` member of the system PARMLIB.	
Grant SAF premissions	**Purpose:** The STC accounts for Zowe need permissions for operating servers, and users need permissions for interacting with the servers. **Action:** Set SAF permissions for accounts	RACF: ZWEIRAC TSS: ZWEITSS ACF2: ZWEIACF
(z/OS v2.4 ONLY) Create Zowe SAF Resource Class	On z/OS v2.4, the SAF resource class for Zowe is not included, and must be created. This step is not needed on z/OS v2.5 and later versions.	RACF: ZWEIRACZ TSS: ZWEITSSZ ACF2: ZWEIACFZ
Copy STC JCL to PROCLIB	**Purpose:** The job ZWESLSTC runs Zowe's webservers. The job ZWESISTC runs the APF authorized cross-memory server. The job ZWESASTC is started by ZWESISTC on an as-needed basis. **Action:** Copy the members ZWESLSTC, ZWESISTC, and ZWESASTC into your desired PROCLIB. If the job names are customized, also modify the YAML values of them in `zowe.setup.security.stcs`.	ZWEISTC

Keyring Tasks

Certificate requirements

Ensure that your Zowe keyring has the following elements:

- **Private key & certificate pair**
  The Zowe Servers will use this certificate. Ensure that the certificate either does not have the `Extended Key Usage` attribute, or alternatively, that the certificate does have `Extended Key Usage` with both `Server Authorization` and `Client Authorization` values. For more information about extended key usage, see Extended key usage heading in the article *Configuring certificates*.

- **Certificate Authorities**
  Every intermediate and root Certificate Authority (CA) that Zowe interacts with must be within the Keyring, unless the `zowe.yaml` value `zowe.verifyCertificates` is set to `DISABLED`. CAs that must be within the keyring include z/OSMF's CAs if using z/OSMF, and Zowe's own certificate's CAs as Zowe servers must be able to verify each other.

There are four options for setting up keyrings: Three scenarios presented in the following table include JCL samples where a keyring is created for you. If you already have a keyring, you can configure Zowe to use this keyring by configuring `zowe.yaml` values within `zowe.certificate` according to the following example:

If you would like Zowe to create a keyring instead, click here for options

Keyring Setup Type	Description	Sample JCL
1	Zowe will create a keyring and populate it with a newly generated certificate and certificate authority. The certificate would be seen as "self-signed" by clients unless import of the CA to clients is performed	RACF: ZWEIKRR1 TSS: ZWEIKRT1 ACF2: ZWEIKRA1
2	Zowe will create a keyring and populate it by connecting pre-existing certificates and CAs that you specify.	RACF: ZWEIKRR2 TSS: ZWEIKRT2 ACF2: ZWEIKRA2
3	Zowe will create a keyring and populate it by importing PKCS12 content from a dataset that you specify.	RACF: ZWEIKRR3 TSS: ZWEIKRT3 ACF2: ZWEIKRA3

(Deprecated) Caching Service VSAM Task

The Caching Service is a server of Zowe that improves the high availability and fault tolerance of Zowe. It is enabled by default and uses Infinispan for its backing storage by default.

Using VSAM instead of Infinispan is deprecated, but still possible.

Click here to see how to set up a VSAM dataset for the Caching Service.

Task	Description	Sample JCL
Create VSAM Dataset for Caching Service	**Action**: Create a RLS or NONRLS dataset for the caching service, and set the name into the YAML value `components.caching-service.storage.vsam.name`	ZWECSVSM

You can also use JCL samples for removing Zowe configuration:

Action	Sample JCL
Remove Instance Datasets	ZWERMVS
Remove SAF Permissions	ZWENOSEC
Remove Keyring	ACF2: ZWENOKRA RACF: ZWENOKRR TSS: ZWENOKRT
Remove Caching Service VSAM Dataset	ZWECSRVS

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Configuring API ML with z/OSMF Workflows

After you install Zowe, you can register and execute the z/OSMF workflows in the web interface to perform a range of API ML/Zowe configuration tasks. The **Stand-alone Zowe API ML Configuration** workflow simplifies configuration of Zowe API Mediation Layer and does not require the level of expertise that is needed to perform manual API ML/Zowe configuration. The **Stand-alone Zowe API ML Configuration** workflow also runs the `zwe install` and `zwe init` command to initialize Zowe z/OS runtime.

> **REQUIRED ROLE: SYSTEM PROGRAMMER**

Prerequisites

Ensure that you meet the following requirements before you start your Zowe configuration:

- Install and configure z/OSMF
- Install Zowe with an SMP/E build, PSWI, or a convenience build

Overview of Stand-alone Zowe API ML Configuration workflow

The following components are automatically enabled after performing the **Stand-alone Zowe API ML Configuration** workflow:

- API Gateway
- ZAAS
- API Catalog
- Discovery service
- Caching service

The following components are automatically disabled:

- Application server
- ZSS component
- JES Explorer
- MVS Explorer
- USS Explorer

> **NOTE**
>
> These disabled components can be enabled by performing manual changes in the yaml file. Note that making such changes to the yaml file is not recommended for simplified and optimized configuration of API ML.

You can execute the **Stand-alone Zowe API ML Configuration** workflow either from a PSWI during deployment or later from a created software instance in z/OSMF. Alternatively, you can execute the configuration workflow in z/OSMF during the workflow registration process.

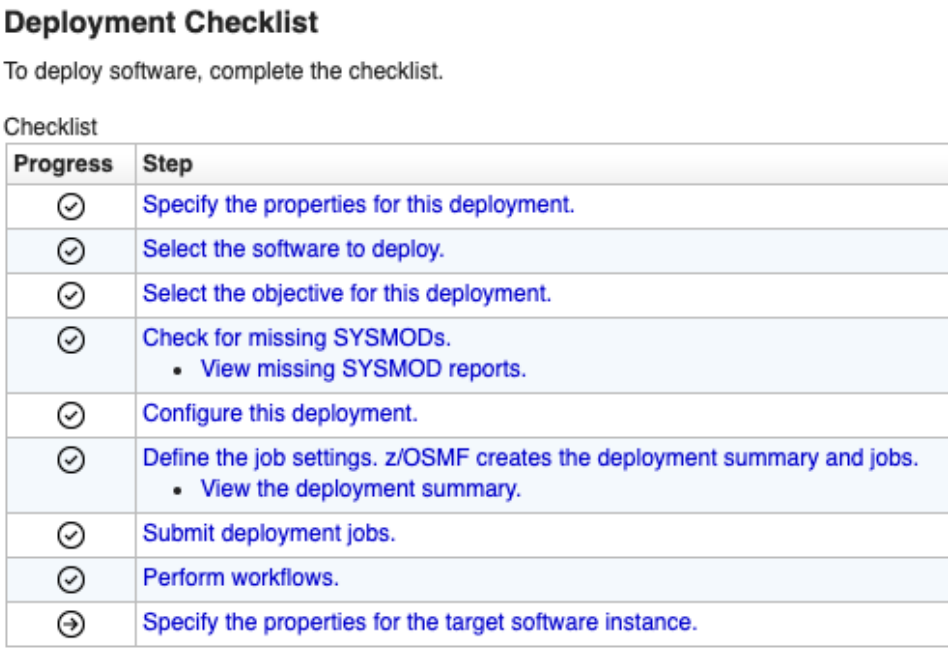
The configuration workflow described in this article is executed directly from a deployment of the Zowe PSWI.

Executing Stand-alone Zowe API ML Configuration workflow from PSWI

After Zowe installation, follow this procedure to perform Zowe API ML Configuration workflow from PSWI.

> **TIP**
>
> For more information about installing Zowe server-side components with z/OSMF, see Installing Product Software Using z/OSMF Deployments.

1. In the **Software Management** panel, click **Actions** and **Add from z/OSMF System**.
2. Specify your system name and file location path (UNIX file).
3. Click **Retrieve**.
4. Review the Deployment Jobs and click **Deployment Checklist**.
5. Follow each step outlined in the **Deployment Checklist**.



Deployment Checklist

To deploy software, complete the checklist.

Checklist

Progress	Step
✓	Specify the properties for this deployment.
✓	Select the software to deploy.
✓	Select the objective for this deployment.
✓	Check for missing SYSMODs. • View missing SYSMOD reports.
✓	Configure this deployment.
✓	Define the job settings. z/OSMF creates the deployment summary and jobs. • View the deployment summary.
✓	Submit deployment jobs.
✓	Perform workflows.
→	Specify the properties for the target software instance.

6. After you complete all of the preceding steps outlined in the Deployment checklist, click **Perform workflows** to leverage configuration of API ML with z/OSMF workflows.

   Each workflow appears in the panel.

> **NOTE**
>
> The **Perform Workflows** step enables you to run either all attached workflows or just the post-deployment workflow for mounting, which is required.

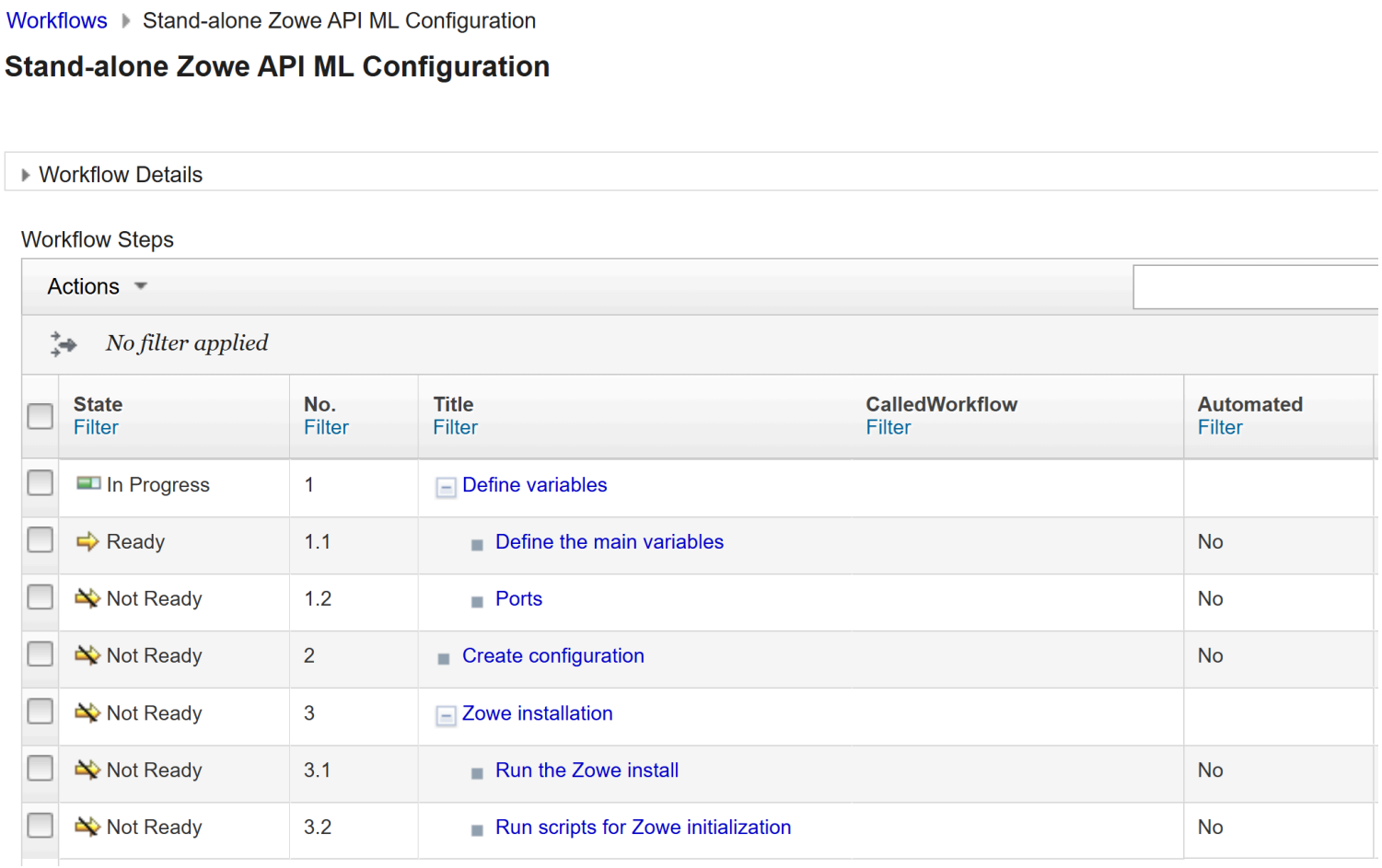
IMPORTANT

Before you start your configuration, ensure that you first perform the **Zowe Mount** workflow. For more information, see Configure - UNIX file system mount points in the IBM documentation.

After you successfully perform the **Zowe Mount** workflow, you can start the **Stand-alone Zowe API ML Configuration** workflow.

Select the **Stand-alone Zowe API ML Configuration** workflow from the list of Workflow Definition Files.

The following screen displays:



Expand the **Workflow Details** panel to see the workflow details and the state of each step. This workflow is in three parts:

Define variables
Create configuration
Perform Zowe installation

Sequence to execute each workflow step

Before you start performing workflow steps, first review the following sequence within a workflow step:

1. Click the title of the step or sub-step.
2. Select the **Perform** tab.

3. Review the step contents and update the variables that are marked by a red asterisk based on your mainframe environment.
4. Select **Next**.
5. Repeat the previous steps in this sequent to complete all items until the **Finish** option is available.

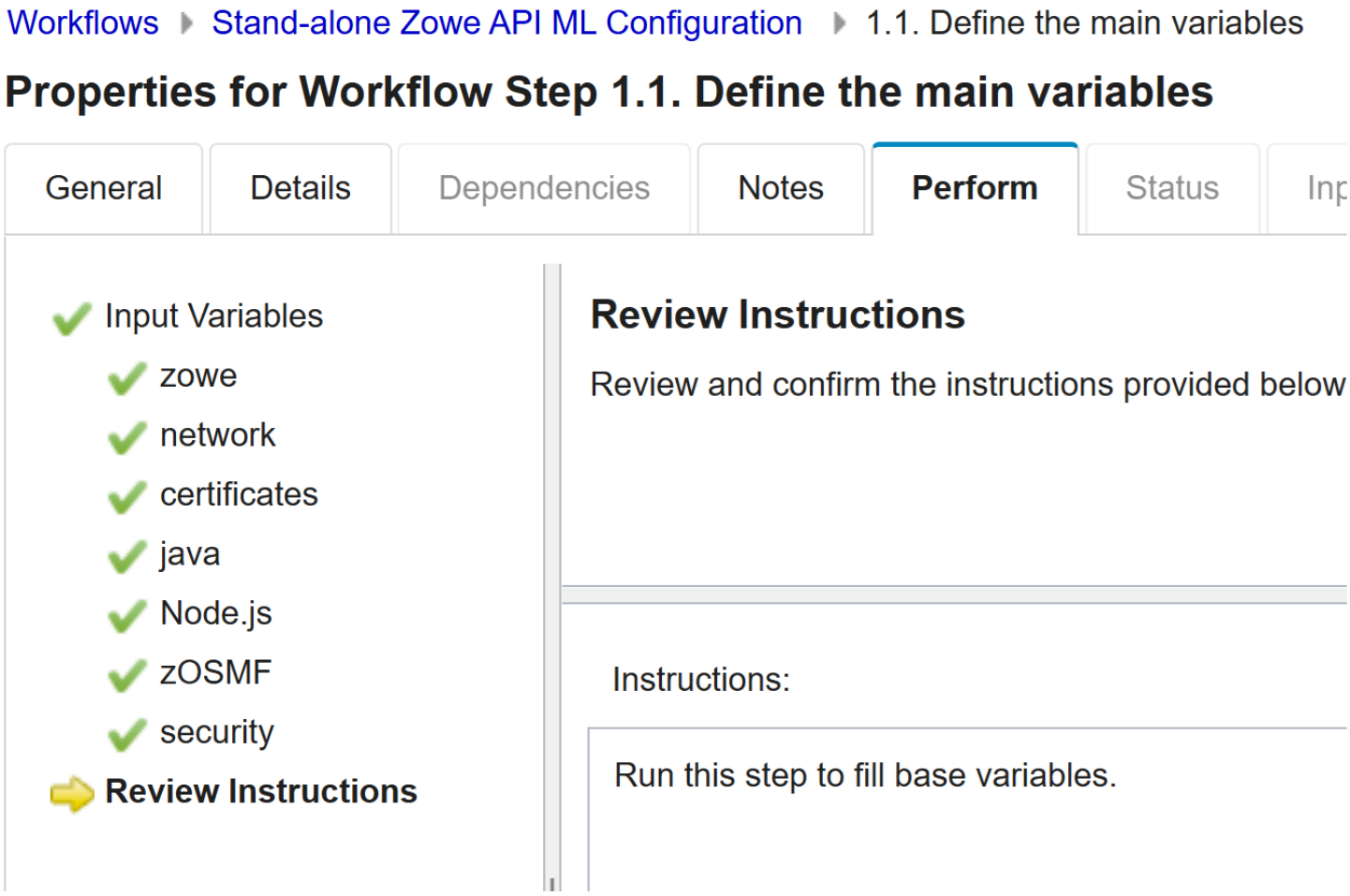
> **NOTES**
>
> - You can click **Save**, to save your values and **Finish** to populate these values in subsequent steps.
> - Basic validation is supported in many of the fields including the proper path structure, dataset name conventions, or numeric size. The workflow, however, does not check, for example, if a target dataset exists, or if a directory has sufficient space.

6. When you complete this list of Input variables, click **Next** to view the components. Tick each component in this list that you want to enable.
7. Click **Finish** to populate the values. This action customizes your workflow according to the components.
   You are then presented with enabled sub-steps according to the Zowe components you specified.
8. Click each sub-step and customize component-specific variables. Click **Next** until you complete your customization of the variables.
9. Click **Finish** to apply the values.

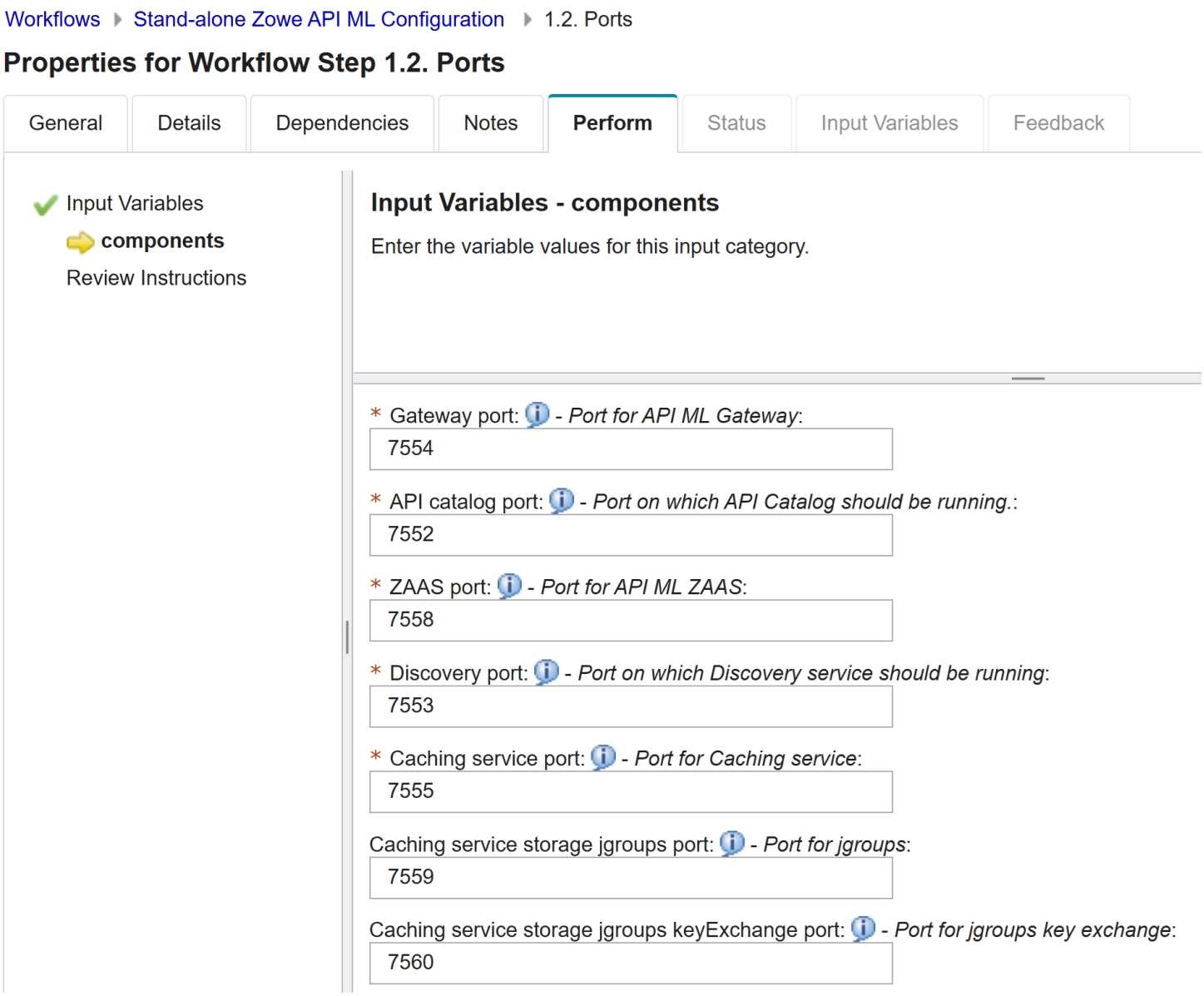
Define variables

The first workflow step in API ML configuration is to define variables.

1. Expand **Define variables**.
2. Under **Input Variables**, click **Define the main variables**.
3. Click the **Perform** tab. The input variables are displayed by category.
4. Customize workflow variables in the fields provided.
   Example:



5. After you complete defining the main variables for your configuration, define all ports for automatically enabled API ML services.



After all sub-steps are completed, the step **Define variables** is marked as Complete.

Create configuration

The second workflow step is to create a configuration zowe.yaml file with the variable setup that was defined in the **Define variables** step.

1. Review your configurations.
2. If necessary, customize the JCL according you your specifications and click **Finish**.
   The zowe.yaml file is ready, and the step is marked as Complete.

> **NOTE**
>
> The **Create configuration** step is mandatory. A valid zowe.yaml is required to execute the **Zowe installation** step.

Perform Zowe Installation

This step consumes the zowe.yaml configuration file and contains two sub-steps:

1. **Run Zowe install** to run the `zwe install` command.
2. **Run Zowe init** to run `zwe init mvs` and `zwe init stc` commands.

> **NOTE**
>
> If you did not set up security prior to this installation, you can submit the `ZWESECUR` JCL. For details, see Configuring security.

For more information about `zwe install` and `zwe init` commands, see the following articles:

- zwe install command
- Configuring Zowe with zwe init

Schema information and next steps

The **Stand-alone Zowe API ML Configuration** workflow strictly follows the Zowe v3 install and configuration schema. This workflow generates the zowe.yaml file and runs the Zowe `zwe` CLI tool.

After completing the workflow execution, you can return to the **Deployment Checklist** for the Zowe PSWI.

After you complete the steps in the checklist you are ready to start your Zowe instance with optimized setup for Zowe API Mediation Layer.

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Configuring Zowe with z/OSMF Workflows

After you install Zowe, you can register and execute the z/OSMF workflows in the web interface to perform a range of Zowe configuration tasks. z/OSMF helps to simplify the Zowe configuration tasks and does not require the level of expertise that is needed to perform manual Zowe configuration. This configuration method also runs the `zwe init` command to initialize Zowe z/OS runtime.

> **REQUIRED ROLE: SYSTEM PROGRAMMER**

Prerequisites

Ensure that you meet the following requirements before you start your Zowe configuration:

- Install and configure z/OSMF
- Install Zowe with an SMP/E build, PSWI, or a convenience build

Overview of Full Zowe server-side configuration for Zowe 3.0 workflow

You can complete the following tasks with the **Full Zowe server-side configuration for Zowe 3.0** workflow:

- Configure the Zowe instance
- Enable the API Gateway
- Enable ZAAS
- Enable the API Catalog
- Enable the Discovery service
- Enable a Caching service
- Enable an Application server
- Enable the ZSS component
- Enable JES Explorer
- Enable MVS Explorer
- Enable USS Explorer

You can execute the **Full Zowe server-side configuration Zowe 3.0** workflow either from a PSWI during deployment or later from a created software instance in z/OSMF. Alternatively, you can execute the configuration workflow in z/OSMF during the workflow registration process.

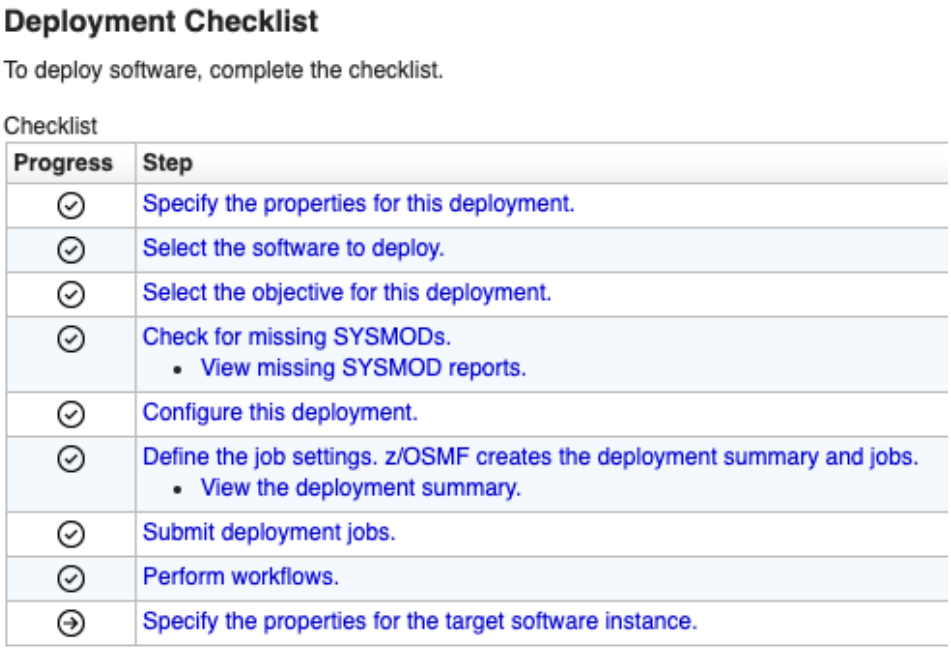
The configuration workflow described in this article is executed directly from a deployment of the Zowe PSWI.

Executing Full Zowe server-side configuration for Zowe 3.0 workflow from PSWI

After Zowe installation, follow this procedure to perform Zowe server-side configuration.

> **TIP**
>
> For more information about installing Zowe server-side components with z/OSMF, see Installing Product Software Using z/OSMF Deployments.

1. In the **Software Management** panel, click **Actions** and **Add from z/OSMF System**.
2. Specify your system name and file location path (UNIX file).
3. Click **Retrieve**.
4. Review the Deployment Jobs and click **Deployment Checklist**.
5. Follow each step outlined in the **Deployment Checklist**.



Deployment Checklist

To deploy software, complete the checklist.

Checklist

Progress	Step
✓	Specify the properties for this deployment.
✓	Select the software to deploy.
✓	Select the objective for this deployment.
✓	Check for missing SYSMODs. • View missing SYSMOD reports.
✓	Configure this deployment.
✓	Define the job settings. z/OSMF creates the deployment summary and jobs. • View the deployment summary.
✓	Submit deployment jobs.
✓	Perform workflows.
→	Specify the properties for the target software instance.

As presented in the **Deployment Checklist**, during deployment you have the option to perform workflows.

After you complete all of the preceding steps outlined in the **Deployment Checklist**, click **Perform workflows** to leverage configuration with z/OSMF workflows.

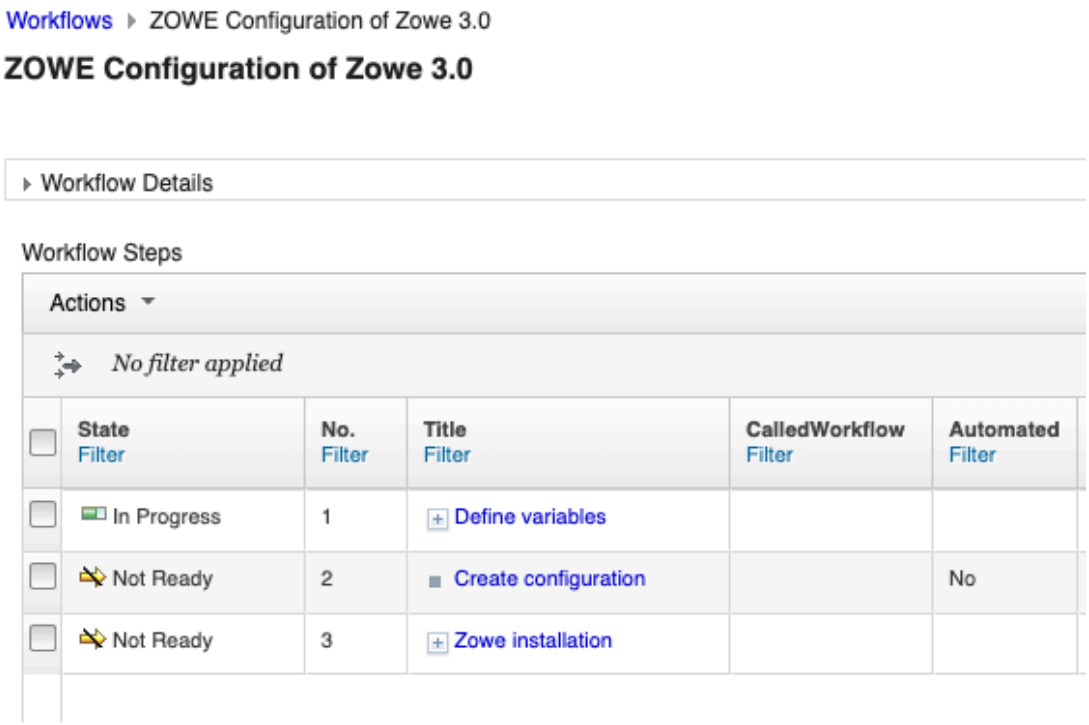
Each workflow appears in the panel.

> **NOTE**
>
> The **Perform Workflows** step enables you to run either all attached workflows or just the post-deployment workflow for mounting, which is required.

> **IMPORTANT**
>
> Before you start your configuration, ensure that you first perform the **Zowe Mount** workflow. For more information, see Configure - UNIX file system mount points in the IBM documentation.

After you successfully perform the **Zowe Mount** workflow, you can start the **Full Zowe server-side configuration for Zowe 3.0** workflow.

Select the **Full Zowe server-side configuration for Zowe 3.0** workflow from the list of Workflow Definition Files. The following screen displays:



Expand the **Workflow Details** panel to see the workflow details and the state of each step. This workflow is in three parts:

Define variables
Create configuration
Perform Zowe installation

Define variables

This workflow step includes the list of Zowe variables for configuration and as well as sub-steps.

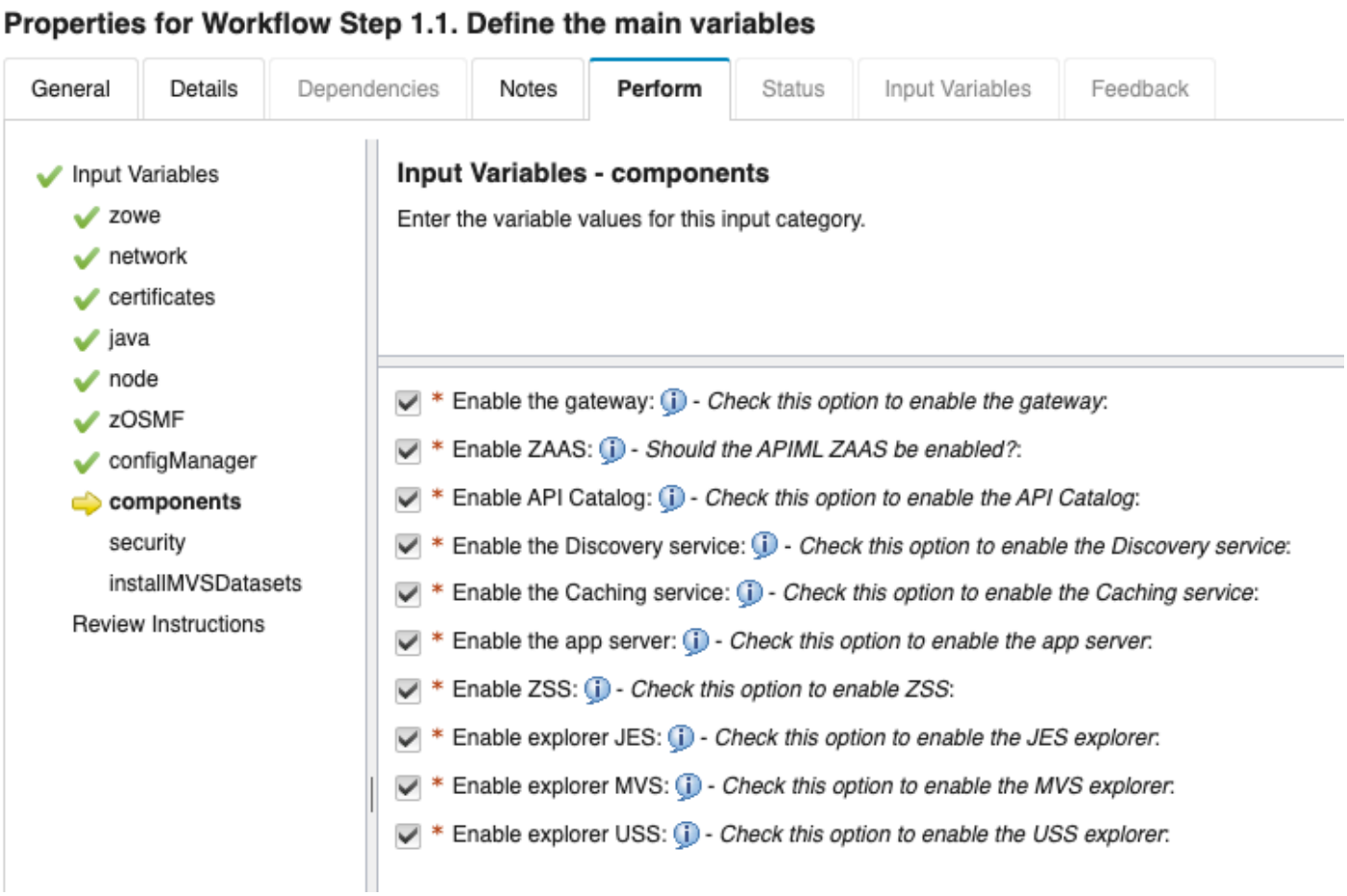
1. Expand **Define variables** to display the following screen:

	In Progress	1	Define variables		
	Ready	1.1	Define the main variables		No
	Not Ready	1.2	Gateway variables		No
	Not Ready	1.3	ZAAS component variables		No
	Not Ready	1.4	API Catalog Variables		No
	Not Ready	1.5	Discovery service variables		No
	Not Ready	1.6	Caching Service variables		
	Not Ready	1.6.1	Main variables for Caching Service		No
	Not Ready	1.6.2	(Optional) Variables for Caching Service - VSAM mode		No
	Not Ready	1.6.3	Variables for Caching Service - infinispan mode		No
	Not Ready	1.7	App Server variables		No
	Not Ready	1.8	ZSS Variables		No

2. Under **Input Variables**, click **Define the main variables**.

3. Click the **Perform** tab. The input variables are displayed by category.

4. Customize workflow variables in the fields provided.
   Example:



5. Perform the applicable sub-steps that correspond to the components you choose to enable.

Sequence to execute steps and sub-steps in the workflow

Perform the following steps for each step and sub-step:

1. Click the title of the step or sub-step.
2. Select the **Perform** tab.
3. Review the step contents and update the variables that are marked by a red asterisk based on your mainframe environment.

> **NOTE**
>
> Once completed, sub-steps for configured components are in the **Ready** state. Components that are not enabled are shown in the **Skipped** state.

4. Select **Next**.
5. Repeat the previous steps in this sequent to complete all items until the **Finish** option is available.

> **NOTES**
>
> - You can click **Save**, to save your values and **Finish** to populate these values in subsequent steps.

> - Basic validation is supported in many of the fields including the proper path structure, dataset name conventions, or numeric size. The workflow, however, does not check, for example, if a target dataset exists, or if a directory has sufficient space.

6. When you complete this list of Input variables, click **Next** to view the components. Tick each component in this list that you want to enable.
7. Click **Finish** to populate the values. This action customizes your workflow according to the components.
   You are then presented with enabled sub-steps according to the Zowe components you specified.
8. Click each sub-step and customize component-specific variables. Click **Next** until you complete your customization of the variables.
9. Click **Finish** to apply the values.

After all sub-steps are completed, the step **Define variables** is marked as Complete.

Create configuration

This step creates a configuration zowe.yaml file with the variable setup that was defined in the **Define variables** workflow.

1. Review your configurations.
2. If necessary, customize the JCL according you your specifications and click **Finish**.
   The zowe.yaml file is ready, and the step is marked as Complete.

> **NOTE**
>
> The **Create configuration** step is mandatory. A valid zowe.yaml is required to execute the **Zowe installation** step.

Perform Zowe installation

This step consumes the zowe.yaml configuration file and contains three sub-steps.

1. **Run Zowe install** runs the `zwe install` command.
2. **Run Zowe init** runs `zwe init mvs` and `zwe init stc` commands.
3. **Run Zowe init security**.
   This sub-step is optional if you already preformed security setup for Zowe. This sub-step requires Security Administrator permissions, which are required to run the `zwe init apfauth` and `zwe init security` commands. If security is not set up for Zowe, contact your Security Administrator to perform this setup.

   > **NOTE**
   >
   > An alternative to executing **Run Zowe init security** is to submit `ZWESECUR` JCL. For details, see Configuring security.

For more information about `zwe install` and `zwe init` commands, see the following articles:

- zwe install command

- Configuring Zowe with zwe init

Schema information and next steps

The **Full Zowe server-side configuration for Zowe 3.0** workflow strictly follows Zowe v3 install and configuration schema. This workflow generates the zowe.yaml file and runs Zowe's zwe CLI tool.

After completing the workflow execution, you can return to the **Deployment Checklist** for the Zowe PSWI. After you complete the steps in the checklist you are ready to start your Zowe instance.

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Configuring security

During the initial installation of Zowe server-side components, it is necessary for your organization's security administrator to perform a range of tasks that require elevated security permissions. As a security administrator, follow the procedures outlined in this article to configure Zowe and your z/OS system to run Zowe with z/OS.

REQUIRED ROLE: SECURITY ADMINISTRATOR (ELEVATED PERMISSIONS REQUIRED)

NOTE

For initial tasks to be performed by the security administrator before Zowe server-side installation, see Addressing security requirements.

Validate and re-run `zwe init` commands

During installation, the system programmer customizes values in the zowe.yaml file. However, due to insufficient permissions of the system programmer, the `zwe init security` command may fail without sufficient user authorization.

Initialize Zowe security configurations

This security configuration step is required for first time setup of Zowe and may require security authorization. If Zowe has already been launched on a z/OS system from a previous release of Zowe v2, and the `zwe init security` subcommand successfully ran when initializing the z/OS subsystem, you can skip this step unless told otherwise in the release documentation.

Choose from the following methods to initialize Zowe security configurations:

Click here to configure with the `zwe init security` command.

Configure with `zwe init security` command

The `zwe init security` command reads data from `zowe.yaml` and constructs a JCL member using `ZWESECUR` as a template which is then submitted. This is a convenience step to assist with driving Zowe configuration through a pipeline or when you prefer to use USS commands rather than directly edit and customize JCL members.

NOTE

If you do not have permissions to update your security configurations, use the `security-dry-run` described in the following tip. We recommend you inform your security administrator to review the `ZWESECUR` job content.

TIP

To avoid having to run the `init security` command, you can specify the parameter `--security-dry-run`. This parameter enables you to construct a JCL member containing the security commmands without running the

member. This is useful for previewing commands and can also be used to copy and paste commands into a TSO command prompt for step by step manual execution.

Example:

Click here to configure with `ZWESECUR` JCL.

Configure with `ZWESECUR` JCL

An alternative to using `zwe init security` is to prepare a JCL member to configure the z/OS system, and edit `ZWESECUR` to make changes.

The JCL allows you to vary which security manager you use by setting the *PRODUCT* variable to be one of the following ESMs:

- `RACF`
- `ACF2`
- `TSS`.

Example:

If `ZWESECUR` encounters an error or a step that has already been performed, it continues to the end, so it can be run repeatedly in a scenario such as a pipeline automating the configuration of a z/OS environment for Zowe installation.

> **IMPORTANT**
> It is expected that your security administrator will be required to review, edit where necessary, and either execute `ZWESECUR` as a single job, or execute individual TSO commands to complete the security configuration of a z/OS system in preparation for installing and running Zowe.

The following video shows how to locate the `ZWESECUR` JCL member and execute it.

TIP

If an error occured in performing security configuration, these configurations can be undone.

Click here for details about undoing security configurations.

To undo all of the z/OS security configuration steps performed by the JCL member `ZWESECUR`, use the reverse member `ZWENOSEC`. This member contains steps that reverse steps performed by `ZWESECUR`. This is useful in the following situations:

- You are configuring z/OS systems as part of a build pipeline that you want to undo, and redo configuration and installation of Zowe using automation.
- You configured a z/OS system for Zowe that you no longer want to use, and you prefer to delete the Zowe user IDs and undo the security configuration settings rather than leave them enabled.

If you run `ZWENOSEC` on a z/OS system, it is necessary to rerun `ZWESECUR` to reinitialize the z/OS security configuration. Zowe cannot be run until `ZWESECUR` is rerun.

Perform APF authorization of load libraries

Zowe contains load modules that require access to make privileged z/OS security manager calls. These load modules are held in two load libraries which must be APF authorized. For more information about how to issue the `zwe init apfauth` command to perform APF authority commands, see Performing APF authorization of load libraries.

Customize security of your z/OS system

Review and perform z/OS configuration steps based on your settings. For a detailed table of configuration procedures and associated purposes for performing these procedures, see Customizing z/OS system security.

Assign security permissions to users

Assign users (ZWESVUSR and ZWESIUSR) and the ZWEADMIN security group permissions required to perform specific tasks. For more information see, Assigning security permissions to users.

Zowe Feature specific configuration tasks

Depending on the specific Zowe server-side components that your organization is wishing to utilize, specific security configuration settings may apply. Review the following table of Zowe server-side component features and their associated configuration tasks, and perform the tasks that apply to your use case.

Feature of a Zowe server-side component	Configuration Task
If using Top Secret as your security manager **Note:** No specific configuration is necessary for security managers other than Top Secret.	Configuring multi-user address space (for TSS only)
High Availability	Configuring ZWESLSTC to run Zowe high availability instances under ZWESVUSR user ID
z/OSMF authentication or onboarding of z/OSMF service	Granting users permission to access z/OSMF
ZSS component enabled (required for API ML certificate and identity mapping)	Configuring an ICSF cryptographic services environment and Configuring security environment switching
API Mediation Layer certificate mapping	Configuring main Zowe server to use client certificate identity mapping
API Mediation Layer identity mapping	Configuring main Zowe server to use distributed identity mapping
API Mediation Layer Identity Tokens (IDT)	Configuring signed SAF Identity tokens (IDT)
Cross memory server (ZIS)	Configuring the cross memory server for SAF and Configuring cross memory server load module and Configuring cross-memory server SAF configuration

Next steps

After Zowe z/OS runtime is initialized, and you complete other procedures in the Configuring security section, the next step is Configuring certificates.

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Performing APF authorization of load libraries

Review this article to learn how to perform APF authorization of Zowe load libraries to make privileged calls. Note that this procedure requires elevated permissions.

> **REQUIRED ROLE: SECURITY ADMINISTRATOR**

Zowe contains load modules that require access to make privileged z/OS security manager calls. These load modules are held in two load libraries which must be APF authorized. The command `zwe init apfauth` reads the PDS names for the load libraries from `zowe.yaml` and performs the APF authority commands. Performing APF authorization presupposes that libraries were already created manually, by `zwe init`, or by `zwe init mvs`.

- **`zowe.setup.dataset.authLoadLib`**
  Specifies the user custom load library, which contains the following load modules:
  - `ZWELNCH`: the Zowe launcher
  - `ZWESIS01`: the ZIS cross memory server
  - `ZWESAUX`: the auxiliary server
- **`zowe.setup.dataset.authPluginLib`**
  References the load library for ZIS plugins

The following command presents an example of running `zwe init apfauth`:

Example:

> **TIP**
> If you do not have permissions to update your security configurations, append the flag `--security-dry-run` to have the command echo the commands that need to be run without executing the command. We recommend you inform your security administrator to review your job content.

Making APF auth be part of the IPL

Add one of the following APF statements to your active `PROGxx` PARMLIB member according to the following example.

Example:
To ensure that the APF authorization is added automatically after next IPL, add `SYS1.PARMLIB(PROG00)`.

- If the load library is not SMS-managed, add the following lines, where `${volume}` is the name of the volume that holds the data set:
- If the load library is SMS-managed, add the following line, where `DSNAME` is the name of the `SZWEAUTH` and `CUST.ZWESAPL` data sets, as created during Zowe installation.

The PDS member `SZWESAMP(ZWESIPRG)` contains the SETPROG statement and PROGxx update for reference.

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Customizing z/OS system security

As a security administrator, configure your z/OS system according to the specific features and functionalities you choose to include in your Zowe installation. Review the following article for specific configuration steps that apply to these features and fuctionalities.

REQUIRED ROLE: SECURITY ADMINISTRATOR

NOTE

Before performing configuration steps specific to your use case, ensure that you meet the z/OS system requirements presented in the section *Preparing for installation*. For detailed information, see Addressing z/OS requirements.

Review the following table to determine which configuration steps are required based on your Zowe use case.

Purpose	Applicable Zowe Component(s)	Configuration step
Set the names for the different z/OS UNIX address spaces for the Zowe runtime components. **Important:** This configuration step is required.	All components	Configure address space job naming
Required for TSS only. A TSS FACILITY needs to be defined and assigned to the `ZWESLSTC` started task.	All components	Configure multi-user address space for TSS only
Required to manually create the user ID and groups in your z/OS environment. Tasks are performed as part of Zowe runtime configuration	All components	Configure user IDs and groups for the Zowe started tasks
Required to configure the started task ZWESLSTC to run under the correct user ID and group. Tasks are performed as part of Zowe runtime configuration.	All components	Configure ZWESLSTC to run Zowe high availability instances under ZWESVUSR user ID.
To use multi-factor authentication (MFA)	All components	Multi-Factor Authentication (MFA)
Required for API Mediation Layer to map a client certificate to a z/OS identity.	API ML	Configure main Zowe server to use client certificate identity mapping
Required for API ML to map the association between a z/OS user ID and a distributed user identity.	API ML	Configure main Zowe server to use distributed identity mapping
Required for API Mediation Layer to issue SMF records.	API ML	Configure the main Zowe server to issue SMF records

Purpose	Applicable Zowe Component(s)	Configuration step
To use OIDC Authentication with API Mediation Layer	API ML	API Mediation Layer OIDC Authentication
To allow users to log on to the Zowe desktop through impersonation.	Application Framework API ML	Configure security environment switching
To configure SAF Identity tokens on z/OS so that they can be used by Zowe components like zss or API Mediation Layer.	Application Framework API ML	Configure signed SAF Identity tokens IDT
Required to configure the cross memory server for SAF to guard against access by non-privileged clients. Tasks are performed as part of Zowe runtime configuration.	Application Framework	Configure the cross memory server for SAF
To use Zowe desktop. This step generates random numbers for zssServer that the Zowe desktop uses.	Application Framework	Configure an ICSF cryptographic services environment
To use Single Sign-On (SSO)	All components	Single Sign-On (SSO)

Configure address space job naming

> **INFO**
>
> This configuration applies to all Zowe components and is required for stand-alone installation of API Mediation Layer.

The user ID `ZWESVUSR` that is associated with the Zowe started task must have READ permission for the `BPX.JOBNAME` profile in the `FACILITY` class. This is to allow setting of the names for the different z/OS UNIX address spaces for the Zowe runtime components.

> **NOTE**
>
> This procedure may require security administrator authorization. Consult with your security administrator.

To display who is authorized to the profile, issue the following command:

Additionally, you need to activate facility class, permit `BPX.JOBNAME`, and refresh facility class:

For more information, see Setting up the UNIX-related FACILITY and SURROGAT class profiles in the "z/OS UNIX System Services" documentation.

Configure multi-user address space (for TSS only)

> **INFO**

> This configuration applies to all Zowe components and is required for stand-alone installation of API Mediation Layer.

The Zowe server started task `ZWESLSTC` is multi-user address space, and therefore a TSS FACILITY needs to be defined and assigned to the started task. Then, all acids signing on to the started task will need to be authorized to the FACILITY.

The following example shows how to create a new TSS FACILITY.

Example:

In the TSSPARMS, add the following lines to create the new FACILITY:

For more information about how to administer Facility Matrix Table, see How to Perform Facility Matrix Table Administration.

To assign the FACILITY to the started task, issue the following command:

To authorize a user to sign on to the FACILITY, issues the following command:

Configure user IDs and groups for the Zowe started tasks

> **INFO**
>
> This configuration applies to all Zowe components and is required for stand-alone installation of API Mediation Layer.

Zowe requires a user ID `ZWESVUSR` to execute its main z/OS runtime started task. This user ID must have a valid OMVS segment.

Zowe requires a user ID `ZWESIUSR` to execute the cross memory server started task `ZWESISTC`. This user ID must have a valid OMVS segment.

Zowe requires a group `ZWEADMIN` that both `ZWESVUSR` and `ZWESIUSR` should belong to. This group must have a valid OMVS segment.

If you have run `ZWESECUR`, you do not need to perform the steps described in this section, because the TSO commands to create the user IDs and groups are executed during the JCL sections of `ZWESECUR`.

If you have not run `ZWESECUR` and are manually creating the user ID and groups in your z/OS environment, the commands are described below for reference.

- To create the `ZWEADMIN` group, issue the following command according to your ESM:

  Click here for command details for RACF.

  RACF:

  Click here for command details for Top Secret.

TSS:

Click here for command details for ACF2.

ACF2:

- To create the `ZWESVUSR` user ID for the main Zowe started task, issue the following command according to your ESM:

Click here for command details for RACF.

RACF:

Click here for command details for Top Secret.

TSS:

Click here for command details for ACF2.

ACF2:

- To create a `ZWESIUSR` for the Zowe cross memory server started task, issue the following command according to your ESM:

Click here for command details for RACF.

RACF:

Click here for command details for Top Secret.

TSS:

Click here for command details for ACF2.

ACF2:

Configure ZWESLSTC to run Zowe high availability instances under ZWESVUSR user ACID

> **INFO**
>
> This configuration applies to all Zowe components and is required for stand-alone installation of API Mediation Layer.

You need Zowe started task `ZWESLSTC` for Zowe high availability. When the Zowe started task `ZWESLSTC` is started, it must be associated with the user ID `ZWESVUSR` and group `ZWEADMIN`. A different user ID and group can be used if required to conform with existing naming standards.

If you have run `ZWESECUR`, you do not need to perform the steps described in this section, because they are executed during the JCL section of `ZWESECUR`.

If you have not run `ZWESECUR` and are configuring your z/OS environment manually, the following steps describe how to configure the started task `ZWESLSTC` to run under the correct user ID and group. Issue the following commands according to your ESM:

<details>
<summary>Click here for command details for RACF.</summary>

If you use RACF, issue the following commands:

</details>

<details>
<summary>Click here for command details for ACF2.</summary>

If you use ACF2, issue the following commands:

</details>

<details>
<summary>Click here for command details for Top Secret.</summary>

If you use Top Secret, issue the following commands:

</details>

Multi-Factor Authentication (MFA)

> **INFO**
>
> This configuration applies to all Zowe components and is required for stand-alone installation of API Mediation Layer.

Multi-factor authentication is supported for several components, such as the Desktop and API Mediation Layer. Multi-factor authentication is provided by third-party products which Zowe is compatible with. The following are known to work:

- CA Advanced Authentication Mainframe
- IBM Z Multi-Factor Authentication.

> **NOTES**
>
> - To support the multi-factor authentication, it is necessary to apply z/OSMF APAR PH39582.
> - MFA must work with Single-Sign-On (SSO). Make sure that SSO is configured before you use MFA in Zowe.

Configure main Zowe server to use client certificate identity mapping

> **INFO**
>
> This configuration is required for stand-alone installation of API Mediation Layer.

This security configuration is necessary for API ML to be able to map client certificate to a z/OS identity. A user running API Gateway must have READ access to the SAF resource `IRR.RUSERMAP` in the `FACILITY` class. To set up this security configuration, submit the `ZWESECUR` JCL member. For users upgrading from version 1.18 and lower use the following configuration steps according to your ESM:

<details>
<summary>Click here for procedure details for RACF.</summary>

If you use RACF, verify and update permission in the `FACILITY` class.

Follow these steps:

1. Verify user `ZWESVUSR` has READ access.
2. Add user `ZWESVUSR` permission to READ.
3. Activate changes.
</details>

<details>
<summary>Click here for procedure details for ACF2.</summary>

If you use ACF2, verify and update permission in the `FACILITY` class.

Follow these steps:

1. Verify user `ZWESVUSR` has READ access.
2. Add user `ZWESVUSR` permission to READ.
3. Activate changes.
</details>

<details>
<summary>Click here for procedure details for Top Secret.</summary>
</details>

If you use TSS, verify and update permission in `FACILITY` class.

Follow these steps:

1. Verify user `ZWESVUSR` has READ access.
2. Add user `ZWESVUSR` permission to READ.

Configure main Zowe server to use distributed identity mapping

> **INFO**
> This configuration is required for stand-alone installation of API Mediation Layer.

This security configuration is necessary for API ML to map the association between a z/OS user ID and a distributed user identity. A user running the API Gateway must have READ access to the SAF resource `IRR.IDIDMAP.QUERY` in the `FACILITY` class. To set up this security configuration, submit the `ZWESECUR` JCL member. For users upgrading from version 1.28 and lower, use the following configuration steps according to your ESM:

Click here for procedure details for RACF.

If you use RACF, verify and update permission in the `FACILITY` class.

Follow these steps:

1. Verify that user `ZWESVUSR` has READ access.
2. Activate the `IDIDMAP` class:
3. Define the `IRR.IDIDMAP.QUERY` profile in the FACILITY class.
4. Add user `ZWESVUSR` permission to with READ access.
5. Activate changes.

Click here for procedure details for ACF2.

If you use ACF2, verify and update permission in the `FACILITY` class.

Follow these steps:

1. Verify that user `ZWESVUSR` has READ access.
2. Add user `ZWESVUSR` permission with READ access.
3. Activate changes.

Click here for procedure details for Top Secret.

If you use TSS, verify and update permission in `FACILITY` class.

Follow these steps:

1. Verify that user `ZWESVUSR` has READ access.
2. Add user `ZWESVUSR` permission with READ access.

Configure the main Zowe server to issue SMF records

> **INFO**
>
> This configuration is required for stand-alone installation of API Mediation Layer.

This security configuration is necessary for API ML to be able to issue SMF records. A user running the API Gateway must have READ access to the RACF general resource `IRR.RAUDITX` in the `FACILITY` class. To set up this security configuration, submit the `ZWESECUR` JCL member. For users upgrading from version 1.18 and lower, use the configuration steps that correspond to the ESM.

- To check whether you already have the auditing profile defined, issue the following command and review the output to confirm that the profile exists and that the user `ZWESVUSR` who runs the `ZWESLSTC` started task has READ access to this profile.

  Click here for command details for RACF.

  If you use RACF, issue the following command:

  Click here for command details for ACF2.

  If you use ACF2, issue the following commands:

  Click here for command details for Top Secret.

  If you use Top Secret, issue the following command:

- If the user `ZWESVUSR` who runs the `ZWESLSTC` started task does not have READ access to this profile, follow the procedure that corresponds to your ESM:

<details>
<summary>Click here for procedure details for RACF.</summary>

If you use RACF, update permission in the `FACILITY` class.

Follow these steps:

i. Add user `ZWESVUSR` permission to `READ`.

ii. Activate changes.
</details>

<details>
<summary>Click here for command details for ACF2.</summary>

If you use ACF2, add user `ZWESVUSR` permission to `READ`. Issue the following commands:
</details>

<details>
<summary>Click here for command details for Top Secret.</summary>

If you use Top Secret, add user `ZWESVUSR` permission to READ. Issue the following command:
</details>

For more information about SMF records, see SMF records in the Using Zowe API Mediation Layer documentation.

API Mediation Layer OIDC Authentication

> **INFO**
> This configuration is required for stand-alone installation of API Mediation Layer.

Zowe requires ACF2 APAR LU01316 to be applied when using the ACF2 security manager.

Configure security environment switching

> **INFO**
> This configuration is required for stand-alone installation of API Mediation Layer and also applies to the Application Framework.

Typically, the user `ZWESVUSR` that the Zowe server started task runs under needs to be able to change the security environment of its process to allow API requests to be issued on behalf of the logged on TSO user ID, rather than the server's user ID. This capability provides the functionality that allows users to log on to the Zowe desktop and use apps such as the File Editor to list data sets or USS files that the logged on user is authorized to view and edit, rather than the user ID running the Zowe server. This technique is known as **impersonation**.

To enable impersonation, you must grant the user ID `ZWESVUSR` associated with the Zowe server started task UPDATE access to the `BPX.SERVER` and `BPX.DAEMON` profiles in the `FACILITY` class.

You can issue the following commands first to check whether you already have the impersonation profiles defined as part of another server configuration, such as the FTPD daemon. Review the output to confirm that the two impersonation profiles exist and the user `ZWESVUSR` who runs the Zowe server started task has UPDATE access to both profiles.

<details>
<summary>Click here for command details for RACF.</summary>

If you use RACF, issue the following commands:

</details>

<details>
<summary>Click here for command details for Top Secret.</summary>

If you use Top Secret, issue the following commands:

</details>

<details>
<summary>Click here for command details for ACF2.</summary>

If you use ACF2, issue the following commands:

</details>

If the user `ZWESVUSR` who runs the Zowe server started task does not have UPDATE access to both profiles follow the instructions below.

<details>
<summary>Click here for procedure details for RACF.</summary>

If you use RACF, complete the following steps:

1. Activate and RACLIST the FACILITY class. This may have already been done on the z/OS environment if another z/OS server has been previously configured to take advantage of the ability to change its security environment, such as the FTPD daemon that is included with z/OS Communications Server TCP/IP services.
2. Define the impersonation profiles. This may have already been done on behalf of another server such as the FTPD daemon.
3. Having activated and RACLIST the FACILITY class, the user ID `ZWESVUSR` who runs the Zowe server started task must be given update access to the BPX.SERVER and BPX.DAEMON profiles in the FACILITY class.

where:

- `<zowe_stc_user>` is `ZWESVUSR` unless a different user ID is being used for the z/OS environment.

/* Activate these changes */

4. Issue the following commands to check whether permission has been successfully granted:

</details>

<details>
<summary>Click here for procedure details for Top Secret.</summary>
</details>

If you use Top Secret, complete the following steps:

1. Define the BPX Resource and access for `<zowe_stc_user>`.

where `<zowe_stc_user>` is `ZWESVUSR` unless a different user ID is being used for the z/OS environment.

2. Issue the following commands and review the output to check whether permission has been successfully granted:

Click here for procedure details for ACF2.

If you use ACF2, complete the following steps:

1. Define the BPX Resource and access for `<zowe_stc_user>`.

where `<zowe_stc_user>` is `ZWESVUSR` unless a different user ID is being used for the z/OS environment.

2. Issue the following commands and review the output to check whether permission has been successfully granted:

You must also grant READ access to the OMVSAPPL profile in the APPL class to the Zowe STC user as well as **all other Zowe users** using various Zowe features. Skip the following steps when the OMVSAPPL profile is not defined in your environment.

Click here for procedure details for RACF.

If you use RACF, complete the following steps:

1. Check if you already have the required access defined as part of the environment configuration. Skip the following steps if access is already granted.

2. Issue the following commands and review the output to check if permission has been successfully granted:

Click here for procedure details for Top Secret.

If you use Top Secret, complete the following steps:

1. Check if you already have the required access as part of the environment configuration. Skip the following steps if access is already granted.

2. Issue the following commands and review the output to check if permission has been successfully granted:

Click here for procedure details for ACF2.

If you use ACF2, complete the following steps:

1. Check if you already have the required access defined as part of the environment configuration. Skip the following steps if access is already granted.
2. Issue the following commands and review the output to check if permission has been successfully granted:

Single Sign-On (SSO)

> **INFO**
>
> This configuration applies to all Zowe components.

Zowe has an SSO scheme with the goal that each time you use multiple Zowe components you should only be prompted to login once.

Requirements:

- IBM z/OS Management Facility (z/OSMF)

Configure signed SAF Identity tokens (IDT)

> **INFO**
>
> This configuration applies to API Mediation Layer and Application Framework.

This section provides a brief description of how to configure SAF Identity tokens on z/OS so that they can be used by Zowe components like zss or API ML. See Implement a new SAF IDT provider.

Follow these steps:

1. Create a PKCS#11 token.
2. Generate a secret key for the PKCS#11 token (you can use the sample program ZWESECKG in the SZWESAMP dataset).
3. Define a SAF resource profile under the IDTDATA SAF resource class.

Details with examples can be found in documentation of external security products:

- **RACF**
  See ***Signed and Unsigned Identity Tokens*** and ***IDT Configuration*** subsections in *z/OS Security Server RACROUTE Macro Reference* in the article Activating and using the IDTA parameter in RACROUTE REQUEST=VERIFY.
- **ACF2**
  See ***IDTDATA Profile Records*** subsection in *Administrating* chapter, in the article IDTDATA Profile Records.
- **Top Secret**
  See ***Maintain Identity Token (IDT) Records*** subsection in *Administrating* chapter, in the article Maintain Identity Token (IDT) Records.

A part of the Signed SAF Identity token configuration is a nontrivial step that has to generate a secret key for the PKCS#11 token. The secret key is generated in ICSF by calling the PKCS#11 Generate Secret Key (CSFPGSK) or Token Record Create (CSFPTRC) callable services. An example of the CSFPGSK callable service can be found in the SZWESAMP dataset as the ZWESECKG job.

Configure an ICSF cryptographic services environment

> **INFO**
>
> This configuration applies to the Application Framework.

The zssServer uses cookies that require random number generation for security. To learn more about the zssServer, see the Zowe architecture. Integrated Cryptographic Service Facility (ICSF) is a secure way to generate random numbers.

If you have not configured your z/OS environment for ICSF, see Cryptographic Services ICSF: System Programmer's Guide for more information. To see whether ICSF has been started, check whether the started task `ICSF` or `CSF` is active.

If you run Zowe high availability on a Sysplex, ICSF needs to be configured in a Sysplex environment to share KDS data sets across systems in a Sysplex. For detailed information, see Running in a Sysplex Environment

The Zowe z/OS environment configuration JCL member `ZWESECUR` does not perform any steps related to ICSF that is required for zssServer that the Zowe desktop uses. Therefore, if you want to use Zowe desktop, you must perform the steps that are described in this section manually.

To generate symmetric keys, the `ZWESVUSR` user who runs Zowe server started task requires READ access to `CSFRNGL` in the `CSFSERV` class.

Define or check the following configurations depending on whether ICSF is already installed:

- The ICSF or CSF job that runs on your z/OS system.
- The configuration of ICSF options in `SYS1.PARMLIB(CSFPRM00)`, `SYS1.SAMPLIB`, `SYS1.PROCLIB`.
- Create CKDS, PKDS, TKDS VSAM data sets.
- Define and activate the CSFSERV class:

<details>
<summary>Click here for command details for RACF.</summary>

If you use RACF, issue the following commands:
</details>

<details>
<summary>Click here for command details for ACF2.</summary>

If you use ACF2, issue the following commands (note that `profile-prefix` and `profile-suffix` are user-defined):

(repeat for userids IKED, NSSD, and Policy Agent)
</details>

<details>
<summary>Click here for command details for Top Secret</summary>
</details>

If you use Top Secret, issue the following command (note that `profile-prefix` and `profile-suffix` are user defined):

(repeat for user-acids IKED, NSSD, and Policy Agent)

NOTES

- Determine whether you want SAF authorization checks against `CSFSERV` and set `CSF.CSFSERV.AUTH.CSFRNG.DISABLE` accordingly.
- Refer to the z/OS 2.3.0 z/OS Cryptographic Services ICSF System Programmer's Guide: Installation, initialization, and customization.
- CCA and/or PKCS #11 coprocessor for random number generation.
- Enable `FACILITY IRR.PROGRAM.SIGNATURE.VERIFICATION` and `RDEFINE CSFINPV2` if required.

Configure the cross memory server for SAF

INFO

This configuration applies to the Application Framework.

Zowe has a cross memory server that runs as an APF-authorized program with key 4 storage. Client processes accessing the cross memory server's services must have READ access to a security profile `ZWES.IS` in the `FACILITY` class. This authorization step is used to guard against access by non-priviledged clients.

If you have run `ZWESECUR` you do not need to perform the steps described in this section.

If you have not run `ZWESECUR` and are configuring your z/OS environment manually, the following steps describe how to configure the cross memory server for SAF.

Activate the FACILITY class, define a `ZWES.IS` profile, and grant READ access to the user ID `ZWESVUSR`. This is the user ID that the main Zowe started task runs under.

To perform these steps, issue the following commands that are also included in the `ZWESECUR` JCL member. The commands assume that you run the Zowe server under the `ZWESVUSR` user.

Click here for command details for RACF.

If you use RACF, issue the following commands:

- To see the current class settings, use:
- To define and activate the FACILITY class, use:
- To RACLIST the FACILITY class, use:
- To define the `ZWES.IS` profile in the FACILITY class and grant Zowe's started task userid READ access, issue the following commands:

where `<zowe_stc_user>` is the user ID `ZWESVUSR` under which the Zowe server started task runs.

- To check whether the permission has been successfully granted, issue the following command:

  This shows the user IDs who have access to the `ZWES.IS` class, which should include Zowe's started task user ID with READ access.

<details>
<summary>Click here for command details for ACF2.</summary>

If you use ACF2, issue the following commands:
</details>

<details>
<summary>Click here for command details for Top Secret.</summary>

If you use Top Secret, issue the following commands, where `owner-acid` can be IZUSVR or a different ACID:
</details>

NOTES

- The cross memory server treats "no decision" style SAF return codes as failures. If there is no covering profile for the `ZWES.IS` resource in the FACILITY class, the request will be denied.
- Cross memory server clients other than Zowe might have additional SAF security requirements. For more information, see the documentation for the specific client.

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Assigning security permissions to users

Assign users (ZWESVUSR and ZWESIUSR) and the ZWEADMIN security group permissions required to perform specific tasks. Each TSO user ID that logs on to Zowe and uses Zowe services that use z/OSMF requires permission to access these z/OSMF services.

REQUIRED ROLES: SECURITY ADMINISTRATOR

Overview of user categories and roles

Specific user IDs with sufficient permissions are required to run or access Zowe. Your organization's security administrator is responsible to assign the following user IDs during Zowe z/OS component configuration.

The following user IDs run Zowe:

- **ZWESVUSR**
  This is the started task ID of the Zowe runtime user who runs most of the Zowe core components.
- **ZWESIUSR**
  This user runs the cross memory server (ZIS). This is a started task ID used to run the PROCLIB `ZWESISTC` that launches the cross memory server (ZIS).

IMPORTANT!

To work with USS, the user ID must have a valid OMVS segment. For more information about OMVS segments, see the article *The OMVS segment in user profiles* in the IBM documentation. For detailed information about which permissions are required to run Zowe core services as well as specific individual components, see the Security Permissions Reference Table in this article.

The security administrator also assigns permissions to the security group **ZWEADMIN**. `ZWEADMIN` is a group consisting of `ZWESVUSR` and `ZWESIUSR`. This group must have a valid OMVS segment.

Additionally, the security administrator assigns permissions to individual Zowe users. If z/OSMF is used for authentication and serving REST APIs for Zowe CLI and Zowe Explorer users, the TSO user ID for end users must belong to one or both of the groups `IZUUSER` or `IZUADMIN`.

Security Permissions Reference Table

The following reference table describes which permissions are required for the user ID `ZWESVUSR` to run Zowe core services and specific individual components.

If you already successfully ran the `ZWESECUR` JCL either separately or by running the `zwe init security` command, you do not need to perform the steps described in this section. The TSO commands to create the user IDs and groups are executed during the JCL sections of `ZWESECUR`. For more information about the `zwe init security` command, see zwe init security.

Feature of a Zowe server-side component	Resource class	Resource name	Type of access required	Reason	Actions
Core	FACILITY	`BPX.JOBNAME`	READ	Allow z/OS address spaces for unix processes to be renamed for ease of identification.	This parameter permits the Zowe main server to set the job name. Run the command that applies to your ESM. • RACF • ACF2 • Top Secret
API Mediation Layer certificate mapping	FACILITY	`IRR.RUSERMAP`	READ	**Optional** Allow Zowe to map an X.509 client certificate to a z/OS identity.	This parameter permits the Zowe main server to use the client certificate mapping service. Run the command that applies to your ESM. • RACF • ACF2 • Top Secret
API Mediation Layer identity mapping	FACILITY	`IRR.IDIDMAP.QUERY`	READ	**Optional** Allow Zowe to map a distributed identity to a z/OS identity.	This parameter permits the Zowe main server to use distributed identity mapping service. Run the command that applies to your ESM. • RACF • ACF2 • Top Secret

Feature of a Zowe server-side component	Resource class	Resource name	Type of access required	Reason	Actions
API Mediation Layer SMF records	FACILITY	`IRR.RAUDITX`	READ	**Optional** Allow API Mediation Layer to issue SMF 83 records about activity of Personal Access Tokens. For more information about configuring the main Zowe server to issue SMF records, see Configure the main Zowe server to issue SMF records	This parameter permits the Zowe main server to cut SMF records. Run the command that applies to your ESM. • RACF • ACF2 • Top Secret
ZSS (required for API ML certificate and identity mapping)	FACILITY	`BPX.SERVER` + `BPX.DAEMON`	UPDATE	Allow Zowe to run code on behalf of the API requester's TSO user ID. For more information, see Security Environment Switching.	This parameter permits the Zowe main server to create a user's security environment. Run the command that applies to your ESM. • RACF • ACF2 • Top Secret
ZSS (required for API ML certificate and identity mapping)	APPL	`OMVSAPPL`	READ	Allow Zowe to run code on behalf of the API requester's TSO user ID. This permission is also required from a requester's TSO user. You can skip this requirement when the resource `OMVSAPPL` in the `APPL` class is not defined. For more information, see Security Environment Switching.	This parameter permits the Zowe main server to run the code on behalf of the user. Run the command that applies to your ESM. • RACF • ACF2 • Top Secret
ZSS	FACILITY	`IRR.RADMIN.LISTUSER`	READ	Allow Zowe to obtain information about	This parameter permits the Zowe

Feature of a Zowe server-side component	Resource class	Resource name	Type of access required	Reason	Actions
				OMVS segment of the user profile using `LISTUSER` TSO command.	main server to obtain information about OMVS segment of the user profile. Run the command that applies to your ESM. • RACF • ACF2 • Top Secret
ZSS	CSFSERV	`Multiple`	READ	Generate symmetric keys using ICSF that is used by Zowe Desktop cookies.	The list of IDs to enable include `CSF1TRD` , `CSF1TRC` , `CSF1SKE` , `CSF1SKD` . The full list of IDs is described in the z/OS Cryptographic Services user guide for your z/OS release level: 2.2, 2.3, 2.4 and 2.5.
Cross memory server (ZIS)	FACILITY	`ZWES.IS`	READ	Allow Zowe ZWESLSTC processes to access the Zowe ZIS cross memory server.	This parameter permits the Zowe main server to use ZIS cross memory server. Run the command that applies to your ESM. • RACF • ACF2 • Top Secret

Granting users permission to access z/OSMF

Each TSO user ID that logs on to Zowe and uses Zowe services that use z/OSMF requires permission to access these z/OSMF services. It is necessary that every user ID be added to the group with the appropriate z/OSMF privileges, `IZUUSER` or `IZUADMIN` (default).

REQUIRED ROLE: SECURITY ADMINISTRATOR

This step is not included in the provided Zowe JCL because it must be done for every TSO user ID who wants to access Zowe's z/OS services. The list of those user IDs will typically be the operators, administrators, developers, or anyone else in the z/OS environment who is logging in to Zowe.

> **NOTE**
>
> You can skip this section if you use Zowe without z/OSMF. Zowe can operate without z/OSMF but services that use z/OSMF REST APIs will not be available, specifically the USS, MVS, and JES Explorers and the Zowe Command Line Interface files, jobs, workflows, tso, and console groups.

To grant permissions to the user ID to access z/OSMF, issue the command(s) that corresponds to your ESM.

<details>
<summary>Click here for command details for RACF.</summary>

- If you use RACF, issue the following command:

</details>

<details>
<summary>Click here for command details for ACF2.</summary>

- If you use ACF2, issue the following commands:

</details>

<details>
<summary>Click here for command details for Top Secret.</summary>

- If you use Top Secret, issue the following commands:

</details>

Next step

After you complete assigning security permissions, the next step is to configure certificates.

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Configuring certificates

Review this article to learn about the key concepts of Zowe certificates, and options for certificate configuration.

REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR

Zowe uses digital certificates for secure, encrypted network communication over Secure Sockets Layer/Transport Layer Security (SSL/TLS) and HTTPS protocols. Communication in Zowe can be between Zowe servers, from Zowe to another server, or even between Zowe's servers and Zowe's client components.

Zowe's certificates are stored in its **keystore**. Verification of these certificates and any incoming certificates from other servers or clients is done by using certificates of certificate authorities (CAs) within Zowe's **truststore**.

Zowe supports using either file-based (`PKCS12`) or z/OS key ring-based (when on z/OS) keystores and truststores, and can reuse compatible stores if they exist. Zowe can assist in creating the stores by either generating certificates or by allowing users to import their own compatible certificates via the `zwe init certificate` command.

- Certificate concepts
- Certificate verification
- Zowe certificate requirements
- Certificate setup type
- Next steps: Creating or importing certificates to Zowe

NOTE

If you are already familiar with certificate concepts and how Zowe uses certificates and are ready to get started, see the options under the section *Next steps: Creating or importing certificates to Zowe* at the end of this article.

Certificate concepts

Before you get started with configuring certificates, it is useful to familiarize yourself with the following key concepts:

- Keystore
- Truststore
- PKCS12
- z/OS key ring
- Server certificate
- Client certificate
- Self-signed certificates

Keystore

The keystore is the location where Zowe stores certificates that Zowe servers present to clients and other servers. In the simplest case, the keystore contains one private key and a certificate pair, which can then be used by each Zowe server. When you are using a key ring, a single key ring can serve both as a keystore and as a truststore if desired.

Truststore

The truststore is used by Zowe to verify the authenticity of the certificates that Zowe encounters. The authenticity is required when Zowe is communicating with another server, with one of Zowe's own servers, or with a client that presents a certificate. A truststore is composed of Certificate Authority (CA) certificates that are compared against the CAs that an incoming certificate claims to be signed by. To ensure a certificate is authentic, Zowe must verify that the certificate's claims are correct. Certificate claims include that the certificate was sent by the host that the certificate was issued to, and that the cryptographic signature of the authorities the certificate claims to have been signed by match those found within the truststore. This process helps to ensure that Zowe only communicates with hosts that you trust and have verified as authentic. When using a key ring, a single key ring can be both a keystore and a truststore if desired.

PKCS12

PKCS12 is a file format that allows a Zowe user to hold many crytopgrahic objects in one encrypted, passworded file. This file format is well supported across platforms but because it is just a file, you can prefer to use z/OS key rings instead of PKCS12 certificates for ease of administration and maintenance.

z/OS key ring

z/OS provides an interface to manage cryptographic objects in "key rings". As opposed to PKCS12 files, using z/OS key rings allows the crypto objects of many different products to be managed in a uniform manner. z/OS key rings are still encrypted, but do not use passwords for access. Instead, SAF privileges are used to manage access. Java's key ring API requires that the password field for key ring access to be set to "password", so despite not needing a password, you can see this keyword.

Use of a z/OS keystore is the recommended option for storing certificates if system programmers are already familiar with the certificate operation and usage. Creating a key ring and connecting the certificate key pair requires elevated permissions. When the TSO user ID does not have the authority to manipulate key rings and users want to create a Zowe sandbox environment or for testing purposes, the USS keystore is a good alternative.

One option for certificate setup for key rings is to copy the JCL `ZWEKRING` member of Zowe's SAMPLIB and customize its values.

Server certificate

Servers need a certificate to identify themselves to clients. Every time that you go to an HTTPS website, for example, your browser checks the server certificate and its CA chain to verify that the server you reached is authentic.

Client certificate

Clients do not always need certificates when they are communicating with servers, but sometimes client certificates can be used wherein the server verifies authenticity of the client similar to how the client verifies authenticity for the server. When client certificates are unique to a client, the certificate can be used as a form of authentication to provide convenient yet secure login.

Self-signed certificates

A self-signed certificate is one that is not signed by a CA at all – neither private nor public. In this case, the certificate is signed with its own private key, instead of requesting verification from a public or a private CA. It means that there is no

chain of trust to guarantee that the host with this certificate is the one you wanted to communicate with. Note that these certificates are not secure against other hosts masquerading as the one you want to access. As such, it is highly recommended that certificates be verified against the truststore for production environments.

Certificate verification

When you configure Zowe, it is necessary to decide whether Zowe verifies certificates against its truststore.

In the Zowe configuration YAML, the property `zowe.verifyCertificates` controls the verification behavior. It can be `DISABLED`, `NONSTRICT`, or `STRICT`.

You can set this property either before or after certificate setup, but **it is recommended to set `zowe.verifyCertificates` before certificate setup** because it affects the automation that Zowe can perform during certificate setup.

DISABLED verification

If you set `zowe.verifyCertificates` to `DISABLED`, certificate verification is not performed. It is not recommended for security reasons, but may be used for proof of concept or when certificates within your environment are self-signed.

If you set `DISABLED` before certificate setup, Zowe does not automate putting z/OSMF trust objects into the Zowe truststore. This action can result in failure to communicate with z/OSMF if later you enable verification. As such. It is recommended to either set verification on by default, or to reinitialize the keystore if you choose to turn on verification at a later point.

NON-STRICT verification

If you set `zowe.verifyCertificates` to `NONSTRICT`, certificate verification is performed except for hostname validation. Using this setting, the certificate Common Name or Subject Alternate Name (SAN) is not checked. Skipping hostname validation facilitates deployment to environments where certificates are valid but do not contain a valid hostname. This configuration is for development purposes only and should not be used for production.

STRICT verification

`STRICT` is the recommended setting for `zowe.verifyCertificates`. This setting performs maximum verification on all certificates Zowe sees, and uses Zowe truststore.

Zowe certificate requirements

If you do not yet have certificates, Zowe can create self-signed certificates for you. The use of self-signed certificates for production is not recommended, so you should bring your own certificates. Note that the certificates must be valid for use with Zowe.

Extended key usage

Zowe server certificates must either not have the `Extended Key Usage` (EKU) attribute, or have both the `TLS Web Server Authentication (1.3.6.1.5.5.7.3.1)` and `TLS Web Client Authentication (1.3.6.1.5.5.7.3.2)` values present within.

Some Zowe components act as a server, some as a client, and some as both - client and server. The component certificate usage for each of these cases is controlled by the Extended Key Usage (EKU) certificate attribute. The Zowe components use a single certificate (or the same certificate) for client and server authentication, so it is required that this certificate is valid for the intended usage/s of the component - client, server, or both. The EKU certificate extension attribute is not required, however, if it is specified, it must be defined with the intended usage/s. Otherwise, connection requests will be rejected by the other party

Supported algorithm

The server certificate could be used to sign JWT tokens when one of the following conditions is valid:

- The token provider is set as SAF (see `apiml.security.auth.provider=saf`)
- The token provider is set as z/OSMF (see `apiml.security.auth.provider=zosmf`), but the z/OSMF is not configured to support JWT tokens
- Personal access token (PAT) are enabled

The supported algorithm is: RSASSA-PKCS1-v1_5 using SHA-256 signature algorithm as defined by RFC 7518, Section 3.3. This algorithm requires a 2048-bit key.

Hostname validity

The host communicating with a certificate should have its hostname match one of the values of the certificate's Common Name or Subject Alternate Name (SAN). If this condition is not true for at least one of the certificates that are seen by Zowe, then you may wish to set NON-STRICT verification within Zowe's configuration.

z/OSMF access

The z/OSMF certificate is verified according to Zowe's Certificate verification setting, as is the case with any certificate that is seen by Zowe. However, Zowe will also set up a trust relationship with z/OSMF within Zowe's truststore during certificate setup automation if the certificate setting is set to any value other than DISABLED.

Certificate setup type

Whether importing or letting Zowe generate certificates, the setup for Zowe certificate automation and the configuration to use an existing keystore and truststore depends upon the content format: file-based (`PKCS12`) or z/OS key ring-based.

File-based (PKCS12) certificate setup

Zowe is able to use PKCS12 certificates that are stored in USS. Zowe uses a `keystore` directory to contain its certificates primarily in PKCS12 (`.p12`, `.pfx`) file format, but also in PEM (`.pem`) format. The truststore is in the `truststore` directory that holds the public keys and CA chain of servers that Zowe communicates with (for example z/OSMF).

z/OS key ring-based certificate setup

Zowe is able to work with certificates held in a **z/OS key ring**.

The JCL member `.SZWESAMP(ZWEKRING)` contains security commands to create a SAF key ring. By default, this key ring is named `ZoweKeyring`. You can use the security commands in this JCL member to generate a Zowe certificate authority

(CA) and sign the server certificate with this CA. The JCL contains commands for all three z/OS security managers: RACF, TopSecret, and ACF2.

There are two ways to configure and submit `ZWEKRING`:

- Copy the JCL `ZWEKRING` member and customize its values.
- Customize the `zowe.setup.certificate` section in `zowe.yaml` and use the `zwe init certificate` command.

  You can also use the `zwe init certificate` command to prepare a customized JCL member by using `ZWEKRING` as a template.

A number of key ring scenarios are supported:

- Creation of a local certificate authority (CA) which is used to sign a locally generated certificate. Both the CA and the certificate are placed in the `ZoweKeyring`.
- Import of an existing certificate that is already held in z/OS to the `ZoweKeyring` for use by Zowe.
- Import of an existing certificate already held in z/OS to the `ZoweKeyring` for use by Zowe.

Next steps: Creating or importing certificates to Zowe

Review the following options and choose which best applies to your use case:

- Take our Certificates Configuration Questionnaire to assist with determining which configuration scenario and associated zowe.yaml format best suits your use case.
- To review the various zowe.yaml files to see which certificate configuration applies to your specific use case, see Certificate configuration scenarios.
- If you have an existing certificate, you can import this certificate to the keystore. For more information, see Import and configure an existing certificate.
- If you do not have an existing certificate, you can create one. For more information, see Generate a certificate.
- When your certificate is already in the keystore, it is ready for use. For more information about how to use it, see Use certificates.
- If you run into any error when configuring certificates, see Troubleshooting the certificate configuration.

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Zowe certificates configuration questionnaire

To properly configure Zowe to use certificates for server-side component installation, review the certificate setup options presented in this article. Understanding these options makes it possible to select the best certificate configuration scenario that fits your Zowe deployment use case.

REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR

If you know that you will be using certificates in a production deployment environment, and that you will be using an external certificate authority (CA), we recommend you consult with your organization's security administrator before you start certificate configuration.

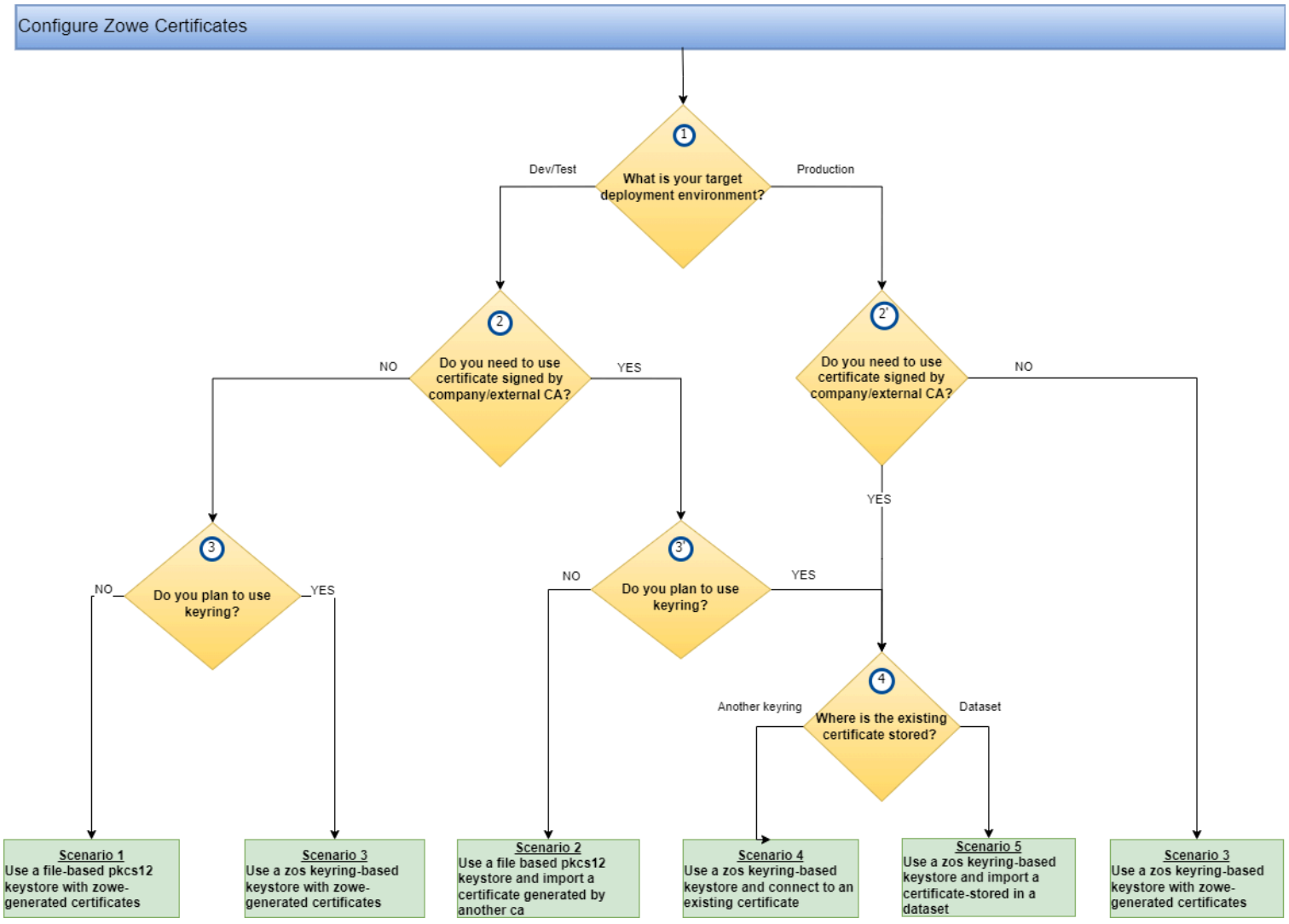
Review the Configure Zowe Certificates diagram and answer the questions presented in the questionnaire at the end of this article.

TIP

Before determining which scenario best suits your use case, it is practical to have a general understanding of the certificate configuration basics and Zowe certificates configuration overview. For more information, see the following articles:

- Certificates concepts in the Zowe Security Glossary
- Zowe certificates overview

The numerated decision blocks (yellow diamonds) in the following diagram correspond to the questions in the questionnaire. Follow this sequence of questions to determine which certificate configuration scenario best suits your certificate use case.



Each of the following certificate configuration scenarios are available in the article Certificate configuration scenarios.

- Scenario 1: Use a file-based (PKCS12) keystore with Zowe generated certificates
- Scenario 2: Use a file-based (PKCS12) keystore and import a certificate generated by another CA
- Scenario 3: Use a z/OS keyring-based keystore with Zowe generated certificates
- Scenario 4: Use a z/OS keyring-based keystore and connect an existing certificate
- Scenario 5: Use a z/OS keyring-based keystore and import a certificate stored in a data set

Certificate configuration questionnaire

Answer each question and find which scenarios are relevant for the selected option:

Question 1: What is your target deployment environment?
Depending on your target environment type (DEV/TEST or PROD), you can create your certificates (self-signed option), acquire new ones from a trusted CA, or use existing certificates.

Question 2: Do you need to use a certificate signed by the CA of the company or by an external CA?
If you plan to use Zowe generated self-signed certificates and your target environment is production, we strongly recommend that you acquire new certificates from your trusted CA.

Question 3: Do you plan to use a keyring?
Decide if you want to store the certificate in a z/OS keyring or to a file based keystore/truststore.

> **TIP**
>
> While using a keystore/truststore pair is possible to store your certificates, we recommend that you use z/OS keyrings for production deployments.

Question 4: Do you plan to use an existing certificate from another keyring or from a dataset?
If you have an existing certificate, you can import or connect this certificate to the planned z/OS keyring based storage.

Before you import your certificates, check to make sure that the certificate format, type, and properties correspond to the required protection and acceptability depending on the planned deployment environment (DEV, TEST, PROD). For example, use Zowe generated self-signed certificates only with development or testing environments and not with production environments.

For more information, see Import and configure an existing certificate.

Next steps

After you select your applicable certificate configuration scenario and review the certificate configurate sample in the article Certificate configuration scenarios, you can continue to Configure Zowe Certificates.

> **TIP**
>
> If you encounter issues when configuring your certificate, see Troubleshooting the certificate configuration, to find resolution of errors.

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Certificate configuration scenarios

After you complete the Zowe certificates configuration questionnaire to determine your specific configuration use case, choose from the five scenarios presented in this article to configure Zowe for automatic certificate setup. Examples of the zowe.yaml files are provided for each scenario.

REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR

TIP

To assist you with determining the specific certificate configuration scenario that applies to your use case, see Zowe certificates configuration questionnaire. This questionnaire guides you through questions that lead to a specific configuration scenario presented in this article.

Zowe servers require both a keystore to store the certificates and a truststore to validate certificates.

For use of Zowe on z/OS, the keystore and truststore can either be Unix file-based (PKCS12) or z/OS keyring-based.

Both the keystore and truststore can automatically be created by Zowe regardless of which storage type is used. Keystores and truststores can be populated either with certificates that the user chooses, or with self-signed certificates generated by Zowe. This automation can be performed by defining and customizing the `zowe.setup.certificate` section of your Zowe YAML configuration. Zowe can then automate the certificate setup via the `zwe init certificate` command.

NOTE

Automated generation of certificates is an option, but is not required. If you already have a keystore that contains a valid certificate *, and the corresponding private key of the certificate, along with a truststore which validates the certificate and any other certificates you expect to encounter, then you also have the option to directly define the parameter `zowe.certificate`, which specifies the location of each of these certificates and their storage objects. Note that this parameter should not be confused with the parameter `zowe.setup.certificate`.

* What is a valid certificate in Zowe?

A valid certificate for use in Zowe conforms to one of the following two options:

- The certificate does not contain the *Extended Key Usage* section.
- The certificate does contain the *Extended Key Usage* section, and also includes the **Server** and **Client** authentication fields.

Considerations for certificate scenario selection

Consider the scenario that best suits your use case:

- Do you plan to use a file-based (PKCS12) certificates, or z/OS keyrings?

- Do you plan to enable Zowe to create self-signed certificates, or will Zowe be using pre-made certificates which you are providing?
- If you are providing certificates to Zowe and using a keyring, does the certificate already exist in your security database, or are you importing it via a dataset?

There are five scenarios/use cases for configuring certificates. Use the applicable certificate configuration scenario according to your needs.

Each scenario described in this article provides the configuration details via code snippets which you can use to edit your Zowe YAML configuration within the `zowe.setup.certificate` section.

- Scenario 1: Use a file-based (PKCS12) keystore with Zowe generated certificates
- Scenario 2: Use a file-based (PKCS12) keystore and import a certificate generated by another CA
- Scenario 3: Use a z/OS keyring-based keystore with Zowe generated certificates
- Scenario 4: Use a z/OS keyring-based keystore and connect an existing certificate
- Scenario 5: Use a z/OS keyring-based keystore and import a certificate stored in a data set

> **NOTE**
>
> Ensure that all alias values for all scenarios use only lower-case.

Scenario 1: Use a file-based (PKCS12) keystore with Zowe generated certificates

Use this procedure to configure the `zowe.setup.certificate` section in your yaml file to enable Zowe to use generated PKCS12 certificates to be used with a keystore directory to store your certificates.

Click here for details.

1. Set the `type` of the certificate storage to `PKCS12`.
2. Customize the keystore directory in the following format:
3. Lock the keystore directory so it is accessible only to the Zowe runtime user and group:
4. Customize the certificate alias name. The default value is `localhost`.
5. Set the keystore password. The default value is `password`.
6. Set the alias name of self-signed certificate authority. The default value is `local_ca`.
7. Set the password of the keystore stored self-signed certificate authority. The default value is `local_ca_password`.
8. (Optional) Specify the distinguished name for Zowe generated certificates.
9. Set the validity in days for the Zowe generated certificates

10. Set the domain names and IPs specified in nested subsection `SAN`. If this field is not defined, the `zwe init` command uses the value `zowe.externalDomains`.

> **NOTE**
>
> A bug in Java SDK 8.0.8.10 has been discovered that makes configuration scenario 1 non-operational. If you see the following message when running the `zwe init certificate` command, upgrade or downgrade your Java version:
>
> For more information, see this article in IBM Support.

Example zowe yaml for scenario 1:

Your yaml file is now configured to enable Zowe to use generated PKCS12 certificates.

For more information about using a file-based PKCS12 certificate in Zowe services, see the video tutorials on YouTube. More information about this certificate configuration scenario is also availabe in this Medium blog post.

Scenario 2: Use a file-based (PKCS12) keystore and import a certificate generated by another CA

Use this procedure to configure the `zowe.setup.certificate` section in your yaml file to enable Zowe to use a file-based PKCS12 keystore to import a certificate generated by another CA.

Click here for details.

1. Set the `type` of the certificate storage to `PKCS12`.
2. Customize the keystore directory in the following format:
3. Lock the keystore directory so it is accessible only to the Zowe runtime user and group:
4. Customize the certificate alias name. The default value is `localhost`.
5. Set keystore password. The default value is `password`.
6. Set the existing PKCS12 keystore which holds the certificate issued by an external CA.
7. Set the password of the keystore set in step 6.
8. Specify the alias of the certificate to be imported.
9. Set the path to the certificate authority that signed the certificate to be imported.

> **NOTE**
>
> PEM format certificate authorities can be imported and trusted.

Example zowe yaml for scenario 2 (PKCS12):

Your yaml file is now configured to enable Zowe to use a file-based PKCS12 keystore to import a certificate generted by another CA.

Scenario 3: Use a z/OS keyring-based keystore with Zowe generated certificates

Use this procedure to configure the `zowe.setup.certificate` section in your yaml file to enable Zowe to use a z/OS keyring-based keystore with Zowe generated certificates.

<details>
<summary>Click here for details.</summary>

1. Set the `type` of the certificate storage to one of the following keyring types:
    - JCEKS
    - JCECCAKS
    - JCERACFKS
    - JCECCARACFKS
    - JCEHYBRIDRACFKS
2. Add the parameter `createZosmfTrust` and set to true.
3. Under the nested subsection `keyring:`, specify the following keyring values:
    - keyring name
    - Label of Zowe certificate. The default value is `localhost`.
    - Label of Zowe CA certificate. The default value is `localca`.
    - The distinguished name for Zowe generated certificates.
4. Set the validity in days for the Zowe generated certificates
5. Set the domain names and IPs specified in the certificate SAN. If this field is not defined, the `zwe init` command uses the value `zowe.externalDomains`.

> **NOTE**
> Due to the limitation of the `RACDCERT` command, this field should contain exactly two entries with the domain name and IP address.

Example zowe yaml for scenario 3:

Your yaml file is now configured to enable Zowe to use a z/OS keyring-based keystore with Zowe generated certificates.
</details>

Scenario 4: Use a z/OS keyring-based keystore and connect to an existing certificate

Use this procedure to configure the `zowe.setup.certificate` section in your yaml file to use a z/OS keyring-based keystore and connect to an existing certificate.

<details>
<summary>Click here for details.</summary>

1. Set the `type` of the certificate storage to one of the following keyring types:
    - JCEKS
    - JCECCAKS
    - JCERACFKS
    - JCECCARACFKS
    - JCEHYBRIDRACFKS
2. Under `keyring:`, specify the keyring name:
3. Under the nested subsection `connect:`, specify the following parameters:
    - The current owner of the certificate. Possible values can be `SITE` or a user ID.
    - The label of the existing certificate to be connected to the Zowe keyring.
    - All certificate authorities you want to be trusted in the Zowe keyring.

> **NOTE**
>
> Due to the limitation of `RACDCERT` command, this field should contain a maximum of 2 entries.

The following example uses an existing JCERACFKS certificate for Zowe's z/OS components. For more information about configuration in this scenario, see this Medium blog post, or the video tutorials in this YouTube playlist.

Example zowe yaml for scenario 4:

If you would like to use this example in your Zowe configuration YAML file, replace the following four fields with your own values:

- Replace `ZoweKeyringZOSMF` with the your own key ring name.
- Replace `IZUSVR` with the user name who is the owner of the existing certificate.
- Replace `DefaultzOSMFCert.IZUDFLT` with the label of the existing certificate you are connecting to (which is owned by the previously referenced user ID).
- Replace `zOSMFCA` with the certificate authority that is used to sign the certificate.

Your yaml file is now configured to use a z/OS keyring-based keystore and connect to an existing certificate.
</details>

Scenario 5: Use a z/OS keyring-based keystore and import a certificate stored in a data set

Use this procedure to configure the `zowe.setup.certificate` section in your yaml file to use a z/OS keyring-based keystore and import a certificate stored in a data set.

<details>
<summary>Click here for details.</summary>

1. Set the `type` of the certificate storage to one of the following keyring types:
    - JCEKS
    - JCECCAKS
    - JCERACFKS
    - JCECCARACFKS
    - JCEHYBRIDRACFKS
2. Under `keyring:`, specify the following keyring values:
    - keyring name
    - Label of Zowe certificate. The default value is `localhost`.
3. Under the nested subsection `import:` specify the following parameters:
    - The name of the data set holds the certificate issued by another CA. This data set should be in PKCS12 format and contain private key.
    - The password for the PKCS12 data set.

Example zowe yaml for scenario 5:

Your yaml file is now configured to use a z/OS keyring-based keystore and import a certificate stored in a data set.
</details>

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Importing and configuring a certificate

One option to use certificates in Zowe is to import and configure existing certificates. Use the procedure that applies to the type of certificate you wish to import.

> **REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR**

Choose from the following certificate importing options:

- Importing a file-based PKCS12 certificate
- Importing a JCERACFKS certificate
- Importing a certificate stored in an MVS data set into a Zowe key ring.

Importing an existing PKCS12 certificate

To import a PKCS12 certificate, it is first necessary to import a certificate authority (CA). There are two options for importing a CA:

- Manually importing a certificate authority into a web browser
- Importing a local CA certificate on Linux

Once you have imported your CA, you can configure the zowe.yaml according to Scenario 2: Use a file-based (PKCS12) keystore and import a certificate generated by another CA described in the article Certificate configuration scenarios.

For PKCS12 certificate users, specify the following parameters in the `zowe.yaml` file:

Parameter	Description
`zowe.setup.certificate.pkcs12.import.keystore`	Specify this parameter if you acquired one or more certificates from another CA, stored them in PKCS12 format, and now want to import the certificate(s) into the Zowe PKCS12 keystore.
`zowe.setup.certificate.pkcs12.import.password`	Specify this password value for the keystore defined in `zowe.setup.certificate.pkcs12.import.keystore`.
`zowe.setup.certificate.pkcs12.import.alias`	This value is the original certificate alias defined in `zowe.setup.certificate.pkcs12.import.keystore`.
`zowe.setup.certificate.pkcs12.name`	The imported certificate is saved under the alias specified in it.

Configure `zowe.yaml` for a PKCS12 certificate:

> **NOTE**

> Due to the limitation of the RACDCERT command, the `importCertificateAuthorities` field can contain a maximum of two entries.

You can now use your imported PKCS12 certificate. See next steps.

Importing a certificate Authority (CA)

Importing a certificate authority (CA) is a prerequisite to importing a PKCS12 certificate. Use the method that applies to your use case.

- Manually importing a certificate authority into a web browser
- Importing a local CA certificate on Linux

Manually importing a certificate authority into a web browser

To avoid the browser untrusted CA challenge, import Zowe certificates into the browser.

Trust in the API ML server is a necessary precondition for secure communication between the browser or API Client application. Ensure this trust by installing a Certificate Authority (CA) public certificate. By default, API ML creates a local CA. Import the CA public certificate to the truststore for REST API clients and to your browser. You can also import the certificate to your root certificate store.

> **TIP**
> If a SAF keyring is used and set up with `ZWEKRING` JCL, the procedure to obtain the certificate does not apply. In this case, we recommended that you work with your security system administrator to obtain the certificate.

The public certificate in PEM format is stored in a USS directory a defined in the `zowe.yaml` configuration file in the section `zowe.certificate.pem.certificateAuthorities`. The certificate is stored in UTF-8 encoding so you need to transfer the certificate as a binary file. Since this is the certificate to be trusted by your browser, it is recommended to use a secure connection for transfer.

> **NOTE**
> Windows currently does not recognize the PEM format. For Windows, use the P12 version of the `local_cer`.

Importing commands according to your operating system

To import the certificate to your root certificate store and trust it, follow the applicable procedure based on your operating system.

For Windows, click here for command details.

Note: Ensure that you open the terminal as **administrator**. This operation installs the certificate to the Trusted Root Certification Authorities.

For macOS, click here for command details.

For Firefox, click here for command deails.

Manually import your root certificate via the Firefox settings, or force Firefox to use the Windows truststore. As a default, Firefox uses its own certificate truststore.

Create a new Javascript file firefox-windows-truststore.js at `C:\Program Files (x86)\Mozilla Firefox\defaults\pref` with the following content:

TIP

To avoid requiring each browser to trust the CA that signed the Zowe certificate, you can use a public certificate authority to create a certificate. Optional public certificate authorities include *Symantec*, *Comodo*, *Let's Encrypt*, or *GoDaddy*. Certificates generated by such public CAs are trusted by all browsers and most REST API clients. This option, however, requires a manual process to request a certificate and may incur a cost payable to the publicly trusted CA.

After successfully manually importing a certificate authority into a web browser, you can now import an existing PKCS12 certificate.

Importing a local CA certificate on Linux

Zowe also supports importing certificates to make REST HTTPS curl request from the command line.

Follow these steps to import `local_ca.cer` from the path `.../zowe/keystore/local_ca`.

NOTE

Steps are verified with Ubuntu 20.04.6 LTS.

1. Rename `local_ca.cer` with `local_ca.crt` and copy to the shared ca-certificates path.

   ```
   $ cp local_ca.cer /usr/local/share/ca-certificates/zowe_local_ca.crt
   ```

2. Execute a ca-certificate store update by running the following command:

   ```
   $ sudo update-ca-certificates
   ```

3. Verify that the new expected certificate was added (the newest will be at the bottom of the list which contains an extended list of concatenated CAs).

   ```
   $ cat /etc/ssl/certs/ca-certificates.crt
   ```

4. Run a basic curl HTTPS request from the command line. For example, run the following command:

After successfully importing your local CA certificate on Linux, you can now import an existing PKCS12 certificate.

Importing an existing JCERACFKS certificate

To import a JCERACFKS certificate, use the example yaml according to Scenario 4: Use a z/OS keyring-based keystore and connect to an existing certificate in the article Certificate configuration scenarios.

To use a JCERACFKS certificate, specify the following parameters in the `zowe.yaml` file:

Parameter	Description
`zowe.setup.certificate.keyring.connect.user`	This is a required parameter that specifies the owner of existing certificate. This field can have value of SITE or a user ID.
`zowe.setup.certificate.keyring.connect.label`	This is a required parameter that sets the label of an existing certificate.

Configure `zowe.yaml` for a JCERACFKS certificate:

> **NOTE**
>
> Due to the limitation of the RACDCERT command, the `importCertificateAuthorities` field can contain a maximum of two entries.

You can now use your imported JCERACFKS certificate. See next steps.

Importing a certificate stored in an MVS data set into a Zowe key ring

To import a certificate that is stored in a data set into a key ring, configure the zowe.yaml according to the example yaml in Scenario 5: Use a z/OS keyring-based keystore and import a certificate stored in a data set

To use a JCERACFKS certificate, specify the following parameters in the `zowe.yaml` file.

Parameter	Description
`zowe.setup.certificate.keyring.connect.dsName`	This is a required parameter which specifies the data set where the certificate stored.
`zowe.setup.certificate.keyring.connect.password`	This parameter specifies the password when importing the certificate.
`zowe.setup.certificate.keyring.label`	This parameter specifies that label of the certificate that is imported.

Configure `zowe.yaml` for a JCERACFKS certificate stored in an MVS data set:

The configuration of `zowe.setup.certificate` populates information to be used by the subcommand `zwe init certificate` of `zwe init`.

Next steps

Once your certificate is successfully imported, review the documentation about how to use certificates in a Zowe production environment.

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Generating a certificate

If you do not have a certificate, follow the procedure in this article that corresponds to the certificate type you choose to generate.

> **REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR**

Choose from the following certificate types:

- Creating a PKCS12 certificate
- Creating a JCERACFKS certificate

Both certificate types are self-signed certificates.

Creating a PKCS12 keystore

Use can create PKCS12 certificates that are stored in USS. This certificate is used for encrypting TLS communication between Zowe clients and Zowe z/OS servers, as well as intra z/OS Zowe server to server communcation. Zowe uses a keystore directory to contain its external certificate, and a truststore directory to hold the public keys of servers it communicate with (for example z/OSMF).

Follow these steps to generate a PKCS12 keystore:

1. Configure the PKCS12 setup section in zowe.yaml
2. Run the command to generate a PKCS12 keystore

Configure the PKCS12 setup section in zowe.yaml

To assist with updating `zowe.yaml`, see the example yaml for scenario 1: Use a file-based (PKCS12) keystore with Zowe generated certificates in the article Certificate configuration scenarios.

For PKCS12 certificate users, customize the following parameters in the `zowe.yaml` file:

Parameter	Description
`zowe.setup.certificate.pkcs12.directory`	Specifies the directory where you plan to store the PKCS12 keystore and truststore. This is required if `zowe.setup.certificate.type` is PKCS12.
`zowe.setup.certificate.pkcs12.lock`	Is a boolean configuration to tell if we should lock the PKCS12 keystore directory only for Zowe runtime user and group. Default value is true.
`zowe.setup.certificate.pkcs12` (*Optional*)	Defines name, password, caAlias and caPassword to customize the keystore and truststore. It is recommended to update these values

Parameter	Description
	from the default values. **Note:** Alias names should be all in lower case.
`dname` (*Optional*)	Specifies the distinguished name. Domain names and IPs should be added into certificate SAN. If the field `san` is not defined, the `zwe init` command uses `zowe.externalDomains`.

Configuring the `zowe.yaml` file for a PKCS12 certificate
The following `zowe.yaml` example generates the following artifacts:

- A `PKCS12` certificate, specified in `zowe.setup.certificate.type`.
- A keystore directory `/var/zowe/keystore`, specified in `zowe.setup.certificate.pkcs12.directory`.
- A certificate name (or alias) `localhost`, specified in `zowe.setup.certificate.pkcs12.name`.
- A certificate authority name `local_ca`, specified in `zowe.setup.certificate.certificate.pkcs12.caAlias`.

Example `zowe.yaml` using PKCS12:

> **TIP**
> To get the san IP address, run `ping dvipa.my-company.com` in your terminal.

Run the command to generate a PKCS12 keystore

After you configure the `zowe.yaml`, use the following procedure to generate the PKCS12 certificate.

1. Log in to your system. In this example, run `ssh dvipa.my-company.com` with your password.
2. Run the following command in the directory with this `zowe.yaml` in the terminal to generate the certificate and update the configuration values in the `zowe.yaml` file.

   ```
   zwe init certificate -c <path-to-your-zowe-configuration-yaml> --update-config
   ```

The following command output shows the generation of a PKCS12 keystore using the default values, and has the following associated artifacts. (Note that some detailed output messages have been omitted.)

- The CA is created.
- The keystore is created and the CA is added to the keystore.
- The certificate is created and is added to the keystore.
- The truststore is created.
- Directory permissions are changed to restrict access to the private key.

Command output:

The `zwe init certificate` command generates a certificate based on `zowe.yaml` values in the `zowe.setup.certificate` section. The certificate values used at runtime are referenced in the `zowe.certificate` section in the `zowe.yaml` file. The command `zwe init certificate -c <path-to-your-zowe-configuration-yaml> --`

`update-config` updates the runtime `zowe.certificate` section to reference the generated certificate generated from the `zowe.setup.certificate`.

3. Open the `zowe.yaml` file to check the references to the newly generated certificate values as shown in the following code snippet:

Updated `zowe.certificate` section in `zowe.yaml`:

4. (Optional) For details about the certificate you generated, run the following command:
   `keytool -v -list -keystore localhost.keystore.p12 -storetype PKCS12`

You completed the procedure to generate a PKCS12 keystore.

For more information about additional commands to manage a keystore, see the keytool documentation.

Next steps after PKCS12 setup

When using a Zowe-generated certificate, you will be challenged by your browser when logging in to Zowe to accept Zowe's untrusted certificate authority. Depending on the browser you are using, there are different ways to proceed. See next steps about how to import the PKCS12 certificate to your browser.

Creating a JCERACFKS certificate

You can create a JCERACFKS certificate for use in a z/OS keystore. JCERACFKS uses SAF and RACF services to protect key material and certificates.

Use the following procedure to configure the `zowe.yaml` file for JCERACFKS certificates:

1. Configure the JCERACFKS setup section in zowe.yaml
2. Run the command to generate a JCERACFKS certificate

To assist with updating `zowe.yaml`, see the example yaml in Scenario 3: Use a z/OS keyring-based keystore with Zowe generated certificates in the article Certificate configuration scenarios.

Configure the JCERACFKS setup section in zowe.yaml

For JCERACFKS certificate (z/OS key ring) users, customize the following parameters in the `zowe.yaml` file:

Parameter	Description
`zowe.setup.certificate.keyring.owner`	The key ring owner. This parameter is optional and the default value is `zowe.setup.security.users.zowe`. If this parameter is not defined, the default value is ZWESVUSR.
`zowe.setup.certificate.keyring.name`	Specifies the key ring name to be created on z/OS. This parameter is required if `zowe.setup.certificate.type` is `JCERACFKS`.

The following `zowe.yaml` example generates the following artifacts:

- A `JCERACFKS` certificate, specified in `zowe.setup.certificate.type`.

- A key ring named `ZoweKeyring` specified in `zowe.setup.certificate.keyring.name`.
- A certificate with the label `localhost` specified in `zowe.setup.certificate.keyring.label`.
- A certificate authority with the label `localca` specified in `zowe.setup.certificate.keyring.caLabel` with a common name `Zowe Service CA`.

Example `zowe.yaml` file using a JCERACFKS certificate:

> **NOTES:**
>
> - Alias names should be all lower cases.
> - The name and lables shown above are the default value in `zowe.yaml`.
> - `dname` for distinguished name is all optional.
> - Domain names and IPs should be added to the certificate SAN. If the field `san` is not defined, the `zwe init` command will use `zowe.externalDomains`. The value for the `san` parameter presented in the example is for demonstration purposes.

Run the command to generate a JCERACFKS certificate

After you configure the `zowe.yaml`, use the following procedure to generate a JCERACFKS certificate.

1. Log in to your system. In this example, run `ssh dvipa.my-company.com` with your password.

2. Run the following command in the directory with this `zowe.yaml` in terminal to generate the certificate and update the configuration values in `zowe.yaml`.

   ```
   zwe init certificate -c <path-to-your-zowe-configuration-yaml> --update-config
   ```

   When the command is run, a customized JCL member name is created in the `CUST.JCLLIB` data set. The PDS name is defined in the `zowe.setup.dataset.jcllib` property. In the following example output, the PDS member `USER.ZWE3.CUST.JCLLIB(ZW101431)` is created that contains the security manager commands, and then submitted as a job ID: `ZWEKRING(JOB03054)`.

The following command output shows the generation of a JCERACFKS certificate using the default values. Note that some detailed output messages have been omitted.

Command output:

> **TIP**
>
> As shown in the example, the job ends with code `0`. There may, however, be failures in the individual steps. It is advised to check the job output. The security manager commands in the job are generated based on the value of `zowe.security.product`. Job steps for each product can be determined by the security manager.

3. Open the `zowe.yaml` file to check the references to the newly generated certificate values. Because the `--update-config` parameter was specified, the runtime configuration section of zowe.yaml is updated to match the values to the generated keystore, certificate, and certificate authority. The updated section is shown in the following code snippet:

Updated `zowe.certificate` section in `zowe.yaml`:

> **NOTE**
>
> `zowe.certificate.keystore.password` has a hardcoded password value. If you are using `type: PKCS12`, the password field must be the real password.

You completed the procedure to generate a JCERACFKS certificate.

Next steps after JCERACFKS setup

For more information about how to use your JCERACFKS certificate, see Use JCERACFKS certificates.

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Using certificates

Once you have generated or imported your certificates, you can now use the certificates with Zowe. Use the procedure descibed in this article that corresponds to the type of certificates you generated or imported.

> **REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR**

Choose from the following procedures:

- Use PKCS12 certificates
- Use JCERACFKS certificates

Use PKCS12 certificates

To use PKCS12 certificates, run the command `zwe start -c ./zowe.yaml` in the directory with the `zowe.yaml` file to start Zowe.

Details about the PKCS12 certificate used when Zowe is launched are specified in the `zowe.yaml` section `certificates`. This section contains information about the certificate name and the location of the certificate, together with the truststore location.

The two most common scenarios for using a PKCS12 certificate are:

- You have an existing certificate and wish to configure Zowe to use the certificate.
- You do not have a certificate and wish to generate a new certificate.

  The `zwe init certificate` command supports both scenarios. The input parameters that control certificate configuration are specified in the section `zowe.setup.certificates`.

To troubleshoot issues during Zowe startup, see Troubleshooting startup of Zowe z/OS components.

Use JCERACFKS certificates

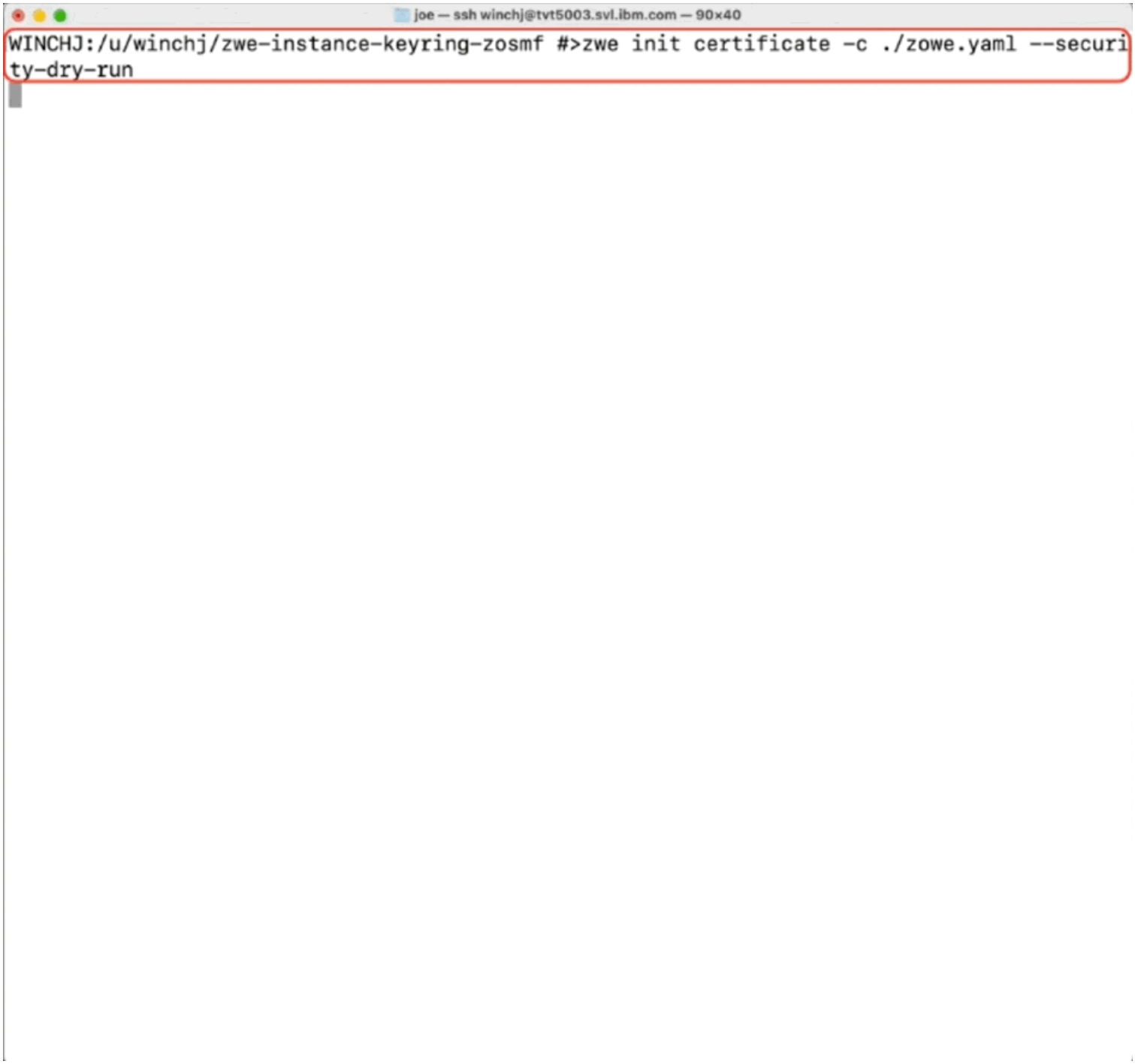
Details about the JCERACFKS certificate used when Zowe is launched are specified in the `zowe.yaml` section `certificates`. This section contains information about the certificate name and location, together with the truststore location.

The two most common scenarios for using a JCERACFKS certificate are:

- You have been given an existing certificate and wish to configure Zowe to use it.
- You do not have a certificate and wish to generate a new one.

  The `zwe init certificate` command supports both scenarios. The input parameters that control certificate configuration are specified in the section `zowe.setup.certificates`. See the example of connecting a JCERACFKS certificate below.

Example:



Note: In this example, the command `zwe init certificate -c ./zowe.yaml --security-dry-run` allows the JCL to be inspected before submission, as well as handed off to a security administrator who has privileges to submit the JCL under their user ID. By default, the JCL id submitted immediately. For details about this example, see this playlist.

Use an existing JCERACFKS certificate 1 - Identify your cert...

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Setting up Zowe certificates using workflows

Zowe can use certificates that are held in z/OS Keyring.

You can use four z/OSMF workflows that enable you to manage keyring setup, certificates, certificate sign requests, and signatures, and load certificates to a keyring.

> **REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR**

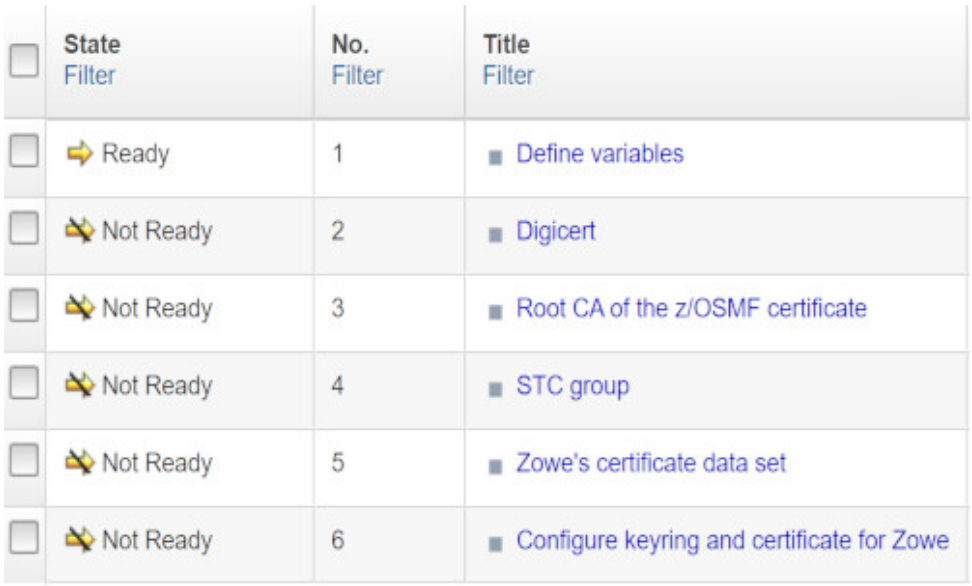
Use the following workflows to set up certificates for Zowe in your environment:

1. Set up a Zowe certificate and keyring using ZWEKRING.xml

   The `ZWEKRING.xml` workflow sets up a Zowe certificate and keyring. The workflow helps you set up the certificate and keyring and has the following features:

   - Generates a Zowe certificate that is signed by the Zowe local CA
   - Imports an existing certificate that is held in z/OS to the keyring for Zowe
   - Imports an external Zowe certificate from a data set in PKCS12 format
   - Connects a z/OSMF certificate authority to the Zowe keyring

   The workflow includes the steps that you can see on the following image:

   Based on the variable setup from the first step, the workflow can perform various certificate configurations and connect certificates to a keyring in RACF, TSS, and ACF2 security systems.

2. Create a certificate sign request (CSR) using ZWECRECR.xml

   The `ZWECRECR.xml` workflow creates a CSR request and has the following features:

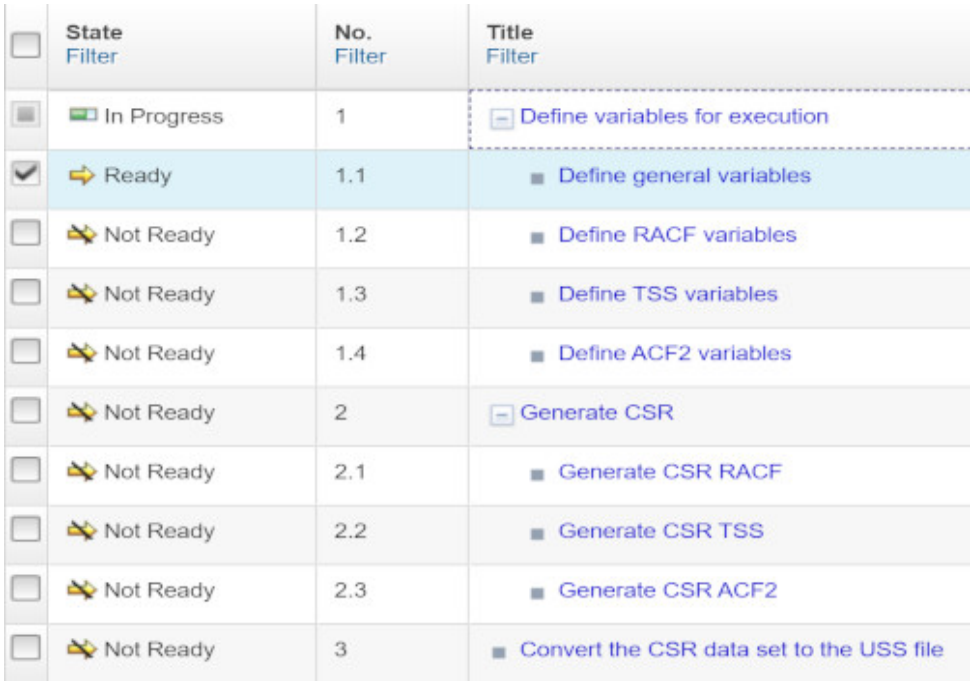
   - Based on a variable setup, generates a certificate sign request.

     You must define variables.

- A CSR request is stored into a data set. Then the data set is automatically converted into a USS file.

  You must specify the USS file path.

The workflow includes the steps that you can see on the following image:



State Filter	No. Filter	Title Filter
In Progress	1	Define variables for execution
Ready	1.1	Define general variables
Not Ready	1.2	Define RACF variables
Not Ready	1.3	Define TSS variables
Not Ready	1.4	Define ACF2 variables
Not Ready	2	Generate CSR
Not Ready	2.1	Generate CSR RACF
Not Ready	2.2	Generate CSR TSS
Not Ready	2.3	Generate CSR ACF2
Not Ready	3	Convert the CSR data set to the USS file

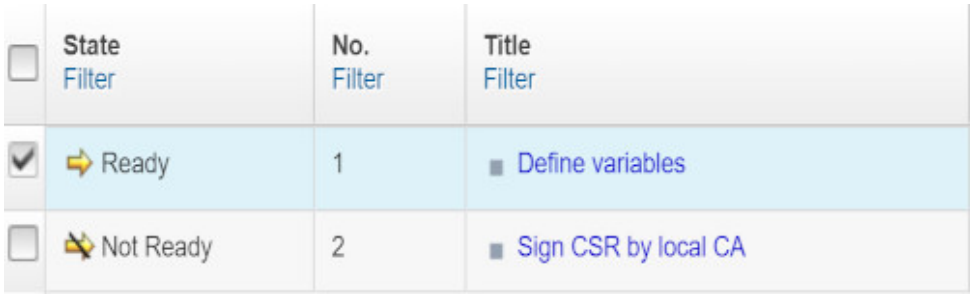
Note: You can find links to the specific security systems (BCM, IBM) official documentation in the instructions section of the workflow in related steps.

3. Sign a CSR request using ZWESIGNC.xml

   The `ZWESIGNC.xml` workflow signs a CSR request.

   After the successful workflow execution, the certificate is signed by the specified certificate authority and is stored in USS.

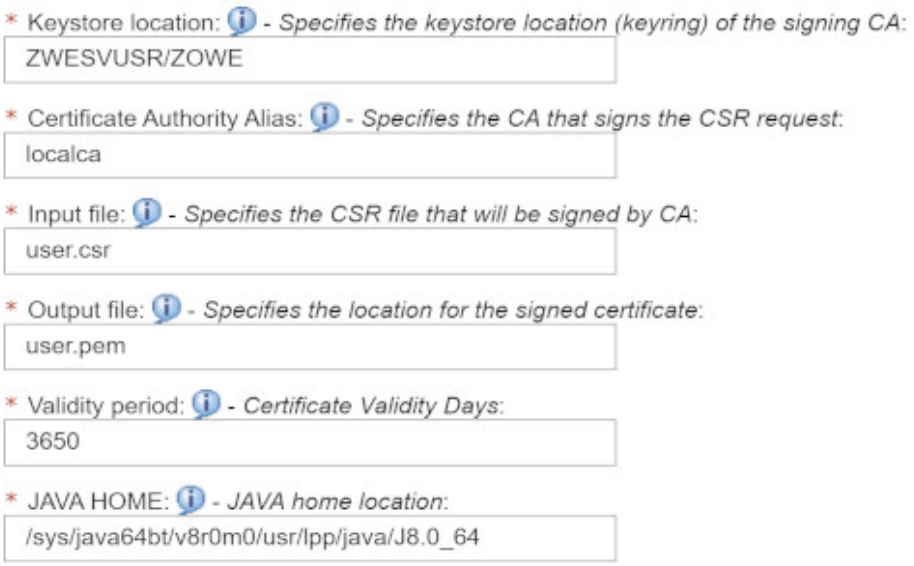
   The workflow includes the steps that you can see on the following image:



State Filter	No. Filter	Title Filter
Ready	1	Define variables
Not Ready	2	Sign CSR by local CA

   Fill in the fields, that you can see on the following image, to sign a CSR request. Ensure that the workflow includes the following information:

   - A USS location path of the CSR file
   - A USS location path where a signed certificate is stored in pem format



4. Load the Signed Client Authentication Certificate into ESM using ZWELOADC.xml

   The `ZWELOADC.xml` workflow loads a signed client authentication certificate into a specific ESM under your ACID.

   The workflow can load ASCII- or EBCDIC-encoded certificate into a data set. Then, based on the variable setup, the workflow loads the certificate into a specific ESM.

   The workflow includes the steps that you can see on the following image:

When you complete setting up Zowe certificate using workflows, you are ready to start the cross memory server `ZWESISTC` on z/OS.

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Customizing Native TLS

Zowe's servers have built-in TLS support to enable HTTPS connections.

This support is the default, and an alternative to using AT-TLS. For information about using AT-TLS, see Configuring AT-TLS for Zowe Server.

REQUIRED ROLE: SECURITY ADMINISTRATOR

Server Parameters

Each Zowe server can be customized by defining attributes within the `zowe.network.server` object of the Zowe YAML configuration file. Alternatively, the same object can be put within an individual component's configuration, such as `components.zss.zowe.network.server` for ZSS. This option allows you to customize each component separate from other components.

Extensions are recommended to adhere to the specific configuration. Ensure that you review the documentation for your extension.

IP Addresses

Zowe's servers by default use the TCP IP address `0.0.0.0` which assigns the servers to be available on all network interfaces available to the jobs.

If this default is not desired, you can either change the configuration either within Zowe or by setting TCPIP port assignment statements. For more information, see IP Addresses in the article *Addressing network requirements*.

To customize IP addresses within Zowe, define the parameter `zowe.network.server.listenAddresses`. For example, to have all Zowe servers use IP `1.2.3.4`, except for App Server which will use IP `2.3.4.5`, set the following section in your Zowe YAML:

TLS Versions

By default, Zowe servers use TLSv1.3.

To customize the version, you use the parameters `zowe.network.server.tls.minTls` and `zowe.network.server.tls.maxTls`. The following values are allowed:

- TLSv1.2
- TLSv1.3

Zowe defaults to the following configuration:

TLS Ciphers

Zowe is always updating the ciphers used to follow industry best practice.

Usually, the ciphers used by Zowe will match Mozilla's recommendations:
https://wiki.mozilla.org/Security/Server_Side_TLS

To customize which ciphers Zowe uses, you can define a list of IANA cipher names within the Zowe YAML parameter `zowe.network.server.tls.ciphers`. A list of IANA ciphers can be found here.

Client parameters

The properties within `zowe.network.server.tls` can also be specified within `zowe.network.client.tls`.

Default and example

The default TLS configuration changes regularly as needed for industry standards, however the following yaml file section is an example of the defaults:

Example:

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Enabling AT-TLS

Zowe's core components use TLS networking as well as support AT-TLS as an alternative. The built-in TLS networking is enabled by default. To learn more, see configuring the built-in TLS.

You can configure parameters in Zowe servers to switch to AT-TLS. Review this article for information about AT-TLS inbound and outbound rules, and the required configuration to use AT-TLS in high availability. You can also find troubleshooting tips as well as security recommendations.

ROLE: SECURITY ADMINISTRATOR

AT-TLS configuration for Zowe

Follow these steps to configure Zowe to support AT-TLS:

While TLS is not handled by the Zowe Server components with AT-TLS enabled on their own, the API Mediation Layer (API ML) requires information about the server certificate that is defined in the AT-TLS rule. Ensure that the server certificates provided by the AT-TLS layer are trusted in the configured Zowe keyring. We strongly recommend that AT-TLS be configured with the same Zowe keyring.

NOTES

- As the API ML Gateway is a core component of API ML, other components that need to interact with the Gateway, such as Zowe App Server, also require AT-TLS configuration.
- Do not set `attls: true` together with `minTls` or `maxTls`. Zowe does not handle TLS in AT-TLS aware mode.

IMPORTANT SECURITY CONSIDERATION

Configuring AT-TLS for Zowe requires careful consideration of security settings. These security settings apply to the Client Certificate authentication feature in Zowe API Mediation Layer components, as well as for onboarded services that support the x.509 client certificates authentication scheme.

Outbound AT-TLS rules (i.e. to make a transparent https call through http) that are configured to send the server certificate should be limited to the services that **require** service to service authentication. If an API ML-onboarded southbound service needs to support X.509 client certificate authentication, we recommend to use the integrated TLS handshake capabilities of API ML. Do not configure an outbound AT-TLS rule for these services.

The Discovery Service endpoints are not reachable by standard API Gateway routing by default.

Zowe v3 includes a new component named ZAAS (Zowe Authentication and Authorization Service). In AT-TLS-aware mode, calls to this service are all internal between API ML components. These must include the X.509 Client Certificate.

Limitations

If using AT-TLS with a z/OS Keyring backed by an ICSF hardware module, the only supported configuration is Zowe with z/OSMF authentication provider in JWT mode. A LTPA token and SAF provider cannot be used in this configuration because API ML cannot access the hardware key to sign its own tokens. Personal Access Tokens (PAT) are not supported in this configuration because API ML cannot access the hardware key to sign the tokens.

AT-TLS rules

This section describes suggested AT-TLS settings, and serves as guidelines to set your AT-TLS rules.

Inbound rules

A generic inbound rule can be set for all Zowe services:

The `PortRange` of this inbound rule is taken from the list of API Mediation Layer components in the `zowe.yaml` file. The `PortRange` should cover the following components:

Port number	Category	Component	Default Jobname
7552	API Mediation Layer	api-catalog	ZWE1**AC**
7553	API Mediation Layer	discovery	ZWE1**AD**
7554	API Mediation Layer	gateway	ZWE1**AG**
7555	API Mediation Layer	Caching Service	ZWE1**CS**
7556	App Framework	app-server	ZWE1**DS** & ZWE1SV
7557	App Framework	zss	ZWE1**SZ**
7558	API Mediation Layer	zaas	ZWE1**AZ**

More information on each component's networking requirements can be found at Addressing network requirements.

Follow this step:

Replace `ZoweKeyring` with the keyring configured for your installation. Follow the SAF keyring instructions in the article *Zowe Certificates overview* to configure keyrings for your Zowe instance.

Note the setting `HandshakeRole`. This setting applies to core services which authenticate through certificates with each other. This setting allows the API Gateway to receive and accept X.509 client certificates from API Clients.

For more granularity in the AT-TLS rules, separate the rules that need to support Client Certificate authentication (Discovery Service, Gateway Service) from the rules that do not need to support Client Certificate authentication (for example a rule covering API Gateway to an onboarded service).

Outbound rules

Outbound rules in this section allow Zowe services to communicate with each other and to other southbound services using HTTP.

> **IMPORTANT:**
> Careful consideration needs to be made regarding which rules are to be configured to send a Client Certificate. Since configuration cannot be performed on a per-request basis, it is essential not to configure the rule to send the Zowe Server certificate to the API Gateway or to a southbound service that supports X.509 Client Certificate authentication. Doing so will result in unintentionally authenticating the server ACID.

Example:

Outbound rule for z/OSMF

This example rule covers the connection between the API Gateway and ZAAS and the z/OSMF instance. This connection is made to authenticate users in z/OS.

If `zowe.network.client.tls.attls` is `true`, this rule is assumed set. The requests to z/OSMF are issued using `http`.

> **NOTE**
> `Jobname` is defined explicitly for the API Gateway and ZAAS component and is formed with the `zowe.job.prefix` setting from `zowe.yaml` plus `AG` (Gateway) and `AZ` (ZAAS) suffixes. Choosing `ZWE1A*` as a jobname pattern captures both servers.

Outbound rule for communication between Zowe core components

Use the example in this section as a template for internal connections between Zowe core services.

> **IMPORTANT**
> The outbound connection from the Gateway Service to the Discovery Service must be configured without a `CertificateLabel`. Ensure that the certificate label is not included (but keep the `CertificateLabel` field) to avoid sending the certificate in case routing would be possible to the Discovery Service. Note that this route is disabled by default.

Outbound rule for communication between API Gateway and extensions' servers

In this example, the rule covers all outbound connections originating from the API Gateway to a server that is not part of Zowe, such as an extension's server, listening on port 8080. Such a rule can apply to any remote destination, as seen in the ApimlClientRule for Zowe core servers in the section Outbound rule for communication between Zowe core components.

Click here for the example of a rule covering API Gateway to extension servers

This example covers routing scenarios.

> **IMPORTANT**

> Outbound connections from the Gateway to southbound services (onboarded services) must not send the server certificate if the service accepts X.509 Client Certificate authentication. If the server certificate is sent, the server user is subsequently authenticated.

Outbound rule for services that validate tokens against the API Mediation Layer

In this scenario, the services issue a request against the API Gateway to validate the received authentication token.

This scenario includes services that set `zoweJwt` as the authentication scheme, those that require an Open ID Connect (OIDC) token, or forwarded X.509 certificates.

In this case, it is necessary to have an Outbound rule from the service to the API Gateway.

These services also already have an outbound rule set for the onboarding process against the Discovery Service.

Ensure these rules are followed:

- Outbound rule to Discovery Service: Sends X.509 Client Certificate to authorize the onboarding.
- Outbound rule to API Gateway: **Do not** set a Client Certificate.

Ciphers

> **NOTE**
>
> This list of ciphers is provided as an example only. Actual ciphers should be customized according to your specific configuration.

The list of supported ciphers should be constructed according to the TLS supported versions. Ensure that the cipher list has matches with non-AT-TLS-aware clients.

Click here for an example of Cipher parameters.

Using AT-TLS for API ML in High Availability

AT-TLS settings for a Zowe installation configured in High Availability mode do not differ extensively. Changes need to be made to the previously described rules to allow for cross-lpar communication:

Ensure that the `RemoteAddr` setting in the rules accounts for the following connections:

- Discovery Service to Discovery Service. This is the replica request.
- Gateway Service to southbound services (including app-server and ZSS) running in another LPAR.
- Gateway Service to ZAAS running in another LPAR.
- Southbound services to Discovery Service. This applies during onboarding.
- All outbound connections need to account for all LPARs including the same where the rules are applied.

Multi-tenancy deployment

For a specific scenario when Central API ML is running on z/OS with AT-TLS enabled, it is important to override the protocol for the external URL. This information is used by the Central API ML to call domain API ML and needs to reflect the outbound AT-TLS rule. In this case, update your domain API ML configuration:

AT-TLS Troubleshooting

This section describes some common issues when using AT-TLS with Zowe and how to resolve these issues.

The message `This combination of port requires SSL` is thrown when accesing an API ML service through a Browser

Make sure the URL starts with `https://`. This message indicates that AT-TLS rules are in place and it is trying to connect on an unsecured port to the API Gateway, however the latter is still only listening on a application-controlled secured port.

Solution: Review settings in the API Gateway. Ensure that the changes described in AT-TLS configuration for Zowe are applied.

AT-TLS rules are not applied

If the application is responding in http, the application may not be properly configured to support http-only calls. AT-TLS is not correctly configured.

Solution:

Ensure the rules are active and that the filters on port range and job names are properly set.

Non matching ciphers / protocols

An error can occur if the list of ciphers or the TLS protocol does not match between the ones configured in the AT-TLS rules and the ones used by non AT-TLS-aware clients.

Solution: Review the supported TLS versions and ciphers used in both the client and the server.

Additional troubleshooting

When asking for support make sure to follow IBM guides for troubleshooting AT-TLS problems. This is covered in the "Diagnosing Application Transparent Transport Layer Security (AT-TLS)" article on IBM documentation.

Ensure you collect the logs and current configurations when contacting support.

Full example of AT-TLS configuration

Review a full working example of an AT-TLS configuration file on z/OS, specifically used for defining secure communication between different services in a mainframe environment. All port values are examples. The example is commented for convenience.

Click here to display the full AT-TLS configuration file.

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Configuring the Zowe cross memory server (ZIS)

The Zowe cross memory server (ZIS) provides privileged cross-memory services to the Zowe Desktop and runs as an APF-authorized program. The same cross memory server can be used by multiple Zowe desktops. The cross memory server is required to log on to the Zowe desktop and operate the desktop apps such as the Code Editor. If you wish to start Zowe without the desktop (for example bring up just the API Mediation Layer), you do not need to install and configure a cross memory server and can skip this step.

REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR

IMPORTANT

This article describes how to configure the cross server manually. However, most of this configuration should already be performed during Zowe configuration. If you have already successfully run the `zwe init` command, the load modules are already installed, and APF authorization and SAF configuration is complete.

In this case, the final step is to configure the load modules to run in key 4 non-swappable.

To install and configure the cross memory server, it is necessary to define APF-authorized load libraries, program properties table (PPT) entries, and a parmlib. Performing these steps requires familiarity with z/OS.

- Configuring the Zowe cross memory server (ZIS)
  - PDS sample library and PDSE load library
  - Load module
    - APF authorize
      - Configuring using `zwe init apfauth`
    - Key 4 non-swappable
  - PARMLIB
  - PROCLIB
  - SAF configuration
  - Zowe auxiliary service
    - Installing the auxiliary service
      - Zowe Auxiliary Address space
  - Summary of cross memory server installation
  - Starting and stopping the cross memory server on z/OS
  - Troubleshooting
  - Next step

PDS sample library and PDSE load library

The cross memory server runtime artifacts, the JCL for the started tasks, the parmlib, and members containing sample configuration commands are found in the `SZWESAMP` PDS sample library.

The load modules for the cross memory server and the corresponding auxiliary server are found in the `SZWEAUTH` PDSE.

- **Convenience Build**
  The location of `SZWESAMP` and `SZWEAUTH` for a convenience build depends on the value of the `zowe.setup.dataset.prefix` parameters in the `zowe.yaml` file used to configure the `zwe install` command, see Install the MVS data sets.

- **SMP/E**
  For an SMP/E installation, `SZWESAMP` and `SZWEAUTH` are the SMP/E target libraries whose location depends on the value of the `#thlq` placeholder in the sample member `AZWE001.F1(ZWE3ALOC)`.

The cross memory server is a long running server process that, by default, runs under the started task name `ZWESISTC` with the user ID `ZWESIUSR` and group of `ZWEADMIN`.

The `ZWESISTC` started task serves the Zowe desktop that is running under the `ZWESLSTC` started task, and provides it with secure services that require elevated privileges, such as supervisor state, system key, or APF-authorization.

The user ID `ZWESIUSR` that is assigned to the cross memory server started tasks must have a valid OMVS segment and read access to the load library `SZWEAUTH` and PARMLIB data sets. The cross memory server loads some functions to LPA for its PC-cp services.

To install the cross memory server, enable the PROCLIB, PARMLIB, and load module. This topic describes the steps to do this manually.

Load module

The cross memory server load module `ZWESIS01` is installed by Zowe into a PDSE `SZWEAUTH`. For the cross memory server to be started, the load module needs to be APF-authorized and the program needs to run in key(4) as non-swappable.

APF authorize

APF authorizes the PDSE `SZWESAUTH`. This allows the SMP/E APPLY and RESTORE jobs used for applying maintenance to be operating on the runtime PDSE itself when PTF maintenance is applied.

Do not add the `SZWEAUTH` data set to the system LNKLIST or LPALST concatenations.

To check whether a load library is APF-authorized,issue the following command:

where the value of DSNAME is the name of the `SZWEAUTH` data set as created during Zowe installation that contains the `ZWESIS01` load module.

Issue one of the following operator commands to dynamically add the load library to the APF list (until next IPL), where the value of DSNAME is the name of the `SZWEAUTH` data set, as created during Zowe installation.

- If the load library is not SMS-managed, issue the following operator command, where `volser` is the name of the volume that holds the data set:

- If the load library is SMS-managed, issue the following operator command:

Configuring using `zwe init apfauth`

If you are using the `zwe init` command to configure your z/OS system, the step `zwe init apfauth` can be used to generate the `SETPROG` commands and execute them directly. The generation of `SETPROG` commands and their execution takes the input parameters `zowe.setup.mvs.authLoadLib` for the `SZWEAUTH` PDS location, and `zowe.setup.mvs.authPluginLib` for the location of the PDS that is used to contain plugins for the cross memory server. For more information on `zwe init apfauth` see, Performing APF Authorization of load libraries.

Key 4 non-swappable

The cross memory server load module `ZWESIS01` and the auxiliary (AUX) address space load module `ZWESAUX` must run in key 4 and be non-swappable. For the server to start in this environment, add the following PPT entries for the server and address spaces to the SCHEDxx member of the system PARMLIB.

The PDS member `SZWESAMP(ZWESISCH)` contains the PPT lines for reference.

Then, issue the following command to make the SCHEDxx changes effective:

PARMLIB

The `ZWESISTC` started task must find a valid `ZWESIPxx` PARMLIB member in order to be launched successfully. The `SZWESAMP` PDS created at installation time contains the member `ZWESIP00` with default configuration values. You can copy this member to another data set, for example your system PARMLIB data set, or else leave it in `SZWESAMP`.

If you choose to leave `ZWESIPxx` in the installation PDS `SZWESAMP` used at installation time, this has advantages for SMP/E maintenance because the APPLY and RESTORE jobs will be working directly against the runtime library.

Wherever you place the `ZWESIP00` member, ensure that the data set is listed in the `PARMLIB DD` statement of the started task `ZWESISTC`.

PROCLIB

For the cross memory server to be started, you must move the JCL PROCLIB `ZWESISTC` member from the installation PDS SAMPLIB `SZWESAMP` into a PDS that is on the JES concatenation path.

You need to update the `ZWESISTC` member in the JES concatenation path with the location of the load library that contains the load module `ZWESIS01` by editing the STEPLIB DD statement of `ZWESISTC`. Edit the PARMLIB DD statement to point to the location of the PDS that contains the `ZWESIP00` member.

For example, the sample JCL below shows `ZWESISTC` where the APF-authorized PDSE containing `ZWESIS01` is `IBMUSER.ZWEV3.SZWEAUTH(ZWESIS01)` and the PDS PARMLIB containing `ZWESIP00` is `IBMUSER.ZWEV3.SZWESAMP(ZWESIP00)`.

SAF configuration

Because the ZIS server makes z/OS security calls it restricts which clients are able to use the services, by requiring them to have `READ` access to a security profile `ZWES.IS` in the `FACILITY` class.

The Zowe launcher started task `ZWESLSTC` needs to be able to access the ZIS server, which requires that the user ID `ZWESVUSR` has access to `ZWES.IS`. The steps to do this are described in Configure the cross memory server for SAF.

Zowe auxiliary service

In some situations when a Zowe extension is supported, the cross memory server starts, controls, and stops an auxiliary address space. This is run as a `ZWESASTC` started task that runs the load module `ZWESAUX`.

> **NOTE**
>
> **When to configure the auxiliary service**
>
> Under normal Zowe operation, no auxiliary address spaces are started. However, if you have installed a vendor product running on top of Zowe, this product may use an auxiliary address space. In this case, the auxiliary service requires configuration to be launchable. The vendor product documentation will specify whether the Zowe auxiliary service requires configuration. Verify that the auxiliary service configuration is required before performing configuration steps.
>
> If you are using just core Zowe functionality, configuring the auxiliary service is not required. Even with the Zowe auxiliary service configured, there is no situation under which you should manually start the `ZWESASTC` started task.

Installing the auxiliary service

To install the auxiliary service to allow this service to run, perform the steps to install and configure the cross memory server as described previously. Note that this procedure will use a different JCL PROBLIC member and a different load module. There is no PARMLIB for the auxiliary service.

- JCL member `ZWESASTC` is copied from `SZWESAMP` installation PDS to a PDS on the JES concatenation path.
- The PDSE load library `SZWEAUTH` is APF-authorized, or load module `ZWESAUX` is copied to an existing APF Auth LoadLib.
- The load module `ZWESAUX` must run in key 4 and be non-swappable by adding a PPT entry to the SCHEDxx member of the system PARMLIB `PPT PGMNAME(ZWESAUX) KEY(4) NOSWAP`.

Zowe Auxiliary Address space

The cross memory server runs as a started task `ZWESISTC` that uses the load module `ZWESIS01`.

In some use cases, the Zowe cross memory server has to spawn child address spaces, which are known as auxiliary (AUX) address spaces. The auxiliary address spaces run as the started task `ZWESASTC` using the load module `ZWESAUX` and are started, controlled, and stopped by the cross memory server.

An example of when an auxiliary address space is used is for a system service that requires a supervisor state but cannot run in cross-memory mode. The service can be run in an AUX address space which is invoked by the Cross Memory Server acting as a proxy for unauthorized users of the service.

Do not install the Zowe auxiliary address space unless a Zowe extension product's installation guide explicitly asks for it to be done. This will occur if the extension product requires services of Zowe that cannot be performed by the cross memory server and an auxiliary address space needs to be started.

A default installation of Zowe does not require auxiliary address spaces to be configured.

> **IMPORTANT**

> The cross memory `ZWESISTC` task starts and stops the `ZWESASTC` task as needed. **Do not start the `ZWESASTC` task manually.**

Summary of cross memory server installation

You can start the cross memory server using the command `/S ZWESISTC` once the following steps have been completed.

- JCL members STC - `ZWESISTC` and `ZWESASTC` are copied from `SZWESAMP` installation PDS to a PDS on the JES concatenation path.
- The PDSE Load Library `SZWEAUTH` is APF-authorized, or Load modules `ZWESIS01` and `ZWESAUX` are copied to an existing APF Auth LoadLib.
- The JCL member `ZWESISTC` DD statements are updated to point to the location of `ZWESIS01` and `ZWESIP00`.
- The load modules `ZWESIS01` and `ZWESAUX` must run in key 4 and be non-swappable by adding a PPT entry to the SCHEDxx member of the system PARMLIB

Starting and stopping the cross memory server on z/OS

The cross memory server is run as a started task from the JCL in the PROCLIB member `ZWESISTC`. It supports reusable address spaces and can be started through SDSF with the operator start command with the REUSASID=YES keyword:

The ZWESISTC task starts and stops the ZWESASTC task as needed. Do not start the ZWESASTC task manually.

To end the Zowe cross memory server process, issue the operator stop command through SDSF:

> **NOTE**
>
> The starting and stopping of the `ZWESLSTC` started task for the main Zowe servers is independent of the `ZWESISTC` cross memory server, which is an angel process. If you are running more than one `ZWESLSTC` instance on the same LPAR, then these will be sharing the same `ZWESISTC` cross memory server. Stopping `ZWESISTC` will affect the behavior of all Zowe servers on the same LPAR that use the same cross-memory server name, for example ZWESIS_STD. The Zowe Cross Memory Server is designed to be a long-lived address space. There is no requirement to recycle regularly. When the cross-memory server is started with a new version of its load module, it abandons its current load module instance in LPA and loads the updated version.

Troubleshooting

To diagnose problems that may occur with the Zowe `ZWESLSTC` not being able to attach to the `ZWESISTC` cross memory server, a log file `zssServer-yyyy-mm-dd-hh-mm.log` is created in the log directory each time ZIS is started. More details on diagnosing errors can be found in Zowe Application Framework issues.

If the `crossMemoryServerName` is changed in `zowe.yaml` and the default name is not applied, manually update the `NAME` in the corresponding `PROCLIB`.

For example, the ZIS server name is changed from its default of `ZWESIS_STD` to be `ZWESIS_02`. The `PROCLIB` member line 1 is updated from `//ZWESIS01 PROC NAME='ZWESIS_STD',MEM=00,RGN=0M` to `//ZWESIS_01 PROC NAME='ZWESIS_02',MEM=00,RGN=0M`. And the `zowe.yaml` file is updated to use the `ZWESIS_02` instance:

Next step

After you complete the configuration of the Zowe cross memory server, you may configure Zowe for High Availability, or proceed to starting Zowe.

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Configuring high availability (optional)

Zowe has a high availability feature built-in. For Zowe in a high availability configuration, one workspace directory is required. This workspace directory must be created on a shared file system (zFS directory) which all LPARs in a Sysplex can access. Review this article and the following articles in this section for the configuration steps to enable the high availability feature. Note that configuring high availability is optional.

> **REQUIRED ROLE: SYSTEM PROGRAMMER**

Enable high availability when Zowe runs in Sysplex

- Sysplex is required to make sure multiple Zowe instances can work together. Check Configuring Sysplex for high availability for more details.
- z/OSMF is an optional prerequisite of Zowe. If your Zowe instance works with z/OSMF, it's recommended to configure z/OSMF for high availability in Sysplex.
- The `haInstances` section must be defined in the Zowe YAML configuration. Check Zowe YAML Configuration File Reference for more details.
- Zowe caching service is required to convert stateful component to stateless component. Check Configuring the Caching Service for HA for details.

Known limitations

- To allow Sysplex Distributor to route traffic to the Gateway, you can only start one Gateway in each LPAR within the Sysplex. All Gateways instances should be started on the same port configured on Sysplex Distributor.
- Zowe App Server should be accessed through the Gateway with a URL like `https://<dvipa-domain>:<external-port>/zlux/ui/v1`.

Enable high availability when Zowe runs in Kubernetes

If you deploy Zowe into Kubernetes, all components can also achieve high availability if you enable more than one replicas for each component.

- HorizontalPodAutoscaler is recommanded to let Kubernetes scales the component based on workdload.
- PodDisruptionBudget is recommended to let Kubernetes automatically handles disruptions like upgrade.

Version: v3.2.x LTS

Configuring Sysplex for high availability

To deploy Zowe high availability, you must set up the Parallel Sysplex® environment. A Parallel Sysplex is a collection of z/OS® systems that cooperatively use certain hardware and software components to achieve a high-availability workload processing environment.

Sysplex environment requirements

Zowe high availability instances require a Sysplex environment that consists of the following:

- One or more central processor complexes (CPCs) that can attach to a coupling facility
- At least one coupling facility
- At least one Sysplex timer
- Connection to shared DASD
- Shared SAF database, see Sharing a database with sysplex communication in data sharing mode
- Sysplex Distributor with configured Dynamic VIPA TCP/IP address, see Configuring Sysplex Distributor for instructions
- USS Shared file system, see How to share file systems in a Sysplex
- JESPlex/JES2 Multi-Access Spool (MAS) environment
- z/OSMF high availability, see Configuring z/OSMF high availability in Sysplex
- Node.js v16.x or higher, required in case you enable Zowe Desktop

> **NOTE**
>
> It is highly recommended that Node.js is installed on a shared file system.

Configuring Sysplex Distributor

The following example DVIPA configuration ensures the availability of Zowe in Hot-Standby mode. For example, suppose that you have a Sysplex of two z/OS systems: A, B.

1. Enable dynamic XCF on each host by adding the following TCP/IP definitions:

   - `IPCONFIG SYSPLEXROUTING DYNAMICXCF x.x.x.A 255.255.255.0 1` for SYSA
   - `IPCONFIG SYSPLEXROUTING DYNAMICXCF x.x.x.B 255.255.255.0 1` for SYSB

2. Define a DVIPA for both systems:

   where,

   - **x.x.x.A**
     Specifies the home address for SYSA.

   - **x.x.x.B**
     Specifies the home address for SYSB.

- **x.x.x.V**
  Specifies the Dynamic VIP Address.

- **7554**
  Specifies the port number of you Zowe API Mediation Layer Gateway. This should be the same port number you configured for `zowe.externalPort` in `zowe.yaml`. See Zowe YAML configuration file reference to learn more about `zowe.yaml`.

The `VIPADISTRIBUTE` statement with `PREFERRED` and `BACKUP` settings is used to enable automatic dynamic VIPA takeover to occur, if needed.

All Zowe instances are bound to the DVIPA x.x.x.V. With both z/OS systems active in the Sysplex, the preferred Zowe instance, SYSA receives all new incoming requests. If SYSA fails, new work requests to Zowe are routed to the server on SYSB. When SYSA resumes normal operations, new work requests for Zowe are routed to SYSA again. This is the default behavior because the `AUTOSWITCHBACK` parameter of the `VIPADISTRIBUTE` statement is in effect by default.

If you do not want the distributor to switch back to the preferred target when it becomes available, you can specify the `NOAUTOSWITCHBACK` parameter for the `VIPADISTRIBUTE` statement.

Version: v3.2.x LTS

Configuring z/OSMF for high availability in Sysplex

z/OSMF high availability (HA) should be configured in Hot Standby mode to ensure availability of REST services. The goal of this configuration is to ensure that one z/OSMF server is always available to provide the REST services.

In Hot Standby mode, there is at least one backup (hot-standby) server and a preferred target server. Both targets are active, and both z/OSMF servers are bound to the DVIPA. The preferred z/OSMF server receives all new incoming requests. When the preferred z/OSMF server fails or the system becomes down, new requests are routed to the backup (hot-standby) server. The distributing DVIPA does not perform load balancing of requests across multiple systems. For more information, read the following articles in IBM Documentation:

- Configuring z/OSMF for availability
- Configuring z/OSMF for high availability

Sysplex environment requirements

Before you begin, ensure that the Sysplex environment meets the following requirements for z/OSMF REST services:

- Shared SAF database. See Sharing a database with sysplex communication in data sharing mode in IBM Documentation.
- USS Shared file system. See How to share file systems in a Sysplex in IBM Documentation.
- JESPlex/JES2 Multi-Access Spool (MAS) environment
- Sysplex distributor, configured Dynamic VIPA TCP/IP address
- Extended MCS console (EMCS)

Setting up z/OSMF nucleus

This information is intended for a first-time z/OSMF setup. Follow these high-level steps to create a z/OSMF nucleus on your system.

For detailed information about each step, see Create a z/OSMF nucleus on your system in IBM Documentation.

1. Create the z/OSMF security authorizations by running the sample JCL **SYS1.SAMPLIB(IZUSEC)**. z/OSMF security authorizations will be used by all z/OSMF servers across multiple systems.

2. Create a shared file system per z/OSMF server by running the sample JCL **SYS1.SAMPLIB(IZUMKFS)**. It holds configuration settings and the persistence data.

3. Copy the Sample Parmlib Member **SYS1.SAMPLIB(IZUPRM00)** to PARMLIB and modify it according to requirements of z/OSMF HA parmlib member in Sysplex. Each system uses a different IZUPRMxx member. For example, IZUPRM0A and IZUPRM0B.

4. Copy the following z/OSMF procedures from **SYS1.PROCLIB** into your JES concatenation:

    - IZUSVR1 (Each z/OSMF server should use the different started procedure. For example, IZUSVRA and IZUSVRB.)

- IZUANG1
- IZUFPROC

5. Define different STARTED profiles for z/OSMF servers.

Requirements of z/OSMF HA parmlib member in Sysplex

- *AUTOSTART_GROUP*, more than one z/OSMF server (independent z/OSMF instances) is to be autostarted in a Sysplex. For instance, System A will autostart a server and similarly, System B will autostart the second z/OSMF server.

  z/OSMF has a default autostart group (IZUDFLT) which is used in monoplex or single z/OS image. To have more z/OSMF servers autostarted in a Sysplex, you must associate each server and the systems it serves with a unique autostart group name. For example, `AUTOSTART_GROUP('IZUDFLA')` for System A and `AUTOSTART_GROUP('IZUDFLB')` for System B

- *AUTOSTART(LOCAL)* should be used by all z/OSMF instances.

- *HOSTNAME*, the DVIPA address will be used as the z/OSMF host name for all instances.

- *HTTP_SSL_PORT*, all servers are listening on the same port.

- *KEYRING_NAME*, all servers should use the same key ring such as `IZUKeyring.IZUDFLT`.

- *SERVER_PROC*, each z/OSMF server should use the different started procedure. For example, IZUSVRA and IZUSVRB.

- *ANGEL_PROC*, all z/OSMF servers can connect to the same z/OSMF angel process such as IZUANG1.

- *SAF_PREFIX*, they should use the same SAF profile prefix such as IZUDFLT.

- *USER_DIR*, each instance uses a shared file system with a unique mount point for each AUTOSTART group that be automatically started. For example, `/global/zosmf/zosmfa` and `/global/zosmf/zosmfb`.

Configuring z/OSMF for high availability

The following DVIPA configuration ensures the availability of z/OSMF for Hot-Standby. For example, suppose that you have a Sysplex of two z/OS systems: A, B.

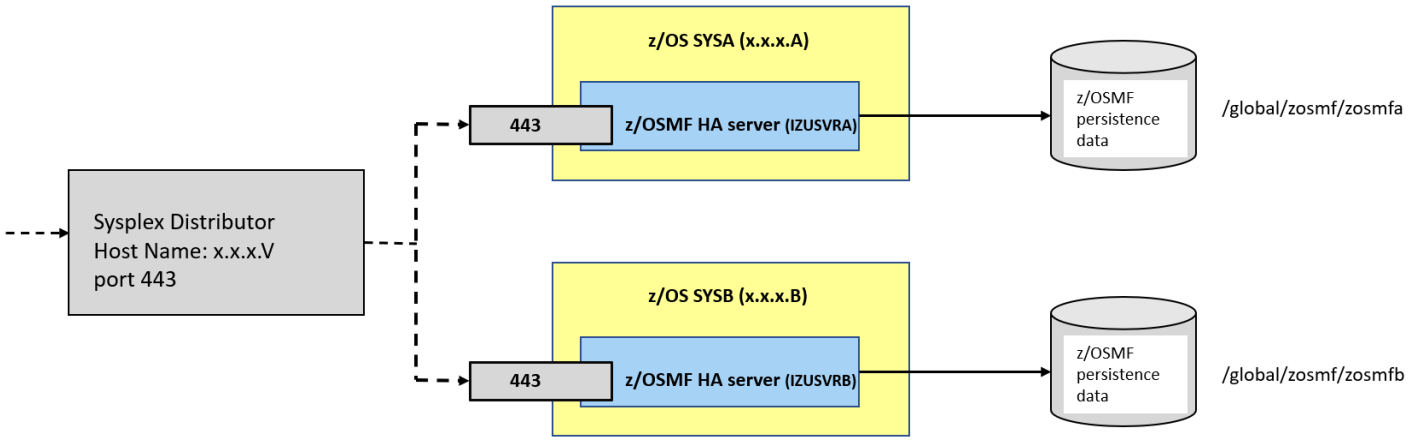
1. Enable dynamic XCF on each host by adding the following TCP/IP definitions:

   - `IPCONFIG SYSPLEXROUTING DYNAMICXCF x.x.x.A 255.255.255.0 1` for SYSA
   - `IPCONFIG SYSPLEXROUTING DYNAMICXCF x.x.x.B 255.255.255.0 1` for SYSB

2. Define a dynamic VIPA (DVIPA) for both systems:

   where,

   - x.x.x.A is the home address for SYSA.
   - x.x.x.B is the home address for SYSB.
   - x.x.x.V is Dynamic VIP Address.



The `VIPADISTRIBUTE` statement with `PREFERRED` and `BACKUP` settings is used to enable automatic dynamic VIPA takeover to occur, if needed.

Both z/OSMF servers are bound to the DVIPA x.x.x.V. With both z/OS systems active in the Sysplex, the preferred z/OSMF server, SYSA receives all new incoming requests. If SYSA fails, new work requests for z/OSMF are routed to the server on SYSB. When SYSA resumes normal operations, new work requests for z/OSMF are routed to SYSA again. This is the default behavior because the `AUTOSWITCHBACK` parameter of the `VIPADISTRIBUTE` statement is in effect by default.

If you do not want the distributor to switch back to the preferred target when it becomes available, you can specify the `NOAUTOSWITCHBACK` parameter for the `VIPADISTRIBUTE` statement.

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Configuring the Caching Service for high availability

Zowe can work in a high availability (HA) configuration where multiple instances of the Zowe launcher are started, either on the same LPAR, or different LPARs connected through sysplex distributor. If you are only running a single Zowe instance on a single LPAR you do not need to create a caching service so you may skip this step.

In an HA setup the different Zowe API Mediation Gateway servers share the same northbound port (by default `7554`), and client traffic to this port is distributed between separate gateways that in turn dispatch their work to different services. When any of the services individually become unavailable the work can be routed to available services, which means that the initial northbound request will be fulfilled.

Zowe uses the Caching Service to centralize the state data persistent in high availability (HA) mode. If you are runnning the caching service on z/OS there are three storage methods: `inMemory`, `infinispan` or `VSAM`. If you are running the caching service off platform, such as a Linux or Windows container image, it is also possible to specify `redis` or `infinispan`.

To learn more about how the Caching Service can be used, see Using the Caching Service.

> **NOTE**
>
> To enable Personal Access Token support when using the Caching Service, **Infinispan** is the required storage solution. Infinispan is part of Zowe installation. No additional software or installation is required when using this storage solution. Infinispan is the recommended storage method to use in production.

inMemory

This storage method is designed for quick start of the service and should be used only for single instance scenario and development or test purpose. Do not use it in production or high availability scenario.

To use this method, set the `components.caching-service.storage.mode` value to `inMemory` in the `zowe.yaml` configuration file. When this method is enabled, the Caching Service will not persist any data.

Infinispan

> **NOTE**
>
> This is the recommended solution for on-prem z/OS production deployments

Infinispan is designed to be run mainly on z/OS since it offers good performance. To enable this method, set the value of `components.caching-service.storage.mode` to `infinispan` in the `zowe.yaml` configuration file. Infinispan environment variables are not currently following the v2 naming convention, so they must be defined into `zowe.environments` section. For more information on these properties and their values see Infinispan configuration.

VSAM (Deprecated)

> **NOTE**
>
> VSAM support in Caching Service will be removed in a future release

This storage method allows you tu use VSAM dataset as a storage for Caching service. You can use `zwe init vsam` command to generate proper dataset.

The command `zwe init vsam` uses the template JCL in `SZWESAMP(ZWECSVSM)`. You can edit and submit this yourself, or else if use `zwe init vsam` which will copy the source template member from `zowe.setup.mvs.hlq.SZWESAMP(ZWECVCSM)` and create a target JCL member in `zowe.setup.mvs.jcllib(ZWECVSCM)` with values extracted from the `zowe.yaml` file.

- `components.caching-service.storage.vsam.name`
  This specifies the data set name that the `ZWECSVSM` JCL will create. This is used to replace all occurrences of `#dsname` in the `ZWECSVSM` data set.

  > **NOTE**
  >
  > The `ZWECSVSM` JCL defines the key length and record length of the VSAM instance. If the key length and record length of this JCL is changed, `zowe.environments.CACHING_STORAGE_VSAM_KEYLENGTH` and `zowe.environments.CACHING_STORAGE_VSAM_RECORDLENGTH` must be set to the new values.

- `components.caching-service.storage.mode`
  This specifies whether you would like to use Record Level Sharing (RLS) for your VSAM data set. `RLS` is recommended for Sysplex deployment. `NONRLS` is also an allowed value.

- `zowe.setup.vsam.storageClass` If you use the `RLS` mode, a storage class is required.

- `zowe.setup.vsam.volume`
  If you set to use the `NONRLS` mode, a storage volume is required.

To preview the member before submitting it, use the value `--security-dry-run`. Otherwise, the command automatically submits the JCL and waits for its completion.

Redis

Redis is not available if you are running the API Mediation Layer on z/OS under Unix System Services. Usage of redis is intended for when API ML is running off platform, such as in a Linux or Windows container as part of a hybrid cloud deployment.

To enable this method, set the value of `components.caching-service.storage.mode` to `redis` in the `zowe.yaml` configuration file. There are a number of values to control the redis nodes, sentinel and ssl properties that need to be set in the `zowe.yaml` file. For more information on these properties and their values see Redis configuration.

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Starting and stopping Zowe

The following article describes how to start and stop Zowe.

Zowe consists of three main started tasks:

- **ZWESISTC**
  Zowe cross memory server
- **ZWESASTC**
  Zowe cross memory auxiliary server
- **ZWESLSTC**
  Zowe main started task

Starting and stopping the cross memory server `ZWESISTC` on z/OS

The cross memory server is run as a started task from the JCL in the PROCLIB member `ZWESISTC`, and supports reusable address spaces. This task can be started through with the operator start command with the `REUSASID=YES` keyword:

> **NOTE**
> If using SDSF to start the cross memory server, enter `/` before `S`.

The `ZWESISTC` task starts and stops the `ZWESASTC` task as needed. Do not start the `ZWESASTC` task manually.

> **NOTE**
> Starting and stopping of the `ZWESLSTC` started task for the main Zowe servers is independent of the `ZWESISTC` cross memory server, which is an angel process. If you are running more than one `ZWESLSTC` instance on the same LPAR, the instances share the same `ZWESISTC` cross memory server. Stopping `ZWESISTC` affects the behavior of all Zowe servers on the same LPAR that use the same cross-memory server name, for example `ZWESIS_STD`. The Zowe cross memory server is designed to be a long-lived address space. There is no requirement to recycle regularly. When the cross memory server is started with a new version of its load module, the cross memory server abandons its current load module instance in LPA and loads the updated version.

To end the Zowe cross memory server process, issue the operator stop command:

> **NOTE**
> If using SDSF to stop the cross memory server, enter `/` before `P`.

Starting and stopping the cross memory auxiliary server `ZWESASTC` on z/OS

Starting and stopping the cross memory auxiliary server `ZWESASTC` on z/OS is handled automatically by Zowe cross memory server. It is not necessary to manually start or stop this started task.

Starting and stopping Zowe main server `ZWESLSTC` on z/OS with `zwe` server command

Zowe ships `zwe start` and `zwe stop` commands to help you start and stop the Zowe main server.

To start Zowe, run the following command:

This command issues the `S` command to Zowe `ZWESLSTC`.

Example:

Job name `ZWE1SV` can be customized with `zowe.job.name` in your Zowe configuration file.

You can use `zwe start` command to start a Zowe high availability instance defined on other LPAR within the Sysplex.

Example:

The following information must be defined in the Zowe configuration file:

The `zwe start` command uses the `ROUTE` command to send the `S ZWESLSTC` command to the `LPAR2` system.

To stop Zowe, run the following command:

This command issues the `P` command to the Zowe job.

Example:

Starting and stopping Zowe main server `ZWESLSTC` on z/OS manually

To start Zowe main server, you can issue the `S ZWESLSTC` command. If required by internal policy, customize the `JOBNAME` parameter.

Example:

If you have a Zowe high availability instance defined and want to start a specific HA instance, for example `myinst1`, you can pass with the `HAINST` parameter.

Example:

> **NOTE**
>
> The Zowe high availability instance name is case insensitive. `HAINST=myinst1` and `HAINST=MYINST1` are equivalent.

If you are starting a Zowe high availability instance for another LPAR in the Sysplex, you can use the `ROUTE` command to route the `S` command to the target system.

Example: To start an HA instance `myinst2` on `LPAR2` when working on SYSNAME `LPAR1`, issue the following command:

To stop the Zowe main server, issue the `P <jobname>` command.

With Zowe version 1, you can issue `C` command to stop Zowe main server. This command is no longer supported in version 2 and later versions. The `P` command is now required to ensure that the Zowe components shut down properly.

Stopping and starting a Zowe component without restarting Zowe main server

You can restart a Zowe component with the MVS system command without restarting the whole Zowe main server. Before issuing the `MODIFY` command consider the following points:

- By default, your Zowe main server job name is configured as `ZWE1SV`. You can find your customized value by checking the `zowe.job.name` defined in the Zowe configuration file.
- Determine the component name you want to stop or start. For a full list of installed components, list the `<RUNTIME>/components` directory and the Zowe extension directory.
- The following components from the `<RUNTIME>/components` directory can be stopped or started:
  - `api-catalog`
  - `app-server`
  - `caching-service`
  - `discovery`
  - `gateway`
  - `zaas`
  - `zss`

To stop a running Zowe component, issue the following command:

Example:

To stop `app-server`, issue the following command:

To start a stopped Zowe component, issue the following command:

Example:

To start `app-server`, issue the following command:

> **NOTE**
>
> Not all components can be restarted with this method. Some components may rely on other components. It may be necessary to restart affected components.

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Verifying Zowe installation on z/OS

After the Zowe™ started task `ZWESLSTC` is running, follow the procedures applicable to your installation to verify that the components are functional.

- Verifying Zowe Application Framework installation
- Verifying API Mediation Layer installation
- Verifying z/OS Services installation

> **NOTE**
>
> Not all components may have been started. Which components have been started depends on your setting of the component `enabled` status in Zowe configuration file (usually `zowe.yaml`).
>
> **Examples:**
>
> - If you set `enabled` to be `true` for `gateway`, `discovery` and `api-catalog`, the API Mediation Layer and z/OS Services are started.
> - If you set `enabled` to be `true` for `app-server` and `zss`, the Zowe Application Framework (Zowe desktop) are started.
> - Configurations that use containerization may only have `ZSS` started.
>
> For more information, see YAML configurations - components.

Verifying Zowe Application Framework installation

If the Zowe Application Framework is installed correctly, you can open the Zowe Desktop from a supported browser.

From a supported browser, open the Zowe Desktop at `https://myhost:httpsPort`

where:

- ***myHost***
  is the host on which you installed the Zowe Application Server.

- ***httpsPort***
  is the port number value `components.app-server.port` in `zowe.yaml`. For more information, see Configure component app-server.

  For example, if the Zowe Application Server runs on host *myhost* and the port number that is assigned to `components.app-server.port` is 12345, you specify `https://myhost:12345`. The web desktop uses page direct to the actual initial page which is `https://myhost:12345/ZLUX/plugins/org.zowe.zlux.bootstrap/web/index.html`. If the redirect fails, try the full URL.

If the desktop appears but you are unable to log on, check Cannot log into the Zowe desktop for troubleshooting tips.

Verifying API Mediation Layer installation

Use your preferred REST API client to review the value of the status variable of the API Catalog service that is routed through the API Gateway using the following URL:

where:

- ***myHost***
  is the host on which you installed the Zowe API Mediation Layer.
- ***httpsPort***
  is the port number value `zowe.externalPort` in `zowe.yaml`. For more information, see Domain and port to access Zowe.

Example:

The following example illustrates how to use the **curl** utility to invoke an API Mediation Layer endpoint and the **grep** utility to parse out the response status variable value. The `curl` command is a powerful tool used for making HTTP requests from the command line. It allows you to send and receive data from various protocols, including HTTP, HTTPS, FTP, and more.

- **`-v`**
  The `-v` option stands for "verbose." When you include this option, curl provides more detailed information during the request and response process. It displays additional information such as the request headers, response headers, and other debugging details.

- **`-k`**
  The `-k` option stands for "insecure" or "insecure SSL." When you include this option, curl allows insecure connections and bypasses SSL certificate verification. It is useful when making requests to HTTPS URLs with self-signed certificates or when dealing with SSL certificate issues. However, it is important to note that using `-k` removes security checks and may expose you to potential security risks. Exercise caution when using this option, especially in production environments.

The response `UP` confirms that API Mediation Layer is installed and is running properly. For more instructions about `curl` command, see the tutorial.

Verifying z/OS Services installation

Zowe z/OS services usually are registered with Zowe API ML Discovery and exposed with a certain service url like `/<service>/api/v1`.

To verify a service is necessary to call any available endpoint, for example:

where:

- **`gatewayPort`**
  is the port number that is assigned to `zowe.externalPort` in the `zowe.yaml` file used to launch Zowe. For more information, see Domain and port to access Zowe.

The path `serviceId/api/v1/version` depends on a specific service. You can also use API Catalog to verify a registered service.

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Advanced API Mediation Layer Configuration

There are multiple options for customizing Zowe API Mediation Layer according to your specific use case. Review the various use cases presented in this section, and follow the links to the corresponding documentation that describes how to perform your specific customization. API ML customization can be performed in the following areas:

- Enabling Single Sign On for Clients
  - Enabling single sign on for clients via client certificate configuration
  - Enabling single sign on for clients via Personal Access Token configuration
  - Enabling single sign on for clients via JWT token configuration
- Enabling Single Sign On for Extending Services
  - Enabling single sign on for extending services via JWT token configuration
  - Enabling single sign on for extending services via PassTicket configuration
- Customizing routing behavior
  - Configuring routing in a multi-tenant environment
  - Customizing Cross-Origin Resource Sharing (CORS)
  - Using encoded slashes
  - Customizing Gateway retry policy
  - Configuring a unique cookie name for a specific API ML instance
  - Retrieving a specific service within your environment
  - Distributing the load balancer cache
  - Setting a consistent service ID
- Customizing management of API ML load limits
  - Customizing connection limits
  - Customizing Gateway timeouts
  - Customizing Java Heap sizes
- Configuring authorization of API ML
  - Limiting access to information or services in the API Catalog
  - Configuring SAF resource checking
- Configuring an authentication provider for API Mediation Layer
- Configuring storage for the Caching service
  - Using Infinispan as a storage solution through the Caching service
  - Using VSAM as a storage solution through the Caching service
  - Using Redis as a storage solution through the Caching service
- Customizing the API Catalog UI
- Configuring AT-TLS for Zowe server
- Customizing logging for API Mediation Layer

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Enabling single sign on for clients

ROLES: SYSTEM PROGRAMMER, SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR

As a system programmer or system administrator, you can customize the way API ML handles authentication towards clients such as CLI and/or users. Each of the following methods limits the frequency the user is reqired to enter credentials to access API Mediation Layer:

- One method to minimize the frequency of re-entering credentials is via Gateway client certificate authentication, whereby you can use a client certificate as the method of authentication for the API Mediation Layer Gateway.

For more information, see Enabling single sign on for clients via client certificate configuration

- Another method to minimize the frequency of entering credentials is to use API Mediation Layer to generate, validate, and invalidate a Personal Access Token (PAT). This method enables access to tools such as VCS without having to use credentials of a specific person. The use of PAT does not require storing mainframe credentials as part of the automation configuration on a server during application development on z/OS.

For more information, see Enabling single sign on for clients via personal access token configuration.

- Minimizing re-entering user credentials can also be performed via the JWT token refresh endpoint. Enabling the refresh endpoint allows you to exchange a valid JWT token for a new token with a new expiration date.

For more information, see Enabling single sign on for clients via JWT token configuration.

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Enabling single sign on for clients via X.509 client certificate configuration

ROLES: SYSTEM PROGRAMMER, SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR

In Zowe you can authenticate against API ML onboarded APIs. This functionality is disabled by default. Follow the steps in this article to enable authentication against API ML onboarded APIs.

There are two methods to enable X.509 client certificate functionality integrated with the SAF:

- The default and recommended method via the Internal Mapper component of API Mediation Layer
  Note: The Internal API ML Mapper is simpler to configure and provides more functionality than ZSS.
- The older and deprecated method via ZSS

Review this article to learn about the required configuration to authenticate with either method.

For information about the usage of the client certificate when this feature is enabled, see Authenticating with client certificates.

General prerequisites

- Zowe has correct TLS setup
- The trust store, which is configured in the config file, needs to contain the CA certificates of all incoming client certificates.

IMPORTANT:

- The Zowe runtime user must be enabled to perform identity mapping in SAF. For more information about identity mapping in SAF, see Configure main Zowe server to use client certificate identity mapping.

Configure Internal API ML Mapper

Use the following procedure to enable the zowe.yaml file to use a X.509 client certificate as the method of authentication for the API Mediation Layer Gateway. Note that the use of the Internal API ML Mapper is the recommended method.

1. Open the `zowe.yaml` configuration file.

2. Configure the following properties, or add these properties if not present in your configuration yaml file:

   - **components.gateway.apiml.security.x509.enabled**
     This property is the global feature toggle. Set the value to `true` to enable client certificate functionality.
   - **components.gateway.apiml.security.useInternalMapper**
     This property is the global feature toggle. Set the value to `true` to enable the Internal API ML Mapper.

3. Restart Zowe.

Configure ZSS

For information about configuring ZSS, see Configure components zss in *Zowe YAML server configuration file references*.

Prerequisites for ZSS

When using ZSS for authentication, ensure that you satisfy the following prerequisites before you set up client certificate authentication:

1. Set the password for the Zowe runtime user. The user is created with the `NOPASSWORD` parameter by the Zowe installer. It is necessary to change this password.

For RACF, issue the following TSO command:

```
ALTUSER <ZOWE_RUNTIME_USER (ZWESVUSR by default)> PASSWORD(<NEWPASSWORD>)
```

For other security systems, refer to the documentation for an equivalent command.

2. Verify that the Zowe runtime user is allowed to log in to z/OSMF. (Check that the user is a member of the default `IZUUSER` group.)

> **NOTE**
>
> Ensure that you have the Issuer certificate imported in the truststore or in the SAF keyring. If you define a certificate using openssl on Linux, import the CA. Certificates can also be generated in SAF.

> **IMPORTANT:**
>
> - PassTicket generation must be enabled for the Zowe runtime user. The user must be able to generate a PassTicket for the user and for the APPLID of z/OSMF. For more information, see Configuring Zowe to use PassTickets.

> **TIP**
>
> There is a limitation with respect to performing authentication using Z Secure Services (ZSS) with ACF2 systems. If you are using ACF2, use the recommended Internal API ML Mapper.

Enabling zowe.yaml to use an X.509 client certificate

Use the following procedure to enable the zowe.yaml file to use a client certificate as the method of authentication for the API Mediation Layer Gateway.

1. Open the `zowe.yaml` configuration file.

2. Configure the following properties:

   - **components.gateway.apiml.security.x509.enabled**
     This property is the global feature toggle. Set the value to `true` to enable client certificate functionality.

- **components.gateway.apiml.security.zosmf.applid**
  When z/OSMF is used as an authentication provider, provide a valid `APPLID` to allow for client certificate authentication. The API ML generates a passticket for the specified `APPLID` and subsequently uses this passticket to authenticate to z/OSMF. The default value in the installation of z/OSMF is `IZUDFLT`.

> **NOTE**
>
> The following steps are only required if the ZSS hostname or default Zowe user name are altered:

3. Change the following property if user mapping is provided by an external API:

> **NOTE**
>
> Skip this step if user mapping is not provided by an external API.

- **components.gateway.apiml.security.x509.externalMapperUrl**
  The API Mediation Gateway uses an external API to map a certificate to the owner in SAF. This property informs the Gateway about the location of this API. ZSS is the default API provider in Zowe. You can provide your own API to perform the mapping. In this case, it is necessary to customize this value.

The following URL is the default value for Zowe and ZSS:

4. Add the following property if the Zowe runtime userId is altered from the default `ZWESVUSR`:

> **NOTE**
>
> Skip this step if the Zowe runtime userId is not altered from the default `ZWESVUSR`.

- **components.gateway.apiml.security.x509.externalMapperUser**
  To authenticate to the mapping API, a JWT is sent with the request. The token represents the user that is configured with this property. The user authorization is required to use the `IRR.RUSERMAP` resource within the `FACILITY` class. The default value is `ZWESVUSR`. Permissions are set up during installation with the `ZWESECUR` JCL or workflow.

If you customized the `ZWESECUR` JCL or workflow (the customization of zowe runtime user: `// SET ZOWEUSER=ZWESVUSR * userid for Zowe started task`) and changed the default USERID, create the `components.gateway.apiml.security.x509.externalMapperUser` property and set the value by adding a new line as in the following example:

Example:

5. Restart Zowe.

You enabled zowe.yaml to use an X.509 client certificate.

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Enabling single sign on for clients via Personal Access Token configuration

> **ROLES: SYSTEM PROGRAMMER, SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR**

Review this article for steps that enable single sign on via Personal Access Tokens.

Prerequisite using the Caching Service

To enable Personal Access Token support when using the Caching Service, **Infinispan** is the required storage solution. Infinispan is part of Zowe installation. No additional software or installation is required when using this storage solution.

To enable this storage method, set the value of `components.caching-service.storage.mode` to `infinispan` in the `zowe.yaml` configuration file. For more information on other properties for infinispan and their values see Infinispan configuration.

Enabling Personal Access Tokens

Use the following procedure to enable Personal Access Tokens.

1. Open the file `zowe.yaml`.
2. Find or add the property with the value `components.gateway.apiml.security.personalAccessToken.enabled: true`.
3. Restart Zowe.

For more information about using Personal Access Tokens, see Authenticating with a Personal Access Token.

> **NOTE**
>
> To enable Personal Access Token support when using the Caching Service, **Infinispan** is the required storage solution. Infinispan is part of Zowe installation. No additional software or installation is required when using this storage solution.

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Enabling single sign on for clients via JSON Web Token (JWT) configuration

> **ROLES: SYSTEM PROGRAMMER, SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR**

As a system programmer, you can customize how JSON Web Token (JWT) authentication is performed, the service that provides the JWT authentication token, the possiblity to refresh JWT, and other characteristics of JWT for consumption.

- Enabling single sign on for clients via JSON Web Token (JWT) configuration
  - Using SAF as an authentication provider
  - Enabling a JWT refresh endpoint
  - Authorization
  - Additional customizable properties when using JWTs

Using SAF as an authentication provider

By default, the API Gateway uses z/OSMF as an authentication provider. It is possible to switch to SAF as the authentication provider instead of z/OSMF. The intended usage of SAF as an authentication provider is for systems without z/OSMF. If SAF is used and the z/OSMF is available on the system, the created tokens are not accepted by z/OSMF. Use the following procedure to switch to SAF.

1. Open the `zowe.yaml` configuration file.
2. Find or add the following property, and set the value to `saf`:

3. Restart Zowe.

Authentication requests now utilize SAF as the authentication provider. API ML can run without z/OSMF present on the system.

Enabling a JWT refresh endpoint

Enable the `/gateway/api/v1/auth/refresh` endpoint to exchange a valid JWT for a new token with a new expiration date. Call the endpoint with a valid JWT and trusted client certificate. When using the z/OSMF authentication provider, enable API Mediation Layer for PassTicket generation and configure the z/OSMF APPLID.

For more information, see Configure PassTickets.

1. Open the file `zowe.yaml`.
2. Configure the following properties:

- **components.gateway.apiml.security.allowtokenrefresh: true**
  Add this property to enable the refresh endpoint.

- **components.gateway.apiml.security.zosmf.applid**
  If you use z/OSMF as an authentication provider, provide a valid `APPLID`. The API ML generates a PassTicket for the

specified `APPLID` and subsequently uses this PassTicket to authenticate to z/OSMF. The default value in the installation of z/OSMF is `IZUDFLT`.

> **NOTE**
>
> Problems have been noted with the functionality of the property `components.gateway.apiml.security.allowtokenrefresh`. For more information about the bug, see issue #3468 in the api-layer repo.
>
> We recommend you use the following workaround:
>
> 1. Configure the following parameter in `environments`:
> 2. Restart Zowe.

Authorization

Authorization is used to set the access rights of an entity.

In the API ML, authorization is performed by any of the following z/OS security managers:

- ACF2
- IBM RACF
- Top Secret.

An authentication token is used as proof of valid authentication. The authorization checks, however, are always performed by the z/OS security manager.

Additional customizable properties when using JWTs

You can also customize the following properties when authenticating with a JWT:

- **components.gateway.apiml.security.auth.zosmf.ServiceId**
  This parameter specifies the z/OSMF service id used as authentication provider. The service id is defined in the static definition of z/OSMF. The default value is `ibmzosmf`.

- **components.gateway.apiml.security.auth.tokenProperties.expirationInSeconds**
  This property is relevant only when the JWT is generated by the API Mediation Layer and specifies to the time before expiration.

  API ML generation of the JWT occurs in the following cases:

  - z/OSMF is only available as an older version which does not support JWTs
  - The SAF provider is used

  To use a custom configuration for z/OSMF which changes the expiration of the LTPA token, it is necessary to also set the expiration in this parameter.

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Enabling single sign on for extending services

ROLES: SYSTEM PROGRAMMER, API SERVICE EXTENDER

Enabling Single Sign On (SSO) in Zowe involves configuring JWT tokens or PassTickets for secure authentication. The JWT token configuration requires setting up a custom HTTP header to store the token, thereby enhancing secure communication with southbound services.

For more information, see Enabling single sign on for extending services via JWT token configuration.

PassTicket configuration, alternatively, allows services that do not natively support JWT tokens or client certificates to authenticate via the API Gateway. This authentication process requires the activation of PassTicket support, recording the APPLID, and configuring the Zowe started task user ID. Additionally, custom HTTP headers can be set up for PassTickets and user IDs, ensuring secure and streamlined access within the Zowe ecosystem.

For more information, see Enabling single sign on for extending services via PassTicket configuration.

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Enabling single sign on for extending services via JSON Web Token (JWT) configuration

ROLE: SYSTEM PROGRAMMER

Adding a custom HTTP Auth header to store Zowe JWT

If a southbound service needs to consume the Zowe JSON Web Token (JWT) from an HTTP request header to participate in the Zowe SSO, you can define a custom HTTP header name as part of the Gateway configuration. The southbound service must use the `zoweJwt` scheme in order to leverage this functionality. Once the HTTP header name is defined, each request to the southbound service contains the JWT in the custom header.

Use the following procedure to add the custom HTTP header.

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.apiml.security.auth.jwt.customAuthHeader` and set the value which represents the header's name.
3. Restart Zowe.

Requests through the Gateway towards the southbound service now contain the custom HTTP header with the JWT.

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Enabling single sign on for extending services via PassTicket configuration

One option to enable single sign-on (SSO) to your extending REST API services is to configure Zowe API ML PassTickets. Passtickets are encoded and encrypted and are only valid for a few minutes after you generate them. PassTickets enable z/OS components and products to authenticate a user ID without storing or caching z/OS passwords or sending the passwords through the network. Follow the procedures described in this article to configure Zowe to use PassTickets, and to enable Zowe to use PassTickets to authenticate towards specific extending services.

REQUIRED ROLE: SECURITY ADMINISTRATOR

Overview of PassTickets

API clients can use various supported methods to access an API service such as a Zowe JWT token or a client certificate even if the API service itself does not support the JWT token or a client certificate. An intermediary for support of JWT or a client certificate can be through the use of PassTickets.

When an API client provides a valid authentication method to API ML, the API Gateway generates a valid PassTicket for any API service that supports PassTickets. A PassTicket is a one-time only password that is generated for a specific user ID. The API Gateway uses the PassTicket to access that API service. The API Gateway provides the user ID and password in the Authorization header which serves as basic authentication in HTTP requests using the Basic authentication scheme.

Configuring Zowe to use PassTickets

Configuring Zowe to use PassTickets involves two processes:

1. Enabling the use of PassTickets in your External Security Manager (ESM)
2. Configuring security to allow the Zowe API Gateway to generate PassTickets for an API service

Enabling the use of PassTickets in your External Security Manager (ESM)

This section applies to users who do not already have PassTickets enabled in the system, or users who need to define a PassTicket for a new APPLID. If you already have an APPLID that you intend to use to define your API service, skip to the section Configuring security to allow the Zowe API Gateway to generate PassTickets for an API service.

TIP

To validate if a PassTicket is already defined, list the APPL and PTKTDATA with a command corresponding to your ESM. Output indicates if a PassTicket is already defined. No results after issuing an ESM command indicates that a PassTicket is not defined. If a PassTicket is defined, the access of the ZWESVUSR can be determined.

Validating an existing PassTicket for ACF2

Click here for procedure details about validating an existing PassTicket for ACF2.

In your ESM command line interface or other security environment, perform the following steps:

1. Issue a `SHOW CLASMAP` command in TSO ACF to verify if the APPL resource is defined in the GSO. Note the 3 character type code associated with APPL. If APPL does not appear in the `SHOW CLASMAP` listing, run the following commands:
2. Replace 'APL' with the type code listed in the `SHOW CLASMAP` output:
3. Verify if PTKTDATA is defined, by executing the following commands:

- `-`
  A wildcard symbol that lists all resources
- `<applid>-`
  Lists everything related to specified applid in a resource (in this case, SAF), or specified in a profile (in this case, PTKTDATA)

Validating an existing PassTicket for Top Secret

Click here for command details about validating an existing PassTicket for Top Secret.

1. In your ESM command line interface or other security environment, execute the following commands:
2. If APPL and PTKTDATA are not yet defined, follow the steps to create them as described in the Enabling PassTickets with Top Secret section.

- `.`
  A wildcard symbol that lists all resources
- `IRRPTAUTH.<applid>.`
  Returns everything about the specified applid for IRRPTAUTH

Validating an existing PassTicket for RACF

Click here for command details about validating an existing PassTicket for RACF.

In your ESM command line interface or other security environment, execute the following commands:

Ensure that you validate PTKTDATA access for APPL.

- `*`
  A wildcard symbol that resturns all resources
- `RLIST PTKTDATA <applid> SSIGNON ALL`
  Validates all applid for PTKDATA class

- `RLIST PTKTDATA IRRPTAUTH.<applid>.* ALL`
  Validates all applid permissions for PTKDATA class

Follow these steps to enable PassTicket Support specific to your ESM.

Enabling PassTickets with ACF2

Click here for command details about configuring Zowe to use PassTickets using ACF2.

1. Issue the `SHOW CLASMAP` command in TSO ACF to identity the 3 character type code associated with APPL. Replace 'APL' with the type code listed in the `SHOW CLASMAP` output:
2. In your ESM command line interface or other security environment, define the application session key by entering the following commands if the session key is not already defined.

- `applid`
  Specifies the application ID used for PassTicket validation to authenticate connections to the server.
- `key-description`
  Specifies the secured sign-on hexadecimal application key of 16 hexadecimal digits (8-byte or 64-bit key). Each application key must be the same on all systems in the configuration and the values must be kept secret and secured.

3. Complete the PassTicket setup by entering the following commands:

   The PassTicket record is now active in the system.
4. Enable the started task user ID to generate PassTickets for the application by entering commands similar to the following:

- `userid`
  Specifies the Zowe server user ID

You configured Zowe to use PassTickets for single sign on using ACF2.

Enabling PassTickets with Top Secret

Click here for command details about configuring Zowe to use PassTickets using Top Secret.

Before you begin this procedure, verify that the `PTKTDATA` class and ownership for the PassTicket resource (`IRRPTAUTH`) have not already been defined as described in the previous tip.

1. Update the resource descriptor table (RDT) to define the `PTKTDATA` class by entering the following commands:

> **NOTE**
> The `PTKTDATA` resource is not a predefined class.

The `PTKTDATA` resource is added to the RDT.

> **NOTE**
>
> Include `RESCODE(n)` in the range of 101 to 13F to make `PTKTDATA` a prefixed resource class.

2. Assign ownership for the PassTicket resource (`IRRPTAUTH`). Execute the following commands:

- **`department`**
  Specifies the department for `PTKTDATA(IRRPTAUTH)`. The default department is `TSODEPT1`.

3. Define PassTicket for application ID *applid* without replay protection:

- **`applid`**
  Specifies the application ID used for PassTicket validation to authenticate connections to the server.
- **`key-description`**
  Specifies the secured sign-on hexadecimal application key of 16 hexadecimal digits (8-byte or 64-bit key). Each application key must be the same on all systems in the configuration and the values must be kept secret and secured.

4. Permit access to the PassTicket resource defined in the previous step for the LDAP Server by executing the following command:

- **`stc-userid`**
  Specifies the Accessor ID (ACID) that you created when you created LDAP Server started task User IDs.

Default: CALDAP

You configured Zowe to use PassTickets using Top Secret.

Enabling PassTickets with RACF

▾ Click here for command details about configuring Zowe to use PassTickets using RACF.

1. Activate the `PTKTDATA` class, which encompasses all profiles containing PassTicket information.

   In your ESM command line interface or other security environment, execute the following command:

2. Specify the application ID requiring access through PassTicket for the Zowe server with the following commands:

- **`applid`**
  Specifies the application ID used for PassTicket validation to authenticate connections to the server. (One to 8 characters)

> **NOTE**
>
> This name is usually provided by the site security administrator.

3. Define the profile for the application with the following command:

- `key-description`
  Specifies the secured sign-on hexadecimal application key of 16 hexadecimal digits (8-byte or 64-bit key). Each application key must be the same on all systems in the configuration and the values must be kept secret and secured.

4. Replace `key-description` with the application name defined previously.

> **IMPORTANT**
> PassTickets for the API service must have the replay protection switched off. This links a secured sign-on application key with the application.

5. Define the profile `IRRPTAUTH` in `PTKTDATA` class for the `<applid>`

6. Allow the application ID (*applid*) to use PassTickets:

- `userid`
  Specifies the value of the LDAP Server started task.

7. Refresh the RACF PTKTDATA definition with the new profile:

You configured Zowe to use PassTickets using RACF.

Configuring security to allow Zowe API Gateway to generate PassTickets for an API service

As a security administrator, you can issue security commands to allow the Zowe started task user ID to generate PassTickets for the API service.

Specify the following variables when generating PassTickets for the API service to enable the Zowe started task user ID:

- `applid`
  The APPLID value used by the API service for PassTicket support (for example, `OMVSAPPL`)

- `zowe-user-id`

The Zowe started task user ID used during the Zowe installation

In the following examples of ESM configuration, replace these variables with actual values.

Use the configuration format that corresponds to your ESM as presented in the following examples.

Generating PassTickets using ACF2

<details>
<summary>Click here for command details about generating PassTickets using ACF2.</summary>

Grant the Zowe started task user ID permission to generate PassTickets for users of the API service.

Example:
</details>

Generating PassTickets using Top Secret

<details>
<summary>Click here for command details about generating PassTickets using Top Secret.</summary>

Grant the Zowe started task user ID permission to generate PassTickets for users of the API service.

Example:

</details>

Generating PassTickets using RACF

<details>
<summary>Click here for command details about generating PassTickets using RACF.</summary>

Grant the Zowe started task user ID permission to generate PassTickets for users of the API service.

Example:

</details>

Verifying your PassTicket Application

In your ESM command line interface or other security environment, execute the commands that correspond to your ESM:

Verifying PassTickets using ACF2

<details>
<summary>Click here for command details for ACF2.</summary>

ACF2:

Replace 'APL' with the type code listed in the `SHOW CLASMAP` output:

- **`applid`**
  Specifies the application ID used for PassTicket validation to authenticate connections to the server

Successful execution of this validation command shows your application and the specific access of the application.

</details>

Verifying PassTickets using Top Secret

<details>
<summary>Click here for command details for Top Secret.</summary>

TSS:

</details>

Verifying PassTickets using RACF

<details>
<summary>Click here for command details for RACF</summary>

</details>

RACF:

Output example:

(Optional) Adding custom HTTP Auth headers to store user ID and PassTicket

If a downstream (southbound) service needs to consume the PassTicket as well as the user ID from custom headers to participate in the Zowe SSO, you can define the custom HTTP headers names as part of the Gateway configuration. The southbound service must use the `httpBasicPassTicket` scheme in order to leverage this functionality. Once the HTTP headers names are defined, each request to the southbound service contains the PassTicket and the user ID in the custom headers.

Use the following procedure to add the custom HTTP headers.

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.apiml.security.auth.passticket.customAuthHeader` and set the value which represents the name of the header.
3. Find or add the property `components.gateway.apiml.security.auth.passticket.customUserHeader` and set the value which represents the name of the header.
4. Restart Zowe.

Requests through the Gateway towards the southbound service now contain the custom HTTP headers with the PassTicket and the user ID.

Version: v3.2.x LTS

Customizing routing behavior

> **ROLES: SYSTEM PROGRAMMER, SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR**

The Zowe API Mediation Layer offers a range of routing configurations for enhanced functionality and security.

You can customize your configuration for how API ML manages both northbound and southbound load limits in single instances, including changing the number of concurrent connections per route passing through the API Gateway, and changing the global Gateway timeout value for the API ML instance.

To change the number of concurrent connections per route passing through the API Gateway, see Customizing connection limits.

To change the global Gateway timeout value for the API ML instance, see Customizing Gateway timeouts.

Also see the following properties in API Gateway configuration parameters:

- `server.maxTotalConnections`
- `server.maxConnectionsPerRoute`

Customizing CORS enables the Gateway to handle Cross-Origin Resource Sharing requests, while settings for encoded slashes and unique cookie names cater to specific operational needs of onboarding applications and multiple Zowe instances.

For more information, see Customizing Cross-Origin Resource Sharing (CORS)

To onboard applications which expose endpoints that expect encoded slashes, see Using encoded slashes

The Gateway retry policy, customizable through zowe.yaml, optimizes request handling, which can be especially useful in high availability scenarios.

To customize the Gateway retry policy, see Customizing Gateway retry policy.

Additionally, API ML supports specific instance access and load balancer cache distribution, improving service identification and scalability. These configurations, including service ID adjustments for compatibility with Zowe v2, demonstrate Zowe's adaptability and robustness in API management.

To configure a unique cookie name for each instance to prevent overwriting of the default cookie name in the case of multiple Zowe instances, or for more complex deployment strategies, see Configuring a unique cookie name for a specific API ML instance.

To determine which service instance is being called, you can customize the Gateway to output a routed instance header. For more information, see Retrieving a specific service within your environment.

To distribute the load balancer cache between instances of the API Gateway, see Distributing the load balancer cache.

To modify the service ID to ensure compatibility of services that use a non-conformant organization prefix with Zowe v2, see Setting a consistent service ID.

Version: v3.2.x LTS

Configuring routing in a multi-tenant environment

In a multi-sysplex environment, both the domain-specific Discovery Service as well as one or more additional Discovery Services may require registration with the Discovery Service in the domain which gathers information about all installed API Gateways in isolated sysplex environments.

The domain-specific Discovery Service is typically in the same LPAR in a multi-sysplex environment. However, the API Gateway in API ML in one domain (for example in Domain API ML 2) may also need to register with the API ML Discovery Service in a separate domain (for example in Domain API ML 1), which gathers information about all installed API Gateways in isolated sysplex environments. After registration, data from the Discovery Service in Domain API ML 1 can be used by the Gateway in Domain API ML 2 for routing to individual API Gateways.

Follow these steps to register with additional Discovery Services:

1. Open the `zowe.yaml` configuration file.
2. Add the property `components.gateway.apiml.service.additionalRegistration` and set the value to a list of Discovery service clusters to additional Disovery Services.

   Example:

   > **NOTE**
   >
   > Ensure that each API ML instance is defined in a separated record. Do not combine multiple API ML instances in a single record. In the case of a high availability setup, the value `discoveryServiceUrls` may contain multiple URLs. We highly recommend to provide all available Discovery URLs in the value `discoveryServiceUrls`.
   >
   > Always provide the direct address to the system. Do not use the DVIPA address. Using this address could lead to unexpected behaviour.

3. Add property `components.gateway.apimlId` and set the value to a unique string to identify gateway for routing.

   Example:

4. Restart Zowe.

You completed the procedure to register with additional Discovery Services.

Version: v3.2.x LTS

Customizing Cross-Origin Resource Sharing (CORS)

> **ROLE: SYSTEM PROGRAMMER**

As a system programmer, you can enable the Gateway to terminate CORS requests for itself and also for routed services. By default, Cross-Origin Resource Sharing (CORS) handling is disabled for Gateway routes `gateway/api/v1/**` and for individual services. After enabling the feature as stated in the following procedure, API Gateway endpoints start handling CORS requests. Individual services can control whether they want the Gateway to handle CORS for them through the Custom Metadata parameters.

When the Gateway handles CORS on behalf of the service, the Gateway sanitizes the following defined headers from the communication (upstream and downstream) in the following comma -separated list:

The resulting request to the service is not a CORS request. No additional specification of the service is required. The list can be overridden by specifying a different comma-separated list in the property `components.gateway.apiml.service.ignoredHeadersWhenCorsEnabled` in `zowe.yaml`.

Additionally, the Gateway handles the preflight requests on behalf of the service when CORS is enabled in Custom Metadata, replying with CORS headers:

- `Access-Control-Allow-Methods: GET,HEAD,POST,DELETE,PUT,OPTIONS`
- `Access-Control-Allow-Headers: origin, x-requested-with`
- `Access-Control-Allow-Credentials: true`
- `Access-Control-Allow-Origin: *`

Alternatively, list the origins as configured by the service, associated with the value **customMetadata.apiml.corsAllowedOrigins** in Custom Metadata.

If CORS is enabled for Gateway routes but not in Custom Metadata, the Gateway does not set any of the previously listed CORS headers. As such, the Gateway rejects any CORS requests with an origin header for the Gateway routes.

Use the following procedure to enable CORS handling.

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.apiml.service.corsEnabled` and set the value to `true`.
3. Restart Zowe.

Requests through the Gateway now contain a CORS header.

Version: v3.2.x LTS

Using encoded slashes

> **ROLE: SYSTEM PROGRAMMER**

By default, the API Mediation Layer accepts encoded slashes in the URL path of the request. If you are onboarding applications which expose endpoints that expect encoded slashes, it is necessary to keep the default configuration. We recommend that you change the property to `false` if you do not expect the applications to use the encoded slashes.

Use the following procedure to reject encoded slashes.

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.apiml.service.allowEncodedSlashes` and set the value to `false`.
3. Restart Zowe.

Requests with encoded slashes are now rejected by the API Mediation Layer.

Version: v3.2.x LTS

Customizing Gateway retry policy

Use the following procedure to change the Gateway retry policy.

> **ROLE: SYSTEM PROGRAMMER**

All requests are disabled as the default configuration for retry with one exception: the server retries `GET` requests that finish with status code `503`.

1. Open the `zowe.yaml` configuration file.
2. Configure the following properties:

- **components.gateway.ribbon.retryableStatusCodes**
  This property provides a list of status codes, for which the server should retry the request.

Example: `components.gateway.ribbon.retryableStatusCodes: "503, 404"`

- **components.gateway.ribbon.OkToRetryOnAllOperations**
  Specifies whether to retry all operations for this service. The default value is `false`. In this case, only `GET` requests are retried if they return a response code that is listed in `ribbon.retryableStatusCodes`. Setting this parameter to `true` enables retry requests for all methods which return a response code listed in `ribbon.retryableStatusCodes`.

> **NOTE**
>
> Enabling retry can impact server resources due to request body buffering.

- **components.gateway.ribbon.MaxAutoRetries**
  Specifies the number of times a failed request is retried on the same server. This number is multiplied with `ribbon.MaxAutoRetriesNextServer`. The default value is `0`.

- **components.gateway.ribbon.MaxAutoRetriesNextServer**
  Specifies the number of additional servers that attempt to make the request. This number excludes the first server. The default value is `5`.

3. Restart Zowe.

Version: v3.2.x LTS

Configuring a unique cookie name for a specific API ML instance

> **ROLE: SYSTEM PROGRAMMER**

By default, in the API Gateway, the cookie name is `apimlAuthenticationToken`. To prevent overwriting of the default cookie name in the case of multiple Zowe instances, a unique cookie name can be configured for each instance.

Follow this procedure to configure a unique cookie name for the instances:

1. Open the Zowe YAML configuration file.
2. Find or add the property `components.gateway.apiml.security.auth.uniqueCookie`, and set it to `true`.
3. Find the property `zowe.cookieIdentifier` and set it to any word or number that you wish to identify your Zowe instance.
4. Restart Zowe.

This sets a suffix for the API Gateway's cookie name based upon the value of `zowe.cookieIdentifier`.

Example:
If the `components.gateway.apiml.security.auth.uniqueCookie` parameter is set to `true` and `zowe.cookieIdentifier` is `1`, the cookie name is `apimlAuthenticationToken.1`.
If this property is not set to `true`, the cookie name remains the default value `apimlAuthenticationToken`.

Version: v3.2.x LTS

Retrieving a specific service within your environment

> **ROLES: SYSTEM PROGRAMMER, SYSTEM ADMINISTRATOR**

Output a routed instance header

The API Gateway can output a special header that contains the value of the instance ID of the API service that the request has been routed to. This is useful for understanding which service instance is being called.

The header name is `X-InstanceId`, and the sample value is `discoverable-client:discoverableclient:10012`. This is identical to `instanceId` property in the registration of the Discovery service.

Use the following procedure to output a special header that contains the value of the instance ID of the API service.

1. Open the file `zowe.yaml`.
2. Find or add the property with value `components.gateway.apiml.routing.instanceIdHeader:true`.
3. Restart Zowe.

Version: v3.2.x LTS

Distributing the load balancer cache

> **ROLE: SYSTEM PROGRAMMER**

You can choose to distribute the load balancer cache between instances of the API Gateway. To distribute the load balancer cache, it is necessary that the caching service is running. Gateway service instances are required to have the same DN (Distinguished name) on the server certificate. This may be relevant for the HA setups.

Use the following procedure to distribute the load balancer cache between instances of the API Gateway.

1. Open the file `zowe.yaml`.
2. Find or add the property with value `components.gateway.apiml.loadBalancer.distribute: true`.
3. Restart Zowe.

Version: v3.2.x LTS

Setting a consistent service ID

ROLE: API SERVICE EXTENDER

As an API service extender you can modify the service ID to ensure compatibility of services that use a non-conformant organization prefix.

For more information, see the following parameter in the article Discovery Service configuration parameters:

- **components.discovery.apiml.discovery.serviceIdPrefixReplacer**
  This parameter is used to modify the service ID of a service instance, before it registers to API ML. Using this parameter ensures compatibility of services that use a non-conformant organization prefix with.

Version: v3.2.x LTS

Customizing management of API ML load limits

> **ROLE: SYSTEM PROGRAMMER**

As a system programmer, you can customize your configuration for how API ML manages both northbound and southbound load limits in single instances:

- To change the number of concurrent connections per route passing through the API Gateway, see Customizing connection limits.
- To change the global Gateway timeout value for the API ML instance, see Customizing Gateway timeouts.
- To change the number of concurrent requests an application should support and its impact on the size of the Java memory heap, see Customizing Java Heap sizes.
- To customize the rate limit for each service, see Customizing Gateway rate limiter.

Version: v3.2.x LTS

Customizing connection limits

> **ROLE: SYSTEM PROGRAMMER**

TCP/IP Connection Limits

By default, the API Gateway accepts up to 100 concurrent connections per route, and 1000 total concurrent connections. Any further concurrent requests are queued until the completion of an existing request. The API Gateway is built on top of Apache HTTP components that require these two connection limits for concurrent requests.

Use the following procedure to change the number of concurrent connections:

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.server.maxConnectionsPerRoute` and set the value to an appropriate positive integer. Defaults to 100 max reusable connections per route.
3. Find or add the property `components.gateway.server.maxTotalConnections` and set the value to an appropriate positive integer. Defaults to 1000 max total concurrent connections.

Websocket Limits

The API Mediation Layer supports Websocket connections. It is possible to configure the limits around timeouts. All the values are in milliseconds. Customizing this limit may be practical if you see problems such as with the usage of the TN3270 terminal in Virtual Desktop.

Use the following procedure to change the limits:

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.server.websocket.connectTimeout`, and set the value to an appropriate positive integer. This timeout limits how long the API Gateway waits until it drops connection if it cannot reach the target server. The default is 45 seconds (45000 milliseconds).
3. Find or add the property `components.gateway.server.websocket.asyncWriteTimeout`, and set the value to an appropriate positive integer. This timeout handles how long it takes before the server fails with unsuccessful response when trying to write a message to the Websocket connection. The default is 60 seconds (60000 milliseconds).
4. Find or add the property `components.gateway.server.websocket.maxIdleTimeout`, and set the value to an appropriate positive integer. This timeout handles how long the Websocket connection remains open if there is no communication happening over the open connection. The default is one hour (3600000 milliseconds).
5. Find or add the property `components.gateway.server.websocket.requestBufferSize` and set the value to an appropriate positive integer. This property handles the max request size allowed in WebSocket handshake requests. The default is 8K.

Version: v3.2.x LTS

Customizing Gateway timeouts

> **ROLE: SYSTEM PROGRAMMER**

Use the following procedure to change the global timeout value for an API Mediation Layer instance.

1. Open the file `zowe.yaml`.
2. Configure the following properties:

- **components.gateway.apiml.connectTimeout**
  Specifies the value in milliseconds which corresponds to the period in which API ML should establish a single, non-managed connection with the service. If omitted, the default value specified in the API ML Gateway service configuration is used.
- **components.gateway.apiml.connection.idleConnectionTimeoutSeconds**
- **components.gateway.apiml.connection.timeToLive**

Example:

3. Restart Zowe.

You completed customization of Gateway timeouts.

Version: v3.2.x LTS

Customizing Gateway rate limiter

> **ROLE: SYSTEM PROGRAMMER**

The API Gateway offers a way to customize the rate limit for each service via a configurable rate limiter, which prevents individual users from overloading the system with excessive requests. Configuring the rate limiter helps ensure that a user's activity does not negatively impact the experience of other users by mitigating the risk of Distributed Denial-of-Service (DDoS) attacks and other automated exploit attempts.

Use the following procedure to customize the Gateway rate limiter:

1. In the zowe.yaml, set the following rate limiting properties in api/gateway:

    - **rateLimiterCapacity**
      Defines the total number of requests that can be allowed at one time per user. The default value is set to 20.

    - **rateLimiterTokens**
      Defines the number of requests that are added to the service’s allowance at regular intervals. This property controls how quickly requests are replenished after being consumed. The default value is set to 20.

    - **rateLimiterRefillDuration**
      Sets the time interval (in minutes) at which new requests (or tokens) are added. The default value is set to 1.

2. Define the services to limit:

    Use `servicesToLimitRequestRate` to specify a list of services to limit. In the following example, this property applies to the API Catalog.

Example configuration:

You configured the properties of the rate limiter for the API Catalog, thereby improving user accessibility and overall system stability.

Version: v3.2.x LTS

Customizing Java Heap sizes

> **ROLE: SYSTEM PROGRAMMER**

The Zowe API Mediation Layer is a Java-based application. As such, one of the main performance considerations is the size of the Java memory heap, where all objects are stored. The Java heap size has a direct impact on the available capacity of the applications. Aspects to consider when defining the size are, for example, how many concurrent requests the application should support, and the expected size of average requests. As a systems programmer, you can customize the available Java memory heap size for API Mediation Layer components.

By default, all services (Gateway, Discovery, API Catalog, Caching Service) have a Java heap size of 32 MB as the initial size, and a maximum heap size of 512 MB.

To change the default settings, set `components.<component>.heap.init` and `components.<component>.heap.max`

- `component`
  Specifies one of the following services:
  - `gateway`
  - `discovery`
  - `caching-service`
  - `api-catalog`
  - `zaas`

Example with Gateway Service:

The unit is megabytes and cannot be changed. The new values are 1 GB.

Recommendation

It is recommended to have a fixed heap size in a production environment.

Version: v3.2.x LTS

Configuring authorization for API ML

> **ROLE: SYSTEM ADMINISTRATOR**

In Zowe's API Mediation Layer, system administrators can limit access to services and information in the API Catalog by hiding sensitive data like service instance URLs, configurable via the apiml.catalog.hide.serviceInfo property in zowe.yaml. Additionally, SAF resource checking for user authorization on specific endpoints is facilitated through various providers, such as Endpoint, Native, and Dummy. These configurations, modifiable in the zowe.yaml file, enhance security by controlling service exposure and ensuring proper authorization checks within the Zowe ecosystem.

- Limiting access to information or services in the API Catalog
- Configuring SAF resource checking
- Configurint Health Endpoint Protection

Version: v3.2.x LTS

Limiting access to information or services in the API Catalog

> **ROLE: SYSTEM ADMINISTRATOR**

As a system administrator, you can limit access to information and/or services available within the API Catalog and through the API Mediation Layer and check for the authorization of the user on certain endpoints.

Choose from the following use cases:

- Use the property `apiml.catalog.hide.serviceInfo` to hide the instance URL value of all services registered to the API ML in the API Catalog.

  See the section Hide service information.

- The API ML can check for the authorization of the user on certain endpoints. Access to a SAF resource is checked via an External Security Manager (ESM).

  See the article SAF Resource Checking.

Hide service information

1. Open the file `zowe.yaml`.
2. Configure the following properties:
   - **apiml.catalog.hide.serviceInfo**

     This parameter is used to hide the instance URL value of all services registered to the API ML in the API Catalog. This customization can be useful when the service owner does not want to expose sensitive information such as the hostname.

     Set the value of the `*apiml.catalog.hide.serviceInfo` parameter to `true` to hide the instance URL for all services registered to the API Catalog.

     In your Zowe YAML configuration (typically `zowe.yaml`), set this parameter by defining `configs.apiml.catalog.hide.serviceInfo`.

     Follow this example to define this parameter globally.

     Example:

     An alternative is to define this parameter only for a high availability instance on lpar1.

     Example:
3. Restart Zowe.

Version: v3.2.x LTS

Configuring SAF resource checking

ROLES: SYSTEM PROGRAMMER, SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR

You can use various SAF resource providers depending on your use case to handle the SAF authorization check. Follow the procedure in this article that applies to your specific configuration use case.

SAF Resource Checking Providers

API ML can check for the authorization of the user on certain endpoints. Access to a SAF resource is checked with your External Security Manager (ESM).

Verification of the SAF resource is possible by any of the following three providers:

- **native**
  The Native JZOS classes from Java are used to determine SAF resource access. This is the default provider.

  Note: This provider cannot be used off-platform.

- **endpoint**
  The endpoint provider relies on APIs such as through a REST endpoint call (for example ZSS). This option is disabled by default. In Zowe, ZSS provides the API to check for SAF resource authorization.

- **dummy**
  The dummy provider is the lowest priority provider. This is the dummy implementation and is defined in a file.

NOTE

Verification of the SAF resource uses the first available provider based on the specified priority. The default configuration resolves to the **native** provider.

Setting the native provider to perform SAF resource check (Default setting)

The Native provider is the easiest approach to use the SAF resource checking feature on the mainframe.

1. Open the file `zowe.yaml`.
2. Find or add the following property with the value set as `native`:

3. Restart Zowe.

TIP

Enable this provider when classes `com.ibm.os390.security.PlatformAccessControl` and `com.ibm.os390.security.PlatformReturned` are available on the classpath. This approach uses the method described in Class PlatformAccessControl in the IBM documentation.

> **NOTE**
>
> Ensure that your system uses the same version of Java as the classes and method signatures.

Setting the endpoint provider to perform SAF resouce check

To use the endpoint provider it is necessary to enable the endpoint property and customize the URL corresponding to the SAF resource authorization. By default, the ZSS API is configured and used.

1. Open the file `zowe.yaml`.
2. Find or add the following properties and their corresponding values:
   - `components.gateway.apiml.security.authorization.provider: endpoint`
   - `components.gateway.apiml.security.authorization.endpoint.enabled: true`
   - (Optional) `components.gateway.apiml.security.authorization.endpoint.url: <endpoint_url>`

   When using ZSS, the default value of the property `components.gateway.apiml.security.authorization.endpoint.url` is `https://<haInstance_hostname>:<gateway_port>/zss/api/v1/saf-auth`

   - **haInstance_hostname**
     Specifies the Zowe instance hostname from the configuration.
   - **gateway_port**
     Specifies the Gateway port from the configuration.
3. Restart Zowe.

Setting the dummy provider to perform SAF resource check

Use the Dummy provider for testing purpose outside of the mainframe.

1. Open the file `zowe.yml`.
2. Find or add the following property with the value `dummy`:
3. Create the file `saf.yml` in the following folders where the application is running:

- `<zowe_installation_dir>/components/zaas/bin folder (V3)`
  The directory for the ZAAS application
- `<zowe_installation_dir>/components/gateway/bin folder (V3)`
  The directory for the Gateway

Alternatively, you can create the file `mock-saf.yml` in the test module (root folder).

4. Restart Zowe.

> **IMPORTANT:**
>
> It is necessary to read the file outside of the JAR. A file (inner or outside) has to exist.

The following YAML presents the structure of the file:

- **CLASS**
  Specifies the name of the SAF class.
- **RESOURCE**
  Specifies the name of the SAF resource.

NOTES

- Classes and resources are mapped into a map with user IDs contained in a list.
- The load method does not support formatting with periods (`.`), such as shown in the following example:

  Example: `{CLASS}.{RESOURCE}`
- Ensure that each element is separated.
- The field `safAccess` is not required to define an empty file without a definition.
- Classes and resources cannot be defined without the user ID list.
- When a user has multiple definitions of the same class and resource only the most privileged access level loads.

Version: v3.2.x LTS

Configuring Health Check Protection

> **ROLE: SYSTEM PROGRAMMER**

As a system programmer, you can disable the security setting for the health check endpoint of the API Gateway. This setting determines whether the health check endpoint is accessible without authentication, or alternatively requires authentication. In Zowe V2, authentication was not required. Disabling protection for the health check endpoint can limit the security of the API Gateway by allowing access to sensitive status information about the Gateway.

Use the following procedure to set the value of the health check endpoint of the API Gateway:

1. Open the file `zowe.yaml`.
2. Configure the following property:

- `components.gateway.apiml.health.protected`
  This property defines whether the health check endpoint is accessible with or without authentication.

> **NOTE**
>
> The default value of this parameter is `true`.

Example:

In this example, setting `protected` to `true` protects the health check endpoint by requiring authentication. Only authenticated users can access the health check endpoint. Requiring authentication ensures that sensitive information about the status of the Gateway is not exposed to unauthenticated users.

To allow open access to the health check endpoint, set the parameter to `false`. Setting this parameter to `false` permits access to this endpoint without authentication. In this case, anyone can access the health check endpoint and obtain information about the status of the Gateway.

- `components.discovery.apiml.health.protected`
  This property defines whether the health check endpoint on Discovery service is accessible with or without authentication.
- `components.apiCatalog.apiml.health.protected`
  This property defines whether the health check endpoint on API Catalog is accessible with or without authentication.

Environment Recommendations

When setting this parameter, we recommend applying the following values according to your environment:

- **In Production Environments**
  It is recommended to set `components.*.apiml.health.protected` to `true` to enhance security and protect sensitive information about the API Gateway's health status. This is the default.

- **In Development/Testing Environments**
  setting `components.*.apiml.health.protected` to `false` can simplify the testing process, reduce development

overhead, and assist with debugging.

Version: v3.2.x LTS

Configuring an authentication provider for API Mediation Layer

REQUIRED ROLES: SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR

Choose from the following providers to handle authentication for the API Gateway:

- Configuring an authentication provider for API Mediation Layer
  - z/OSMF Authentication Provider
  - SAF Authentication Provider

NOTE

For development purposes, a dummy authentication provider is also available. This provider is not intend for production purposes. For more information, see Dummy Authentication Provider in *Deploy API Mediation Layer locally*.

TIP

- In most cases, we recommend you use the z/OSMF Authentication Provider. z/OSMF is part of z/OS. As such, this provider is the best option for providing the authentication API.
- When z/OSMF is not available, we recommend you use the SAF Authentication provider. With the SAF provider, the API Gateway acts as the authentication service. The provided credentials are validated directly by API Gateway via SAF APIs.

z/OSMF Authentication Provider

The `z/OSMF Authentication Provider` allows the API Gateway to authenticate with the z/OSMF service. The user needs z/OSMF access in order to authenticate.

Use the following properties of the API Gateway to enable the `z/OSMF Authentication Provider`:

NOTE

z/OSMF is the required authentication provider for the following Zowe Desktop application plugins:

- JES Explorer
- MVS Explorer
- USS Explorer

components.gateway.apiml.security.auth.provider: zosmf

SAF Authentication Provider

The `SAF Authentication Provider` allows the API Gateway to authenticate directly with the z/OS SAF provider that is installed on the system. The user needs a SAF account to authenticate.

Use the following property of the API Gateway to enable the `SAF Authentication Provider`:

Version: v3.2.x LTS

Using Infinispan as a storage solution through the Caching Service

> **REQUIRED ROLES: SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR**

You can configure Infinispan as a storage solution through the Caching Service, as well as configure Infinispan for high availability (HA) to replicate data to provide data durability and availability.

- Using Infinispan as a storage solution through the Caching Service
  - Understanding Infinispan
    - Infinispan replica instances
  - Infinispan configuration

Understanding Infinispan

Infinispan is a storage solution that stores data structures in key-value pairs. The API Caching Service uses hash sets, where each service storing data via the Caching Service has its own hash, and each data entry is a key-value entry within that service's Infinispan hash set.

For more information on Infinispan, see the official Infinispan documentation.

Infinispan replica instances

Infinispan can be used with both a standalone instance and high availability mode. When using multiple Caching Service instances, it is necessary to specify all of the cluster nodes (members). Each Infinispan node is bound to a specific Caching Service instance and runs on a different port and host, which can be configured. For more information about configuring multiple Infinispan modes, see the Infinispan configuration.

For more information on Infinispan replication and how to configure a replica instance, see the Infinispan Cross-site Replication documentation.

Infinispan configuration

Configure Infinispan as a storage solution through the Caching Service by setting the following configuration parameters in the `zowe.yaml`.

- **`components.caching-service.storage.infinispan.initialHosts`**

  This property specifies the list of cluster nodes (members). In case of multiple instances, the value for each Caching Service instance can be either a list of all the members, separated by a comma, or just the replica. The format is `${haInstance.hostname}[${components.caching-service.storage.infinispan.jgroups.port}]`.

- **`components.caching-service.storage.infinispan.jgroups.port`**

(Optional) The default value is `7600`. The port number used by Infinispan to synchronise data among Caching Service instances.

> **NOTE**
>
> We recommend you define this value to avoid potential problems or errors in future Zowe upgrades.

- **`components.caching-service.storage.infinispan.jgroups.host`**

  (Optional) The default value is taken from zowe hostname. The hostname used by Infinispan to synchronise data among Caching Service instances.

  > **NOTE**
  >
  > We recommend you define this value to avoid potential problems or errors in future Zowe upgrades.

- **`components.caching-service.storage.infinispan.keyExchange.port`**

  (Optional) The default value is `7601`. The port number used by Infinispan to exchange encryption key among Caching Service instances.

- **`components.caching-service.storage.infinispan.jgroups.port`**

  (Optional) The default value is `7600`. The port number is used by Infinispan to synchronise data among Caching Service instances.

  > **NOTE**
  >
  > We recommend you define this value to avoid potential problems or errors in future Zowe upgrades, for example from version 2.x through v3.1 to v3.2 and newer versions.

- **`components.caching-service.storage.infinispan.jgroups.host`**

  (Optional) The default value is taken from zowe hostname. The hostname used by Infinispan to synchronise data among Caching Service instances.

- **`components.caching-service.storage.infinispan.jgroups.keyExchange.port`**

  (Optional) The default value is taken from zowe hostname. The hostname used by Infinispan to synchronise data among Caching Service instances.

- **components.caching-service.storage.infinispan.jgroups.keyExchange.port**

  (Optional) The default value is `7601`. The port number is used by Infinispan to exchange encryption key among Caching Service instances.

  > **NOTE**
  >
  > We recommend you define this value to avoid potential problems or errors in future Zowe upgrades, for example from version 2.x through v3.1 to v3.2 and newer versions.

Example of Caching Service HA configuration using Infinispan:

Version: v3.2.x LTS

Using VSAM as a storage solution through the Caching service **Deprecated**

REQUIRED ROLES: SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR

IMPORTANT

VSAM as a storage solution is deprecated in Zowe V3. Please use Infinispan, which is packaged as part of the Caching Service.

In Zowe v2 or previous versions, it is possible to configure VSAM as a storage solution through the Caching service. Configuring VSAM ensures that you do not lose data if you need to restart. Configuring VSAM also makes it possible to leverage multiple caching services concurrently, whereby clients can retreive data through VSAM.

- Using VSAM as a storage solution through the Caching service **Deprecated**
  - Understanding VSAM
    - VSAM configuration
    - VSAM performance

Understanding VSAM

`Virtual Storage Access Method (VSAM)` is both a data set type, and a method for accessing various user data types. Using VSAM as an access method makes it possible to maintain disk records in a unique format that is not understandable by other access methods. VSAM is used primarily for applications, and is not used for source programs, JCL, or executable modules. ISPF cannot be used to display or edit VSAM files. VSAM can be used to organize records into four types of data sets: key-sequenced, entry-sequenced, linear, or relative record. The API Caching service supports VSAM as a storage method to cache APIs, and uses the `Key Sequence Data Set (KSDS)` dataset. Each record has one or more key fields, and a record can be retrieved (or inserted) by the key value, thereby providing random access to data. Records are of variable length. IMS™ uses KDSDs.

For more information about VSAM, see the IBM documentation.

VSAM configuration

Configure VSAM as a storage solution through the Caching service by modifying the following configuration parameters in `components.caching-service` in `zowe.yaml`.

- **`storage.vsam.name`**

  The ZFile filename. The ZFile is a wrapper around a z/OS file based on the supplied name and options. This method calls the fopen() and fldata() C-library routines. The ZFile filename should follow the specific naming convention `//'DATASET.NAME'`.

- **`storage.vsam.keyLength`**

  The VsamKey length. The default value is 128 bytes.

- **`storage.vsam.recordLength`**

  The record length. The default value is 4096 bytes.

- **`storage.vsam.encoding`**

  The character encoding. The default value is IBM-1047.

VSAM performance

Accessing VSAM via java results in a performance limitation. The VSAM solution has been tested in a few scenarios.

The following sequence describes the test process:

1. Load 1000 records into the cache concurrently (5 threads).
2. Update all records for 120 seconds with increasing the thread count, up to `<x>` amount of threads.
3. Read all records for 120 seconds with increasing the thread count, up to `<x>` amount of threads.
4. Read and update all records for 120 seconds with increasing the thread count, up to `<x>` amount of threads.
5. Delete all loaded records from the cache concurrently (5 threads).

Tests were run with 3 scenarios:

- Low load: 5 threads
- Medium load: 15 threads
- High load: 50 threads

Test subjects:

- Single Caching Service with VSAM storage
- Two Caching Services with shared VSAM storage

Results:

- The most important operation is `READ`.
- Two Caching Services achieve better `READ` performance than a single Caching Service.
- Based on data from the testing results, the `READ` performance appears to be acceptable, ranging from 300 ms to 1000 ms.
- With two Caching Services and a high load, `READ` performance significantly increased.
- Response times of other operations are also acceptable, yet error rates increase with higher concurrency.
- Two Caching Services produce higher load on shared resource (VSAM) and have higher error rate.
- VSAM implementation appears to be sufficient for user-based workloads. For light automation workloads VSAM implementation appears to be acceptable as well. For heavy workloads this implementation may not be sufficient.
- VSAM does not scale well beyond 1000 RPM on a node.

Version: v3.2.x LTS

Using Redis as a storage solution through the Caching service

> **REQUIRED ROLES: SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR**

You can configure Redis as a storage solution through the Caching service, as well as configure Redis for high availability to replicate data to provide data durability and availability.

- Understanding Redis
- Redis configuration

Understanding Redis

Redis is an off-Z storage solution that stores data structures in key-value pairs. The API Caching service uses hash sets, where each service storing data via the Caching service has its own hash, and each data entry is a key-value entry within that service's Redis hash set.

For more information on Redis, see the official Redis documentation.

Redis replica instances

Redis can be used with one standalone instance. For data durability, however, a master/replica configuration is recommended. Redis replicas automatically connect, and re-connect when necessary, to the master Redis instance and attempt to be an exact copy of the master.

For more information on Redis replication and how to configure a replica instance, see the official Redis Replication documentation.

Redis Sentinel

Redis Sentinel is a configuration that provides high availability for Redis master/replica instances. Sentinel instances are used to monitor the master instance and use a quorum to automatically determine if a failover procedure needs to occur from a master instance to one of its replicas.

For more information on Redis Sentinel and how to configure Sentinel instances with master/replica instances, see the official Redis Sentinel documentation.

Redis SSL/TLS

Redis supports SSL/TLS starting in version 6. For information on enabled SSL/TLS with Redis, see the official Redis TLS Support documentation.

Redis and Lettuce

The Lettuce library is used to connect to Redis. Lettuce uses Master or Sentinel node registration information to automatically discover other instances. The IP address used to register between nodes is therefore what Lettuce uses to

connect to downstream replica instances. This means the IP address of replica instances, or the IP address of both master and replica instances in the case of Sentinel topology, must be accessible to the Caching service. For example, in a master/replica topology running in separate Docker containers, the replica container's IP address needs to be accessible to the Caching service, rather than only exposing a port.

Redis configuration

Configure Redis as a storage solution through the Caching service by setting the following environment variables. Environment variables can be set by adding them to the `components.caching-service` section of the `zowe.yaml` configuration file.

- **`storage.redis.masterNodeUri`**

  The URI used to connect to the Redis master instance in the form `username:password@host:port`.

  - The host section of the URI is mandatory
  - The port section is optional and if not included defaults to `6379`.
  - The username section is optional and if not included defaults to the Redis default username `default`.
  - The password section is optional, but must be included if a username is included. If the password is not set a username cannot be set.

- **`storage.redis.timeout`**

  The timeout duration in seconds for the Caching service when first connecting to Redis. Defaults to 60 seconds.

- **`storage.redis.sentinel.enabled`**

  A flag indicating if Redis is being used with Redis Sentinel instances. Defaults to `false`.

- **`storage.redis.sentinel.masterInstance`**

  The Redis master instance ID used by the Redis Sentinel instances. Required if Redis Sentinel is being used.

- **`storage.redix.sentinel.nodes`**

  The URI used to connect to a Redis Sentinel instance in the form `username:password@host:port`.

  - The host section of the URI is mandatory
  - The port section is optional and if not included defaults to `6379`.
  - The password section is optional and defaults to no password.

  To supply multiple Redis Sentinel URIs, concatenate the URIs with a comma `,`.

- **`storage.redix.ssl.enabled`**

  A flag indicating if Redis is being used with SSL/TLS support. Defaults to `true`.

- **`storage.redis.ssl.keystore`**

  The keystore file used to store the private key. Defaults to the Caching Service's keystore.

- `storage.redis.ssl.keystorePassword`

  The password used to unlock the keystore. Defaults to the Caching Service's keystore password.

- `storage.redis.ssl.truststore`

  The truststore file used to keep other parties public keys and certificates. Defaults to the Caching Service's truststore.

- `storage.redix.ssl.truststorePassword`

  The password used to unlock the truststore. Defaults to the Caching Service's truststore password.

Version: v3.2.x LTS

Customizing the API Catalog UI

> **ROLE: SYSTEM ADMINISTRATOR**

As a system administrator, you can customize the API Catalog UI to have a similar interface to your organization's service, or with your existing visualization portal.

- To customize the logotype and selected syle options in the zowe.yaml file, see API Catalog branding.
- To replace or remove the API Catolog service from the Gateway home page and health checks, see Replace or remove the Catalog with another service.

API Catalog branding

It is possible to customize the logotype and selected style options directly in `zowe.yaml`.

1. Open the file `zowe.yaml`.
2. Configure the following properties by setting them under `configs.apiml.catalog.customStyles`:

   - **logo**
     Specifies the location of the logo that will replace the default Zowe logo in the API Catalog header. The supported image formats are: `svg`, `png` and `jpg/jpeg`.
   - **titlesColor**
     Specifies the title color.
   - **fontFamily**
     Specifies the font family to use across the API Catalog.
   - **headerColor**
     Specifies the HTML color of the header element in the API Catalog home page
   - **backgroundColor**
     Specifies the HTML color of the main background across the API Catalog
   - **textColor**
     Specifies the HTML color of the main text across the API Catalog
   - **docLink**
     Specifies a custom link to be displayed in the header. Use this property to refer to applicable documentation. The format is `<link_name>|<link_url>`
     Example: `docLink: Custom Documentation|https://somedoc.com`

     Follow this example to define this parameter globally.

     Example:

     Properties in the example that are not set default to Zowe API Catalog css values.

3. Restart Zowe.

Replace or remove the Catalog with another service

By default, the API Mediation Layer contains the API Catalog as a service showing available services. As the API Mediation Layer can be successfully run without this component it is possible to replace or remove the service from the Gateway home page and health checks. The following section describes the behavior of the Gateway home page and health checks.

The default option displays the API Catalog.

A value can also be applied to `components.gateway.apiml.catalog.serviceId`.

Examples:

- **none**
  Nothing is displayed on the Gateway home page and the Catalog is removed from `/application/health`
- **alternative-catalog**
  An alternative to the API Catalog is displayed

> **NOTES:**
> - If the application contains the `homePageUrl` and `statusPageRelativeUrl`, then the full set of information is displayed.
> - If the application contains the `homePageUrl` the link is displayed without the `UP` information.
> - If the application contains the `statusPageRelativeUrl` then `UP` or `DOWN` is displayed based on the `statusPage` without the link.

Use the following procedure to change or replace the Catalog service.

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.apiml.catalog.serviceId`. Set the value with the following options:
   - Set the value to `none` to remove the Catalog service.
   - Set the value to the ID of the service that is onboarded to the API Mediation Layer.
3. Restart Zowe.

Version: v3.2.x LTS

Customizing Zowe API Mediation Layer logging

Zowe API Mediation Layer uses logback for its logging. You can customize the logging of Zowe API Mediation Layer by specifying the customized `logback.xml` file in `zowe.yaml` for each service separately.

To change the default logback configuration file, set `components.<component>.logging.config` with a path to your `logback.xml`.

- `component`
  Specifies one of the following services:
  - `gateway`
  - `discovery`
  - `api-catalog`
  - `caching-service`
  - `zaas`

Example with Gateway Service:

Default logging configuration file

The following `logback.xml` is an example of logging configuration file which is used by default in all API Mediation Layer components:

> **NOTE**
>
> You can find the current default logging configuration file by following this link.

Customization example

One of the examples of possible customization is changing the pattern for the logged messages. The pattern is defined in the `apimlLogPattern` property in `logback.xml`. By default, the API Mediation Layer prints log messages, as in the following example:

In the following table you can see each part of the `apimlLogPattern` in the example of the message above:

Pattern part	Message part
`%d{yyyy-MM-dd HH:mm:ss.SSS,UTC}`	`2024-08-01 12:52:27.922`
`%clr<${logbackService:-${logbackServiceName}}:%thread:${PID:-}> %magenta`	`<ZWEAGW1:DiscoveryClient-InstanceInfoReplicator-0:33948829>`
`(%X{userid:-})`	`ZWESVUSR`
`%cyan(%-5level)`	`INFO`

Pattern part	Message part
`%clr\(\(%logger{15}\)\)`	`(o.z.a.g.h.GatewayHealthIndicator)`
`%msg`	`ZWEAM001 API Mediation Layer started`

You can edit, move, remove, or add some parts in the pattern based on your requirements.

> **NOTE**
>
> The full documentation of Logback pattern are available on Logback site.

Version: v3.2.x LTS

Configuring initial API Mediation Layer startup message for SYSLOG

ROLE: SYSTEM PROGRAMMER

FUNCTIONALITY OF THIS FEATURE IS AVAILABLE FROM ZOWE 2.18.

Startup of the API Mediation Layer can be configured to present a message in the SYSLOG that the API Mediation Layer is started and ready. This setup is typically used in combination with Workload Automation tools to manage the lifecycle of Zowe.

This functionality requires the following changes to the zowe.yaml:

1. Validate whether the `zowe.sysMessages` property contains ZWEAM001I. If this property does not contain ZWEAM001I, add the value `- "ZWEAM001I"` to this property.

   This property change ensures that the message containing `ZWEAM001I` is presented in the SYSLOG.

   Example of the message in the SYSLOG:

   `2024-09-30 10:17:53.814 <ZWEAGW1:DiscoveryClient-InstanceInfoReplicator-%d:3335> jb892003 INFO ((o.z.a.g.c.GatewayHealthIndicator)) ZWEAM001I API Mediation Layer started`

2. Prepare custom logging configuration. The current default logging implementation starts with information about the current time. This message content is unlike the message id which is typical in z/OS. To change this message behavior, it is necessary to change the logback.xml configuration. The following example shows the custom logback.xml which prepends the message with the first 9 characters of the message.

   Example:

   Custom configuration that changes the structure of the message to prepend 9 characters to the beginning is prepared.

   TIP

   For detailed information about how to provide this changed configuration, see Customizing Zowe API Mediation Layer logging.

3. Add the new configuration to the API Mediation Layer for the Gateway service, which issues the message that the API Mediation Layer started.

4. Validate the configuration was properly applied. You successfully changed the structure of the log message if you see the message `ZWEAM001I` in the SYSLOG when the API Mediation Layer fully starts and is ready to handle requests.

Message example: `ZWEAM001I 2024-09-30 10:17:53.814 <ZWEAGW1:DiscoveryClient-InstanceInfoReplicator-%d:3335> jb892003 INFO ((o.z.a.g.c.GatewayHealthIndicator)) ZWEAM001I API Mediation Layer started`

Version: v3.2.x LTS

Zowe Configuration Manager

When you install the Zowe™ server components on z/OS, a utility called `configmgr` or "Configuration Manager" is bundled within. It can be used directly in a few ways, or leveraged by the `zwe` command to empower it with several abilities and even performance enhancements.

The purpose of Configuration Manager is to deliver unified, validated configuration data to programs without requiring the programs to know where the configuration is stored or prove that the configuration is valid. This reduces the burden on each Zowe component to support different data storage types such as both datasets AND files and also ensures that all Zowe components have sufficient configuration validation to avoid silent or hard-to-troubleshoot errors.

Validation error reporting

Configuration Manager will not let Zowe servers start unless the configuration passes validation when checking it against the Zowe configuration schema. This gives a degree of assurance that the servers will not encounter issues due to typographical errors or missing required fields. It also avoids silent errors where a field might be an integer rather than a string.

When a validation error occurs, the command you ran will end with output that shows what and where the error was.

Example

Consider the following Zowe configuration section about certificates:

In the example, the certificate type `PCKS12` does not exist. It is a typo. Without schema validation, the servers might start and then crash due to the typo.

With the schema file, you can see that there are listed choices for certificate types:

The type can only be one from the `enum` list. This allows you to not only detect this error but also see the options available.

When `zwe` runs and fails schema validation due to the "PCKS12" typo, it will print out the following message:

This output shows that `type` has an issue. You can read the `enum` to see the choices before restarting Zowe.

JSON-Schema validation

Configuration Manager uses JSON Schema to validate a configuration. As a result, Zowe itself and all components and extensions must have schema files for Configuration Manager to perform validation. Developers should read how to add schemas to components as it is required in v2.

Zowe now publishes these schema files so that you can see all the configuration properties that are possible in Zowe, see how they have changed between versions, and see what values are valid for them. Below is a list of some of these schemas:

Component	Name	Purpose	Github Link
Base	server-base	Validates zowe.yaml except `components` section	link
Base	server-common	Common structures reusable by other schemas	link
Base	server-component-manifest	Validates each components' manifest.yaml	link
Base	trivial-component-schema	For copying as a starting point for developers	link
app-server	appfw-plugin-definition	Validates any components' pluginDefinition.json for `zwe components install`	link
app-server	component	Validates `components.app-server`	link
discovery	component	Validates `components.discovery`	link
gateway	component	Validates `components.gateway`	link
zss	component	Validates `components.zss`	link
explorer-ip	component	Trivially validates `components.explorer-ip`	link

From the GitHub links above, if you want to see changes between versions, you can compare by the GitHub tags.

Splitting configuration into multiple storage types

When `zwe` is using Configuration Manager, the `CONFIG=` parameter in the z/OS ZWESLSTC JCL and the `--config` parameter in any `zwe` command that supports `--configmgr` can take a list of YAML locations as an alternative to the backward-compatible single YAML file used in prior Zowe versions.

When using a single Unix file, the syntax is just the path to the file, such as `CONFIG=/my/zowe.yaml`. However, when using multiple storage types, you must use the syntax `FILE(file1):PARMLIB(DSN(MEMBER)):...` where each storage types is surrounded with `FILE()` or `PARMLIB()` and storage types are separated by the colon `:` character. An example of using multiple configuration storage types would be as follows:

Note: Characters `=`, `:`, `(` and `)` are considered as reserved. It is highly recommended to avoid using of these characters in the name of zowe.yaml file.

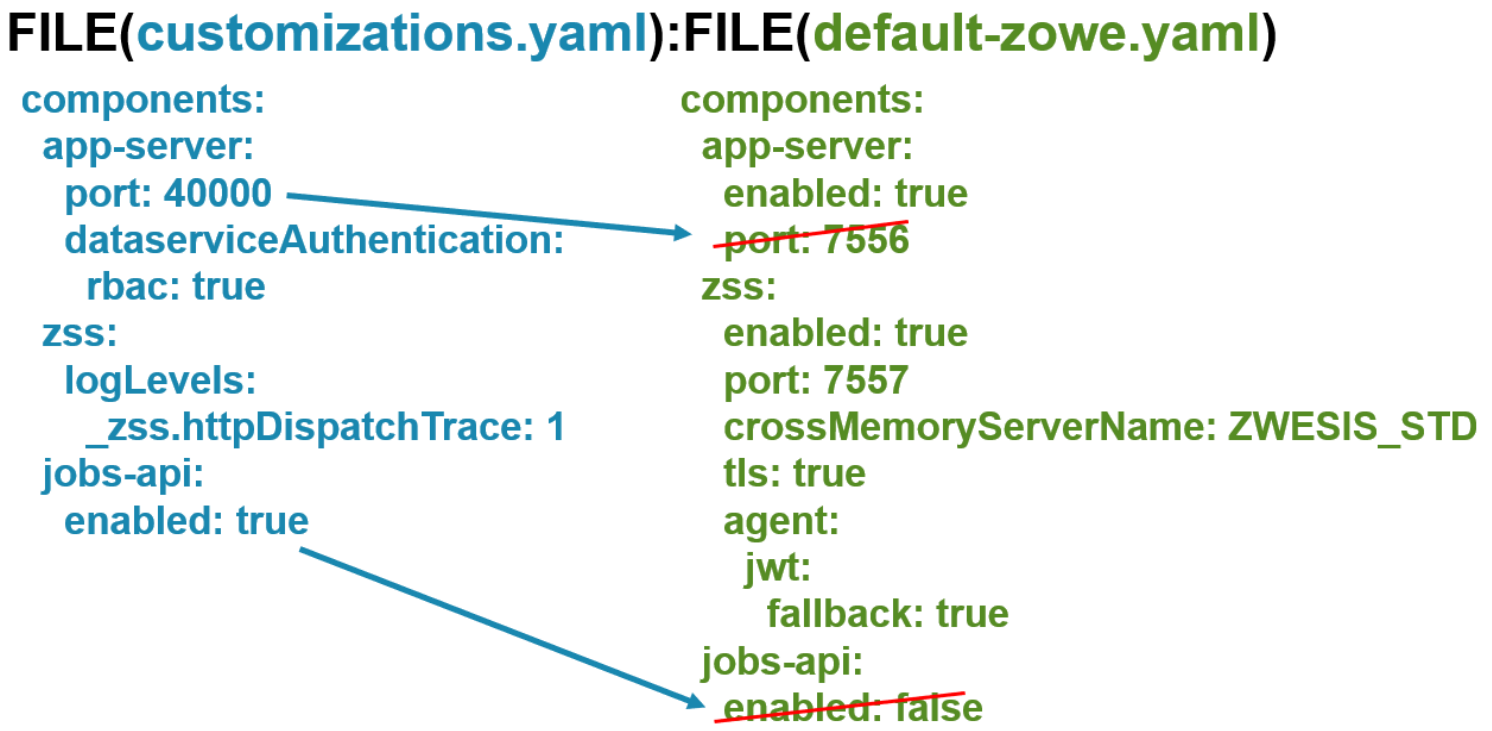
Each storage type in the list you provide must adhere to the same Zowe configuration schema, but the contents can be any subset you want per storage types. Zowe will merge together the contents of all the storage types into one unified configuration, so the collection of storage types must result in a configuration which is valid against the Zowe schema.

Schema validation occurs upon the merged result, not the individual storage type. There are a few reasons you may want to split your Zowe configuration into multiple storage types, such as:

- Having a Zowe configuration file that is very small and containing only what is not the default configuration of Zowe, and then running Zowe with 2 configuration files: Your customizations, and the Zowe default such as `CONFIG=FILE(/home/me/zowe-customizations.yaml):FILE(/global/zowe/example-zowe.yaml)`
- Splitting the Zowe configuration among administrators with certain responsibilities. You could have a file about the z/OSMF configuration, a file about the Java configuration, and so on. An example of this could look like `CONFIG=FILE(/home/me/zowe-customizations.yaml):FILE(/global/org/zosmf-zowe.yaml):FILE(/global/org/java-zowe.yaml):FILE(/global/zowe/example-zowe.yaml)`

Note: When specifying many storage types, you may reach the line length limit in your STC JCL. The default JCL contains `_CEE_ENVFILE_CONTINUATION=\` to allow you to continue the `CONFIG` parameter to multiple lines. An example of this is as follows:

When you use multiple storage types, Zowe constructs the unified configuration by having the storage types listed on the left override the values of storage types to their right in the list. This means the left-most storage type's values take priority, and the right-most storage type should be treated as a set of defaults. Here is an example of splitting configuration into multiple files:



Parmlib support

Zowe YAML content can be stored in PARMLIB as well. The structure is the same as in the unix files, so be sure to have sufficient record length to fit the YAML content within the member. The syntax is `PARMLIB(datasetname(member))`. In the previous section, there was an example of using multiple files to split configuration into parts. This ability can be done with PARMLIB, FILE, or any mix of the two. An example of using PARMLIB with Zowe configuration may look like this in your STC JCL:

Configuration templates

Each Zowe configuration provided to Zowe when using Configuration Manager can contain values which are templates. These templates are not the literal values of a parameter, but will be substituted for a real value by Configuration Manager. This allows you to simplify complex or tedious configuration such as:

- Replacing occurrences of the same path in the configuration with templates that reference that path. Instead of needing to update every occurrence of a path when it changes, you would only need to update it once.
- Having a value that is linked to another, such as that you may only want the gateway component to be enabled when the discovery component is enabled.
- Having a value that is derived from multiple other values, such as a URL that has many parts.
- Having a value that is a set of multiple conditions, having many fallback behaviors so that your configuration is valid for many environments.

Templates are resolved after merging files, but before schema validation occurs, so you can split up your configuration into multiple files and template them however you'd like if the merged, resolved result is valid against the Zowe configuration schema.

To make a template, you use the syntax `${{ assignment }}` in which there must be a space after `${{` and before `}}`. The *assignment* can be a ECMAScript 2020 statement, such as a JSON path or a conditional. Here are some examples of templates that you can use to simplify your configuration:

Templated example using defined `zowe.setup.dataset.prefix` for other datasets:

Resolved output:

Template functions

Following examples demonstarates how to define the logging for `zss` component based on the `crossMemoryServerName`. When the default name of `ZWESIS_STD` is used, the general logging is set to `2`. For other names the `logLevels` is set to specific trace level(s) with the highest value of `5`.

Resolved template:

> **NOTE**
>
> The `components.zss.agent.jwt.fallback` was not defined in the template, but is is defined the defaults.yaml. That is the reason to be included in the resolved template.

Using System Properties in Templates

"Global" objects and functions exist in configmgr templates that can be used base Zowe YAML values upon environmental properties. This allows the YAML to be more portable and usable on many systems without modification. The following is a list of useful functions organized by their global objects.

`std`

- `getenv(environment_variable_name: string)`
  - Input: `environment_variable_name` (string): The name of an environment variable you wish to read.
  - Output: (string or undefined) The value of the environment variable, or undefined if the variable is not set.

`zos`

- `getEsm()`
  - Output: (string) The string value `RACF`, `TSS`, or `ACF2` are returned corresponding to the ESM that is running on the system.
- `getZosVersion()`
  - Output: (string) A numerical representation of the z/OS version number of the system.
- `resolveSymbol(zos_symbol_name: string)`
  - Input: `zos_symbol_name` (string): The name of a z/OS system symbol to load. The value must begin with `&` and must not end with `.`.
  - Output: (string or undefined) The value of the symbol, or undefined if the symbol is not set.

An example for how to use these functions to make a Zowe YAML file more portable is as follows:

Configuration Manager Unix executable

`configmgr` is a file located within `<zowe.runtimeDirectory>/bin/utils` in the Zowe server component runtime for z/OS. If you run it with no arguments, it prints a help command that details what you can do with it. `configmgr` commands focus on providing input files and schemas, and then providing output such as validation success or printing the configuration.

The `configmgr` executable needs the following as input:

- A list of configuration locations. Each location can be a different type such as a Unix file or parmlib from a dataset, but each must be YAML format. Every configuration object in the list must only contain data from the same schema because the list will be merged together into a single configuration object during processing.
- A list of json-schema Unix files separated by a colon `:`, with the top-level schema being the left-most in the list. The unified configuration will be validated against this top-level schema and any references in the other schema files in the list.

The `configmgr` executable can do the following with the input:

- Report whether the configuration is valid against the schema. If invalid, a reason will be printed to help pinpoint issues.
- Validate and then output a list of environment variables in the syntax used by Zowe components that use environment variables to consume Zowe configuration.
- Validate and then output a specific property of the configuration when given a JSON path to the property desired.

The `configmgr` binary does not need to be used for Zowe configuration and Zowe schemas alone. It can validate any YAML against any json-schema. However, its environment variable output list is in the Zowe format.

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Server Component and Extension Management

This page covers how to install and manage Zowe server components or extensions by using `zwe components` commands.

Installing a component

Zowe ships the `zwe components install` command to help end-user to install any Zowe server extensions (extensions are components that are not part of Zowe core). In order to be compatible with the command, components must follow Zowe server component package format standard.

More information such as parameters and examples can be found on the `zwe components install` reference page

Note: The automatic tagging process is opinionated about which file extensions should be in which encoding. If this does not fit in your needs, a `pax` format is recommended to include the tagging information into your package. This option is only applicable for z/OS. The following list presents the allowed values:

- `yes`

  This option automatically tag the encoding of the files.

- `no`

  Do not automatically tag encoding of the files.

- `auto`

  Tag only when manifest is in `ISO8859-1` encoding.

- **`--log-dir|--log|-l`**

  (String, Optional) Specifies the path to the log directory.

- **`--debug|--verbose|-v`**

  (Boolean, Optional) Enable debug level logging. This will help on troubleshooting issues.

- **`--trace|-vv`**

  (Boolean, Optional) Enable the most detail trace level logging. This will help on troubleshooting issues.

Enable and disable component

Each component and extension of Zowe can be enabled or disabled by changing the value of the `enabled` property of their object in the Zowe configuration YAML. For example, to enable or disable the API Catalog, set this value to `true` or `false` in the YAML:

Zowe ships `zwe components enable` and `zwe components disable` commands to help you enable and disable Zowe server component (extension). In order to be compatible with these commands, components must follow Zowe server

component package format standard.

Important these commands will update your `zowe.yaml` configuration file.

Note `zwe components install` command will enable the component globally if `--skip-enable` is not passed to it.

More information such as parameters and examples can be found on the `zwe components enable` reference page and the `zwe components disable` reference page

Limiting Zowe to specific service groups

Zowe's server installation contains groups of components that are useful to run together, but often you do not need to enable all parts of Zowe. You can save system resources by disabling the parts of Zowe that you do not use.

Category	Component	Purpose
API Mediation Layer	api-catalog	Used to view API swagger / openAPI specifications for registered API services of the API Mediation Layer.
API Mediation Layer	discovery	This server is used to register API services and track the health of them for use in the API Mediation Layer.
API Mediation Layer	gateway	The gateway unifies all the services of Zowe under one proxied server for improved security, management, and high availability.
API Mediation Layer	caching-service	The caching service is used to share state between different Zowe instances in a high availability topology.
API Mediation Layer	zaas	ZAAS provides authentication services used by the API Mediation Layer.
App Framework	app-server	The App server powers the Zowe Desktop accessible via web browsers.
App Framework	zss	Z Secure Services (ZSS) provides REST API services for file, dataset, and other z/OS content. Its APIs are used by apps in the Desktop, such as the the File Editor.

Upgrading a component

`zwe components install` is only used for installing a component that is not yet installed. If you need to install a new version of an existing component, you must use the `zwe components upgrade` command instead.

More information such as parameters and examples can be found on the `zwe components install` reference page

This command can be used to upgrade all components that have an upgrade available when using `zwe` with a component package registry. More information can be found within the component package registry documentation

Uninstalling a component

`zwe components uninstall` can be used to remove a previously installed extension. It will not remove core components.

More information such as parameters and examples can be found on the `zwe components uninstall` reference page

Searching for a component

`zwe components search` helps you find components that are available for installation from your chosen component package registry. This command requires that you have configured your Zowe instance for use with such a registry. Click here for more information on how to set up and use a component package registry

More information such as parameters and examples can be found on the `zwe components search` reference page

Manual Component management

It's recommended to use `zwe components` for all component management. The information below is provided for troubleshooting purposes.

Zowe core components

The Zowe runtime directory delivers its core components in the `<RUNTIME_DIR>/components/` directory. A typical components directory looks like this:

Same as all Zowe server components, Zowe core components can be enabled or disabled by setting `components.<component>.enabled` to `true` or `false`.

Zowe z/OS extensions

All Zowe z/OS extension runtime programs are installed into a single location which is defined as `zowe.extensionDirectory` in `zowe.yaml`. Each extension should be represented with the extension name in this directory, and use either a directory or a symbolic link.

The Zowe launch script reads `components.<component>.enabled` and `haInstances.<ha-instance>.components.<component>.enabled` defined in `zowe.yaml` to determine whether to start an extension in current HA instance. The value of this `enabled` is boolean either `true` or `false`.

Example:

The vendor MYVENDOR has a product named MYAPP that installs into `/usr/lpp/myvendor/myapp`. There is one Zowe extension shipped within the product in the directory `/usr/lpp/myvendor/myapp/zowe-ext`. This subdirectory is a Zowe extension so that the product can be started and stopped with Zowe and run as an address space under the `ZWESLSTC` started task in the Zowe USS shell.

The directory `/usr/lpp/myvendor/myapp/zowe-ext` should include a `manifest.yaml` file to describe the extension. The script `/usr/lpp/myvendor/myapp/zowe-ext/bin/validate.sh` checks that the environment is configured correctly and the script `/usr/lpp/myvendor/myapp/zowe-ext/bin/start.sh` starts the vendor application. The `/usr/lpp/myvendor/myapp/zowe-ext/manifest.yaml` should look like this:

Because MYAPP is shipped within another product, the installation should create a symbolic link in `zowe.extensionDirectory` directory.

Also, `myapp` is enabled in `zowe.yaml` like this.

When the Zowe instance is launched by running `zwe start` command, it will read manifest `commands` instructions and call the `/usr/lpp/myvendor/myapp/zowe-ext/bin/start.sh` script. The started task will create an address space under `ZWESLSTC` for the vendor component. When the Zowe instance is stopped, the address space is terminated.

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Advanced Application Framework Configuration

The Zowe Application ("App") Framework is configured in the Zowe configuration file. Configuration can be used to customize functionalities such as verbosity of logs, the way in which the App server communicates with the Mediation Layer, how ZSS operates, whether to use HTTPS or AT-TLS, what language the logs should be set, and many more attributes.

When you install Zowe™, the App Framework is configured as an API Mediation Layer client by default. This is simpler to administer because the App framework servers are accessible externally through a single port: API ML Gateway port. It is more secure because you can implement stricter browser security policies for accessing cross-origin content.

You can modify the Zowe App Server and Zowe System Services (ZSS) configuration, as needed, or configure connections for the Terminal app plugins.

Accessing ZSS

The `zss` server should be accessed through the `gateway` when both are present. When both are ready, ZSS can be accessed from the API Mediation Layer Gateway, such as

`https://<zowe.externalDomain>:<components.gateway.port>/zss/api/v1/`.

Although you access the ZSS server via the Gateway port, the ZSS server still needs a port assigned to it which is the value of the *components.zss.port* variable in the Zowe configuration file.

If the mediation layer is not used, ZSS directly at `https://<zowe.externalDomain>:<components.zss.port>/`.

Configuration file

app-server configuration

The app-server uses the Zowe server configuration file for customizing server behavior. For a full list of parameters, requirements, and descriptions, see the json-schema document for the app-server which describes attributes that can be specified within the configuration file section `components.app-server`

zss configuration

ZSS shares some parameters in common with the app-server, so you can consult the above json-schema document to find out which parameters are valid within `components.zss` of the Zowe configuration file. However, some parameters within the app-server schema are not used by ZSS, such as the `node` section. A ZSS-centric schema will be available soon.

Configuring the framework as a Mediation Layer client

The App Server and ZSS automatically register to the API Mediation Layer when present. If this is not desired, registration can disabled by setting the properties `components.app-server.mediationLayer.server.enabled=false` for app-server and `components.zss.mediationLayer.enabled=false` for ZSS.

Setting up terminal app plugins

Follow these optional steps to configure the default connection to open for the terminal app plugins.

Setting up the TN3270 mainframe terminal app plugin

The file `_defaultTN3270.json` within the `tn3270-ng2` app folder `/config/storageDefaults/sessions/` is deployed to the configuration dataservice when the app-server runs for the first time. This file is used to tell the terminal what host to connect to by default. If you'd like to customize this default, you can edit the file directly within the configuration dataservice `<components.app-server.instanceDir>/org.zowe.terminal.tn3270/sessions/_defaultTN3270.json`. Or you can open the app, customize a session within the UI, click the save icon (floppy icon) and then copy that file from `<components.app-server.usersDir>/<your user>/org.zowe.terminal.tn3270/sessions/_defaultTN3270.json` to `<components.app-server.instanceDir>/org.zowe.terminal.tn3270/sessions/_defaultTN3270.json`. Either way, you will see a file with the following properties:

Setting up the VT Terminal app plugin

The file `_defaultVT.json` within the `vt-ng2` app folder `/config/storageDefaults/sessions/` is deployed to the configuration dataservice when the app-server runs for the first time. This file is used to tell the terminal what host to connect to by default. If you'd like to customize this default, you can edit the file directly within the configuration dataservice `<components.app-server.instanceDir>/org.zowe.terminal.vt/sessions/_defaultVT.json`. Or you can open the app, customize a session within the UI, click the save icon (floppy icon) and then copy that file from `<components.app-server.usersDir>/<your user>/org.zowe.terminal.vt/sessions/_defaultVT.json` to `<components.app-server.instanceDir>/org.zowe.terminal.vt/sessions/_defaultVT.json`. Either way, you will see a file with the following properties:

Network configuration

Note: The following attributes are to be defined in the Zowe configuration file.

The App Server and ZSS both can be accessed over HTTPS, either natively or via AT-TLS by setting appropriate AT-TLS rules and Zowe YAML assignments. When using native HTTPS, the TLS properties can be further customized within the YAML.

Port configuration

The Zowe YAML property `components.<component-name>.port` can be used to set the port for any Zowe server. By default, the following is used but can be overridden:

IP configuration

By default, all Zowe servers listen on the IP address `0.0.0.0`. This can be customized. The Zowe YAML property `zowe.network.server.tls.listenAddresses` can be used to instruct both `app-server` and `zss` of which IP to listen on. This property can be nested within each component if it is desired to customize them individually. Alternatively, TCPIP port rules can be used to control the assignment of `0.0.0.0` into a particular alternative IP address. You can read more about this in the network requirements page.

Native TLS

Both `app-server` and `zss` server components default to using HTTPS without the need for AT-TLS. AT-TLS is also possible. When using the native TLS, attributes such as TLS version and ciphers can be customized within the `zowe.network.server.tls` and `zowe.network.client.tls` objects of the Zowe configuration. These objects can also be placed within the `components.zss` and `components.app-server` objects, such as `components.zss.zowe.network.server.tls` in order to individually customize each server TLS configuration. For more information, read TLS configuration.

AT-TLS

You can instruct Zowe servers to expect TLS using the property `zowe.network.server.tls.attls: true`. Use this property is to set AT-TLS for all Zowe servers. For more granular control, you can set the following section in the yaml file:

This configuration instructs only the `app-server` component to expect AT-TLS for both inbound and outbound traffic. Similarly, set the parameter `zowe.network.server.tls.attls` to `true` for the `zss` component. Use `zowe.network.server.tls.attls: true` to instruct both servers to expect AT-TLS altogether. For more information, see Configuring AT-TLS for Zowe server.

AT-TLS Rule Suggestions

The `app-server` and `zss` components of Zowe are servers that may accept incoming connections from each other, other Zowe servers, and clients outside z/OS such as browsers either directly or indirectly such as when API ML is used.

As such, both Inbound and Outbound direction AT-TLS rules are needed for these servers. The Inbound rules can be filtered by the listening ports of the servers, but Outbound rules may need to be set by either jobnames or destination ports.

The ports and jobnames can be found in the Addressing network requirements documentation.

The Outbound rules can have HandshakeRole of Client, but when API ML is enabled, it is required that `app-server` and `zss` include their server certificates as client certificates using the `CertificateLabel` property of a `TTLSConnectionAdvancedParms` rule. For more information, see Configuring AT-TLS for Zowe server.

The Inbound rules can have a HandshakeRole of Server or ServerWithClientAuth.

Native TLS

The configuration object `zowe.network.server.tls` and `zowe.network.client.tls` can be set to control all Zowe components, or just `app-server` or `zss` but nesting the object within them. This object can control ciphers by listing IANA cipher names, minimum and maximum TLS levels, and for some servers even curves can be customized via a list.

An example for configuration is given below, but the specification for all options is found within the Zowe YAML schema

Configuration Directories

When running, the App Server will access the server's settings and read or modify the contents of its resource storage. All of this data is stored within a hierarchy of folders which correspond to scopes:

- Product: The contents of this folder are not meant to be modified, but used as defaults for a product.

- Site: The contents of this folder are intended to be shared across multiple App Server instances, perhaps on a network drive.
- Instance: This folder represents the broadest scope of data within the given App Server instance.
- Group: Multiple users can be associated into one group, so that settings are shared among them.
- User: When authenticated, users have their own settings and storage for the Apps that they use.

These directories dictate where the Configuration Dataservice will store content. For more information, see the Configuration Dataservice documentation

App plugin configuration

The App framework will load plugins from Components such as extensions based upon their enabled status in Zowe configuration. The server caches knowledge of these plugins in the `<workspaceDirectory>/app-server/plugins` folder. This location can be customized with the *components.app-server.pluginsDir* variable in the Zowe configuration file.

Logging configuration

For more information, see Logging Utility.

Enabling tracing

To obtain more information about how a server is working, you can enable tracing within the Zowe configuration file via *components.app-server.logLevels* or *components.zss.logLevels* variable. For more information on all loggers, check out the Extended documentation.

For example:

All settings are optional.

Log files

The app-server and zss will create log files containing processing messages and statistics. The log files are generated within the log directory specified within the Zowe configuration file (`zowe.logDirectory`). The filename patterns are:

- App Server: `<zowe.logDirectory>/appServer-yyyy-mm-dd-hh-mm.log`
- ZSS: `<zowe.logDirectory>/zssServer-yyyy-mm-dd-hh-mm.log`

Retaining logs

By default, the last five log files are retained. You can change this by setting environment variables within the `zowe.environments` section of the Zowe server configuration file. To specify a different number of logs to retain, set `ZWED_NODE_LOGS_TO_KEEP` for app-server logs, or *ZWES_LOGS_TO_KEEP* for zss logs. For example, if you set `ZWED_NODE_LOGS_TO_KEEP` to 10, when the eleventh log is created, the first log is deleted.

Controlling the logging location

At minimum, the log information for both app-server and zss are written to STDOUT such that messages are visible in the terminal that starts Zowe and when on z/OS, the STC job log.

By default, both servers additionally log to files and the location of these files can be changed or logging to them can be disabled. The following environment variables can be used to customize the app-server and zss log locations by setting the values within the `zowe.environments` section of the Zowe configuration file.

- `ZWED_NODE_LOG_DIR`: Overrides the zowe configuration file value of `zowe.logDirectory` for app-server, but keeps the default filenames.
- `ZWES_LOG_DIR`: Overrides the zowe configuration file value of `zowe.logDirectory` for zss, but keeps the default filenames.
- `ZWED_NODE_LOG_FILE`: Specifies the full path to the file where logs will be written from app-server. This overrides both `ZWED_NODE_LOG_DIR` and `zowe.logDirectory`. If the path is `/dev/null` then no log file will be written. This option does not timestamp logs or keep multiple of them.
- `ZWES_LOG_FILE`: Specifies the full path to the file where logs will be written from zss. This overrides both `ZWES_LOG_DIR` and `zowe.logDirectory`. If the path is `/dev/null` then no log file will be written. This option does not timestamp logs or keep multiple of them.

If the directory or file specified cannot be created, the server will run (but it might not perform logging properly).

ZSS configuration

ZSS provides APIs that any server or client can use. By default, the Zowe Desktop includes Apps which rely upon ZSS APIs, and therefore it's recommended that whenever the `app-server` is enabled in the Zowe YAML, that `zss` is also enabled.

ZSS 64 or 31 bit modes

Two versions of ZSS are included in Zowe, a 64 bit version and a 31 bit version. It is recommended to run the 64 bit version to conserve shared system memory but you must match the ZSS version with the version your ZSS plugins support. Official Zowe distributions contain plugins that support both 64 bit and 31 bit, but extensions may only support one or the other.

Verifying which ZSS mode is in use

You can check which version of ZSS you are running by looking at the logs. At startup, the message ZWES1013I states which mode is being used, for example:

```
ZWES1013I ZSS Server has started. Version 3.0.0 64-bit
```

Or

```
ZWES1013I ZSS Server has started. Version 3.0.0 31-bit
```

Verifying which ZSS mode plugins support

You can check if a ZSS plugin supports 64 bit or 31 bit ZSS by reading the pluginDefinition.json file of the plugin. In each component or extension you have, its manifest file will state if there are `appFw` plugin entries. In each folder referenced by the `appFw` section, you will see a pluginDefinition.json file. Within that file, if you see a section that says `type: 'service'`, then you can check its ZSS mode support. If the service has the property `libraryName64`, then it supports 64 bit. If it says `libraryName31`, then it supports 31 bit. Both may exist if it supports both. If it instead only contains

`libraryName`, this is ambigious and deprecated, and most likely that plugin only supports 31 bit ZSS. A plugin only supporting 31 bit ZSS must be recompiled for 64 bit support, so you must contact the developers to accomplish that.

Example: the sample angular app supports both 31 bit and 64 bit zss

Setting ZSS 64 bit or 31 bit mode

You can switch between ZSS 64 bit and 31 bit mode by setting the value `components.zss.agent.64bit` to true or false in the Zowe configuration file. The value will not take effect until next server restart.

Customizing ZSS session duration

In a standard Zowe installation, all Zowe servers utilize the API Mediation Layer's token-based, single-sign on authentication. This authentication in turn cooperates with z/OSMF, and the session duration is typically that of z/OSMF's, which defaults to 8 hours before the session expires. In that situation, customization of session duration is best done by customizing z/OSMF's session duration, as a part of its Liberty configuration.

If you are not using the API Mediation Layer, or are trying to contact ZSS directly, then ZSS's own session logic is used. When authenticated directly to ZSS, it will respond to authenticated HTTP requests with a cookie which is valid by default for 1 hour. This can be customized by creating and editing a file named "timeouts.json" within ZSS's instance directory. The default location is `<zowe.workspaceDirectory>/app-server/serverConfig/timeouts.json`, because the default instance directory is `<zowe.workspaceDirectory>/app-server`, but can be customized by editing the value of `components.zss.instanceDir`.

The timeouts.json file has the following layout:

Where you can have a "users" section that lists user accounts on the z/OS system, and "groups" section that lists groups on that system. The numbers for each entry are in seconds, where in the example `zoweuser1` has the default session duration value of 1 hour. It is possible that a user specified in this file is also in a group specified in this file. If so, the user value takes priority. If a user authenticates to ZSS and their user or group is not found in this file, then the default value of 1 hour is used. If this file is missing, Zowe will print a message about it missing, but it does not harm Zowe as the default value of 1 hour would be used for all direct authentications to ZSS.

Using multiple ZIS instances

When you install Zowe, it is ready to be used for 1 instance of each component. However, ZIS can have a one-to-many relationship with the Zowe webservers, and so you may wish to have more than one copy of ZIS for testing or to handle different groups of ZIS plugins.

The following steps can be followed to point a Zowe instance at a particular ZIS server.

1. Create a copy of the ZIS server. You could run multiple copies of the same code by having different STC JCLs pointing to the same LOADLIB, or run different copies of ZIS by having JCLs pointing to different LOADLIBs.
2. Edit the JCL of the ZIS STC. In the `NAME` parameter specify a unique name for the ZIS server, for example:

   Where `ZWESIS_MYSRV` is the unique name of the new ZIS.
3. Start the new ZIS with whatever PROCLIB name was chosen.
4. Stop the Zowe instance you wish to point to the ZIS server.

5. Locate the zowe configuration file for the Zowe instance, and edit the parameter `components.zss.privilegedServerName` to match the name of the ZIS STC name chosen, such as `ZWESIS_MYSRV`

6. Restart the Zowe instance

7. Verify that the new ZIS server is being used by checking for the following messages in the `ZWESLSTC` server job log:

```
ZIS status - Ok (name='ZWESIS_MYSRV ', cmsRC=0, description='Ok', clientVersion=2)
```

Controlling access to apps

You can control which apps are accessible (visible) to all Zowe desktop users, and which are accessible only to individual users. For example, you can make an app that is under development only visible to the team working on it.

You control access by editing JSON files that list the apps. One file lists the apps all users can see, and you can create a file for each user. When a user logs into the desktop, Zowe determines the apps that user can see by concatenating their list with the all users list.

You can also control access to the JSON files. The files are accessible directly on the file system, and since they are within the configuration dataservice directories, they are also accessible via REST API. We recommend that only Zowe administrators be allowed to access the file system locations, and you control that by setting the directories and their contents to have file permissions on z/OS that only allow the Zowe admin group read & write access. You control who can read and edit the JSON files through the REST API by controlling who can access the configuration dataservice objects URLs that serve the JSON files.

Enabling RBAC

By default, RBAC is disabled and all authenticated Zowe users can access all dataservices. To enable RBAC, follow these steps:

1. To enable RBAC, set the *components.zss.dataserviceAuthentication.rbac* and *components.app-server.dataserviceAuthentication.rbac* variables to `true` in the Zowe configuration file.

Controlling app access for all users

Note:

- `<zowe.runtimeDirectory>` variable comes from the Zowe configuration file.

1. Enable RBAC.

2. Navigate to the following location:

3. Copy the `allowedPlugins.json` file and paste it in the following location:

4. Open the copied `allowedPlugins.json` file and perform either of the following steps:

    - To make an app unavailable, delete it from the list of objects.
    - To make an app available, copy an existing plugin object and specify the app's values in the new object. Identifier and version attributes are required.

5. Restart the app server.

Controlling app access for individual users

1. Enable RBAC.
2. In the user's ID directory path, in the `\pluginStorage` directory, create `\org.zowe.zlux.bootstrap\plugins` directories. For example:
3. In the `/plugins` directory, create an `allowedPlugins.json` file. You can use the default `allowedPlugins.json` file as a template by copying it from the following location:
4. Open the `allowedPlugins.json` file and specify apps that user can access. For example:

   Notes:

   - Identifier and version attributes are required.
   - When a user logs in to the desktop, Zowe determines which apps they can see by concatenating the list of apps available to all users with the apps available to the individual user.
5. Restart the app server.

Controlling access to dataservices

To apply role-based access control (RBAC) to dataservice endpoints, you must enable RBAC for Zowe, and then use a z/OS security product such as RACF to map roles and authorities to the endpoints. After you apply RBAC, Zowe checks authorities before allowing access to the endpoints.

You can apply access control to Zowe endpoints and to your app endpoints. Zowe provides endpoints for a set of configuration dataservices and a set of core dataservices. Apps can use configuration endpoints to store and their own configuration and other data. Administrators can use core endpoints to get status information from the App Framework and ZSS servers. Any dataservice added as part of an app plugin is a service dataservice.

Creating authorization profiles

For users to access endpoints after you enable RBAC, in the ZOWE class you must create System Authorization Facility (SAF) profiles for each endpoint and give users READ access to those profiles.

Endpoints are identified by URIs in the following format:

`/ZLUX/plugins/<plugin_id>/services/<service>/<version>/<path>`

For example:

`/ZLUX/plugins/org.zowe.foo/services/baz/_current/users/fred`

Where the path is `/users/fred`.

SAF profiles have the following format:

`ZLUX.<zowe.rbacProfileIdentifier>.<servicename>.<pluginid_with_underscores>.<service>.<HTTP_method>.<url_with_forward_slashes_replaced_by_periods>`

For example, to issue a POST request to the dataservice endpoint documented above, users must have READ access to the following profile:

`ZLUX.1.SVC.ORG_ZOWE_FOO.BAZ.POST.USERS.FRED`

For configuration dataservice endpoint profiles use the service code `CFG`. For core dataservice endpoints use `COR`. For all other dataservice endpoints use `SVC`.

Creating generic authorization profiles

Some endpoints can generate an unlimited number of URIs. For example, an endpoint that performs a DELETE action on any file would generate a different URI for each file, and users can create an unlimited number of files. To apply RBAC to this type of endpoint you must create a generic profile, for example:

`ZLUX.1.COR.ORG_ZOWE_FOO.BAZ.DELETE.**`

You can create generic profile names using wildcards, such as asterisks (*). For information on generic profile naming, see IBM documentation.

Configuring basic authorization

The following are recommended for basic authorization:

- To give administrators access to everything in Zowe, create the following profile and give them UPDATE access to it: `ZLUX.**`
- To give non-administrators basic access to the site and product, create the following profile and give them READ access to it: `ZLUX.*.ORG_ZOWE_*`
- To prevent non-administrators from configuring endpoints at the product and instance levels, create the following profile and do not give them access to it: `ZLUX.1.CFG.**`
- To give non-administrators all access to user, create the following profile and give them UPDATE access to it: `ZLUX.1.CFG.*.*.USER.**`

Endpoint URL length limitations

SAF profiles cannot contain more than 246 characters. If the path section of an endpoint URL is long enough that the profile name exceeds the limit, the path is trimmed to only include elements that do not exceed the limit. To avoid this issue, we recommend that appliction developers maintain relatively short endpoint URL paths.

For information on endpoint URLs, see Using dataservices with RBAC

Customizing Security Plugins

By default, the `app-server` handles security questions by utilizing either the API Mediation Layer, or ZSS, depending on which is present. If the API Mediation Layer is present, it is used to establish an SSO session which ZSS also respects. When RBAC is enabled, ZSS is queried for authorization questions.

This behavior is performed by an `app-server` security plugin named `sso-auth`. Security plugins can be installed as part of Zowe extensions, and `app-server` can be customized to prefer them via the Zowe YAML. Different security plugins could be used to operate in different environments, with different security systems, or with different session characteristics. For more information, read the extender's guide on security plugins

Session duration and expiration

After successful authentication, a Zowe Desktop session is created by authentication plugins.

The duration of the session is determined by the plugin used. Some plugins are capable of renewing the session prior to expiration, while others may have a fixed session length.

The session duration and expiration behavior of the default security plugin, `sso-auth`, is determined by API Medation Layer configuration if present, and otherwise upon ZSS configuration. If API Medation Layer is enabled, by default it will use z/OSMF as the session provider and the session duration will be based upon z/OSMF settings. You can read more about API Mediation Layer providers here. If the API Mediation Layer is not enabled, you can use or customize ZSS's default session duration of one hour.

When a session expires, the credentials used for the initial login are likely to be invalid for re-use, since MFA credentials are often one-time-use or time-based.

In the Desktop, Apps that you opened prior to expiration will remain open so that your work can resume after entering new credentials.

Administering the servers and plugins using an API

The App Server has a REST API to retrieve and edit both the App Server and ZSS server configuration values, and list, add, update, and delete plugins. Most of the features require RBAC to be enabled and for your user to have RBAC access to utilize these endpoints. For more information see documentation on how to use RBAC

The API returns the following information in a JSON response:

API	Description
/server (GET)	Returns a list of accessible server endpoints for the Zowe App Server.
/server/config (GET)	Returns the Zowe App Server configuration which follows this specification.
/server/log (GET)	Returns the contents of the Zowe App Server log file.
/server/loglevels (GET)	Returns the verbosity levels set in the Zowe App Server logger.
/server/environment (GET)	Returns Zowe App Server environment information, such as the operating system version, node server version, and process ID.

API	Description
/server/reload (GET)	Reloads the Zowe App Server. Only available in cluster mode.
/server/agent (GET)	Returns a list of accessible server endpoints for the ZSS server.
/server/agent/config (GET)	Returns the ZSS server configuration which follows this specification.
/server/agent/log (GET)	Returns the contents of the ZSS log file.
/server/agent/loglevels (GET)	Returns the verbosity levels of the ZSS logger.
/server/agent/environment (GET)	Returns ZSS environment information.
/server/logLevels/name/:componentName/level/:level (POST)	Specify the logger that you are using and a verbosity level.
/plugins (GET)	Returns a list of all plugins and their dataservices.
/plugins (PUT)	Adds a new plugin or upgrades an existing plugin. Only available in cluster mode (default).
/plugins/:id (DELETE)	Deletes a plugin. Only available in cluster mode (default).

Swagger API documentation is provided in the `<zowe.runtimeDirectory>/components/app-server/share/zlux-app-server/doc/swagger/server-plugins-api.yaml` file. To see it in HTML format, you can paste the contents into the Swagger editor at https://editor.swagger.io/.

Note: The "agent" end points interact with the agent specified in the zowe configuration file. By default this is ZSS.

Managing Cluster Mode for app-server

On the Zowe servers, the component "app-server" has an environment variable "ZLUX_NO_CLUSTER" which controls whether or not it uses cluster mode. Cluster mode is enabled by default. However, you might need to disable cluster mode under certain circumstances. When cluster mode is disabled, make sure you are aware of the potential drawbacks and benefit.

When you **disable** cluster mode, you will lose the following benefits:

1. **Performance under high user Count:** This is due to the absence of redundant workers, which can impact the system's efficiency when dealing with a large number of users.

2. **Reduced downtime during unexpected exceptions:** The low-downtime characteristic, where only one request is interrupted compared to around 15 seconds of downtime, is compromised.

To turn the cluster mode on

- Do NOT include the `zowe.environments.ZLUX_NO_CLUSTER` in the `zowe.yaml` file.

To turn the cluster mode off

- Include `zowe.environments.ZLUX_NO_CLUSTER=1` in the `zowe.yaml` file.

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Installing Zowe client-side components

Review this article to prepare to install, configure, and deploy Zowe client-side components.

> **REQUIRED ROLES: SYSTEMS PROGRAMMER, SECURITY ADMINISTRATOR, STORAGE ADMINISTRATOR**

To prepare for an installation or upgrade, your installation team should review the configuration requirements for both z/OSMF and the particular component to be installed.

Doing so can help you complete the process faster without any delays due to missing pre-requisites that may require a system administrator to configure.

To install your product, we recommend that your team understands the following topics:

- JCL
- TSO/ISPF
- Your organization's IT environment, enterprise structure, and region structure
- z/OS environment and installing software in this environment
- z/OS UNIX System Services

Consult with the following team roles, as required:

- Security administrator for access
- Storage administrator for DASD allocations
- Systems programmer for z/OS and VTAM definitions

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Configuring z/OSMF

For client-side components to communicate with the mainframe, z/OSMF requires configuration to make this happen.

> **REQUIRED ROLE: SYSTEMS PROGRAMMER**

Complete the following IBM z/OSMF configuration tasks for the implementation of Zowe CLI, Zowe Explorer for Visual Studio Code, or the Zowe Explorer plug-in for IntelliJ IDEA.

> **NOTE**
>
> If you are connecting to the mainframe with methods other than a z/OSMF profile, you do not need to configure z/OSMF. Other connection options might include using FTP, or your custom API.

Obtaining z/OSMF installation and configuration materials

Before you start the configuration process, review Overview of z/OSMF in the IBM Documentation.

Installing and configuring z/OSMF

Zowe client-side components were designed and tested to integrate with z/OSMF running on IBM version 2.5 z/OS mainframe systems. To use Zowe client-side components, ensure that your z/OS system meets the requirements that are described in the following table:

Requirement	Description
AXR (System Rexx)	The AXR (System Rexx) component lets z/OS perform Incident Log tasks. It also lets REXX execs execute outside of conventional TSO and batch environments. For more information, see Communicating with System REXX on the IBM Documentation.
CEA (Communications Enabled Applications) Server	CEA server is a co-requisite for the CIM server. The CEA server lets z/OSMF deliver z/OS events to C-language clients. z/OSMF requires the CEA server to perform the following types of tasks: • Problem determination • Sysplex • z/OS classic interfaces • z/OS Operator Console **Notes:** • Start the CEA server before you start z/OSMF (the IZU* started tasks). • Set up CEA server in Full Function Mode and assign the TRUSTED attribute to the CEA started task.

Requirement	Description
	For more information, see Customizing for CEA on the IBM Documentation.
CIM (Common Information Model) Server	z/OSMF requires the CIM server to perform the following types of tasks: • Capacity provisioning • Problem determination • Workload management **Note:** Start the CIM server before you start z/OSMF (the IZU* started tasks). For more information, see Configuring the CIM server for your system on the IBM Documentation. For more information on how to perform asynchronous operations, review the required authorizations for z/OSMF on the IBM Documntation.
Console Command	The `CONSOLE` and `CONSPROF` commands must exist in the authorized command table.
Java version	IBM® 64-bit SDK for z/OS®, Java™ Technology Edition V8 SR4 FP10 (5655-DGH) or higher is required. However, we experienced problems accessing z/OSMF 2.2 using Java version 8. If you use z/OSMF 2.3, Java version 8.0_64 is required. For more information, see Software prerequisites for z/OSMF on the IBM Documentation.
Maximum region size	To prevent exceeds maximum region size errors, ensure that you have a TSO maximum region size of at least 65536 KB for the z/OS system.
User IDs	User IDs require a TSO segment (access) and an OMVS segment. During workflow processing and REST API requests, z/OSMF may start one or more TSO address spaces under the following job names: • *userid* • *substr(userid, 1, 6)//CN* (Console) Example: `(userid = USRMY01, USRMY0CN )`

Selecting and configuring your z/OSMF plug-ins

Plug-in	Functionality	Task
(Optional) Cloud Portal	The Cloud Portal plug-in lets you make software services available to marketplace consumers and it adds the Marketplace and Marketplace Administration tasks to the z/OSMF navigation tree.	For information about how to enable the plug-in, see Cloud provisioning marketplace on the IBM Documentation.
Configuration Assistant	The Configuration Assistant plug-in lets z/OSMF configure TCP/IP policy-based networking functions. For more information about the functionality that	For information about how to enable the plug-in, see Updating z/OS for the

Plug-in	Functionality	Task
	the plug-in provides, see Network Configuration Assistant and Security Configuration Assistant on the IBM Documentation.	Configuration Assistant plug-in on the IBM Documentation.
ISPF	The ISPF plug-in lets z/OSMF access traditional ISPF applications. For information about the functionality that the plug-in provides, see ISPF task overview on the IBM Documentation.	For information about how to enable the plug-in, see Updating z/OS for the ISPF service on the IBM Documentation.
Workload Management	The Workload Management plug-in lets z/OSMF operate and manage workload management service definitions and policies. For information about the functionality that the plug-in provides, see Workload Management task overview on the IBM Documentation.	For information about how to enable the plug-in, see Updating z/OS for the Updating z/OS for the Workload Management service on the IBM Documentation.

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Configuring z/OSMF Security

Review the tasks that security administrators must complete to configure z/OSMF security for your installation of Zowe client-side components.

REQUIRED ROLE: SECURITY ADMINISTRATOR

Configuring z/OS REST services SAF security

NOTE

If you are connecting to the mainframe with methods other than a z/OSMF profile, you do not need to configure z/OSMF security. Other connection options might include using FTP, or your custom API.

A security administrator must configure security to allow z/OSMF System Authorization Facility (SAF) access to the resources that Zowe client-side components require. Zowe client-side components use REST endpoints that are associated with each z/OSMF REST API. After you complete all z/OSMF and z/OSMF cloud provisioning configurations, you can test your connection to z/OSMF to verify that your Zowe client-side components can communicate with z/OS systems.

CAUTION

Before you allow users to issue z/OS console commands with Zowe client-side components, security administrators should ensure that they provide access to commands that are appropriate for their organization.

The following table details the required z/OSMF REST services and examples of the features they enable.

z/OSMF REST Service	REST Endpoint	Description	More information
Cloud provisioning services	Endpoints that begin with: `/zosmf/provisioning/`	Cloud provisioning for development environments (`zowe provisioning list instance-info`).	• Used by Zowe CLI • Cloud provisioning services
TSO/E address space services	Endpoints that begin with: `/zosmf/tsoApp`	TSO commands (`zowe zos-tso issue`).	• Used by Zowe CLI, Zowe Explorer • TSO/E address space services • Class activations that z/OSMF

z/OSMF REST Service	REST Endpoint	Description	More information
			requires
z/OS console services	Endpoints that begin with: `/zosmf/restconsoles/` Example: `/zosmf/restconsoles/defcn`	Console commands (`zowe zos-console issue`). Any MVS console command such as MODIFY and DISPLAY.	• Used by Zowe CLI, Zowe Explorer • z/OS console services • Resource authorizations for the z/OS console services REST interface
z/OS data set and file REST interface	Endpoints that begin with: `/zosmf/restfiles/` Example: `/zosmf/restfiles/ds/<dsname>`	Create data sets (`zowe zos-files create`), delete data sets (`zowe zos-files delete`), read (download) data sets (`zowe zos-files download`), and write (upload) data sets (`zowe zos-files upload`). Access to access method services (IDCAMS) (`zowe zos-files invoke access-method-services`).	• Used by Zowe CLI, Zowe Explorer • z/OS data set and file REST interface • Resource authorizations for the z/OS data set and file REST interface
z/OS jobs REST interface	Endpoints that begin with: `/zosmf/restjobs/` Example: `/zosmf/restjobs/jobs/<jobname>/<jobid>`	Submit jobs (`zowe zos-jobs submit`), purge jobs, and read job output. List jobs (`zowe zos-jobs list`).	• Used by Zowe CLI, Zowe Explorer • z/OS jobs REST interface • Resource authorizations for the z/OS jobs REST interface

z/OSMF REST Service	REST Endpoint	Description	More information
z/OSMF workflow services	Endpoints that begin with: `/zosmf/workflow/`	Cloud provisioning for development environments (`zowe zos-workflows list active-workflows`).	• Used by Zowe CLI • z/OSMF workflow services

Configuring z/OS console REST interface

Review the following recommendations for configuring the security for z/OS console REST services:

- Add the COMMON_TSO statement to the IZUPRMxx parmlib member to customize the z/OSMF options for the logon procedure.
- Define a value of at least 50000 KB as the size of the address space for the user's logon procedure. To help you prevent system memory exception errors from occurring, confirm that this value is acceptable in your environment.
- Ensure that the members in your z/OSMF user security group can issue TSO and CONSOLE commands. IBM provides RACF statements for user group IZUUSER. To prevent all z/OSMF users from issuing TSO and CONSOLE commands, you can create more z/OSMF user groups for more granular security.
- Ensure that the OPERCMD class is active and that your MVS commands are protected. MVS commands include, but are not limited to, the MVS and MVS.MCSOPER resource prefixes.
- Ensure that the z/OSMF user security groups can access (authorized) the logon procedure name and account number that is specified in the COMMON_TSO statement.
- Define a TSO segment for all the z/OSMF users.

Configuring z/OS data set and file REST interface

Review the following recommendations for configuring the z/OS security for data set and file REST services:

- Add the COMMON_TSO statement to the RESTAPI_FILE parmlib member to customize the z/OSMF options for the logon procedure.
- Define a value of at least 65536 KB as the size of the address space for the user's logon procedure. To help you prevent system memory exception errors from occurring, confirm that this value is acceptable in your environment.
- Authorize z/OSMF user groups and the z/OSMF server to CEA TSO/E address space services.
- Ensure that the z/OSMF user security groups can access (authorized) the logon procedure name and account number that is specified on the COMMON_TSO statement.
- Define a TSO segment for all the z/OSMF users.
- Define at least 20971520 KB (20 MB) the IPCMSGQBYTES option of your parmlib member named BPXPRMxx. IBM recommends this value to let TSO and z/OSMF communicate using z/OS USS interprocess communications.

Configuring z/OSMF plug-in security

Ensure that you implement all the required security for the plug-ins. For more information, see Setting up structures for z/OSMF in the IBM Documentation.

> **NOTE**
>
> - For systems that are secured by RACF, ensure that the TRUSTED attribute is assigned to the CEA started task.
> - To enable Zowe client-side components to authenticate to z/OSMF using certificates, security administrators can configure the certificates for users of Zowe client-side components. For more information, see Using the z/OSMF REST services in the IBM Documentation.

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Installing Zowe CLI

For a better understanding of Zowe CLI, review the various reference materials that document the application.

Get to know what's new in the Zowe ecosystem, review the quick start guide, and find ways to get the most out of Zowe CLI.

About Zowe CLI

- Check out **Zowe release notes** to learn about the latest Zowe CLI updates.
- Watch **Office Hours** videos that outline major features in Zowe CLI V2 and Zowe CLI V3.
- New to Zowe? Pick up terms and basic concepts with the **Zowe Glossary**.

Zowe CLI quick start

Ready to start using Zowe CLI *right now*? Speed up the installation process with the **Zowe CLI quick start** to get Zowe CLI up and running in your environment sooner.

Getting the most from Zowe CLI

The following blog posts on the publishing platform Medium go over use cases and provide recommendations on best practices, providing tips on how to best use Zowe CLI to meet your needs.

- Zowe CLI: Getting started with **Team Config**.
- **Password management** for Zowe CLI profiles
- **Enterprise rollout** of Zowe CLI
- Zowe CLI **Tips & Tricks**
- Zowe CLI and **TSO commands**

> **FIND OUT MORE**
>
> Check out **Medium** for more informative blogs on Zowe CLI.

Contributing to Zowe CLI

- Review the **Contributing guidelines** for a summary of conventions and best practices for development of Zowe CLI.

Zowe CLI community resources

The Zowe ecosystem is more than a collection of applications and extensions. An entire community exists to work on enhancements, help answer questions, and discuss plans for the future of the open source project.

- Join the **#zowe-cli** Slack channel to **ask questions about Zowe CLI**, propose new ideas, and interact with the Zowe community.
- You can join **Zowe CLI squad meetings** to get involved. The meeting schedule is posted in the Zowe calendar.
- **Discuss Zowe topics** in the Open Mainframe Project Community Forums.
- If you have an issue that is specific to Zowe CLI, you can **submit an issue** in the `zowe-cli` repository on GitHub.

Community resources

- **Slack channel**

  Join the #zowe-cli Slack channel to ask questions about Zowe CLI, propose new ideas, and interact with the Zowe community.

- **Zowe CLI squad meetings**

  Join Zowe CLI squad meetings to get involved.

- **Zowe CLI Blogs on Medium**

  Read a series of blogs about Zowe CLI on Medium to explore use cases, best practices, and more.

- **Community Forums**

  Look for discussion on Zowe topics on the Open Mainframe Project Community Forums.

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Zowe CLI installation checklist

This checklist outlines the required steps for a first-time installation of Zowe CLI.

> **REQUIRED ROLES: SYSTEMS ADMINISTRATOR, DEVOPS ARCHITECT, SECURITY ADMINISTRATOR, SYSTEMS PROGRAMMER**

The checklist includes a brief description of the steps required for installation of Zowe CLI. The checklist also identifies the roles that are typically required to complete the step, which enables the pre-installation planning team to focus on the tasks for which they are responsible.

For a printable version of this checklist, click here.

Preparing for installation

Step	Description	Role	Time Estimate
Addressing Zowe CLI software requirements and Zowe CLI plug-ins software requirements	Check the following items: • Node.js • Node Package Manager (npm) • Disk space • Plug-in configuration	Systems administrator	15 min.
Configuring your PC to install from an online registry by proxy	Configure log-in credential requirements in the NPM configuration file to use a proxy server to download Zowe CLI.	Systems administrator	15 min.
Configuring z/OSMF	Confirm that z/OS components, region sizes, and user IDs meet Zowe CLI requirements.	Systems programmer	40 min.
Configuring z/OSMF security	Configure security for: • SAF access to REST endpoints • z/OS console REST interface • z/OS data set and file REST services	Security administrator	50 min.

Installing Zowe CLI and Zowe CLI plug-ins

Step	Description	Role	Time Estimate
Installing Zowe CLI and Zowe CLI plug-ins from a local package or an NPM public online registry	Install Zowe CLI from an online registry or a local package.	Systems administrator	30 min.
Updating Zowe CLI and Zowe CLI plug-ins	Identify the currently installed version of Zowe CLI and update to the most recent version. Or, revert to a specific previous release of Zowe CLI.	Systems administrator	30 min.

Configuring Zowe CLI

Step	Description	Role	Time Estimate
Configuring Zowe CLI environment variables	Set the location of the CLI home directory to contain log files, profiles, and other files. Set log levels to adjust the detail included in log files. Set CLI daemon mode properties.	Security administrator and/or DevOps architect	15 min.
Initializing team configuration	Create team profiles to streamline profile management in one location: • Create service profiles to store connection information for a specific mainframe service. • Create base profiles to store connection information used with one or more services.	Security administrator and/or DevOps architect	15 min.
Configuring daemon mode	Enable daemon mode and configure daemon mode properties to run Zowe CLI commands significantly faster.	Security administrator and/or DevOps architect	15 min
Verifying your Zowe CLI installation	Confirm the connection to z/OSMF. Access the product help.	Systems administrator and/or DevOps architect	15 min.

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Zowe CLI system requirements

Before installing Zowe CLI, ensure that your environment meets the prerequisites that are described here.

> **REQUIRED ROLE: SYSTEMS ADMINISTRATOR**

Client-side requirements

Zowe CLI is supported on Windows, Linux, and Mac operating systems. Meet the following requirements before you install the CLI.

Node.js

The JavaScript runtime environment Node.js must be installed to run JavaScript applications (such as Zowe CLI) outside of a web browser.

To install Node.js:

1. Go to Node.js LTS to select and install a runtime version with active support.

For a list of supported LTS versions, see Nodejs Releases.

2. Restart the command prompt after installing Node.js, if required.

3. Verify that Node.js is installed. Issue the following command in the command prompt:

Node.js is installed on your PC when a message returns with the correct Node.js version.

If you issue the `node --version` command and get an error message, confirm that your PATH environment variable includes the path to the Node.js installation location.

npm

Node Package Manager (npm) is included with most Node.js installations and is used to install and manage Node.js packages on your personal computer. (Zowe CLI supports the npm version packaged with Node.js.)

Your installed version of npm must be compatible with your version of Node.js.

To determine the installed version of npm:

1. Issue the following command in the command prompt:

A message returns with the installed version of npm.

2. Verify that your installed version of npm is compatible with your version of Node.js by referring to the Node.js release matrix.

   If your npm version is not compatible, install a new version of Node.js.

Secure credential storage

On Linux systems, you must install the packages `gnome-keyring` and `libsecret` (or `libsecret-1-0` on Debian and Ubuntu).

For information on performing this configuration, see Configuring secure credential storage on headless Linux operating systems.

Plug-in client requirements

If you plan to install plug-ins, review the Software requirements for CLI plug-ins.

> **IMPORTANT**
>
> Ensure that you meet the client-side requirements for the **IBM Db2** plug-in *before* it is installed.

Host-side requirements

IBM z/OSMF

IBM z/OSMF must be configured and running.

You do not need to install the full Zowe solution to install and use Zowe CLI.

Minimally, an instance of IBM z/OSMF must be running on the mainframe before you can issue Zowe CLI commands successfully. z/OSMF enables the core capabilities, such as retrieving data sets, executing TSO commands, submitting jobs, and more.

If Zowe API Mediation Layer (API ML) is configured and running, Zowe CLI users can choose to connect to API ML rather than to every separate mainframe service.

Plug-in services

Services for plug-ins must be configured and running.

Plug-ins communicate with various mainframe services. The services must be configured and running on the mainframe before issuing plug-in commands. For example, the CICS plug-in requires an instance of IBM CICS on the mainframe with CICS management client interface (CMCI) (REST services) running. For more information, see Software requirements for CLI plug-ins

Zowe CLI on z/OS is not supported

Zowe CLI can be installed on an IBM z/OS environment and run under Unix System Services (USS). However, the IBM Db2 plug-in and the Zowe Secrets SDK cannot run on z/OS due to native code requirements. This means that any z/OS credentials display as plain text on a team configuration file. As such, Zowe CLI is *not supported* on z/OS and is currently experimental.

Free disk space

Zowe CLI requires approximately **100 MB** of free disk space. The actual quantity of free disk space consumed might vary depending on your operating system, the plug-ins that you install, and the user profiles that are saved to disk.

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Zowe CLI plug-ins software requirements

Before installing a Zowe™ CLI plug-in, meet the software requirements to run the plug-in as expected.

REQUIRED ROLE: SYSTEMS ADMINISTRATOR

Plug-in	Requirements
IBM CICS Plug-in for Zowe CLI	• Ensure that IBM CICS Transaction Server v5.2 or later is installed and running in your mainframe environment. • IBM CICS Management Client Interface (CMCI) is configured and running in your CICS region.
IBM Db2 Database Plug-in for Zowe CLI	• Download and prepare the ODBC driver (required for only package installations) and address the licensing requirements. *Perform this task before you install the plug-in*. • **(MacOS)** Download and Install Xcode. • **Note**: Linux users might need to resolve an incompatible glibc version.
IBM z/OS FTP Plug-in for Zowe CLI	• Ensure that z/OS FTP service is enabled and configured with `JESINTERFACELEVEL` = 2. • FTP over SSL is recommended.
IBM MQ Plug-in for Zowe CLI	• Ensure that IBM® MQ™ v9.1.0 or later is installed and running in your mainframe environment. Please read this blog for more information: Exposing the MQ REST API via the Zowe API Mediation Layer
Visual Studio Code Extension for Zowe	• Node.js V8.0 or later • Access to z/OSMF; at least one profile is configured • Configure TSO/E address space services, z/OS data set, file REST interface, and z/OS jobs REST interface. For more information, see z/OS Requirements.

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Configuring your PC to install from an online registry by proxy

You can install Zowe CLI and Zowe CLI plug-ins from an online registry using a proxy server on Windows, macOS, or Linux operating systems.

> **REQUIRED ROLE: SYSTEMS ADMINISTRATOR**

If your site functions behind a proxy server and blocks access to public registries, complete the following steps before you install Zowe CLI core and Zowe CLI plug-ins from your desired online registry.

1. Contact your site administrator and obtain the IP address and port number to your proxy server.
2. Configure your NPM configuration file using one of the following methods:
    - If your proxy server **does not require** login credentials:

      Issue one of the following commands to add to the URL for the proxy server to your NPM configuration file.

      For `HTTPS` protocol:

      For `HTTP` protocol:

      - `https-proxy`

        Specifies to communicate with the proxy server using https communication.

      - `proxy`

        Specifies to communicate with the proxy server using http communication.

      - `[proxy_name]`

        Specifies the IP address or the host name of the proxy server.

      - `[port_number]`

        Specifies the port number of the proxy server.

    - If your proxy server **requires** login credentials:

      Issue one of the following commands to add the URL for the proxy server and your login credentials to your NPM configuration file.

      For `HTTPS` protocol:

      For `HTTP` protocol:

      - `https-proxy`

Specifies to communicate with the proxy server using https communication.

- `proxy`

  Specifies to communicate with the proxy server using http communication.

- `[username]`

  Specifies the user name to log in to the proxy server.

- `[password]`

  Specifies the password to log in to the proxy server.

- `[proxy_name]`

  Specifies the IP address or the host name of the proxy server.

- `[port_number]`

  Specifies the port number of the proxy server.

3. Install Zowe CLI and Zowe CLI plug-ins from an NPM public online registry.

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Installing Zowe CLI and Zowe CLI plug-ins

Follow these guidelines to install Zowe™ CLI on your computer.

REQUIRED ROLE: SYSTEMS ADMINISTRATOR

If you want to get started using Zowe CLI quickly, see Zowe CLI quick start. You can learn about new CLI features in the release notes.

NOTES

- As you install Zowe CLI, you might encounter **error messages** that relate to `cpu-features` and `ssh`. You can safely ignore error messages of this type; the installation completes successfully. This behavior can occur when you install CLI from npm and also from a local package.
- **Linux users** might need to prepend `sudo` to `npm` commands. For more information, see Known Zowe CLI issues.

Installing Zowe CLI and Zowe CLI plug-ins from a local package

To install Zowe CLI from a local package:

1. Meet the Zowe CLI software requirements.
2. Navigate to Download Zowe. In the **Client-side component installer** section, click the **Zowe <X.Y.Z> CLI Core** button (where <X.Y.Z> specifies the release number).
3. Read the End User License Agreement for Zowe and click **I agree** to download the core package.

   `zowe-cli-package-next-YYYYMMDD.zip` is downloaded to your computer (where YYYYMMDD indicates the year, month, and day of the build).
4. If installing Zowe CLI plug-ins, meet the software requirements to install Zowe CLI plug-ins.
5. If installing Zowe CLI plug-ins, navigate to Download Zowe and click the **Zowe <X.Y.Z> CLI Plugins** button (where <X.Y.Z> specifies the release number).
6. If installing Zowe CLI plug-ins, read the End User License Agreement for Zowe and click **I agree** to download the plug-ins package.

   `zowe-cli-plugins-next-YYYYMMDD.zip` is downloaded to your computer.
7. Unzip the contents of `zowe-cli-package-<X.Y.Z>.zip` (and `zowe-cli-plugins-<X.Y.Z>.zip`, if downloaded) to a working directory.

8. To install Zowe CLI core, open a command-line window and issue the following commands to the working directory that was used the previous step:

   > **NOTE**
   >
   > If an `EACCESS` error displays, see Resolving EACCESS permissions errors when installing packages globally in npm Docs.

9. To install all available Zowe CLI plug-ins, issue the following command to the working directory that was used in Step 7:

   Zowe CLI and the optional plug-ins are installed on your computer.

Installing Zowe CLI and Zowe CLI plug-ins from an npm online registry

To install Zowe CLI from an npm registry:

1. To install Zowe CLI core, open a command-line window and issue the following command:

   Zowe CLI is installed.

2. If installing Zowe CLI plug-ins, meet the software requirements to install Zowe CLI plug-ins.

3. If installing all available Zowe CLI plug-ins, issue the following command:

   Zowe CLI and the optional plug-ins are installed on your computer.

Other installation options

There are some users who might prefer to install Zowe CLI on the mainframe, or on an operating system where secure credential storage is not required or cannot be installed from its package.

For those users, mainframe installation offers the ability to install Zowe CLI in one place yet still be accessible to multiple mainframe developers. This can help with training purposes, or for scripts that run on both a local computer and the mainframe. These users often request instructions on mainframe installation, and they are provided here.

Note, however, that Zowe CLI was not designed for mainframe installation and unexpected behavior can occur.

> **CAUTION**
>
> Installing Zowe CLI on the mainframe is not supported by Zowe conformant support providers. By choosing this installation method, you need to perform your own independent troubleshooting if any problems arise.

Installing Zowe CLI on z/Linux

Installation steps for Zowe CLI depend on whether your z/Linux environment requires the secure credential storage.

Installing with secure credential storage

1. Follow the steps in Configuring secure credential storage on headless Linux operating systems.
2. Follow the steps in Installing Zowe CLI and Zowe CLI plug-ins from an npm online registry or Installing Zowe CLI and Zowe CLI plug-ins from a local package.

Installing without secure credential storage

1. Follow the steps in Installing Zowe CLI and Zowe CLI plug-ins from an npm online registry or Installing Zowe CLI and Zowe CLI plug-ins from a local package.
2. Follow the steps in Configuring Zowe CLI where secure credential storage is not available.

Installing Zowe CLI on a USS system, or an OS without secure credential storage

Follow the steps in Configuring Zowe CLI where secure credential storage is not available.

Next steps

After installing Zowe CLI, set environment variables, configure Zowe profiles, and, optionally, enable daemon mode.

Version: v3.2.x LTS

Configuring secure credential storage on headless Linux operating systems

Perform the following configurations on headless Linux or z/Linux operating systems.

REQUIRED ROLE: SYSTEMS ADMINISTRATOR

NOTE

For CI/CD pipelines, we recommend using the credential management provided by the CI/CD tool (for example, Jenkins credentials or GitHub secrets) to store credentials and load them into environment variables in the pipeline. See Using environment variables for more information.

Headless Linux operating systems

Requirements for headless Linux operating systems

- Ensure that you installed the secure credential storage requirements that are described in Zowe CLI software requirements.
- Unlock the Gnome keyring to allow you to load and store credentials on headless Linux operating systems. You can unlock the keyring manually or automatically, see the following instructions.

Unlocking the keyring manually

You must unlock the keyring in each user session.

To unlock the keyring manually, open the command prompt and issue the following command:

NOTE

The `gnome-keyring-daemon -r --unlock --components=secrets` command can appear to hang, but it is waiting for you to enter a password. Type your keyring password (typically the same as your Linux user password), then press `Ctrl`+`D` twice to continue the terminal session.

Unlocking the keyring automatically

When you are using SSH or TTY to log in to Linux, you can configure the Gnome keyring to unlock automatically when you log in.

NOTE

The following steps were tested on CentOS, SUSE, and Ubuntu operating systems. The steps do not work on WSL (Windows Subsystem for Linux) because it bypasses TTY login. Results may vary on other Linux distributions.

To unlock the Gnome keyring automatically when you log in:

1. Follow instructions for your Linux distribution on installing the PAM module for Gnome keyring. The package name depends on your distribution:

   - `gnome-keyring-pam`: CentOS, Fedora, SUSE
   - `libpam-gnome-keyring`: Debian, Ubuntu

2. Use a text editor or the applicable command to edit the files `/etc/pam.d/login` (for TTY login) and `/etc/pam.d/sshd`, if it exists (for SSH login).

   - Add the following statement to the end of the `auth` section:

   - Add the following statement to end of the `session` section:

3. Use a text editor or the applicable command to add the following commands to the `~/.bashrc` file:

   The first command launches DBus, which the Gnome keyring requires. The second command starts the keyring daemon so that it is ready to be used by Zowe CLI commands.

4. Restart your computer.

   You have successfully completed the configuration to unlock the Gnome keyring automatically.

5. Issue a Zowe CLI command that uses secure credentials to validate the automatic keyring unlock.

z/Linux operating systems

Configuring z/Linux

Zowe CLI does not contain the native, pre-built binaries that are required to access the credential vault on z/Linux operating systems. Developers must build the credential manager binaries on z/Linux systems during the Zowe CLI installation process.

For instructions to set up the credential manager binaries for Red Hat Enterprise Linux (RHEL) V8.X and Ubuntu z/Linux systems, refer to this section. For instructions specific to RHEL V7.X, see Configuring RHEL V7.X.

To install and build the credential storage binaries on z/Linux RHEL V8.X and Ubuntu systems:

1. Use the command prompt to install the following Linux packages on the z/Linux system:

   - `make`
   - `gcc-c++` (sometimes available as `g++`)
   - `gnome-keyring`
   - `libsecret` (sometimes available as `libsecret-1-0`)
   - `libsecret-devel` (sometimes available as `libsecret-1-dev`)
   - Python 3.6 or later

> **NOTE**

> If you are installing the Linux packages on a z/Linux system, the system where you are configuring secure credential storage might require Internet access. When a site hosts its own package repositories, the repositories might not contain all of the packages that are required to configure the secure credential storage. In this scenario, the z/Linux system requires Internet access to install the required packages.

2. If you are configuring secure credential storage on a Ubuntu z/Linux operating system, install Zowe CLI.

   For all other platforms (RHEL), continue to the next step.

3. Enable the `rhel-#-for-system-z-optional-rpms` repository to download libsecret-devel.

   If your license entitles you to this repository, open the command prompt and issue the following command to enable it:

   Replace `#` with the major version of RHEL that is running on the z/Linux system.

4. Unlock the keyring manually or unlock the keyring automatically to load and store credentials.

5. If you are configuring secure credential storage to run on RHEL V8.x or later, install Zowe CLI.

Configuring RHEL V7.X

To install and build the credential storage binaries on z/Linux RHEL V7.X:

1. Use the command prompt to install the following Linux packages on the z/Linux system:

   - `make`
   - `gcc-c++` (sometimes available as `g++`)
   - `gnome-keyring`
   - `libsecret` (sometimes available as `libsecret-1-0`)
   - `libsecret-devel` (sometimes available as `libsecret-1-dev`)
   - Python 3.6 or later

   > **NOTE**
   >
   > If you are installing the Linux packages on a z/Linux system, the system where you are configuring secure credential storage might require Internet access. When a site hosts its own package repositories, the repositories might not contain all of the packages that are required to configure the secure credential storage. In this scenario, the z/Linux system requires Internet access to install the required packages.

2. Enable the `rhel-#-for-system-z-optional-rpms` repository to download libsecret-devel.

   If your license entitles you to this repository, open the command prompt and issue the following command to enable it:

   Replace `#` with the major version of RHEL that is running on the z/Linux system.

3. Install the Red Hat Developer Toolset to ensure that you are running a version of the gcc-c++ compiler that can build the secure credential storage native binaries.

Issue the following commands to enable the repositories that are required to install the toolset:

4. Install the toolset by issuing the following command:

5. Install Zowe CLI.

6. Unlock the keyring manually or unlock the keyring automaticallyto load and store credentials.

> **IMPORTANT**
>
> The secure credential storage capability is installed every time that you install or update Zowe CLI. On RHEL V7.x, ensure that the Red Hat Developer Toolset is enabled every time you install or update Zowe CLI. When you do not enable the toolset, secure credential management is not available on the system. To ensure that the toolset is enabled when you install Zowe CLI, issue the following commands instead of the standard `npm install` commands.
>
> When you run these commands, Zowe CLI installs globally and the system uses the latest version of the C++ compiler to build the native components. Refer back to the keyring unlocking instructions to set up the the Zowe CLI secure credential storage.

Version: v3.2.x LTS

Configuring Zowe CLI where secure credential storage is not available

By default, Zowe CLI attempts to store sensitive information and credentials in the operating system's credential storage. If the information cannot be stored securely, Zowe CLI displays an error when you attempt to initiate team configuration.

> **REQUIRED ROLE: SYSTEMS ADMINISTRATOR**

Team configuration

In team configuration, team profiles are stored in the `zowe.config.json` file and user profiles are saved in `zowe.config.user.json`.

By default, every configuration file includes an `autoStore` property that is set to automatically store values that are prompted from the user. The value that you enter when prompted is stored for future commands to use to avoid re-entering information repeatedly.

This can cause potential problems when secure credential storage is not available.

If Zowe CLI cannot find the value for a user ID or password, for example, it prompts the user for that information and then stores the information securely when secure storage is available.

In cases where secure storage is not possible, and the `autoStore` property is set to `true`, the credentials are saved as text in the applicable configuration file.

Stopping automatic storage of prompted values

To stop storing information prompted by Zowe CLI:

1. Use a text editor to open the configuration file used by your commands.

   For project configuration, locate the file in your project directory. For global configuration, the file is found in the `ZOWE_CLI_HOME` directory.

2. Navigate to the `autoStore` property and set the value to `false`:

   Zowe CLI is configured to prompt for all missing values on all commands that you issue.

Version: v3.2.x LTS

Updating Zowe CLI and Zowe CLI plug-ins

Zowe™ CLI is updated continuously. You can update Zowe CLI to a more recent version using either the online registry or the local package method.

> **REQUIRED ROLE: SYSTEMS ADMINISTRATOR**

You must update Zowe CLI using the method that you used to install Zowe CLI.

Identifying the currently installed version of Zowe CLI and Zowe CLI plug-ins

For Zowe CLI core, open a command line window and issue the following command:

For Zowe CLI plug-ins, open a command line window and issue the following command:

Updating to the Zowe CLI V3 Long-term Support (v3-lts) version

If you are running the Zowe CLI version included with Zowe release v2.0.0 to v2.15.x, you can update to `@zowe-v3-lts` (LTS version) to leverage the latest Zowe CLI and Zowe CLI plug-ins functionality.

Updating from an npm online registry

1. To update and install Zowe CLI core, open a command line window and issue the following command:

2. To update and install all Zowe plug-ins, open a command line window and issue the following command:

   To install a subset of the plug-ins, remove the syntax for the plug-in(s) that you do not want to update. For example:

3. When updating from Zowe V1 to Zowe V3, migrate your Zowe CLI profiles from your current installation to your V3 installation:

   Profile data is backed up in case you want to revert the profiles to your previous Zowe CLI installation.

4. When updating from Zowe V1 to Zowe V3, if you no longer require the profiles for your previous Zowe CLI installation, you can delete them:

   > **IMPORTANT**
   > We do not recommend deleting the profiles from your previous Zowe CLI installation until you have tested your V3 installation and are satisfied.

   You have successfully updated to the Zowe CLI V3-LTS version.

5. See Next steps for recommended tasks after installation.

Updating from a local package

To update Zowe CLI core and Zowe CLI plug-ins from an offline (`.tgz`), local package, uninstall your current package then reinstall from a new package.

1. To uninstall Zowe CLI and Zowe CLI plug-ins, follow the instructions in Uninstalling Zowe CLI and Zowe CLI Plug-ins.
2. To install a new package for Zowe CLI and Zowe CLI plug-ins, follow the instructions in Installing Zowe CLI and Zowe CLI plug-ins from a local package.
3. See Next steps for recommended tasks after installation.

Updating or reverting Zowe CLI and Zowe CLI plug-ins to a specific version

If necessary, you can update or revert Zowe CLI to a known, previously released version.

Updating or reverting from an npm online registry

1. To update or revert Zowe CLI and Zowe CLI plug-ins to a specific known version, open a command line window and issue the following command:

   - `<X.Y.Z>`

   Specifies release number that Zowe CLI or Zowe CLI plug-ins are to be updated or reverted to. For example, `npm install -g @zowe/cli@8.0.0`.

2. See Next steps for recommended tasks after installation.

Updating or reverting from a local package

1. Uninstall Zowe CLI and Zowe CLI plug-ins. Follow the instructions in Uninstalling Zowe CLI and Zowe CLI Plug-ins.
2. Navigate to Download Zowe. Select the specific release you want to update or revert to from **All Zowe V2.x Releases** or **All Zowe V3.x Releases**.

   The End User License Agreement for Zowe displays.

3. Read the End User License Agreement for Zowe and click **I agree** to download the core package.

   `zowe-cli-package-next-<X.Y.Z>.zip` is downloaded to your computer (where `<X.Y.Z>` indicates the year, month, and day of the build).

4. If updating or reverting Zowe CLI plug-ins, navigate to Download Zowe and click the **Zowe <X.Y.Z> CLI Plugins** button (where <X.Y.Z> specifies the release number).
5. If updating or reverting Zowe CLI plug-ins, read the End User License Agreement for Zowe and click **I agree** to download the plug-ins package.

   `zowe-cli-plugins-next-<X.Y.Z>.zip` is downloaded to your computer.

6. Unzip the contents of `zowe-cli-package-<X.Y.Z>.zip` (and `zowe-cli-plugins-<X.Y.Z>.zip`, if downloaded) to a working directory.

7. To install Zowe CLI core, open a command-line window and issue the following command to the working directory that was used the previous step:

   > **NOTE**
   >
   > If an `EACCESS` error displays, see Resolving EACCESS permissions errors when installing packages globally in npm Docs.

8. To update or revert all available Zowe CLI plug-ins, issue the following command to the working directory that was used in Step 6:

   Zowe CLI and the optional plug-ins are installed on your computer.

   To update or revert a subset of the plug-ins, remove the syntax for the plug-in(s) that you do not want to update. For example:

9. See Next steps for recommended tasks after installation.

Next steps

Review the release notes for the notable changes in the newly installed version.

Issue familiar commands and run scripts to ensure that your profiles/scripts are compatible. Take corrective action to address any breaking changes.

Version: v3.2.x LTS

Configuring Zowe CLI environment variables

Configure Zowe CLI using environment variables to define directories, log levels, daemon mode properties, and more.

> **REQUIRED ROLES: SECURITY ADMINISTRATOR, DEVOPS ARCHITECT**

By default, Zowe CLI configuration is stored on your computer in the `C:\Users\user01\.zowe` directory. The directory includes log files, profile information, and installed Zowe CLI plug-ins. When troubleshooting, refer to the logs in the `imperative` and `zowe` folders.

> **NOTE**
>
> For information on how to define Zowe CLI environment variables to execute commands more efficiently, see Using environment variables.

Setting the Zowe CLI home directory

You can set the location on your computer where Zowe CLI creates the `.zowe` directory, which contains log files, profiles, and plug-ins for the product.

Environment variable	Description	Values	Default
`ZOWE_CLI_HOME`	Zowe CLI home directory location	Any valid path on your computer	Your computer default home directory

Setting a shared plug-in directory

You can set the location of a shared directory to manage Zowe CLI plug-ins for multiple users.

A project administrator can pre-install, and update, a Zowe CLI plug-in stored in the shared directory to make the same version of that plug-in available to all users. This avoids managing separate copies of a plug-in across a development team.

The plug-in directory must be defined before any Zowe CLI plug-ins are installed.

> **IMPORTANT**
>
> Any plug-in installed before specifying the environment variable cannot be managed with Zowe CLI. To resolve this, re-install the plug-in after the environment variable is set.

Environment variable	Description	Values	Default
`ZOWE_CLI_PLUGINS_DIR`	Zowe CLI plug-in directory location	Any valid path on your computer	Plug-ins folder inside the Zowe CLI home

Setting CLI log levels

You can set the log level to adjust the level of detail that is written to log files.

> **⚠ WARNING**
>
> Setting the log level to `TRACE` or `ALL` might result in sensitive data being logged. For example, command line arguments are logged when `TRACE` is set.

Environment variable	Description	Values	Default
`ZOWE_APP_LOG_LEVEL`	Zowe CLI logging level	Log4JS log levels (`OFF`, `TRACE`, `DEBUG`, `INFO`, `WARN`, `ERROR`, `FATAL`)	`WARN`
`ZOWE_IMPERATIVE_LOG_LEVEL`	Imperative CLI Framework logging level	Log4JS log levels (`OFF`, `TRACE`, `DEBUG`, `INFO`, `WARN`, `ERROR`, `FATAL`)	`WARN`

Setting CLI daemon mode properties

By default, the CLI daemon mode binary creates or reuses a file in the user's home directory each time a Zowe CLI command runs. In some cases, this behavior might be undesirable. For example, when the home directory resides on a network drive and has poor file performance.

To change the location that the daemon uses, set the environment variables that are described in the following table.

Platform	Environment variable	Description	Values	Default
All	`ZOWE_DAEMON_DIR`	Lets you override the complete path to the directory that will hold daemon files related to this user. The directory can contain the following files: • `daemon.lock` • `daemon.sock` • `daemon_pid.json`	Any valid path on your computer	`<your_home_dir>/.zowe/daemon` Examples: Windows: `%HOMEPATH%\.zowe\daemon` Linux: `$HOME/.zowe/daemon`

Platform	Environment variable	Description	Values	Default
Windows (only)	`ZOWE_DAEMON_PIPE`	Lets you override the last two segments of the name of the communication pipe between the daemon executable (.exe) and the daemon.	Any valid path on your computer	`\\.\pipe\%USERNAME%\ZoweDaemon`

Showing secure values

See the secure credentials used by a command to help troubleshoot a configuration problem.

Environment variable	Description	Values	Default
`ZOWE_SHOW_SECURE_ARGS`	Displays secure property values used by a Zowe CLI command **Notes**: Use the `--show-inputs-only` option in a Zowe CLI command to view the property values used by the command. When the `ZOWE_SHOW_SECURE_ARGS` is set to `true`, the response also includes the secure values used and defined in the user's client configuration. Use the `zowe config list` command in Zowe CLI to view your team configuration settings. When `ZOWE_SHOW_SECURE_ARGS` is set to `true`, the response includes the secure values in plain text.	`TRUE`, `FALSE`	`FALSE`

Using Zowe CLI with a proxy

If your network configuration requires communication with the mainframe to be performed through a proxy server, set environment variables to route Zowe CLI traffic through an HTTP/HTTPS proxy.

Environment Variable	Description	Example Value
`HTTPS_PROXY`, `https_proxy`	Use an `https` proxy to route communication to the mainframe when your proxy server supports `https`.	If authentication required: `https://[user]:[password]@[address]:[port]` If authentication not required: `https://[address]:[port]`
`HTTP_PROXY`, `http_proxy`	Use an `http` proxy to route communication to the mainframe when your proxy server does not support `https`.	If authentication required: `http://[user]:[password]@[address]:[port]` If authentication not required: `http://[address]:[port]`

Environment Variable	Description	Example Value
`NO_PROXY`	Set a list of host addresses (separated by commas) to connect to the specified hosts without going through a proxy.	`https://[address_1],https://[address_2]`, `http://[address_1],http://[address_2]`, `*.address_1,*.address_2`

Version: v3.2.x LTS

Configuring an environment variables file

If it is not possible to configure your own system environment variables, create a special configuration file to set these variables for Zowe CLI commands.

> **REQUIRED ROLES: SECURITY ADMINISTRATOR, DEVOPS ARCHITECT**

Although not common, there are cases where users do not have the ability to configure their own system environment variables. This can happen when users are working on hosted integrated development environments (IDEs), or in a highly locked down environment.

When working under these kinds of restrictions, you can set environment variables that apply to CLI commands. To do this, create a `.zowe.env.json` file storing key-value pairs that specify your configurations.

> **NOTE**
>
> Use a `.zowe.env.json` file *only* when it is not possible to set your own system environment variables. If you are able to configure environment variables in your system, continue to do so.

How `.zowe.env.json` works

When a Zowe command is issued, the command initializes the Imperative CLI Framework so that it loads all the utilities that allow the command to function. Imperative reads the `.zowe.env.json` configuration file and sets the environment variables before any loggers or Zowe CLI finish their own initialization.

The `.zowe.env.json` environment variables are set for only the duration of a Zowe CLI command.

If an existing environment variable is set in your system and the variable is also in `.zowe.env.json`, the values in `.zowe.env.json` overwrite it.

`.zowe.env.json` can be used to set any environment variable. This allows setting environment variables to change the default behavior of Node.JS, in addition to all of the Zowe environment variables.

Creating the configuration file

Create a dedicated JSON file to store settings for environment variables:

1. In your Files Explorer, go to the home directory (`%HOMEPATH%` for Windows, `$HOME` for Linux and Mac) or the path set in the `ZOWE_CLI_HOME` environment variable.
2. Create a JSON file titled `.zowe.env.json`.
3. Use a text editor to open `.zowe.env.json` and enter environment variables, as in the following example:

> **NOTE**

> If you have the `ZOWE_CLI_HOME` environment variable set in your system, do not include it in the `.zowe.env.json` file. Otherwise, unexpected behavior can occur.

Using daemon mode

Daemon mode is a long-running background process that significantly improves Zowe CLI performance.

When changes are made to your work environment, daemon mode does not capture the changes. Restarting daemon mode lets the daemon capture any updates since its last start up.

This means that if the Zowe CLI daemon is in use, the daemon must be restarted when the `.zowe.env.json` file is created or updated.

Issue the following command to stop the currently running daemon and start a new daemon:

See Restart daemon mode for more information.

Version: v3.2.x LTS

Initializing team configuration

Team configuration is a profile management method introduced in Zowe Version 2.

> **REQUIRED ROLES: SECURITY ADMINISTRATOR, DEVOPS ARCHITECT**

Under this method, team-specific profiles are saved in the `zowe.config.json` configuration file and user-specific profiles in the `zowe.config.user.json` configuration file. Team configuration profile management can be applied *globally* and/or *per project*, depending on the development project. See Team configurations for more information.

Use one of the following methods to initialize global team configuration. These instructions show how to create a configuration file that you can later open in a text editor or IDE (such as Visual Studio Code) to add or modify profiles.

> **NOTE**
>
> If API Mediation Layer is running on your site, Connecting profiles to API Mediation Layer is the recommended method to use to initialize team configuration.

Creating a global team configuration file

1. To initialize a global team configuration file, open a command line window and issue the following command:

2. Respond to subsequent prompts with a username and password for a mainframe service such as z/OSMF.

   The `zowe config init` command ensures that your credentials are stored securely on your computer by default.

   When the credentials are received, the `zowe.config.json` team configuration file is added to the local `.zowe` directory. Use a text editor or IDE to add or modify connection details for your mainframe services.

   > **NOTE**
   >
   > Run the `zowe config init --global-config` command again after installing a new plug-in to add the plug-in profile to the global configuration file. See Creating team plug-in profiles for information.

3. To test access to z/OSMF, issue a Zowe CLI command.

   For example, list all data sets under your user ID:

   - `IBMUSER`

     Specifies your user ID.

   A list of data sets is returned, indicating Zowe CLI is successfully configured to access a z/OSMF instance.

   If the CLI returns an error message, verify that you have access to the target system. Examine the configuration files in a text editor to check that the entered information is correct.

> **IMPORTANT**
>
> After the configuration file is in place (by using either the `zowe config init` command or a file provided by a system administrator), the `zowe profiles` commands used in Zowe V1 no longer function. Zowe CLI returns errors when deprecated profile commands are issued.

Creating team plug-in profiles

After the `zowe.config.json` team configuration file is created and new plug-ins are installed, run the `zowe config init` (or `zowe config auto-init`, if using API ML) command again to add the plug-in profiles to the configuration file.

To create a team plug-in profile:

1. Install a new plug-in.

   For example, open a command line window and issue the following command to install the IBM CICS Plug-in from an npm online registry:

   > **NOTE**
   >
   > If the `zowe.config.json` file has not yet been created in the `.zowe` directory, see Creating a global team configuration file.

2. Issue the `zowe config init --global-config` or `zowe config auto-init --global-config` command.

   This adds a plug-in profile to the configuration file in the `.zowe` home directory.

3. Open the `zowe.config.json` file and confirm the plug-in profile is included.

   In the example from Step 1, the profile information displays similarly to the example below:

   The plug-in profile has been successfully added to the `zowe.config.json` file in the `.zowe` home directory.

   > **NOTE**
   >
   > To add plug-in profiles to a configuration file in the current working directory, enter the base command without the `--global-config` option: `zowe config init`.

Connecting profiles to API Mediation Layer

You can use profiles to connect to the API Mediation Layer. This more efficient way to connect to the mainframe allows you to specify a host and port only once on a base profile instead of multiple host-and-port combinations across several service profiles.

To set up the `zowe.config.json` file to automatically access the services that are registered to API ML and support Single Sign-On:

1. Open a command line window and issue the following command:

> **NOTE**
>
> To add a profile to a configuration file in the current working directory, enter the base command without the `--global-config` option: `zowe config auto-init`.

2. Respond to subsequent CLI prompts with the following information:

   - The host name and port to your API ML instance.
   - Your username and password.

   A default base profile is added to the configuration file in the `.zowe` home directory.

> **NOTE**
>
> To use certificates instead of basic authentication (such as user ID and password), you can specify the options `--cert-file` and `--cert-key-file` on the base command (`zowe config auto-init`). For more information on how to log in with certificates, see Integrating with API Mediation Layer.

Version: v3.2.x LTS

Configuring daemon mode

Daemon mode significantly improves the performance of Zowe CLI commands by running Zowe CLI as a persistent background process (daemon). Running Zowe CLI as daemon lets Zowe absorb the one-time startup of Node.js modules, which results in significantly faster responses to Zowe commands.

> **REQUIRED ROLES: SECURITY ADMINISTRATOR, DEVOPS ARCHITECT**

When you run Zowe CLI in daemon mode, you run all Zowe commands as you normally run them. The first time you run a command, it starts the daemon in the background automatically and runs your desired Zowe command. Since the first Zowe command starts the daemon, the first command usually runs slower than a traditional Zowe command. However, subsequent Zowe commands run significantly faster. The daemon continues to run in the background until you close your terminal window.

Preparing for installation

Review the following installation notes before you configure Zowe CLI to run in daemon mode:

- Daemon mode does not function on z/OS UNIX System Services (USS) systems.
- When you want Zowe CLI to run in daemon mode on z/Linux operating systems, you must build the daemon mode binary on the z/Linux systems. For information about how to build the binary, see Configuring daemon mode on z/Linux operating systems. The sections Enabling daemon mode and Disabling daemon mode (in this article) **do not apply** to running Zowe CLI in daemon mode on z/Linux operating systems.
- We do not recommend using daemon mode in an environment where multiple users use the same system. For example, a shared Linux server. This could result in increased consumption of system resources.
- When you are running Zowe on a Windows operating system in a virtual environment (for example, Windows Sandbox), you might receive an error message that indicates that a library named `VCRUNTIME140.dll` is missing. To correct the error, install Visual C++ Redistributable for Visual Studio 2015. For more information, see Download Visual C++ Redistributable for Visual Studio 2015 in the Microsoft Download Center.

Enabling daemon mode

To enable daemon mode and configure Zowe to run Zowe CLI constantly in daemon mode:

1. Open a terminal window and issue the following command:

   The command copies the Zowe executable for your operating system into the `$ZOWE_CLI_HOME/bin` (`.zowe/bin`) directory. The next command that you issue starts the daemon.

2. Add the binary file path to the Zowe executable to your PATH environment variable. For example:

   > **IMPORTANT**

> Ensure that you position the path to your Zowe executable before the path into which NPM installed the Node.js script. For example, `C:\Program Files\nodejs\zowe.cmd`. For information about configuring environment variables, see the documentation for your computer's operating system.

You have successfully configured Zowe CLI to run on daemon mode. Each time a Zowe CLI command is issued, the daemon binary is loaded from the user's home directory to run the Zowe executable.

> **NOTE**
>
> In some cases, using the home directory might be undesirable. (For example, the home directory resides on a network drive and has poor file performance.) To change the location that the daemon uses, see Setting CLI daemon mode properties.

Restarting daemon mode

Daemon mode is a long-running background process that significantly improves Zowe CLI performance by, essentially, waiting for work to perform. When you make changes to your work environment, daemon mode does not capture the changes.

Restarting daemon mode lets the daemon capture the changes.

To stop the currently running daemon and start a new daemon, open a command line window and issue the following command:

Changes that require daemon mode restart

You must restart daemon mode under the following scenarios:

- You changed the value of any of the following Zowe CLI environment variables:
  - `ZOWE_CLI_HOME`
  - `ZOWE_APP_LOG_LEVEL`
  - `ZOWE_IMPERATIVE_LOG_LEVEL`
- You installed, updated, or uninstalled a plug-in.
- You installed a newer version of Zowe CLI and daemon mode was running while you installed the newer version of Zowe CLI.

> **NOTE**
>
> When you install another version of Zowe CLI, you should always run the `zowe daemon enable` command again.

- You issued a Zowe command and the following message displays:
- You created or updated the `.zowe.env.json` file in your home directory or the path set in the `ZOWE_CLI_HOME` environment variable. See Configuring an environment variables file for more information.

Disabling daemon mode

You can disable Zowe CLI from running in daemon mode at any time. For example, if the daemon experiences an unexpected error.

To disable daemon mode, open a terminal window and issue the following command:

The `disable` command stops daemon mode, removes the Zowe executable from your `.zowe/bin` directory, and disables daemon mode.

Version: v3.2.x LTS

Configuring daemon mode on z/Linux operating systems

Currently, Zowe CLI does not offer a prebuilt daemon that can run on z/Linux operating systems. However, developers can build the daemon binary from source.

> **REQUIRED ROLES: SECURITY ADMINISTRATOR, DEVOPS ARCHITECT**

To install and build the daemon binary on z/Linux systems:

1. Ensure that the z/Linux system can communicate using the Internet.
2. Install Zowe CLI on the z/Linux system.
3. Install the following Linux packages on the z/Linux system:
    - make
    - gcc-c++ (or g++)
    - git
    - Rust

      For information about how to install Rust, see the Rust documentation.
4. Shallow clone the Zowe CLI Git repository for the version of CLI that you installed. Open a command line window and issue the following command:
5. Change to the following directory:
6. Build the daemon binary. Issue the following command from the `zowe-cli/zowex` directory:

   After the command completes successfully, the Zowe daemon binary is a file named `zowe` that can be found in the `target/release` directory.
7. Copy the binary to another location on the system and add that location to your PATH.
8. To allow others to use the same binary, modify the file permissions in the binary:

   The following example illustrates the command to allow all users to run the Zowe binary. However, only the user that created the binary can overwrite the binary.

> **NOTE**
>
> You can delete the `.zowe-cli` folder that was created in Step 4 after the binary builds successfully. The Zowe daemon commands will not function, and the daemon will need to be rebuilt for all new versions of Zowe CLI.

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Verifying your Zowe CLI installation

Verify that Zowe CLI has been installed successfully by checking your connection to z/OSMF and accessing the in-product help.

REQUIRED ROLES: SYSTEMS ADMINISTRATOR, DEVOPS ARCHITECT

NOTE

Use these commands to validate connection to z/OSMF, not user credentials. To confirm credentials, issue any fully qualified command, such as `zowe zos-files list data-set <dataSetName> [options]`.

Testing connections to z/OSMF

Issue a command at any time to receive diagnostic information from the server and confirm that Zowe CLI can communicate with z/OSMF or other mainframe APIs.

Refer to the following sections for instructions on how to connect to z/OSMF with different types of profiles.

IMPORTANT

When z/OSMF receives a request via a Zowe CLI command, z/OSMF uses an SSL/TLS certificate to ensure a secure connection during the user session.

In the event that your z/OSMF instance does not have a SSL/TLS certificate registered with a Certificate Authority (CA), use the `--reject-unauthorized` (or `--ru`) `false` flag to the end of each command listed here to bypass this security check.

Determine the potential security risks. For the most secure environment, system administrators configure a server keyring with a server certificate signed by a CA. For more information, see Working with certificates.

Connecting to z/OSM without a profile

Follow these steps when you have installed Zowe CLI but have not yet created a configuration file, or the configuration file has an incomplete profile for z/OSMF.

1. Verify that your Zowe CLI instance can communicate with z/OSMF:

   - `<host>`

     Specifies the host.

   - `<port>`

     Specifies the port.

   - `<username>`

Specifies the username.

- `<password>`

  Specifies the password.

2. Verify that the installed z/OSMF services are plug-ins listed in the response.

   You have confirmed that Zowe CLI is connected to z/OSMF.

Connecting to z/OSMF with a default profile

Follow these steps when you have created a default profile in a configuration file (such as a global team config:

1. Verify the default profile can communicate with z/OSMF:

2. Check that the installed z/OSMF services and plug-ins are listed in the response.

   You have confirmed that Zowe CLI is connected to z/OSMF.

Connecting to z/OSM with a specific profile

Follow these steps when you have created a custom profile in a configuration (such as a global team configuration file).

1. Verify that you can use that specific profile to communicate with z/OSMF:

   - `<profile name>`

     Specifies the name of the custom profile.

2. Check that the installed z/OSMF services and plug-ins are listed in the response.

   You have confirmed that Zowe CLI is connected to z/OSMF.

Troubleshooting Zowe CLI connection

The preceding commands return a success or failure message and display information about your z/OSMF server, such as the z/OSMF version number. Report failures to your systems administrator and use the response information for diagnostic purposes.

Accessing Zowe CLI help

The in-product help is used as a reference of all the commands and plug-ins that are installed on the computer. If any part of the installation corrupts during installation, the help does not display.

Viewing top level Zowe CLI help

1. To view top-level help:

   Alternatively, to display a full list of all available commands:

2. Verify that the help content displays and includes installed plug-ins.

You have confirmed that you successfully installed Zowe CLI.

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Uninstalling Zowe CLI and Zowe CLI plug-ins

You can uninstall Zowe™ CLI from the desktop if you no longer need to use it.

REQUIRED ROLES: SYSTEMS ADMINISTRATOR

IMPORTANT

The uninstall process does not delete the profiles and credentials that you created when using the product from your computer. To delete the profiles from your computer, delete them before you uninstall Zowe CLI.

To list the profiles that you created, delete the profiles, and uninstall Zowe CLI.

1. Open a command line window.

   NOTE

   If you do not want to delete the Zowe CLI profiles from your computer, proceed to Step 5.

2. List all configuration files that you created. Issue the following command:

   Example response for Windows:

   Example response for Linux and Mac OS:

3. Delete all of the configuration files that are listed. Issue the following command:

   TIP

   For this command, use the results of the `zowe config list` command.

   For Windows:

   For Linux and Mac OS:

4. Uninstall Zowe CLI by issuing the following command:

   NOTE

   You might receive an `ENOENT` error when issuing this command if you installed Zowe CLI from a local package (.tgz) and the package was moved from its original location. To resolve this, add the `--force` option to the `npm uninstall --global @zowe/cli` command and to bypass any errors.

   The uninstall process removes all Zowe CLI installation directories and files from your computer.

5. Delete the `~/.zowe` or `%homepath%\.zowe` directory on your computer. The directory contains the Zowe CLI log files and other miscellaneous files that were generated when you used the product.

INFO

Deleting the directory does not harm your computer.

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Installing Zowe Explorer

The Zowe Explorer extension for Visual Studio Code (VS Code) modernizes the way developers and system administrators interact with z/OS mainframes, and lets you interact with data sets, USS files, and jobs.

For a better understanding of Zowe Explorer, review the various reference materials that document the VS Code extension.

About Zowe Explorer

- Check out **Zowe release notes** to learn about the latest Zowe Explorer updates.
- If you have a question, review the **Zowe Explorer FAQs**, which answer the most commonly asked questions about Zowe Explorer.

Installing and configuring

- Review the system requirements and steps for installing the Zowe Explorer in **Installing Zowe Explorer**.
- Learn how to create and work with **Zowe Explorer profiles**. A profile enables you to connect to services running on a mainframe, integrate with the API Mediation Layer, and more.

Getting the most out of Zowe Explorer

- Review **Using Zowe Explorer** to go over how to use Zowe Explorer in a remote environment and managing credentials.
- Learn how to **extend Zowe Explorer** to introduce new functionalities.
- Add CICS functionality and the FTP protocol to the Zowe Explorer VS Code extension with the **Zowe Explorer CICS Extension** and the **Zowe Explorer FTP Extension**.
- Check out the **Zowe Explorer GitHub repository** to view the source code for Zowe Explorer and other Zowe Explorer-related extensions.
- Watch the following videos to learn how to get started with Zowe Explorer, and work with data sets:

Getting Started with Zowe Explorer: Part 1

Zowe Explorer Video: How to Work with Data Sets Part 2

Contributing to Zowe Explorer

- Review the **Contribution Guidelines** for a summary of conventions and best practices for development of the Visual Studio Code Extension for Zowe.

Zowe Explorer community resources

The Zowe ecosystem is more than a collection of applications and extensions. An entire community exists to work on enhancements, help answer questions, and discuss plans for the future of the open source project.

- Join the **#zowe-explorer-vscode** Slack channel to ask questions, propose new ideas, and interact with the Zowe community.
- You can join **Zowe Explorer squad meetings** to get involved. The meeting schedule is posted in the Zowe calendar.
- Read informative **blog posts about Zowe** on Medium to explore use cases, best practices, and more.
- **Discuss Zowe topics** in the Open Mainframe Project community forums.
- If you have an issue that is specific to Zowe Explorer, you can **submit an issue** in the `zowe-explorer-vscode` repository on GitHub.

Community resources

- **Slack channel**

  Join the `# zowe-explorer` Slack channel to ask questions, propose new ideas, and interact with the Zowe community.

- **Zowe Explorer squad meetings**

  You can join one of the Zowe Explorer squad meetings to get involved.

- **Zowe Blogs on Medium**

  Read a series of blog articles about Zowe on Medium to explore use cases, best practices, and more.

- **Community Forums**

  Look for discussion on Zowe topics on the Open Mainframe Project Community Forums.

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Zowe Explorer installation checklist

This checklist outlines the required steps for a first-time installation of Zowe Explorer.

> **REQUIRED ROLES: SYSTEMS ADMINISTRATOR, DEVOPS ARCHITECT, SECURITY ADMINISTRATOR, SYSTEMS PROGRAMMER**

The checklist includes a brief description of the steps required for installation of Zowe Explorer. The checklist also identifies the roles that are typically required to complete the step, which enables the pre-installation planning team to focus on the tasks for which they are responsible.

For a printable version of this checklist, click here.

Preparing for installation

Step	Description	Role	Time Estimate
Addressing Zowe Explorer system requirements	Check the following items: • your operating system • development environments	Systems administrator	15 min.
(Optional) Configuring z/OSMF	Confirm that z/OS components, region sizes, and user IDs meet Zowe Explorer requirements. Required step when using a z/OSMF profile connection.	Systems programmer	40 min.
(Optional) Configuring z/OSMF security	Configure security for: • SAF access to REST endpoints • z/OS console REST interface • z/OS data set and file REST services Required step when using a z/OSMF profile connection.	Security administrator	50 min.
(Optional) Installing Zowe CLI	Set up team configuration with Zowe CLI to communicate with the mainframe.	Systems administrator	60 min.

Installing Zowe Explorer

Step	Description	Role	Time Estimate
Installing Zowe Explorer and Zowe Explorer extensions	Install Zowe Explorer and Zowe Explorer extensions from the Visual Studio Marketplace or with a `VSIX` file.	Systems administrator and/or developer	10 min.
Updating Zowe Explorer and Zowe Explorer extensions	Updates are done automatically unless otherwise specified.	Systems administrator and/or developer	10 min.

Configuring Zowe Explorer

Step	Description	Role	Time Estimate
Creating Zowe Explorer profiles	Connect to the mainframe with a Zowe Explorer profile.	Systems administrator	30 min.
Configuring Zowe Explorer	Save your preferences as settings.	Developer	30 min.
Verifying your Zowe Explorer installation	Confirm the connection to z/OSMF.	Systems administrator and/or DevOps architect	15 min.

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Zowe Explorer system requirements

Before installing Zowe Explorer, make sure that you meet the following requirements.

> **REQUIRED ROLES: SYSTEMS ADMINISTRATOR, DEVOPS ARCHITECT**

Client side requirements

Operating systems

- macOS

  > **NOTE**
  >
  > Only Mac operating system versions supported by Apple.

- Unix-like:
  - CentOS 8+
  - RHEL 8+
  - Ubuntu 20.04+
- Windows 10+

Integrated development environments:

- Red Hat CodeReady Workspaces

  > **NOTE**
  >
  > Secure credentials are not supported in Red Hat CodeReady Workspaces as the keyring is not unlocked by default. However, you can use the Kubernetes Secrets plug-in for Zowe CLI and Zowe Explorer as an alternative, or you can create your own Custom Credential Managers in Zowe Explorer and Zowe CLI.

- VS Code 1.79.0+

Server side requirements

- IBM z/OSMF is configured and running.
  - See z/OSMF REST services for Zowe clients for a list of services that need configuration.
- Applicable plug-in services are configured and running on the mainframe.
  - Plug-ins communicate with various mainframe services. The services must be configured and running on the mainframe before issuing plug-in commands.

- See Zowe Explorer CICS Extension system requirements.
- See Zowe Explorer FTP Extension system requirements.

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Installing and updating Zowe Explorer

codecov unknown chat on Slack

> **REQUIRED ROLES: SYSTEMS ADMINISTRATOR**

Install Zowe Explorer directly to Visual Studio Code to enable the extension within the GUI.

Working with data sets and USS files from VS Code can be more convenient than using 3270 emulators, and complements your Zowe CLI experience. The extension provides the following benefits:

- Enables you to create, modify, rename, copy, and upload data sets directly to a z/OS mainframe.
- Enables you to create, modify, rename, and upload USS files directly to a z/OS mainframe.
- Provides a more streamlined way to access data sets, USS files, and jobs.
- Lets you create, edit, and delete Zowe CLI `zosmf` compatible profiles.

> **NOTE**
>
> Zowe Explorer is a subcomponent of Zowe. The extension demonstrates the potential for plug-ins powered by Zowe.

Installing Zowe Explorer

Installing from VS Code Extensions

To install Zowe Explorer:

1. Address the system requirements.
2. Open VS Code, and navigate to the **Extensions** tab on the **Activity Bar**.
3. Type `Zowe Explorer` in the **Search** field.

   `Zowe Explorer` appears in the list of extensions in the **Side Bar**.
4. Click the green **Install** button to install the extension.
5. Restart VS Code.

The extension is now installed and available for use.

Installing from a `VSIX` file

For information about how to install the extension from a `VSIX` file and run system tests on the extension, see the Developer README.

Changing the installed version of Zowe Explorer

Depending on their circumstances, developers might want to run a specific version of Zowe Explorer.

> **IMPORTANT**
>
> Releases older than Zowe Explorer v2.10 do not support secure credentials in Visual Studio Code v1.83+ due to the removal of the keytar library from VS Code.

To install a particular version on VS Code:

1. Refer to Installing Zowe Explorer to install Zowe Explorer for Visual Studio Code if not already installed.
2. In VS Code, select the **Extensions** tab on the **Activities Bar** to display a list of installed extensions.
3. In the **Side Bar**, click the **Manage** icon next to Zowe Explorer to open a dropdown menu that lists available options.
4. Select **Install Another Version...** to open a dropdown menu that lists previous versions of Zowe Explorer.
5. Click the version of Zowe Explorer you want to install.

Preventing automatic updates to retain a specific version

By default, VS Code automatically updates extensions as new versions are released. Refer to the following steps to prevent automatic updates:

1. On the VS Code menu bar, click **File**, **Preferences**, and click **Settings** to display the Settings editor.
2. Select the **User** or **Workspace** tab, depending on which settings you want to update.
3. In the Settings navigation menu, click **Features** and click **Extensions**.
4. In the **Auto Update** dropdown menu, select **None**. This prevents VS Code from updating your extensions automatically.

   VS Code is configured to stop updating your extensions, and Zowe Explorer extensions, automatically.

Installing Zowe Explorer extensions

Installing from VS Code Extensions

1. Navigate to **Extensions** tab of your VS Code application.
2. In the **Search** field, enter the name of the Zowe Explorer extension.

   The name of the extension appears in the list that displays in the **Side Bar**.
3. Click **Install** at the top of the page.

   The selected extension is installed in VS Code.

Installing Zowe Explorer Extension for FTP from a `VSIX` file

1. Go to the Zowe Explorer Extension for FTP download site.
2. Select the `DOWNLOAD` button to download the latest version of the `.vsix` file.

3. Open the Extensions icon in the **Side Bar**, navigate to the **...** menu, select **Install from VSIX ...** and select the downloaded `Zowe.zowe-explorer-ftp-extension-3.x.x-next.<DATE>` file.

   A message displays to confirm the installation was successful.

4. Close and reopen VS Code to check that the notification message "Zowe Explorer was modified for FTP support" displays.

   Once installed, the notification displays every time you open VS Code to confirm that the FTP extension is available.

Updating Zowe Explorer and Zowe Explorer extensions

By default, VS Code automatically updates extensions as new versions are released. To stop automatic updates, see Preventing automatic updates to retain a specific version.

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Installing Zowe Explorer extensions

To successfully install Zowe Explorer extensions, meet the following system requirements.

Zowe Explorer CICS Extension system requirements

Client side requirements

- Visual Studio Code
- Zowe Explorer V3

Server side requirements

The following services must be installed, configured, and running on the mainframe:

- CICS Management Client Interface (CMCI) APIs
- z/OSMF (optional but recommended)

Zowe Explorer FTP Extension system requirements

Client side requirements

- Visual Studio Code
- Zowe Explorer V3

Server side requirements

- Ensure that you can obtain remote access to a z/OS FTP service before using the extension.
- Some functionality within the FTP extension requires the FTP server on the mainframe to be configured with the `JESINTERFACELevel` parameter set to `2`. For more information, see the JESINTERFACELEVEL (FTP server) statement.

  The `JESINTERFACELevel` parameter can be found in multiple locations within the mainframe, depending on your site's security policies.

  Contact your system administrator to determine if your FTP server is configured with the correct `JESINTERFACELevel`. For more information, see FTP configuration statements in FTP.DATA.

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Installing Zowe Explorer CICS Extension

Installation methods

Install or update the Zowe Explorer CICS Extension from Visual Studio Code Extensions or from a `VSIX` file.

Installing from Visual Studio Code Extensions

1. Select the **Extensions** tab on the **Side Bar** of the VS Code application.
2. Search for `Zowe Explorer for IBM CICS` and select the matching search result.
3. Click the **Install** button at the top of the **Editor** page.

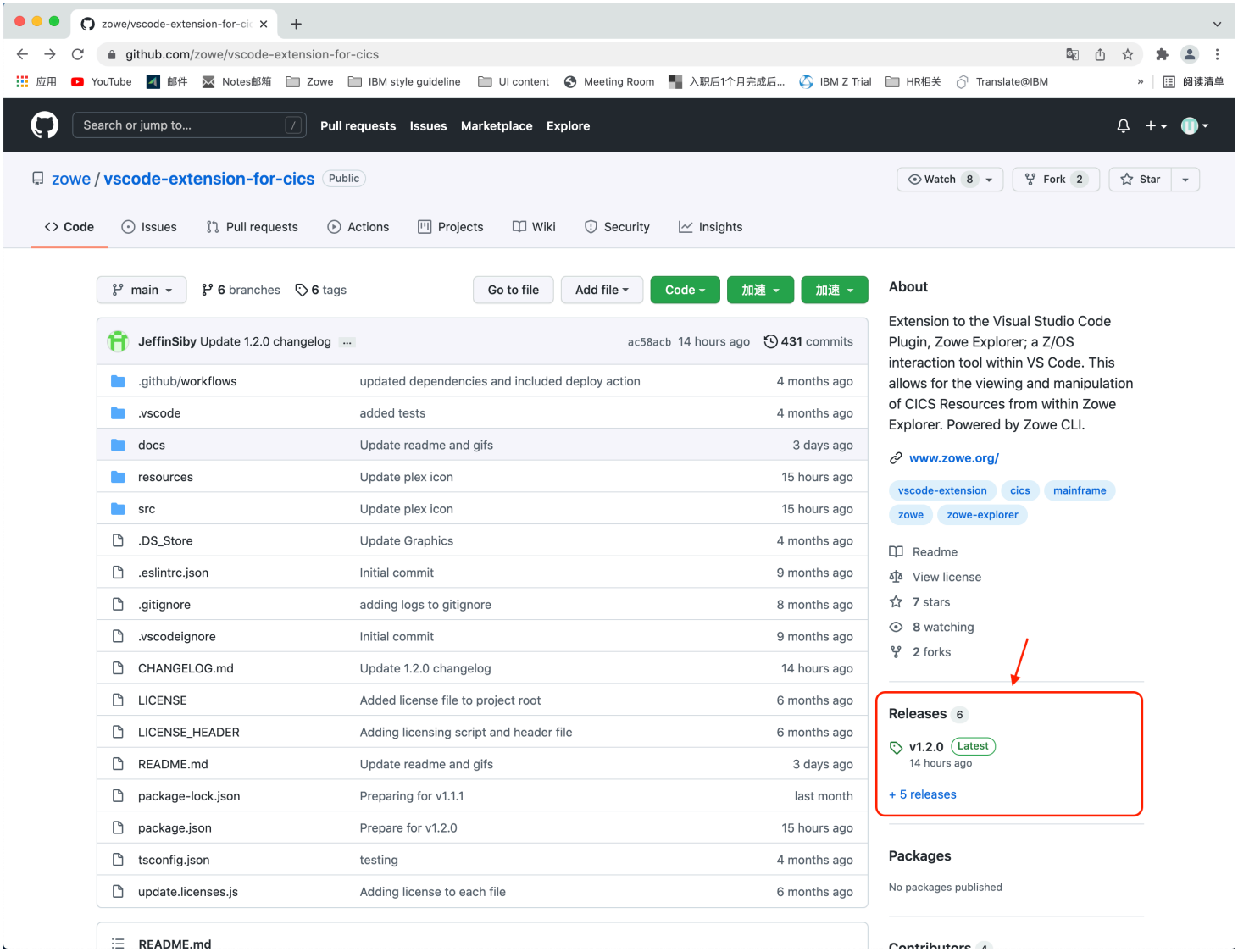
   The extension is installed. If Zowe Explorer is not already installed, it also installs automatically.

Installing from a `VSIX` file

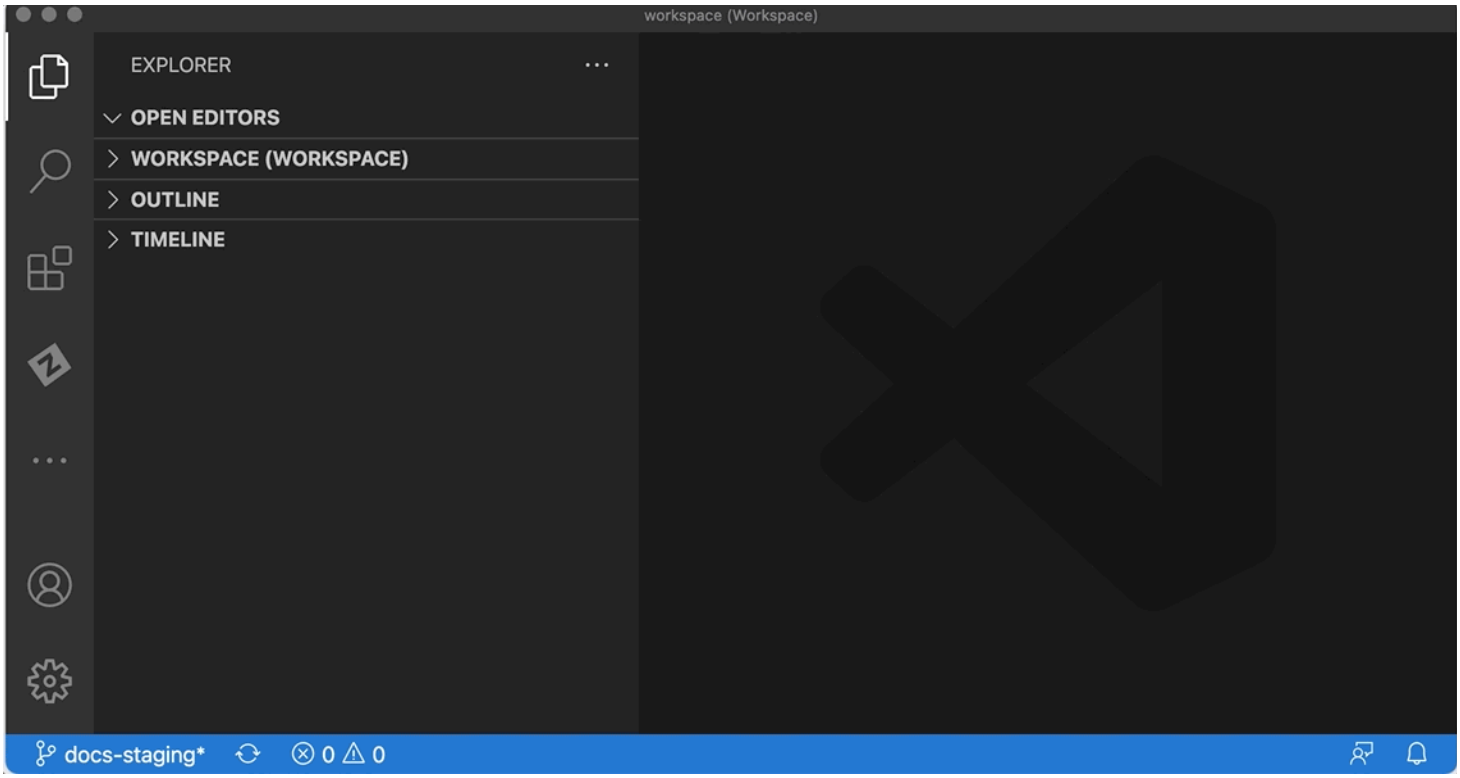
Before you install Zowe Explorer CICS Extension from a `VSIX` file, ensure that Zowe Explorer is installed. Zowe Explorer is a required dependency. See Installing Zowe Explorer for instructions..

If Zowe Explorer is installed, you can install Zowe Explorer CICS Extension from a `VSIX` file.

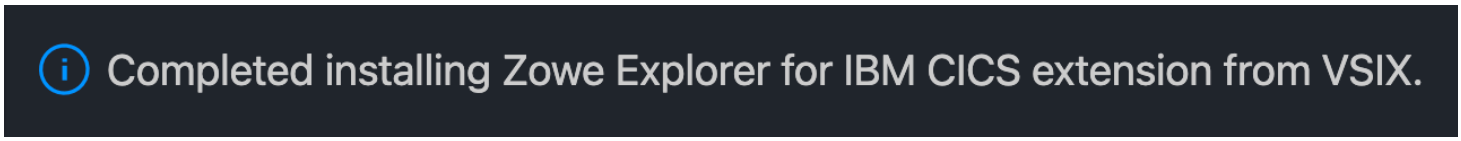
1. Go to the Zowe Explorer for IBM CICS Extension download site. Select the **Latest** button, which directs to a page that includes the latest version of the `.vsix` file. Download it to your PC.



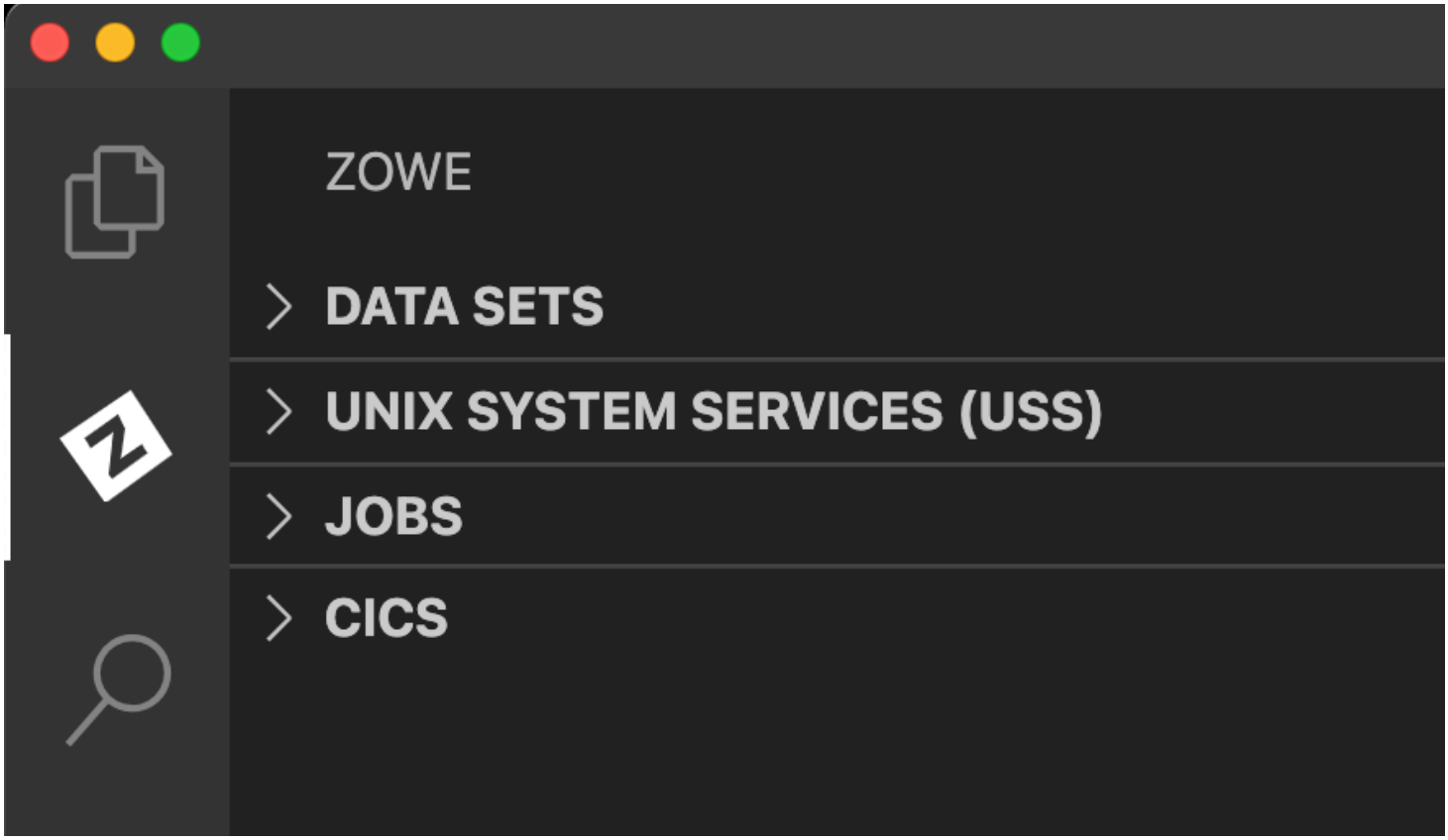
2. Open the Extensions icon in the **Side Bar**, navigate to the **...** menu, select **Install from VSIX ...** and select the downloaded `Zowe.cics-extension-for-zowe-3.x.x.vsix` file.



The following message indicates that the extension is installed successfully.



The Zowe Explorer pane shows tree views for **Data Sets**, **Unit System Services (USS)** and **Jobs**, and a new view for **CICS**.


ZOWE
DATA SETS
UNIX SYSTEM SERVICES (USS)
JOBS
CICS

Version: v3.2.x LTS

Zowe Explorer FTP Extension

Zowe Explorer FTP extension adds the FTP protocol to the Zowe Explorer VS Code extension, allowing you to use z/OS FTP profiles to connect and interact with z/OS USS.

Installing

1. Install the VS Code extension from the Microsoft or Open VSX marketplace.

   > **NOTE**
   >
   > The installation includes Zowe Explorer if it is not already installed as it is a required dependency.

2. Close and reopen VS Code to check that the notification message "Zowe Explorer was modified for FTP support" displays.

   Once installed, the notification displays every time you open VS Code to confirm that the FTP extension is available.

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Creating Zowe Explorer profiles

After you install Zowe Explorer, you must have a Zowe Explorer profile to use all functions of the extension.

> **REQUIRED ROLES: SYSTEMS ADMINISTRATOR**

Configuring Zowe profiles

Zowe uses team configuration to simplify profile management by letting you edit, store, and share mainframe connection details in one location, a configuration file.

You can use a text editor or an IDE to populate configuration files with profiles, which contain the connection information for your mainframe services. By default, your *global* team configuration file is located in the `.zowe` folder in your home folder, whereas a *project* configuration file is located in the main directory of your project.

> **NOTE**
>
> When multiple profiles with the same name are available in Zowe Explorer, project configuration takes precedence over global configuration. To learn more, see How Zowe CLI uses configurations.

Creating team configuration files

Create a team configuration file:

1. Navigate to the explorer tree.
2. Hover over **DATA SETS**, **USS**, or **JOBS**.
3. Click the **+** icon.
4. Select **Create a New Team Configuration File**.
5. If no workspace is open, a global configuration file is created. If a workspace is open, choose either a global configuration file or a project-level configuration file.
6. Edit the configuration file to include the host information and save the file.
7. Refresh Zowe Explorer by either clicking the button in the notification message shown after creation, `alt` + `z`, or the `Zowe Explorer: Refresh Zowe Explorer` command palette option.

   Your team configuration file appears either in your `.zowe` folder if you choose the global configuration file option, or in your workspace directory if you choose the project-level configuration file option. The notification message that displays in VS Code after the configuration file creation includes the path of the file created.

Managing profiles

Change profile validations and edit the profiles in your project or global configuration files:

1. Right-click on a profile icon in the **DATA SETS**, **USS**, or **JOBS** tree view.
2. Select the **Manage Profile** option to choose from several authentication and profile management actions for the credentials detected in your Zowe Explorer session.

   Authentication options display according to the detected credentials:

   - **Add Credentials** to store a username and password. Credentials are stored securely in the credential vault when the team or user profile has values in the `secure` array. Otherwise, the credentials are stored as plain text in the profile.
   - **Update Credentials** to update the username and password. Credentials are stored securely in the credential vault when the team or user profile has values in the `secure` array. Otherwise, the credentials are stored as plain text in the profile.
   - **Log in to authentication service** to obtain a new authentication token when the token in the profile is no longer valid or is missing.
   - **Log out of authentication service** to invalidate the token in the profile so a valid token is not stored.

   Profile management options displays for specific profile actions:

   - **Disable/Enable Profile Validation** to disable or enable validation of access to z/OSMF.
   - **Edit Profile** to update profile information in an **Editor** tab.
   - **Hide Profile** to hide the profile name from the tree view.
   - **Delete Profile** to manually remove the profile information in an **Editor** tab.
3. Refresh the view by clicking the **Refresh** icon in the **DATA SETS**, **USS**, or **JOBS** tree view.

   You successfully edited your configuration file.

Example profiles configuration

Review the profile examples below to understand how settings are organized in a configuration file. In this example, the default `lpar1.zosmf` profile is loaded upon activation.

You can use this example to customize your own profiles in a configuration file. Ensure that you edit the `host` and `port` values before you work in your environment.

Using base profiles and tokens with existing profiles

As a Zowe user, you can leverage the base profile functionality to access multiple services through Single Sign-on. Base profiles enable you to authenticate using Zowe API Mediation Layer (API ML). You can use base profiles with more than one service profile. For more information, see Base Profiles.

::: note

If you want to access services through multiple API ML gateways, the same following steps apply. However, you must first edit your configuration file to follow a specific structure.

Review Accessing services for multiple API ML instances to see how profiles are structured in the configuration file.

:::

Accessing services through API ML using SSO

Connect your service profile with a base profile and token:

1. Right-click on the profiles you want to connect through with API ML.
2. Select the **Manage Profile** option from the context menu
3. In the **Quick Pick**, select **Log in to Authentication Service**.
4. In the next **Quick Pick** menu, select the appropriate option for authenticating to API ML
5. Answer the proceeding prompts for information.

   Tokens are stored either in a base profile or, if using a nested profile structure, in a parent profile that has a secure array that contains `tokenValue`. If not using a nested profile structure, and if a base profile does not exist, a base profile is created that contains your token. For more information about API integration and using tokens, see Token Management.

Logging out of API ML using SSO

If you do not want to store your token, request the server to revoke your token and delete it from your local profile. Use the **Log out from Authentication Service** feature to invalidate the token.

1. Open Zowe Explorer.
2. Right-click your profile.
3. Select the **Manage Profile** option.
4. In the **Quick Pick**, select the **Log out from Authentication Service** option.

   Your token has been successfully invalidated.

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Configuring Zowe Explorer

> **REQUIRED ROLE: DEVELOPER**

Configure Zowe Explorer in the settings file so the extension performs according to your preferences.

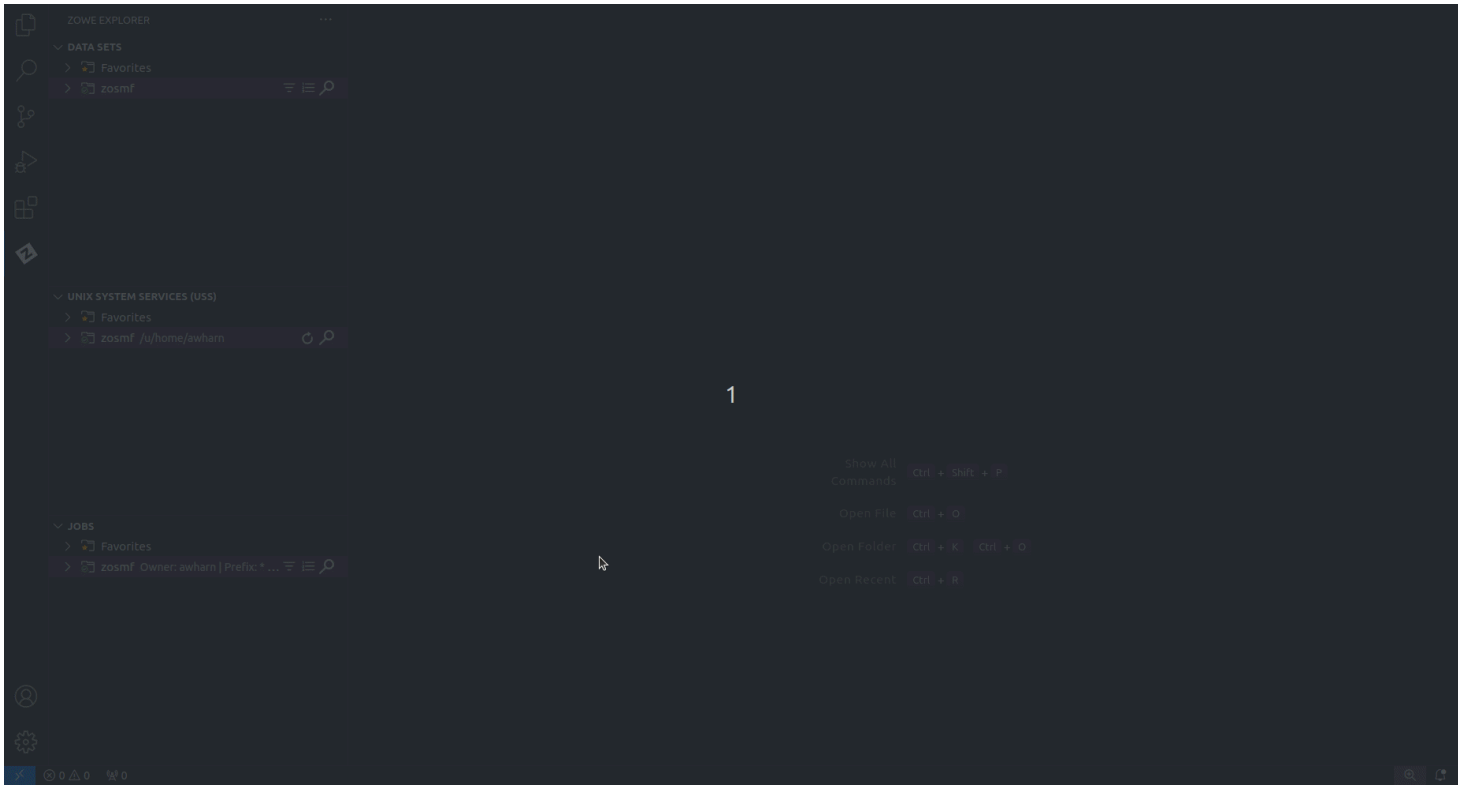
To access Zowe Explorer settings:

1. Click the **Manage** icon at the bottom of the **Activity Bar**.
2. Select the **Settings** option.
3. Open the **Extension** option listed in the **Commonly Used** menu.
4. Select **Zowe Explorer** to access its settings.
5. Scroll the list to find the setting that needs modification.

Modifying creation settings for data sets, USS files, and jobs

1. In Zowe Explorer settings, scroll to a data set, USS file, or job setting type.
2. Click the setting's corresponding **Edit in settings.json** link.

   This opens the `settings.json` file in an **Editor** tab. (The suggestions widget also opens if the functionality is enabled.)
3. Edit the settings in the file as needed.
4. Save the file to keep changes.



Modifying REST timeout settings

1. Navigate to Zowe Explorer Settings.
2. Scroll to **Zowe › Settings**.
3. Determine which REST timeout to change:
    - **Socket Connect Timeout** - Specify the maximum number of milliseconds to wait for the REST client to perform the initial connection and handshake with the server.
    - **Request Timeout** - Specify the maximum number of milliseconds to wait for a REST request to complete.

Modifying pagination options for data sets

Zowe Explorer v3.2 and above have pagination enabled by default when listing data sets and PDS members, splitting the results into pages rather than showing all items at once. To configure the number of data sets and PDS members to display per page:

1. Navigate to Zowe Explorer settings.
2. Scroll to **Zowe › Ds › Paginate: Data Sets Per Page**.
3. Specify the number of items to list per page in the input box. Set the value to zero to disable pagination for data sets and PDS members.

Modifying the `Secure Credentials Enabled` setting

When environment conditions do not support the Zowe CLI built-in credential manager, change the `Secure Credentials Enabled` setting:

1. Navigate to Zowe Explorer settings.
2. Scroll to **Security: Secure Credentials Enabled**.
3. Deselect the checkbox to disable secure credentials.

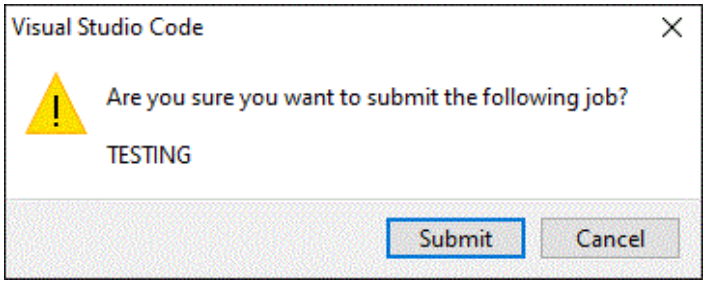
    When disabled, if the `autoStore` setting in the `zowe.config.json` file is set to `true`, z/OS credentials are stored as text in the file.

    If the `autoStore` setting is set to `false`, you are prompted for the missing credentials in VS Code. The credentials are stored and used for the duration of the session.

Setting confirmation requirements for submitting jobs

Submitting the wrong job can risk potential problems on your server. This can happen when the user enters the wrong job or inadvertently selects the **Submit Jobs** option.

To help prevent this, enable the option to require confirmation before submitting a job. Once enabled, a dialog window asking for user confirmation displays when **Submit Jobs** is selected.



To configure confirmation settings for submitting a job:

1. On the VS Code menu bar, click **File**, **Preferences**, and click **Settings** to display the Settings editor.
2. Select the **User** or **Workspace** tab, depending on the settings you want to update.
3. In the Settings navigation menu, open the **Extensions** menu and click **Zowe Explorer**.
4. In the **Jobs: Confirm Submission** section, open the drop-down menu to select a different confirmation setting.
    - If enabled, a confirmation dialog displays when a job matching the selected option is submitted.

Modifying level of detail included in logs

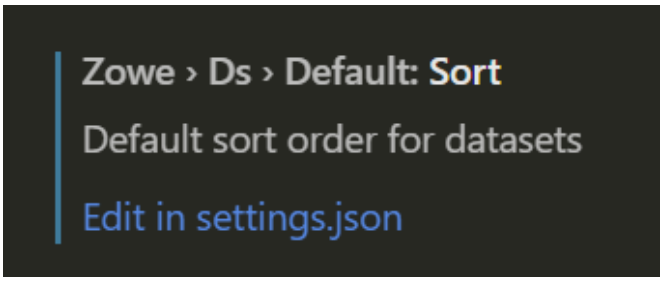
To define the level of detail included in log files:

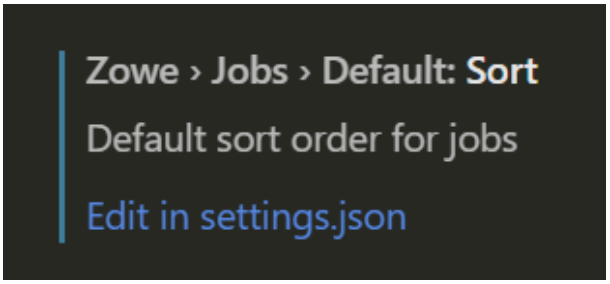
1. On the VS Code menu bar, click **File**, **Preferences**, and click **Settings** to display the Settings editor.
2. Select the **User** or **Workspace** tab, depending on the settings you want to update.
3. In the Settings navigation menu, open the **Extensions** menu and click **Zowe Explorer**.
4. In the **Logger** section, open the drop-down menu to select a different detail setting.

Modifying the default sort order for data sets and jobs

To change the default sort order for data sets and jobs:

1. In Zowe Explorer settings, scroll to a data set or job setting type.
2. Click the setting's corresponding **Edit in settings.json** link.
3. This opens the `settings.json` file in an **Editor** tab.





TIP

> Alternately, on the VS Code Command Palette (`Ctrl`/`Cmd` + `Shift` + `P`), enter **Preferences: Open User Settings (JSON)** to display the Settings editor.

The following allowed directions are available for sorting both data sets and jobs:

Direction	Description
`Ascending`	Sorts in ascending order.
`Descending`	Sorts in descending order.

The following allowed methods are available for sorting data sets:

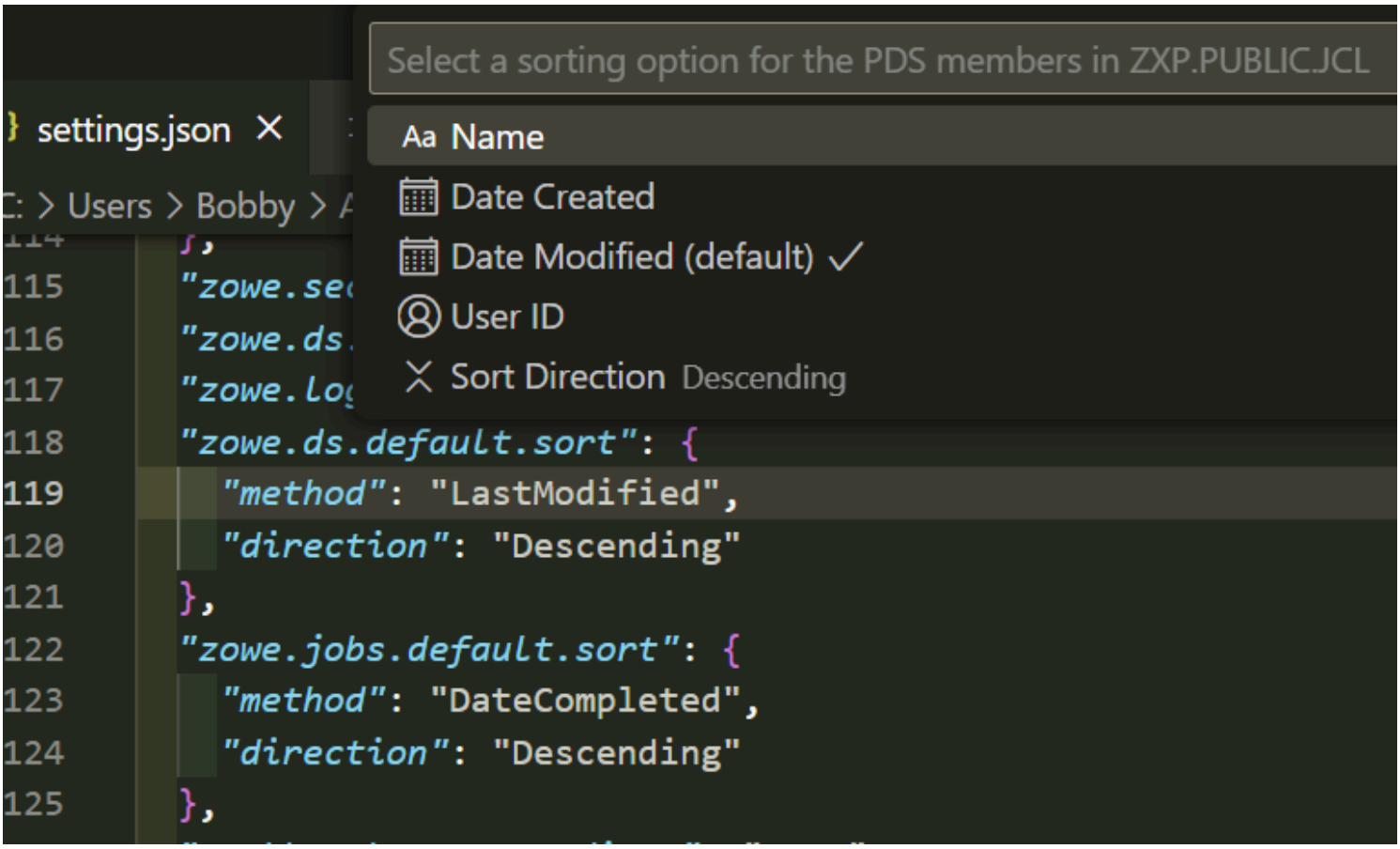
Method	Description
`Name`	Sorts by the name of the data set.
`DateCreated`	Sorts by the date the data set was created.
`LastModified`	Sorts by the date the data set was last modified.
`UserId`	Sorts by the user ID who last modified the data set.

The following allowed methods are available for sorting jobs:

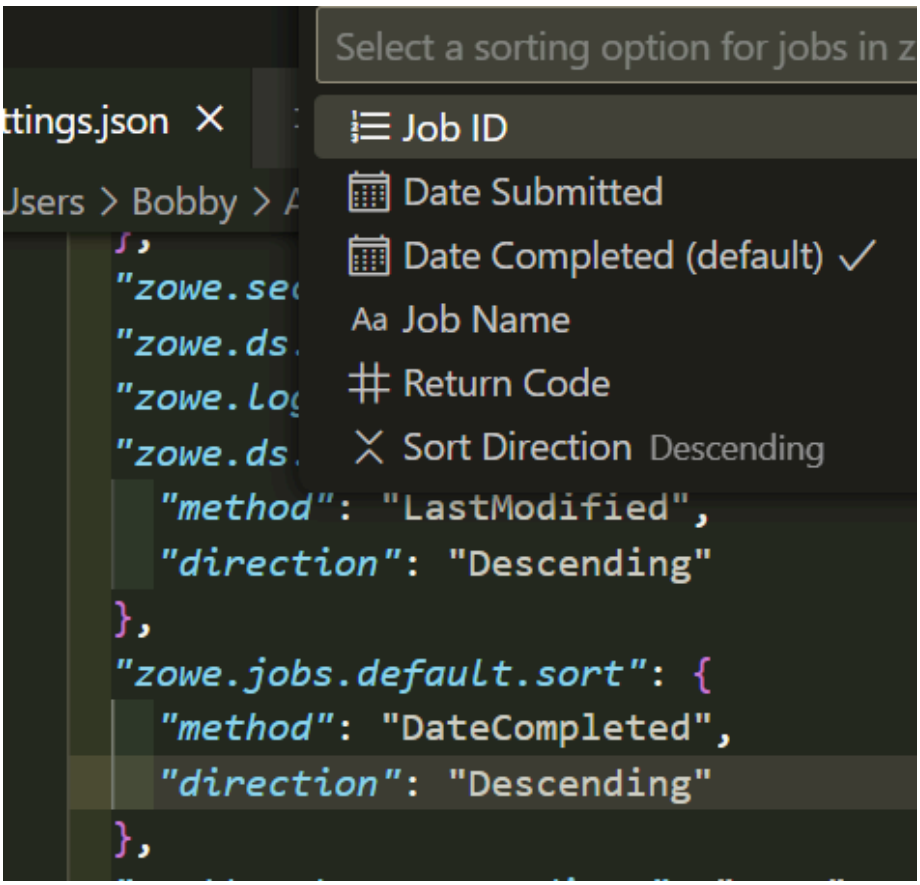
Method	Description
`Id`	Sorts by the job ID.
`DateSubmitted`	Sorts by the date the job was submitted.
`DateCompleted`	Sorts by the date the job was completed.
`JobName`	Sorts by the name of the job.
`ReturnCode`	Sorts by the return code of the job.

Examples

To change the default data set sort order to `LastModified` in `Descending` order, change the following setting in the `settings.json` file:



To change the default data set sort order to `DateCompleted` in `Ascending` order, change the following setting to the `settings.json` file:



Version: v3.2.x LTS

Verifying your Zowe Explorer installation

Verify that Zowe Explorer has been installed successfully by searching data sets to test your connection to z/OSMF.

REQUIRED ROLES: SYSTEMS ADMINISTRATOR, DEVOPS ARCHITECT

Using your profile to search data sets

1. Expand **DATA SETS** in the **Side Bar**, and hover over the profile you want to filter.
2. Click the **Search** icon.
3. Use the **input box** field to enter your username and password when prompted.
4. Select the **+ Create a new filter** option.
5. Enter the criteria to filter search results.

   If Zowe Explorer is able to connect with z/OSMF and the user credentials are valid, the filtered data sets display in the **DATA SETS** tree view.

   If there is a problem with the z/OSMF connection and/or user credentials, an error displays. See Troubleshooting Zowe Explorer for possible next steps.

Version: v3.2.x LTS

Uninstalling Zowe Explorer

You can uninstall Zowe™ Explorer from Visual Studio Code (VS Code) if you no longer need to use it.

REQUIRED ROLES: SYSTEMS ADMINISTRATOR

IMPORTANT

The uninstall process does not delete the profiles and credentials that you created when using the product from your computer. To delete the profiles from your computer, delete them before you uninstall Zowe Explorer.

Uninstalling the Zowe Explorer VS Code extension

Uninstall Zowe Explorer once any installed Zowe Explorer extensions have already been removed. See Uninstalling Zowe Explorer CICS Extension and Uninstalling Zowe Explorer FTP Extension for instructions.

1. Navigate to the **Extensions** icon on the **Activity Bar** in VS Code to display a list of installed extensions.
2. Find `Zowe Explorer` and click it.

   An Editor tab opens with the marketplace page for Zowe Explorer.
3. Click **Uninstall** at the top of the Editor tab.
4. A reload may be required. If a button appears for reload, click it.

   Zowe Explorer is no longer installed.

Uninstalling Zowe Explorer CICS Extension

To uninstall the Zowe Explorer CICS Extension:

1. Navigate to the **Extensions** icon on the **Activity Bar** in VS Code to display a list of installed extensions.
2. Find `Zowe Explorer for IBM CICS` and click it.

   An Editor tab opens with the marketplace page for Zowe Explorer CICS Extension.
3. Click **Uninstall** at the top of the Editor tab.
4. A reload may be required. If a button appears for reload, click it.

   Zowe Explorer CICS Extension is no longer installed.

Uninstalling Zowe Explorer FTP Extension

To uninstall the Zowe Explorer FTP Extension:

1. Click the **Extension** icon on the **Activity Bar** in VS Code to display a list of installed extensions.
2. Find `Zowe Explorer FTP Extension` and click it.

   An Editor tab opens with the marketplace page for Zowe Explorer FTP Extension.
3. Click **Uninstall** at the top of the Editor tab.
4. A reload may be required. If a button appears for reload, click it.

   Zowe Explorer FTP Extension is no longer installed.

Version: v3.2.x LTS

Prerequisites

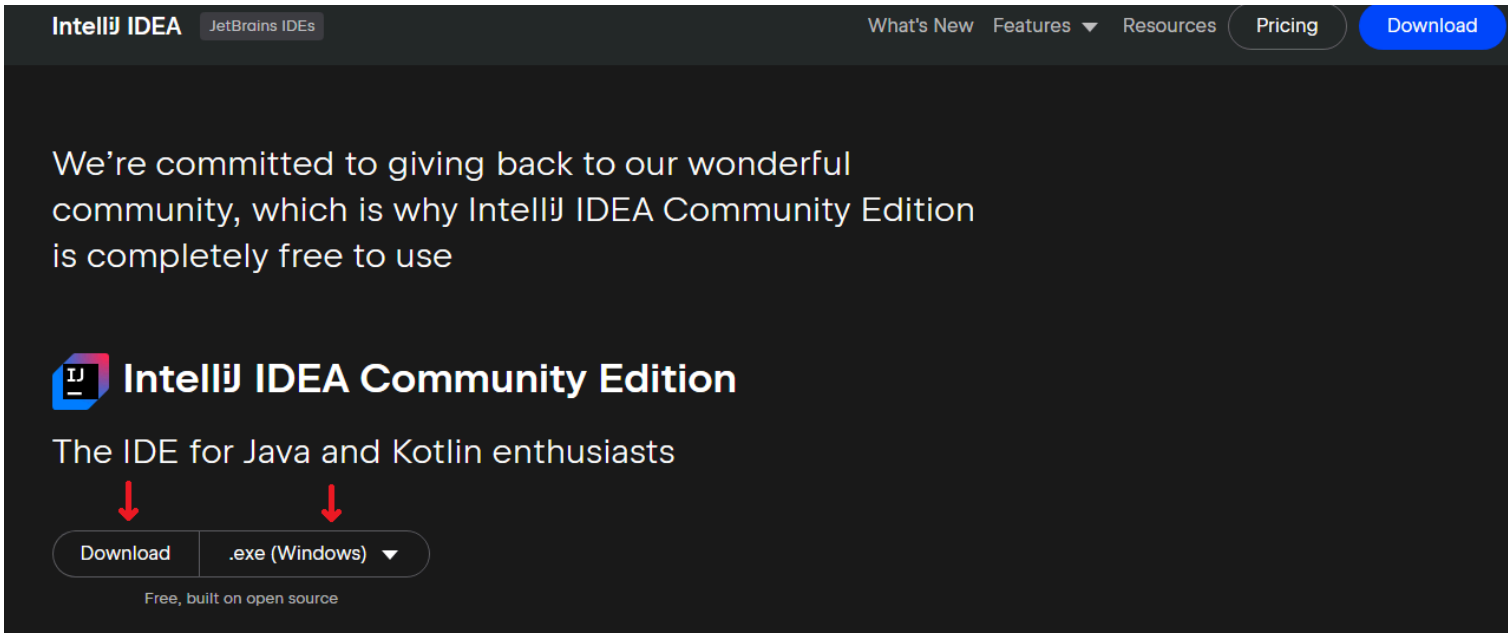
The plug-in is supported on all of the operating systems with GUI. To use the plug-in, you need to install an IntelliJ IDEA platform's IDE. The platform has a nubmer of IDEs for different purposes. E.g. if you have Java/Kotlin developers, there is an IntelliJ IDEA IDE, for Python developers, there is a PyCharm IDE, for web developers, there is a WebStorm IDE, etc.

There are two **Community** versions of the IDEs: **IntelliJ IDEA Community** and **PyCharm Community**. It means that these IDEs are open-source and free of charge. The plug-in is supported on any IntelliJ IDEA IDE, it is enough to have the **Community** version of any of the IDEs to work with the plug-in.

> **NOTE**
>
> Most of the other IntelliJ IDEA IDEs are available under the *Ultimate* version. It means that they are available to use after purchasing them. They have a 30-day trial if you want to try them before the purchase.

To install the **IntelliJ IDEA Community**:

1. Proceed to the official JetBrains download page
2. Scroll down to the **Community** version of the IDE, select the binary to download



3. After the binary is downloaded, walk through the installation wizard and install the IDE

After these steps, you will be ready to proceed with the plug-in installation.

Version: v3.2.x LTS

Installing the plug-in

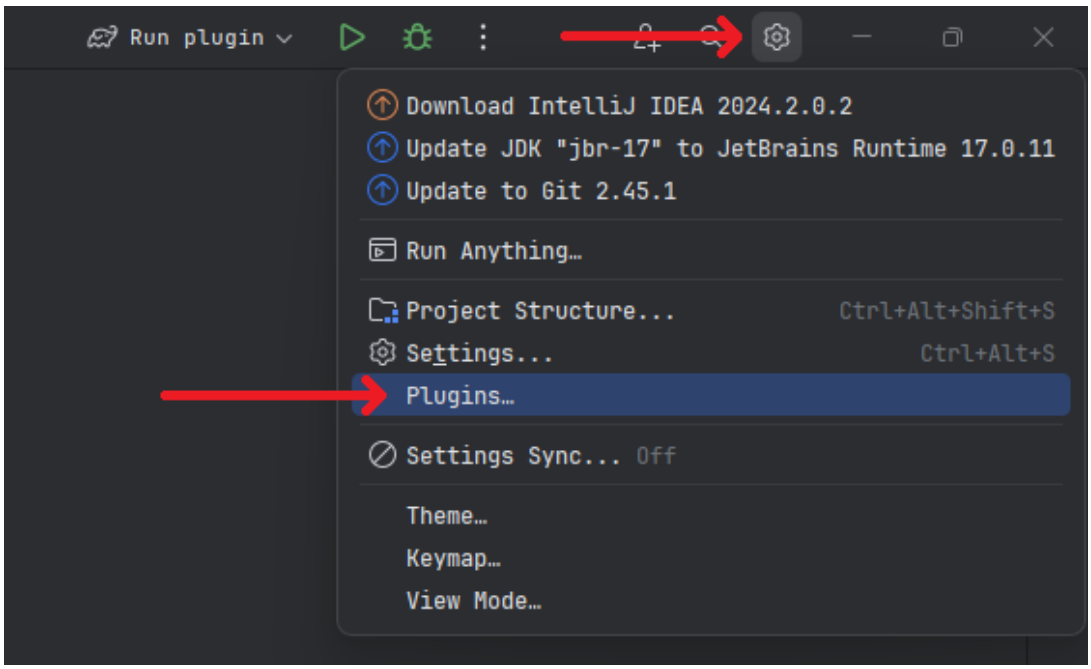
There are two ways to install the plug-in:

1. **(Preferred)** Install the plug-in directly inside IntelliJ IDEA
2. Download and install binaries either from JetBrains Marketplace page or from our GitHub repository

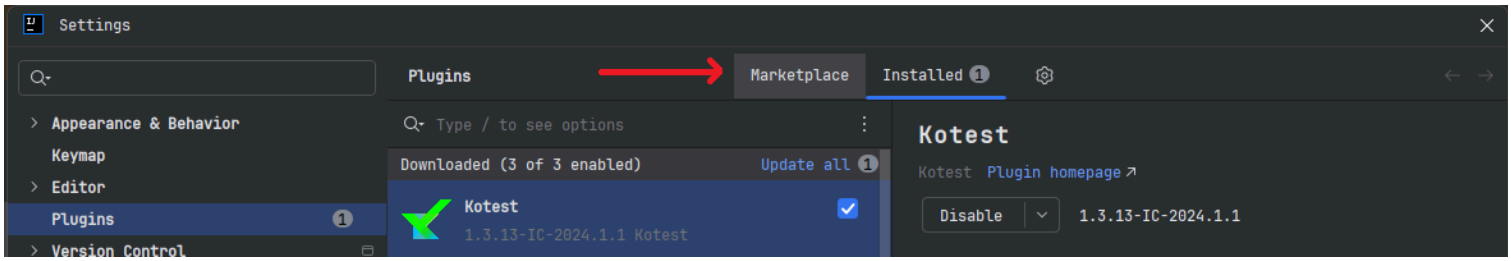
Installing inside IntelliJ IDEA

To install the plug-in from IntelliJ:

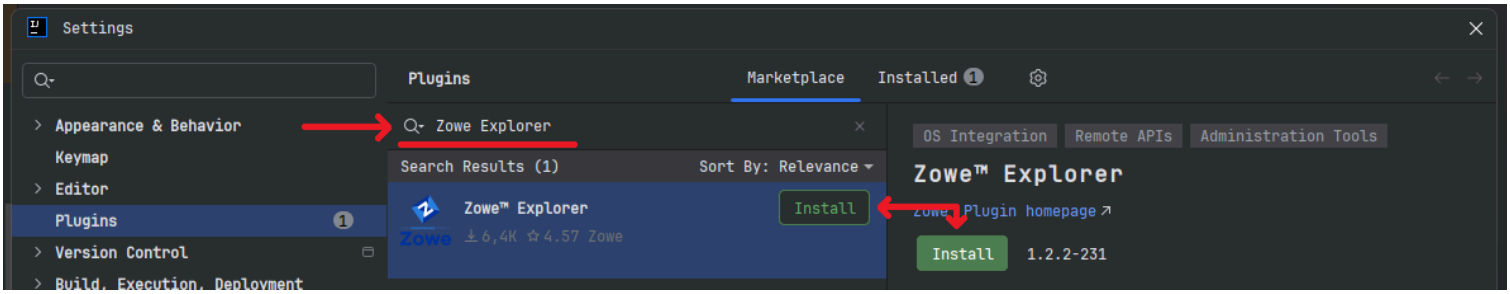
1. At the right top corner click the gear button and from the dropdown list select the **Plugins** option



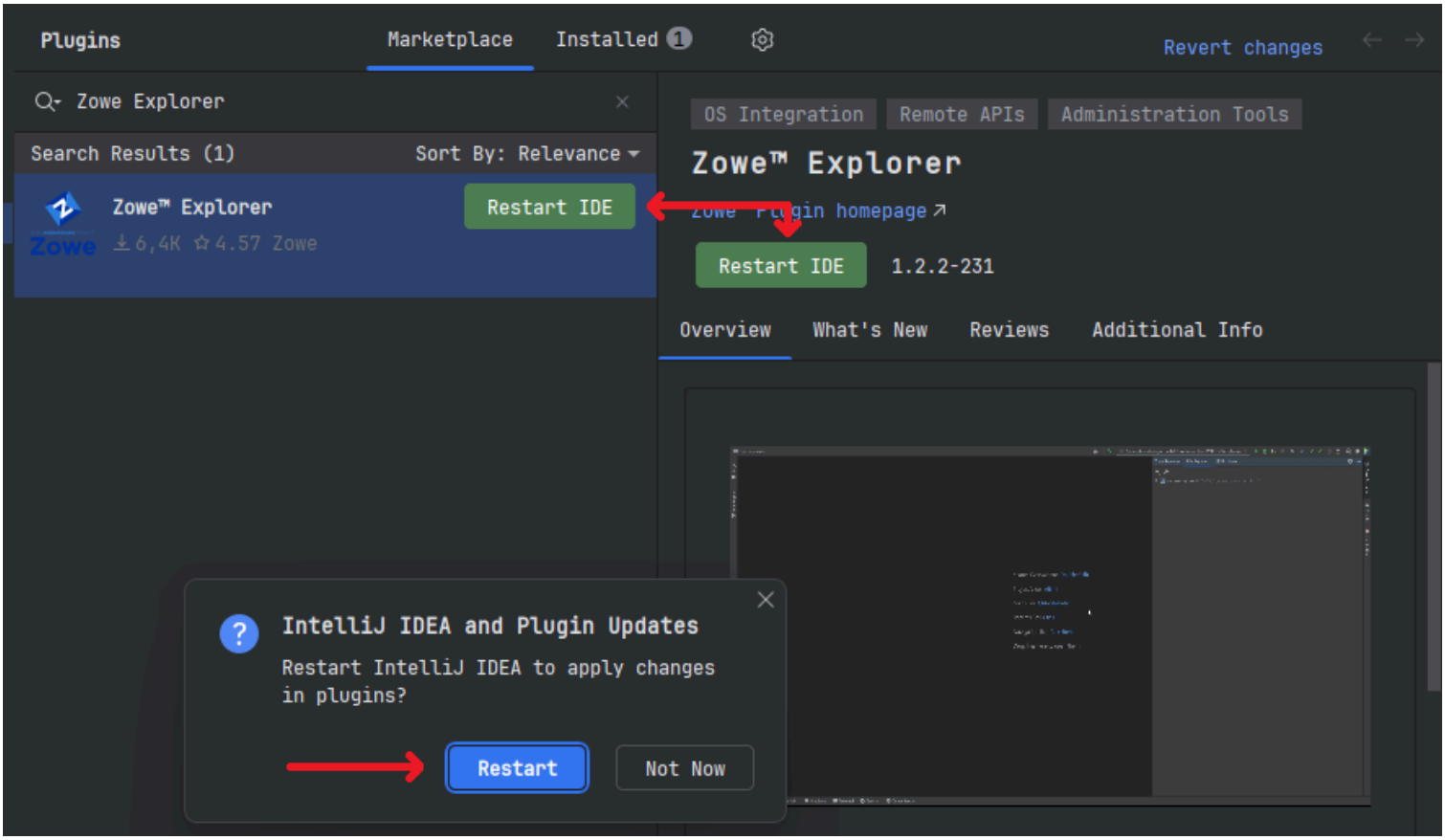
2. Select the **Marketplace** tab on top of the window



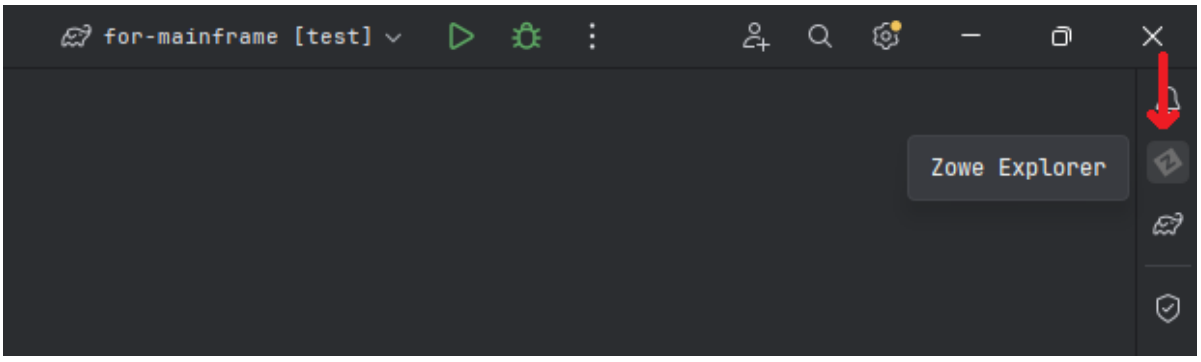
3. Type **Zowe Explorer** and click **Install**.



4. Wait until the plug-in is installed, then click **Restart IDE**. IntelliJ IDEA will ask you if you want to restart the IDE to applly all the changes in plugins. Select **Restart**, wait until the IDE is restarted

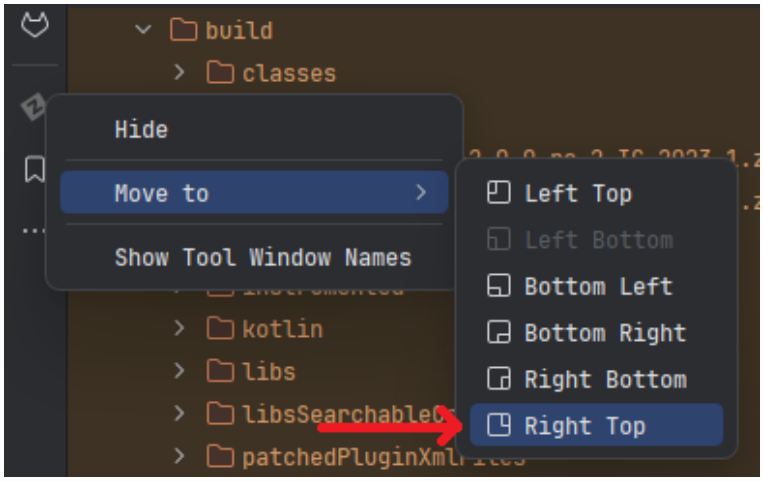


After the IDE is restarted, the plug-in's icon will appear at the right top corner. It means that you are ready to work with it.



> **NOTE**

> Sometimes the plug-in's icon appear at some different place, other than the right top corner. To fix it, right-click on the icon, in the **Move To** dropdown select the **Right Top** option.



Downloading binaries

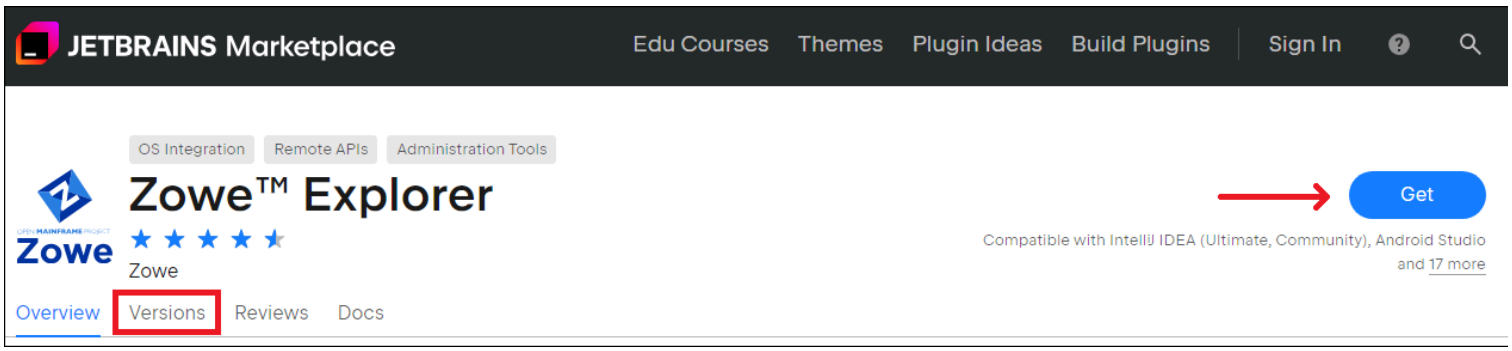
> **⚠ ALWAYS DOUBLE-CHECK THE BINARIES YOU ARE TRYING TO INSTALL!**
>
> We are responsible for the genuine software provided by the zowe community only. If you have any questions regarding the installation or the usage of the plug-in, feel free to contact any person directly related to Zowe

There are three ways of downloading binaries of the Zowe Explorer plug-in for IntelliJ IDEA:

1. JetBrains Marketplace page
2. GitHub Releases of our repository
3. GitHub Actions of our repository

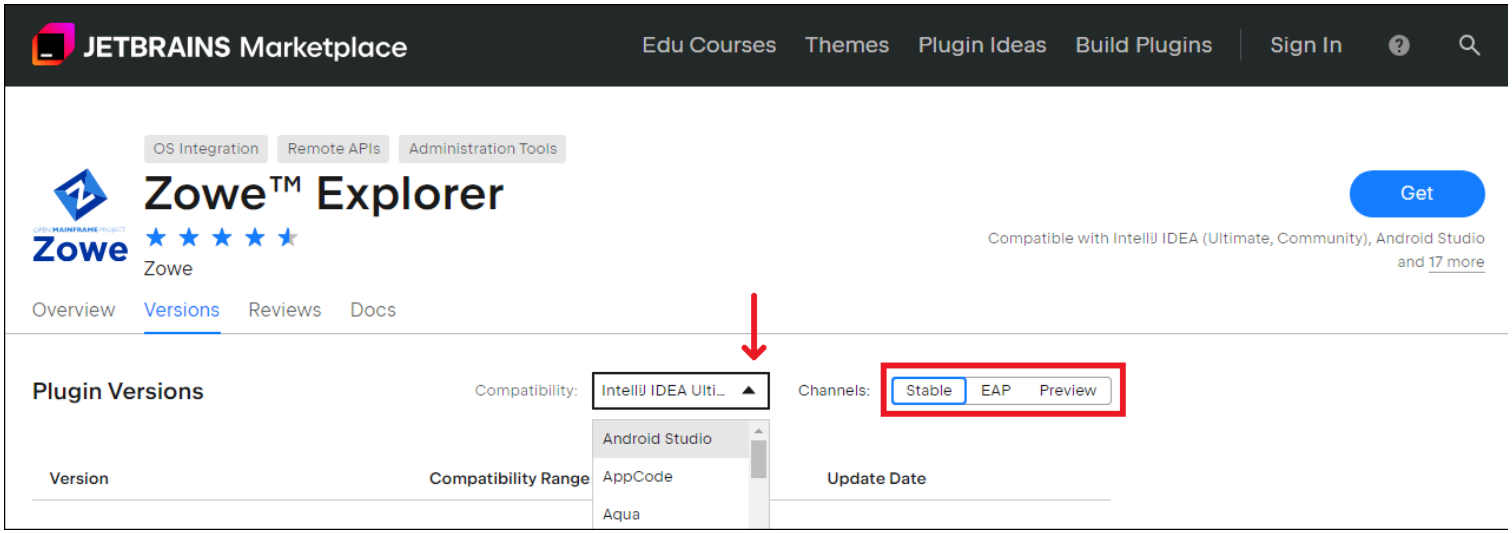
Downloading binaries from JetBrains Marketplace page

1. Proceed to the JetBrains Marketplace page of the plug-in
2. Click **Get** button or select the **Versions** tab

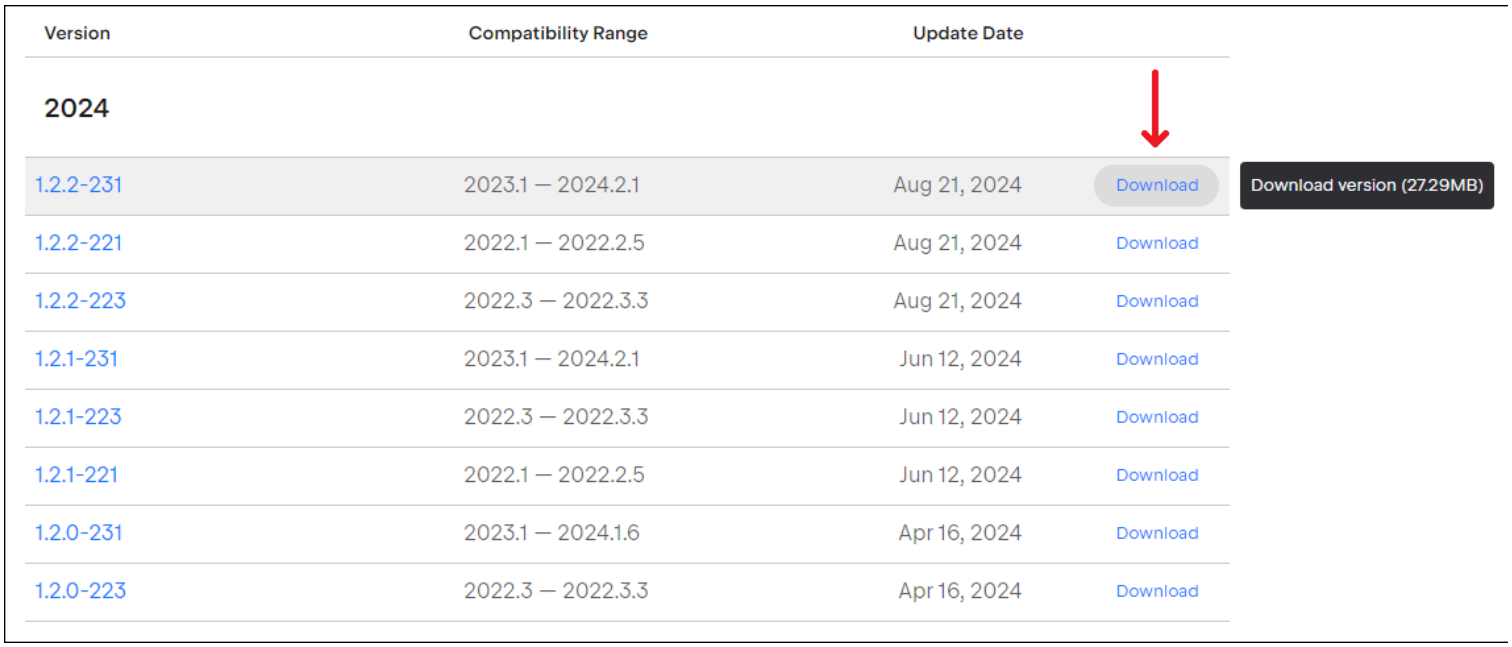


3. Select the compatibility option and the channel of the distribution:
   - **Stable** - the stable versions of the plug-in
   - **EAP** - the *Early Access Program* versions of the plug-in, sometimes are provided for the EAP versions of the IntelliJ IDEA

- **Preview** - the next versions of the plug-in, that contain the bleeding-edge features of the plug-in, which may be unstable



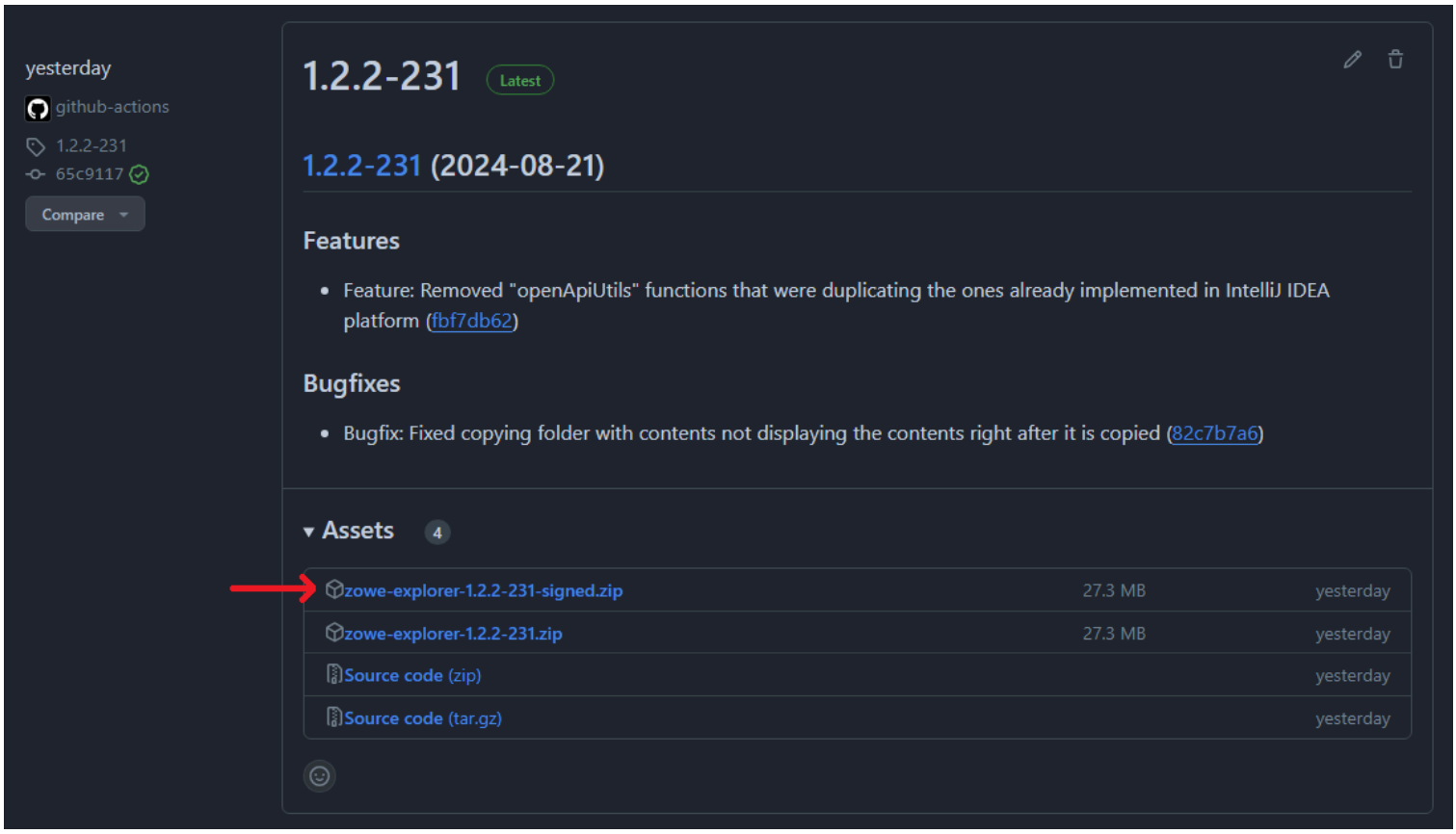
4. Select the version of the plug-in you want to download, click **Download** button against it



Downloading binaries from GitHub Releases

1. Proceed to the GitHub Releases of the repository
2. Select the release version you want to install and click on the .zip file to download the binary

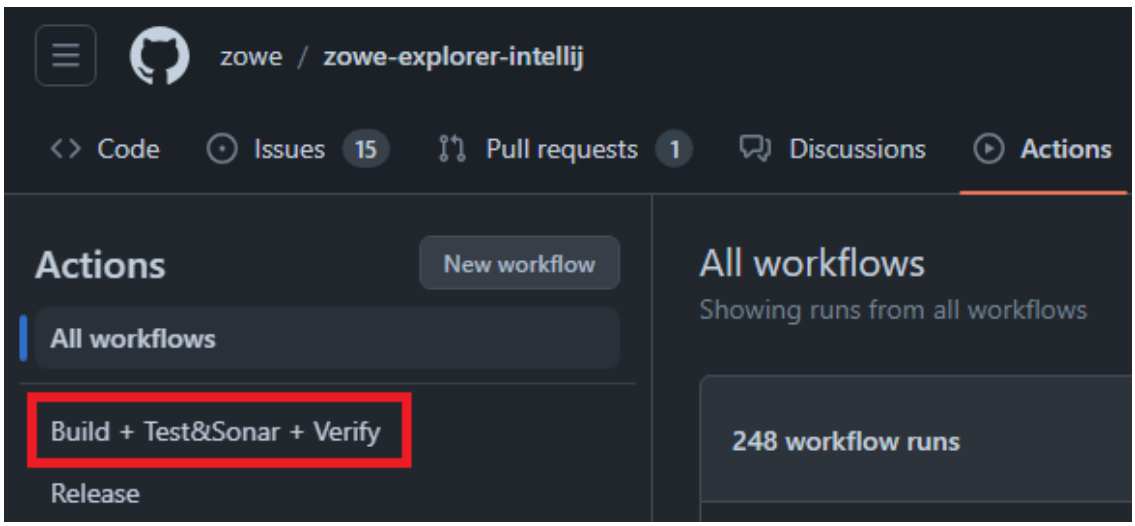
> **NOTE**
>
> Prefer the "*-signed.zip" over the regular one



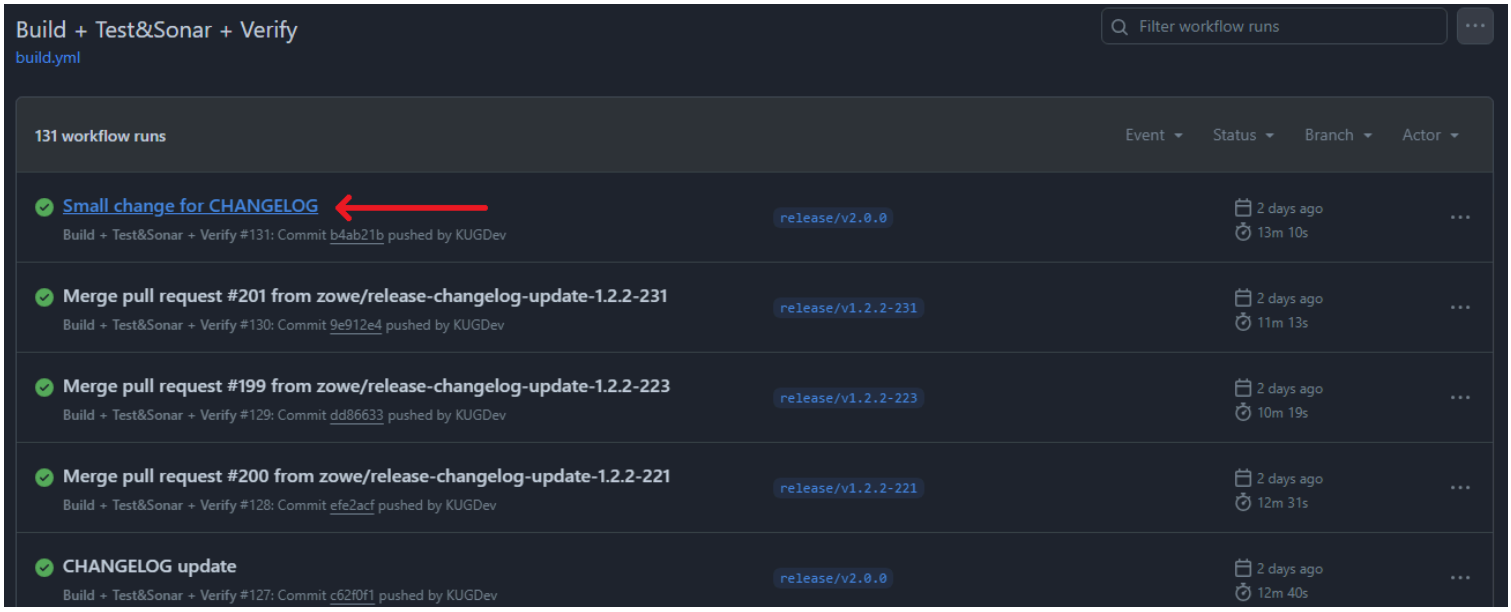
Downloading binaries from GitHub Actions

> **NOTE**
>
> You need to be logged into a GitHub account to be able to download artifacts

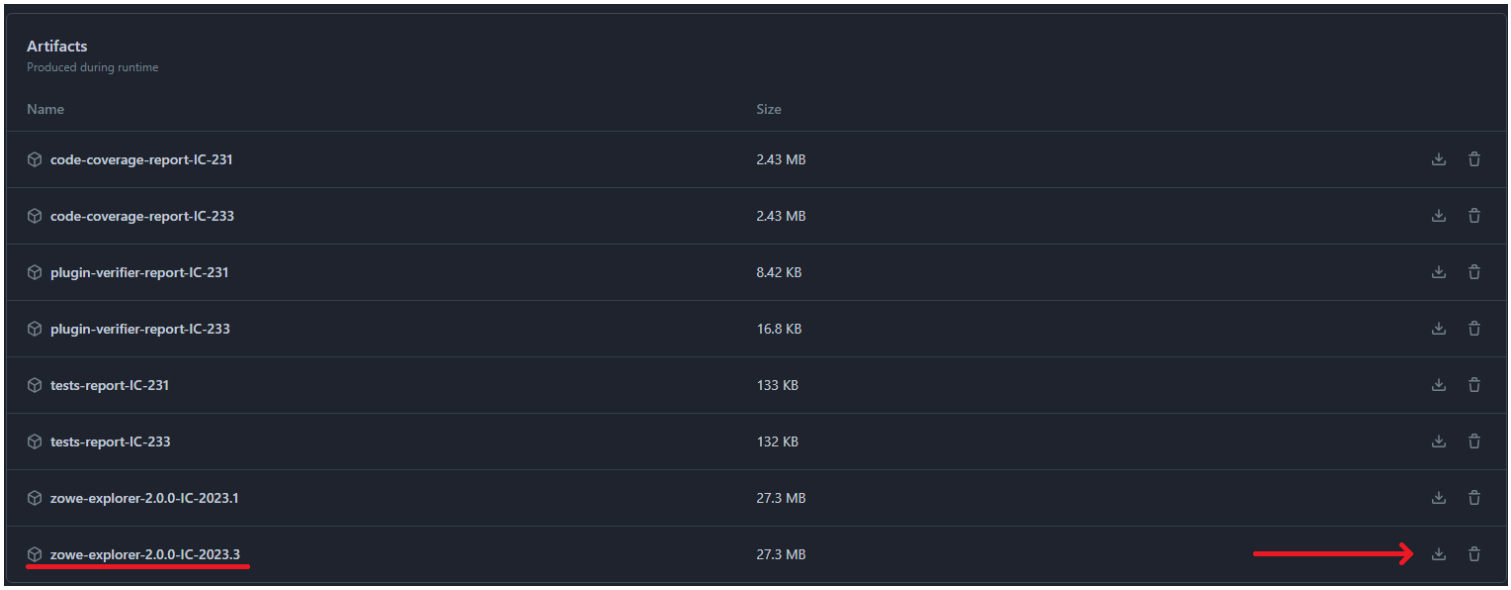
1. Proceed to the GitHub Actions of the repository
2. Select a build workflow



3. Select the build of a branch you want to download



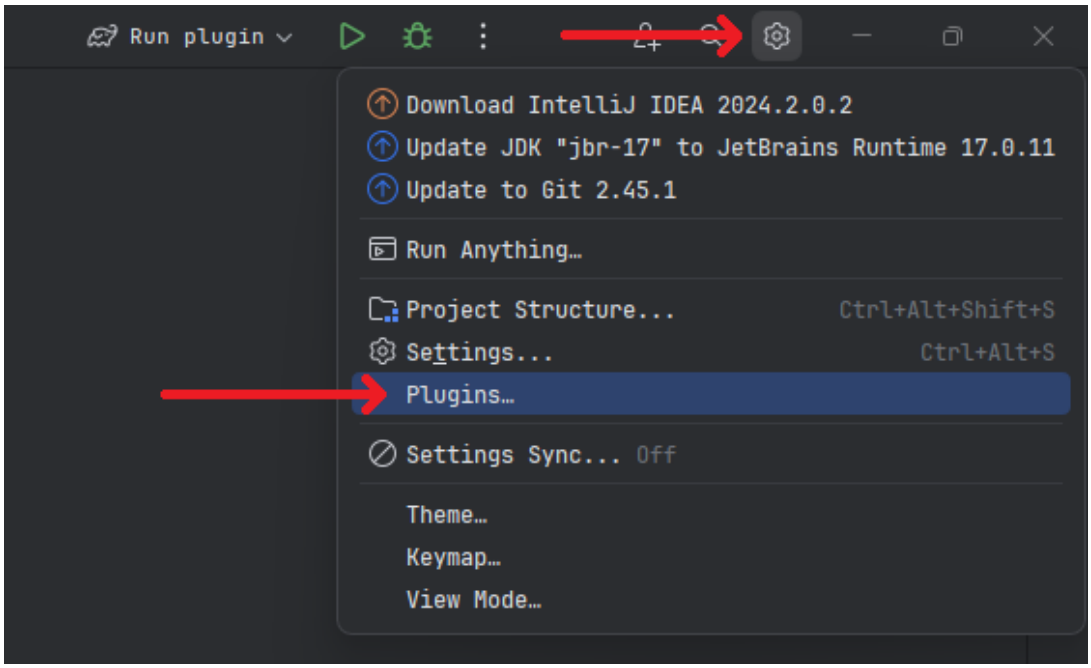
4. At the bottom of the page, in the *Artifacts* section, select the .zip file with the version build to download



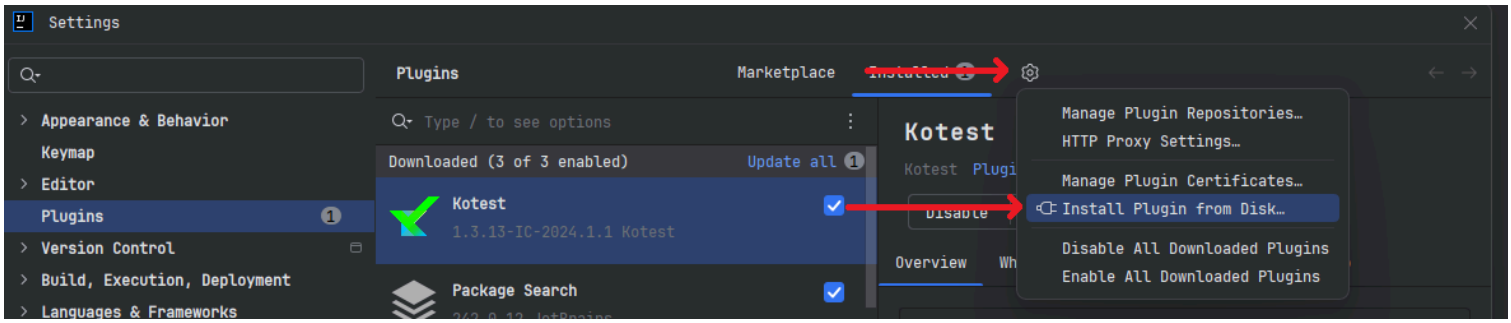
Installing binaries

After the .zip is downloaded, do the next steps:

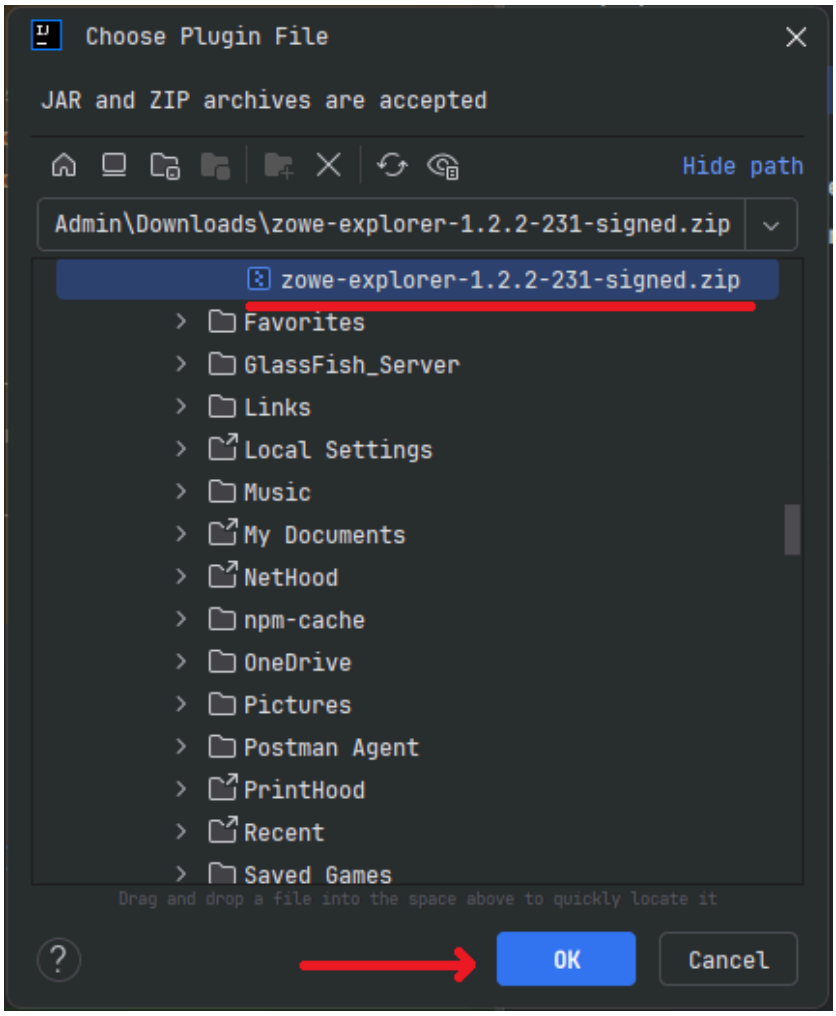
1. At the right top corner click the gear button and from the dropdown list select the **Plugins** option



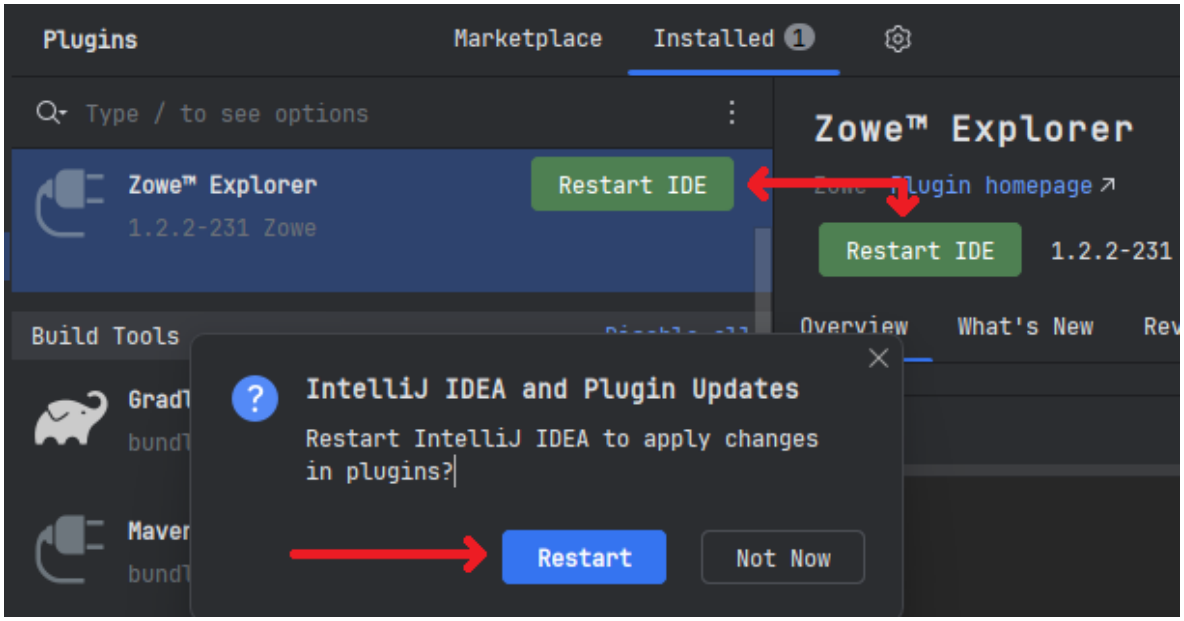
2. Near the **Installed** tab, click the gear button, from the dropdown select the **Install Plugin from Disk** option



3. In the **Choose Plugin File** dialog window, search for the .zip you want to install. Select it and click **OK** button



4. The plug-in will appear in the **Installed** tab, click the **Restart IDE** button, and then the **Restart** button in the dialog window.



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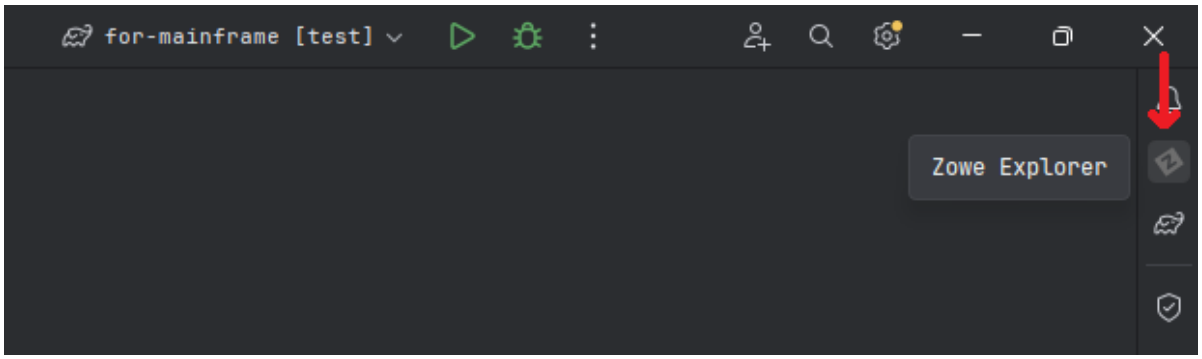

NOTE

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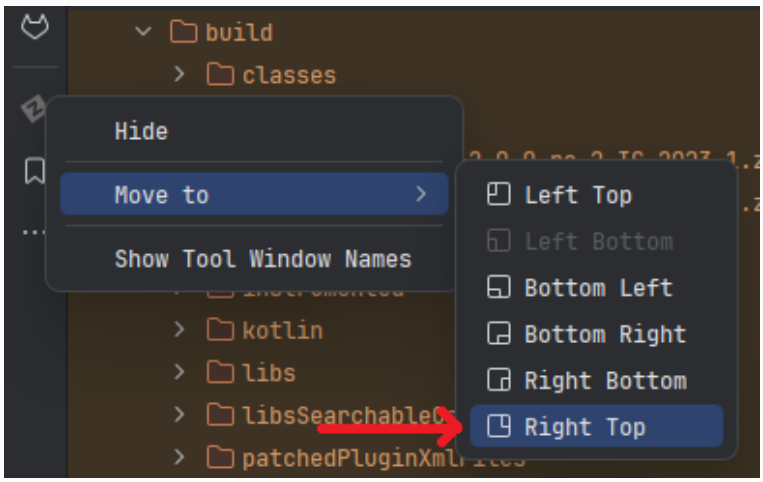


Version: v3.2.x LTS

Configuring the plug-in

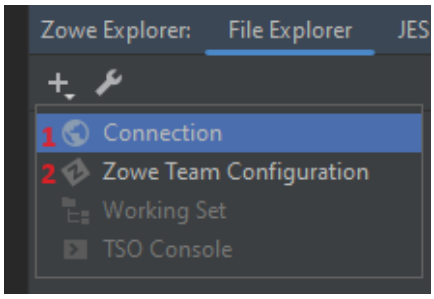
After you install the Zowe Explorer plug-in for Intellij IDEA, you must create a z/OSMF connection to your mainframe and some working sets.

> **NOTE**
>
> z/OS v2.3 or later is required with a REST API z/OSMF configured properly. To use it, you need the user ID to be connected to the IZUUSER RACF group. Contact your RACF administrator to complete the setup process.

Creating z/OSMF connection

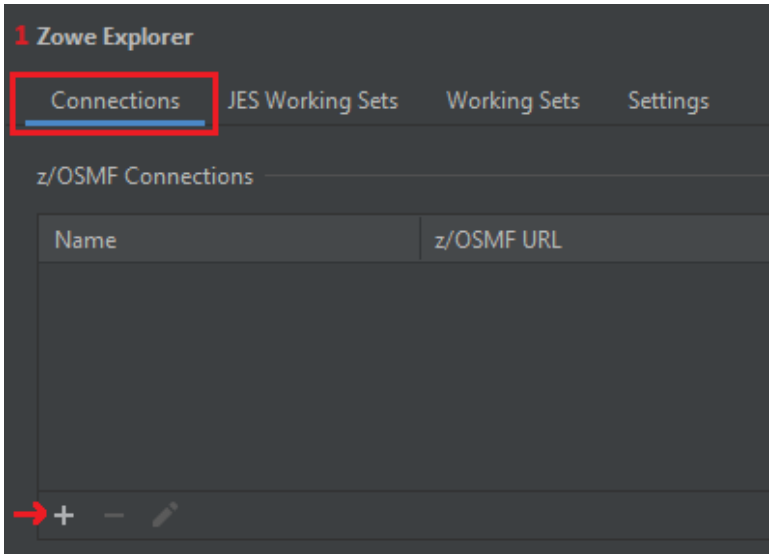
There are two ways to create a z/OSMF connection:

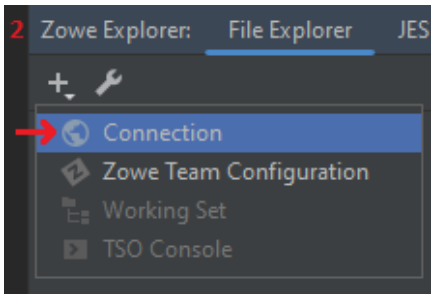
- using the in-built plug-in's connection configurations **(1)**
- using Zowe Team Config v2 **(2)**



Creating the connection using the plug-in's connection configurations

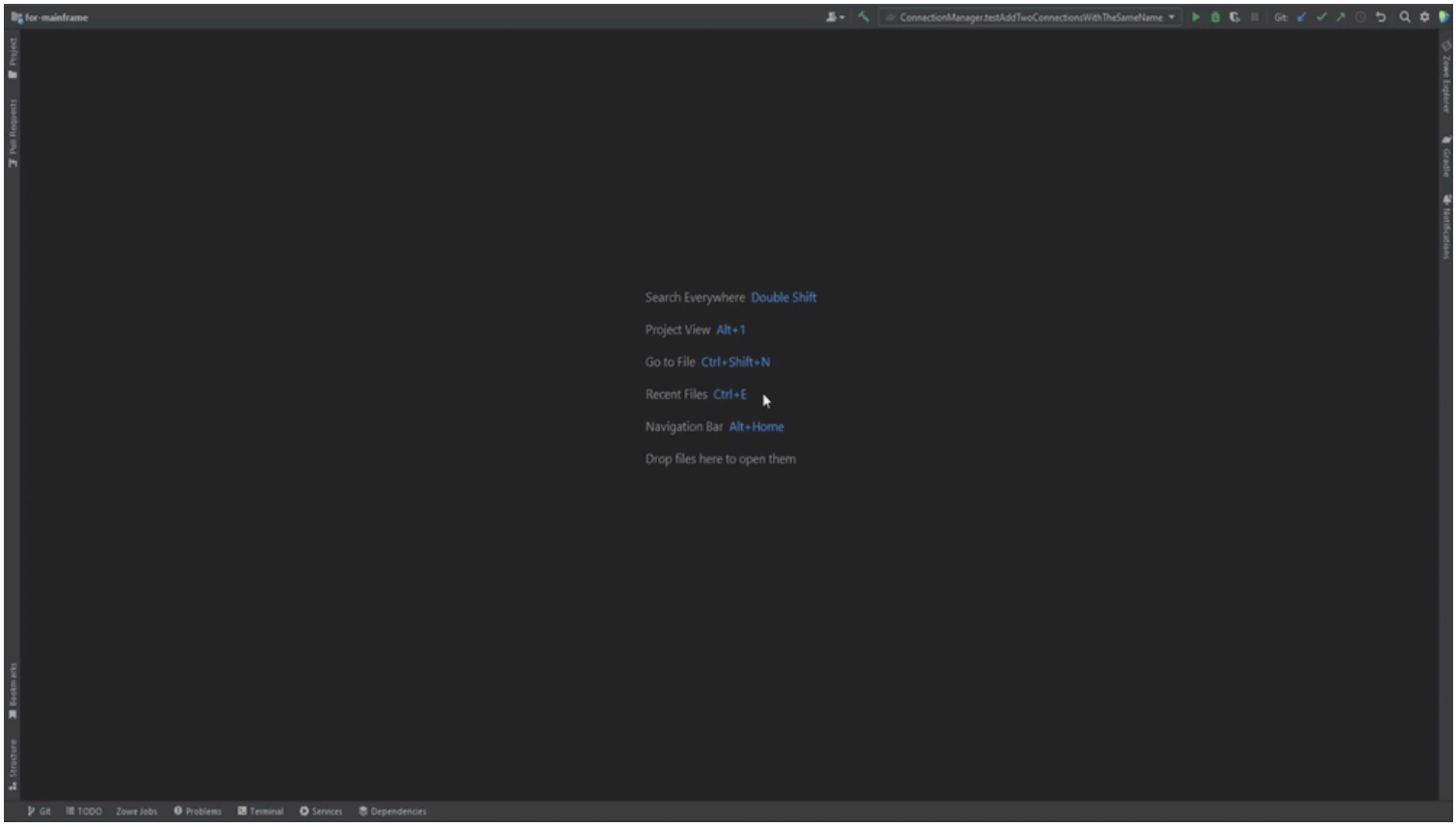
You can create a connection to a z/OSMF REST API either by manually specifying all the needed information through the "Settings" tab **(1)**, or by clicking the "+" sign **(2)**.





To create the connection:

1. In the Zowe Explorer click **+** button
2. Select **Connection**
3. Type in all the necessary information in the dialog
4. Wait until the connection test is finished and all the necessary information is fetched

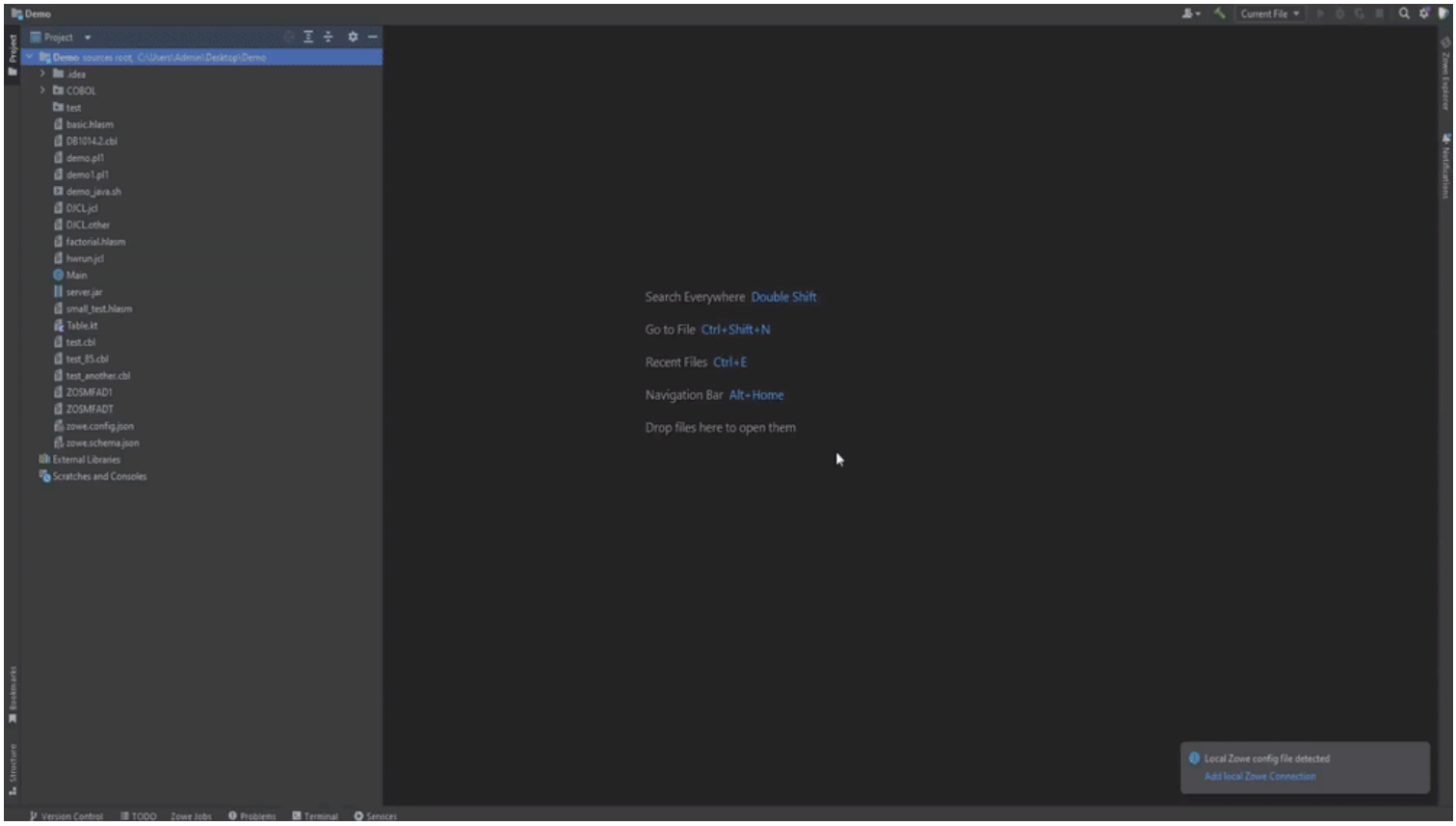


Creating the connection using Zowe Config v2

To create the z/OSMF connection with Zowe Config v2 there are two ways.

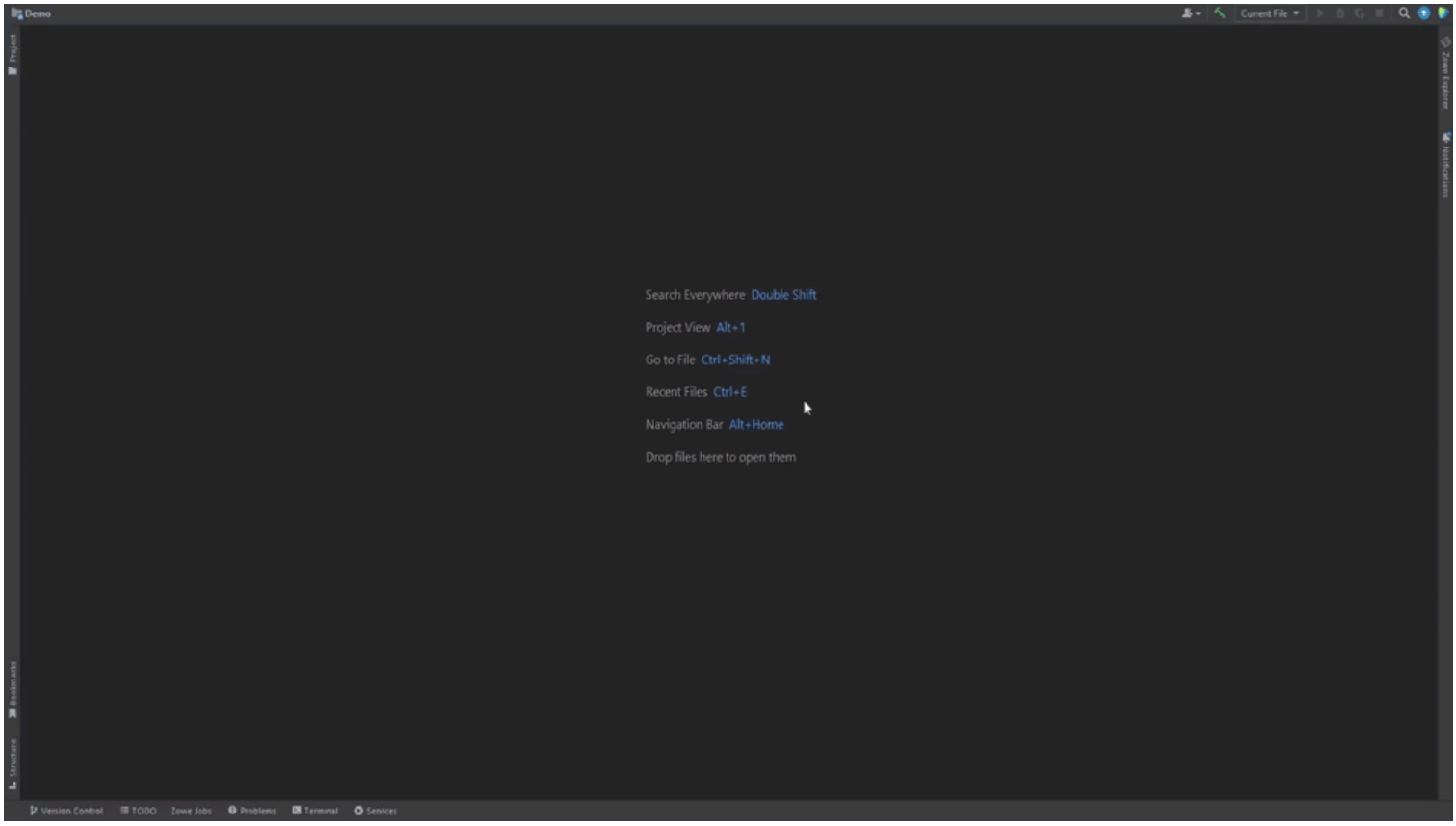
The first scenario - adding already existing Zowe Config v2 from a local opened project

1. Open the project with the **zowe.config.json**
2. *Zowe config file detected* notification should appear, click **Add Zowe Connection**
3. Wait until the connection is tested



The second scenario - creating a new Zowe Config v2 from scratch:

1. In the Zowe Explorer click **+** button
2. Select **Zowe Team Configuration**
3. Fill in all the necessary information in the dialog
4. Wait until the connection test is finished and all the necessary information is fetched



After the configuration is made, you will be able to use all the features of the plug-in.

Version: v3.2.x LTS

Zowe SDKs installation

Leverage the Zowe Client Software Development Kits (SDKs) to build client applications and scripts that interface with the mainframe.

The SDKs include programmatic APIs, each of which performs a particular mainframe task. For example, one API package provides the ability to upload and download z/OS data sets. You can leverage that package to rapidly build a client application that interacts with data sets.

The following SDKs are available.

- Zowe Client Java SDK
- Zowe Client Kotlin SDK
- Zowe Client Node.js SDK
- Zowe Client Python SDK *technical preview*

Fundamentals

- New to Zowe Client SDKs? This Zowe Client SDK overview briefly introduces the SDKs.
- The blog Zowe SDKs - Build z/OS Connected Applications Faster introduces Zowe SDKs and their benefits.

SDK documentation

For detailed SDK documentation, see the following:

- Zowe Client Java SDK
- Zowe Client Kotlin SDK
- Zowe Client Node.js SDK
- Zowe Client Python SDK *technical preview*
- Zowe SDK Sample Scripts

SDK software requirements and dependencies

Java SDK

Requires Java Runtime Environment (JRE) 17.

To install this library in your project, use a build tool such as Maven, Gradle, or Ant. Get the necessary artifacts from the Java SDK repository.

If you add the Java SDK as a dependency to your project, Maven or Gradle automatically downloads any additional dependencies needed to use the SDK.

For a Maven project, add the SDK as a dependency by updating the `pom.xml` file:

For a Gradle project, add the SDK as a dependency by updating the `build.gradle` file:

Kotlin SDK

Requires Java Runtime Environment (JRE) 17.

For detailed information about how to install the library, refer to the official installation guide for Zowe Client Kotlin SDK

Node.js

If you install Node SDK packages from the online registry, the required dependencies are installed automatically.

If you download Node SDK packages from Zowe.org, the downloaded folder contains dependencies that you must install manually. Extract the `TGZ` files from the folder, copy the files to your project, and issue the following commands to install the dependencies:

Python SDK *technical preview*

If you install Python SDK packages from the online registry, the required dependencies are installed automatically.

If you download the Python SDK packages from Zowe.org, the downloaded folder contains dependencies that you must install manually. Extract the `WHL` files from the folder, copy the files to your project, and issue the following command for each dependency:

Installing a Zowe Client SDK

To get started, import the SDK package to your project. You can pull the packages from an online registry, or download the packages from Zowe.org to install locally.

Installing an SDK from an online registry

Pull the packages from an online registry such as npm or PyPi:

1. In command-line window, navigate to your project directory. Issue the following command to install a package from the registry:

   - To import a Node.js package: `npm install <PackageName>`
   - To import a Python package: `pip install <PackageName>`
     - `<packageName>` The name of the SDK package that you want to install, such as `zos-files-for-zowe-sdk`.

   The package is installed.

   - Node packages are defined in `package.json` in your project.
   - Python packages are installed by default to `$PYTHONPATH/Lib/site-packages` (Linux) or to the Python folder in your local `/AppData` folder (Windows).
   - For the Java and Kotlin SDKs, Maven puts libraries in the `~/.m2/repository` directory and Gradle puts libraries in the `~/.gradle/caches/modules-2/files-2.1` directory, where `~` represents the path to the user's home directory.

2. **(Optional)** You might want to automatically update the SDK version when updates become available, or you might want to prevent automatic updates.

    - To define the versioning scheme for Node packages, use semantic versioning.
    - To define versioning for Python packages, specify versions or version ranges in a `requirements.txt` file checked-in to your project. For more information, see pip install in the pip documentation.
    - To define versioning for Python packages, specify versions or version ranges in the `pom.xml` or `build.gradle` files checked-in to your project.
        - In Maven, versioning ranges can be specified in the `pom.xml` file.
        - In Gradle, versioning ranges can be specified in the `build.gradle` file.

Installing an SDK from a local package

Download and install the packages:

1. Navigate to Zowe.org Downloads. Select your desired programming language in the **Zowe Client SDKs** section.

    The SDK is downloaded to your computer.

2. Unzip the SDK folder, which contains the packages for each set of functionality (such as z/OS Jobs). Copy each file that you want to install and paste them into your project directory.

3. Install required dependencies, which are included in the bundle. See Software requirements and dependencies for more information.

4. In a command-line window, navigate to your project directory. Issue *one* of the following commands.

    - To install a Node.js package: `npm install <packageName>.tgz`
    - To install a Python package: `pip install <packageName>.whl`

    -`<packageName>` The name of the package that you want to install, such as `zos-files-for-zowe-sdk`.

5. Repeat the command for each package that you need.

    Packages are now installed.

Version: v3.2.x LTS

Zowe Chat (Technical Preview)

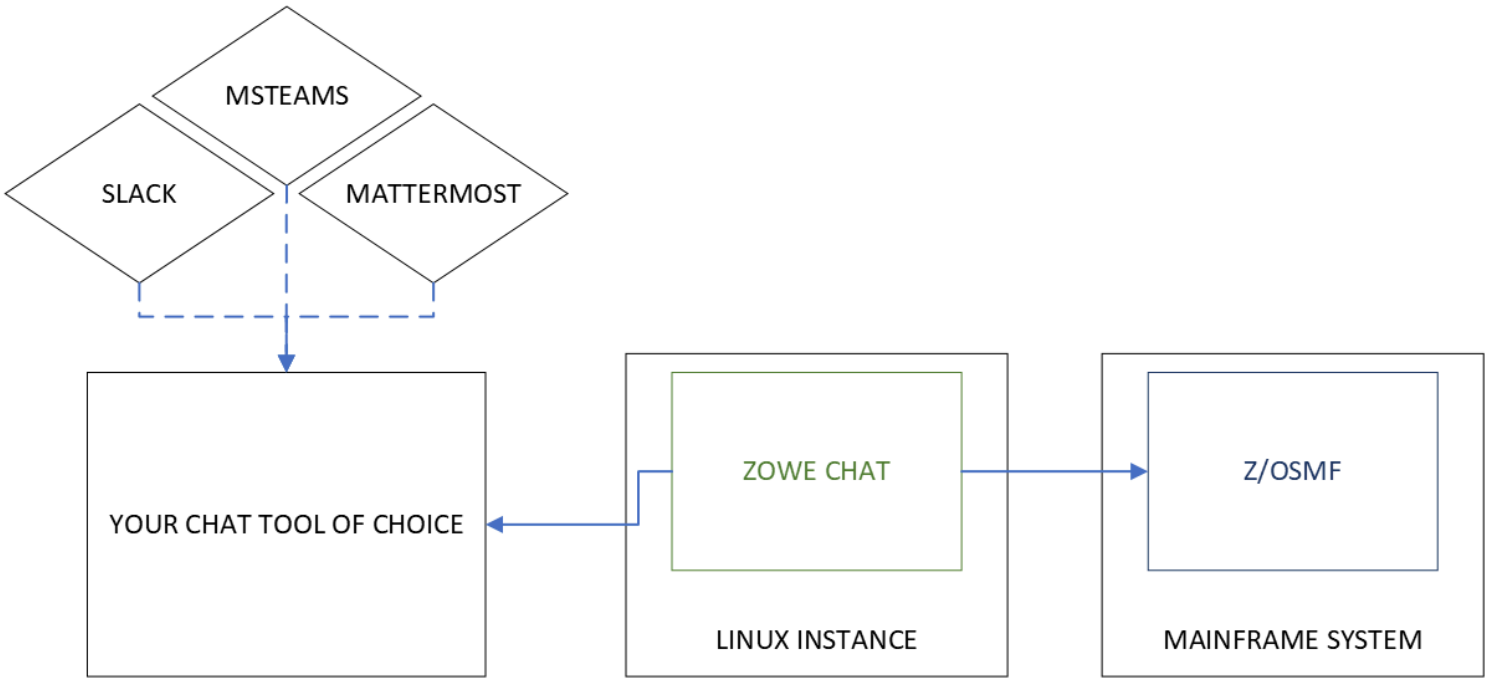
Zowe Chat Technical Preview is an early access build of the newest incubating technology in Zowe, Zowe Chat! Zowe Chat is a chatbot that aims to enable a ChatOps collaboration model by bringing simple access to z/OS resources and tools within the chat tools you use everyday in your organization. As this is an early access build, it is recommended to deploy the technical preview in development and test environments.

The following topics will guide you in setting up and using Zowe Chat.

1. System Requirements
2. Configuring Chat Tools
3. Installing Zowe Chat
4. Configuring Zowe Chat
5. Starting, stopping, and monitoring
6. Uninstalling Zowe Chat

Deployment diagram

Zowe Chat works by connecting to your chat tool of a choice as a Bot account, and is configured against a single sysplex environment through a z/OSMF installation. Zowe Chat requires network connectivity to each of the configuration endpoints. For more details and information on installation and configuration, follow the topics above.



Version: v3.2.x LTS

System requirements

Before installing Zowe Chat, ensure that your target environment meets the prerequisites that are described in this article.

Zowe Chat must be able to communicate with the chat tool you plan to use. More information is provided in the network requirements section.

- Linux System Requirements
  - Node.js
  - Optional: Zowe CLI
- z/OS System Requirements
  - z/OSMF
- Network Requirements
  - Ports
  - Connectivity Requirements
- Chat Tool Requirements

Linux system requirements

The chat server must meet the following requirements:

- Operating System: Any Linux distribution (Linux or zLinux)

  > **NOTE**
  >
  > Zowe Chat can only be deployed to Linux or zLinux environments now. z/OS support is pending further review. If you are interested in running Zowe Chat on z/OS, let us know by opening a question.

- Processor count: 1
- Memory: 4 GB
- Disk space: 300 M

Node.js

- Node.js v16.x. Zowe Chat has not yet been tested with 14.x or 18.x.

  If Node.js is not included out of the box in your Linux distribution, you must install it. To install Node.js, follow the instructions on the Node.js Download Page. It is recommended that you use a package manager as outlined here if possible.

Zowe CLI (Optional)

If you want to run Zowe CLI on Zowe Chat, you must install Zowe CLI on your Zowe Chat server. To install Zowe CLI, see Installing Zowe CLI.

z/OS system requirements

z/OSMF

- IBM z/OS Management Facility (z/OSMF) Version 2.3 or Version 2.4.

z/OSMF is included with z/OS so does not need to be separately installed. You must configure z/OSMF with REST APIs enabled because these APIs are used by Zowe Chat as data provider.

- For non-production use of Zowe Chat (such as development, proof-of-concept, demo), you can set up z/OSMF Lite. See Configuring z/OSMF Lite (non-production environment).
- For production use of Zowe Chat, see Configuring z/OSMF.

Network requirements

Ports

The following ports are required to run Zowe Chat. You can change the defaults as part of the Zowe Chat configuration. See the Configuring Zowe Chat topic for more detail.

Port number	Configuration file	Configuration field	Description
7701	`$ZOWE_CHAT_HOME/config/chatServer.yaml`	`webapp.port`	Used to host a web application required to login users
7702	`$ZOWE_CHAT_HOME/config/chatTools/<mattermost | msteams | slack>.yaml`	`messagingApp.port`	Used as the messaging endpoint by some chat tools.

Connectivity Requirements

Zowe Chat requires network connectivity to the mainframe system z/OSMF is running on, as well as network connectivity to the chat tool of your choice. Since mainframes reside inside organizations' private networks, by default we assume that Zowe Chat will also be deployed in such a private network, and recommend it. Each chat tool has its own connectivity requirements that require additional consideration as part of your installation plan.

Slack:

- Public internet access is required. There are two ways to connect to Slack, over HTTP or using Socket mode. Socket mode sets up a persistent connection to the Slack chat platform using secure WebSockets, while in HTTP mode Slack issues requests directly to Zowe Chat over HTTP.
- We strongly recommend that you use Socket mode, as it reduces your overall network configuration burden and is equally secure when compared to HTTP mode.
  - Socket mode requires that Zowe Chat has *outbound* public internet access.

- HTTP mode requires that Zowe Chat has both *outbound* and *inbound* public internet access. To set up inbound access, you must configure your network firewall or use proxy servers to ensure that the Slack platform (on the public net) can reach the HTTP endpoint of the Zowe Chat server (on your private network).

For more Slack related configuration, see Configuring the chat tool Slack.

Microsoft Teams:

Both *outbound* and *inbound* public internet access are required if you plan to connect your Zowe Chat with Microsoft Teams chat platform, and will require network firewall configuration or use of proxy servers to allow the inbound traffic.

For more Teams-related configuration, see Configuring messaging endpoint for Microsoft Teams.

Mattermost:

Mattermost requires both *outbound* and *inbound* network access. However, the specific connectivity details depend on the deployment of Mattermost in your organization.

- If you use a cloud-hosted instance of Mattermost, you will require network firewall configuration or use of proxy servers to allow inbound traffic to reach Zowe Chat.
- If you use an on-premises instance of Mattermost, no additional network configuration is required.

Chat Tool Requirements

See Configuring chat platforms for information.

Version: v3.2.x LTS

Configuring chat platforms

Before you install Zowe Chat on your site, you must set up a bot in the chat tool you plan to connect with Zowe Chat. You will use the information from the bot setup in a future Zowe Chat configuration step.

Mattermost

- Must be version 7.0 or newer. See Configuring Mattermost chat platform.

Microsoft Teams

- See Configuring Microsoft Teams chat platform.

Slack

- See Configuring Slack chat platform.

Version: v3.2.x LTS

Configuring Mattermost

If you use Mattermost as your chat platform, you must configure your Mattermost before using Zowe Chat. You need to create an administrator account, a team, and a bot account in Mattermost.

1. Installing Mattermost chat platform server

   You can use commands to install Mattermost Container on your server.

2. Creating administrator account and Mattermost team

   After you start the Mattermost container, you can create an administrator account and a team in Mattermost, and invite your colleagues to join the team.

3. Creating the bot account

   Create a bot account in Mattermost.

4. Inviting the created bot to your Mattermost team

   Invite your bot user to your team so that you can invite it to your Mattermost channel, and talk with it in the channel.

5. Inviting the created bot to your Mattermost channel

   You can create your own private channel in Mattermost, invite your bot user to your channel by adding new members, and talk with it in the channel.

6. Enabling insecure outgoing connections for mouse navigation

Version: v3.2.x LTS

Installing Mattermost chat platform server

You can use commands to install Mattermost Container on your server.

Mattermost is a chat solution whose free trial version is available as a Container image. You can use it for your PoC or testing environment. If you want to use Mattermost in your production environment, you must follow the Mattermost installation guide to install the enterprise version. The following steps show you how to install Mattermost Container in *Preview Mode* to explore its function.

Installing

To install Mattermost Container on a Linux® server, perform the following steps:

1. Make sure that Docker/Podman is set up on the Linux server, and you can access Docker Hub - mattermost/mattermost-preview on the Linux server.

   > **NOTE**
   >
   > The following command will use Docker as example. You can simply replace Docker with Podman if you are using Podman.

2. Run the following command to pull the mattermost-preview image:

3. Run the following command to install Mattermost in *Preview Mode*.

   For more information about installing Mattermost in *Preview Mode* on local machines by using Docker, see Local Machine Setup using Docker.

4. Run the following command to verify that the Mattermost container is started.

   When you see the name is **mattermost** in the response, your Mattermost container is started.

Your Mattermost is installed successfully.

Next steps

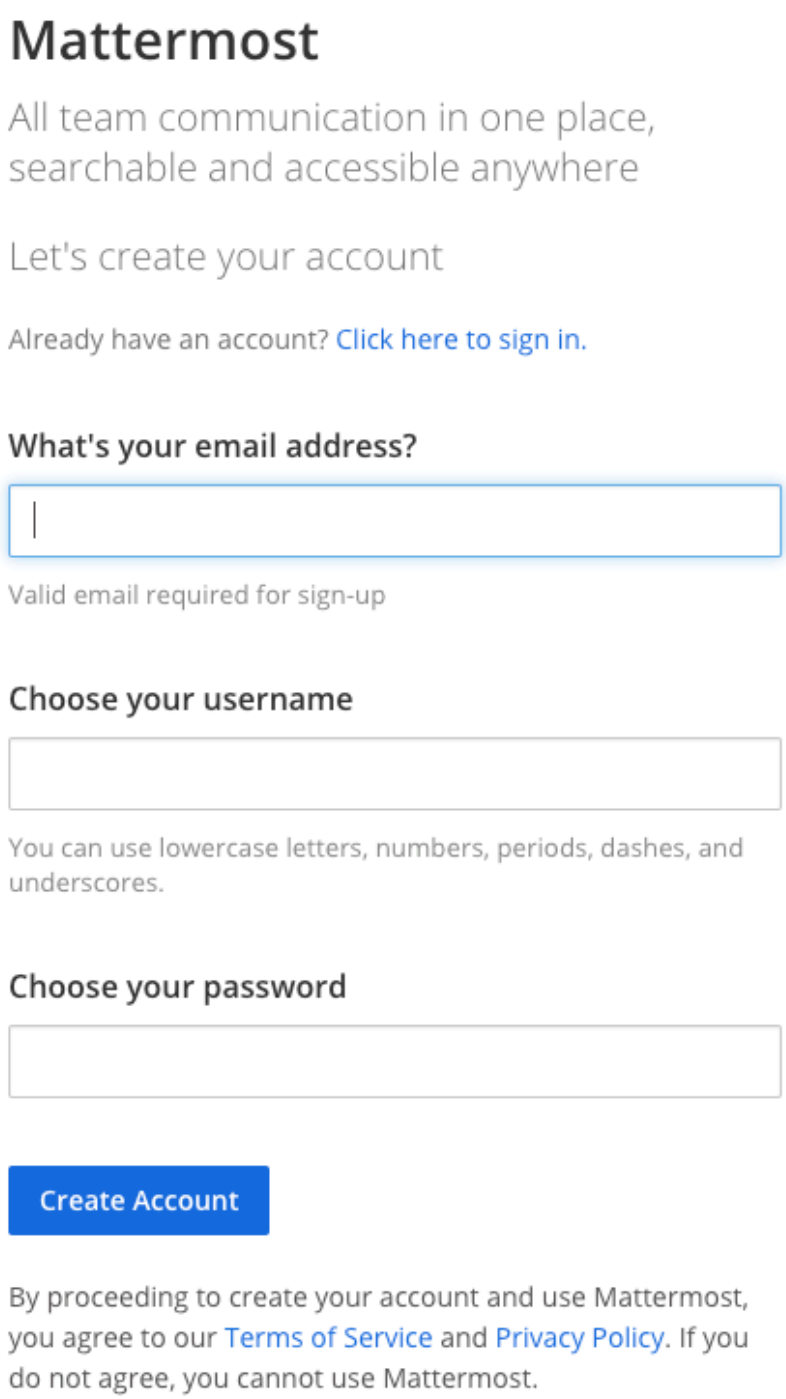
You must configure your Mattermost before using Zowe Chat. You need to create an administrator account, a team, and a bot account in Mattermost. See Creating administrator account and Mattermost team.

Version: v3.2.x LTS

Creating administrator account and Mattermost team

After you start the Mattermost container, you can create an administrator account and a team in Mattermost, and invite your colleagues to join the team.

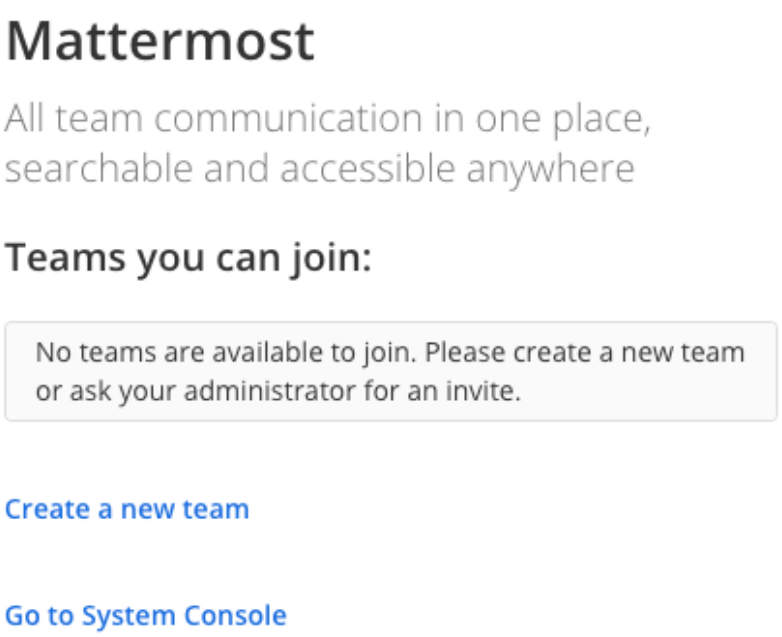
1. Open `http://YOUR\_MATTERMOST\_SERVER:8065/` in your browser.
2. Create an administrator account.
    i. Specify your email address, username, and password.



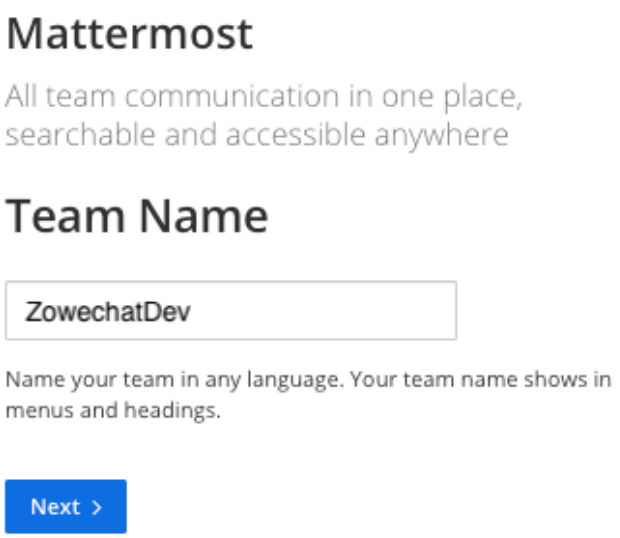
ii. Click **Create Account**, and your administrator account is created.

3. Create a team.

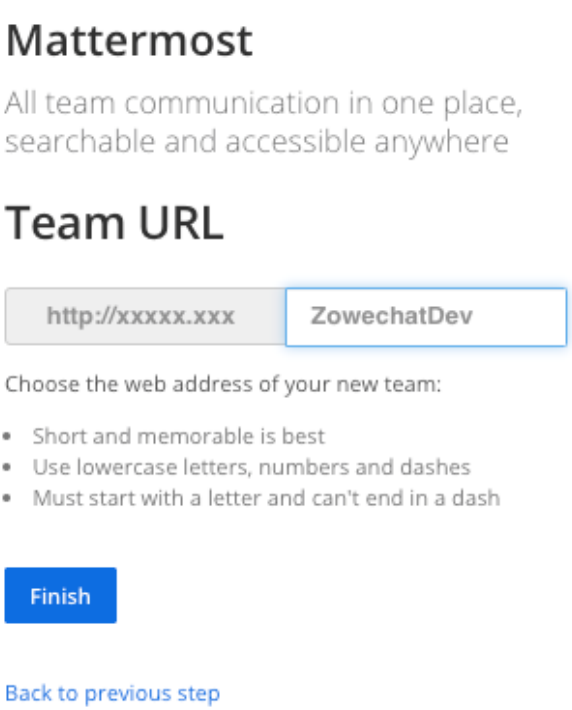
i. Click **Create a new team**.



ii. Specify your **Team name**, for example, BnzDev. Click **Next**.



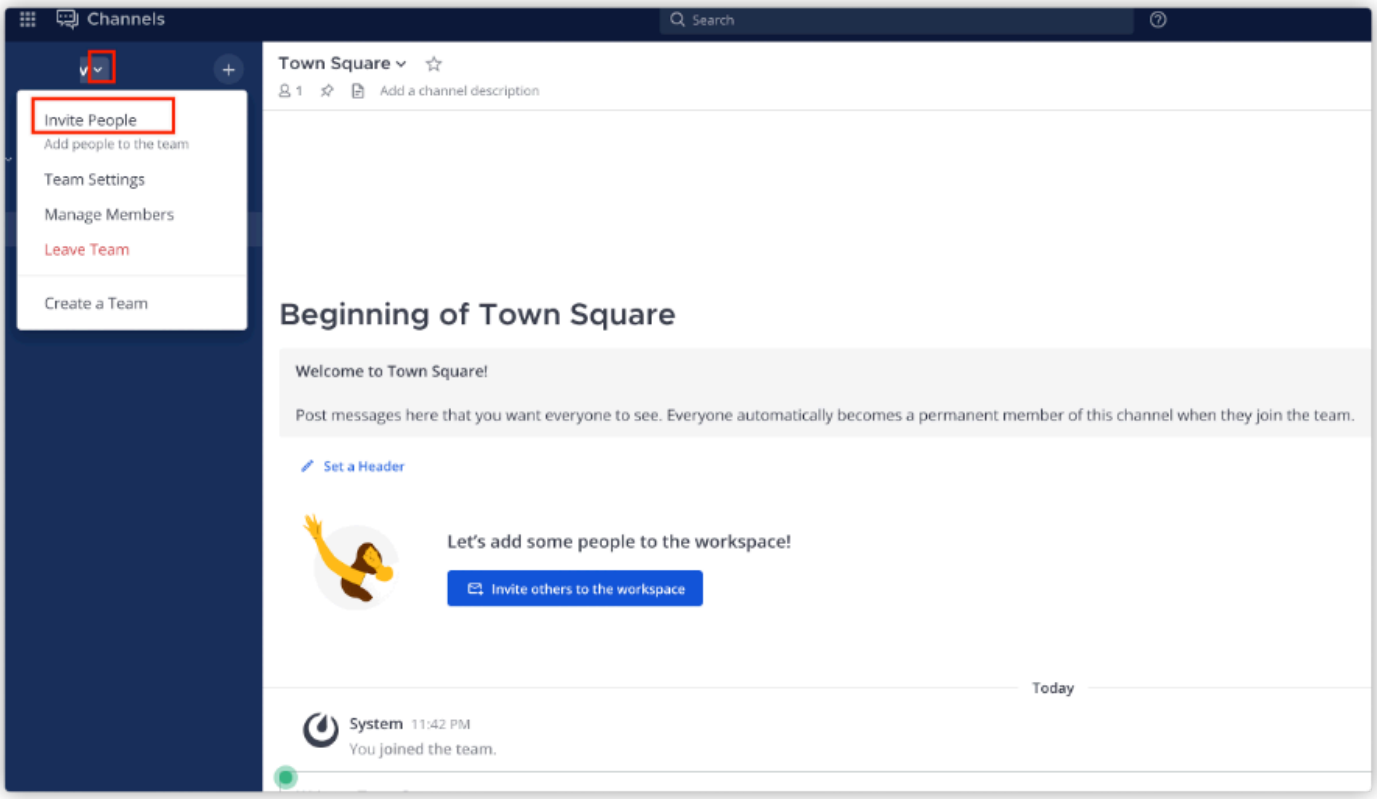
iii. Specify your **Team URL**, for example, bnzdev. Click **Finish**.



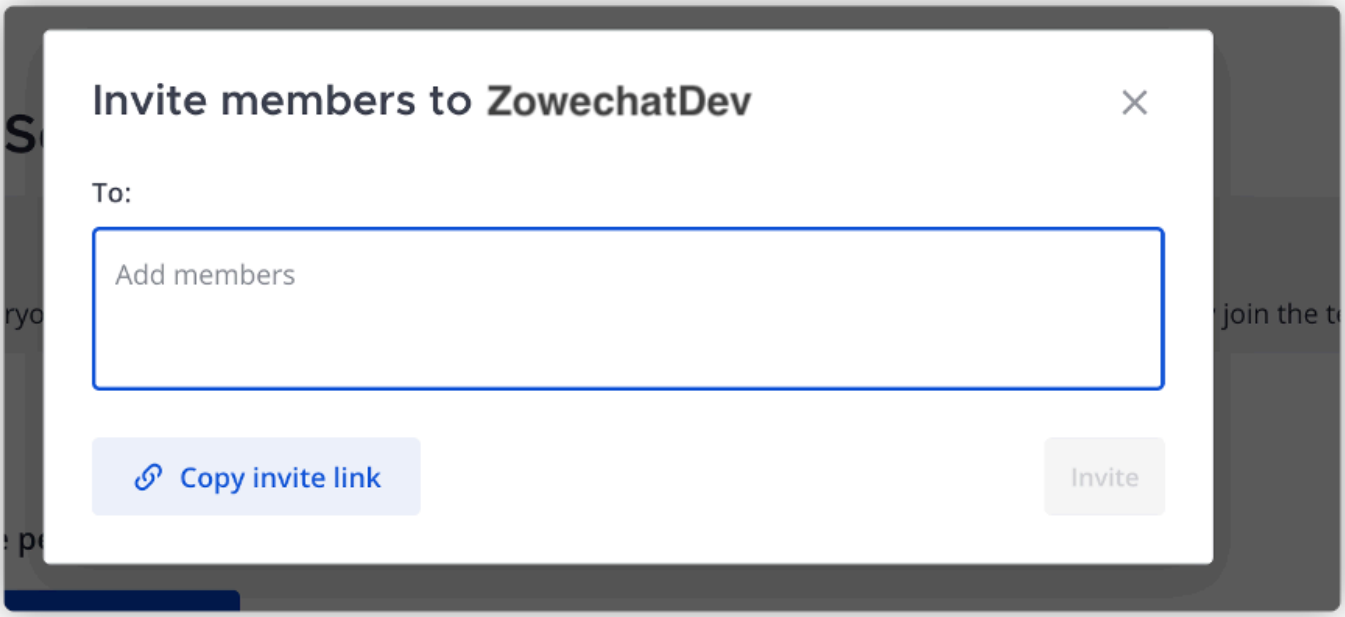
> **NOTE**
>
> Remember your Team URL, it will be used when you configure Mattermost.

4. Invite people to your team.

   i. In the chat window, click the Main Menu icon, then click **Invite People**.



ii. If your team member does not have an account yet, click **Copy invite link** and send the invitation link to them so that they can join by themselves. If your team members have their accounts, you can specify their account information in the **Invite members to BnzDev** field, select their accounts, and click **Invite** to add them to the team.



5. Optional: If you want to enable TLS on Mattermost Server, you can refer to Configuring TLS on Mattermost Server for specific steps.

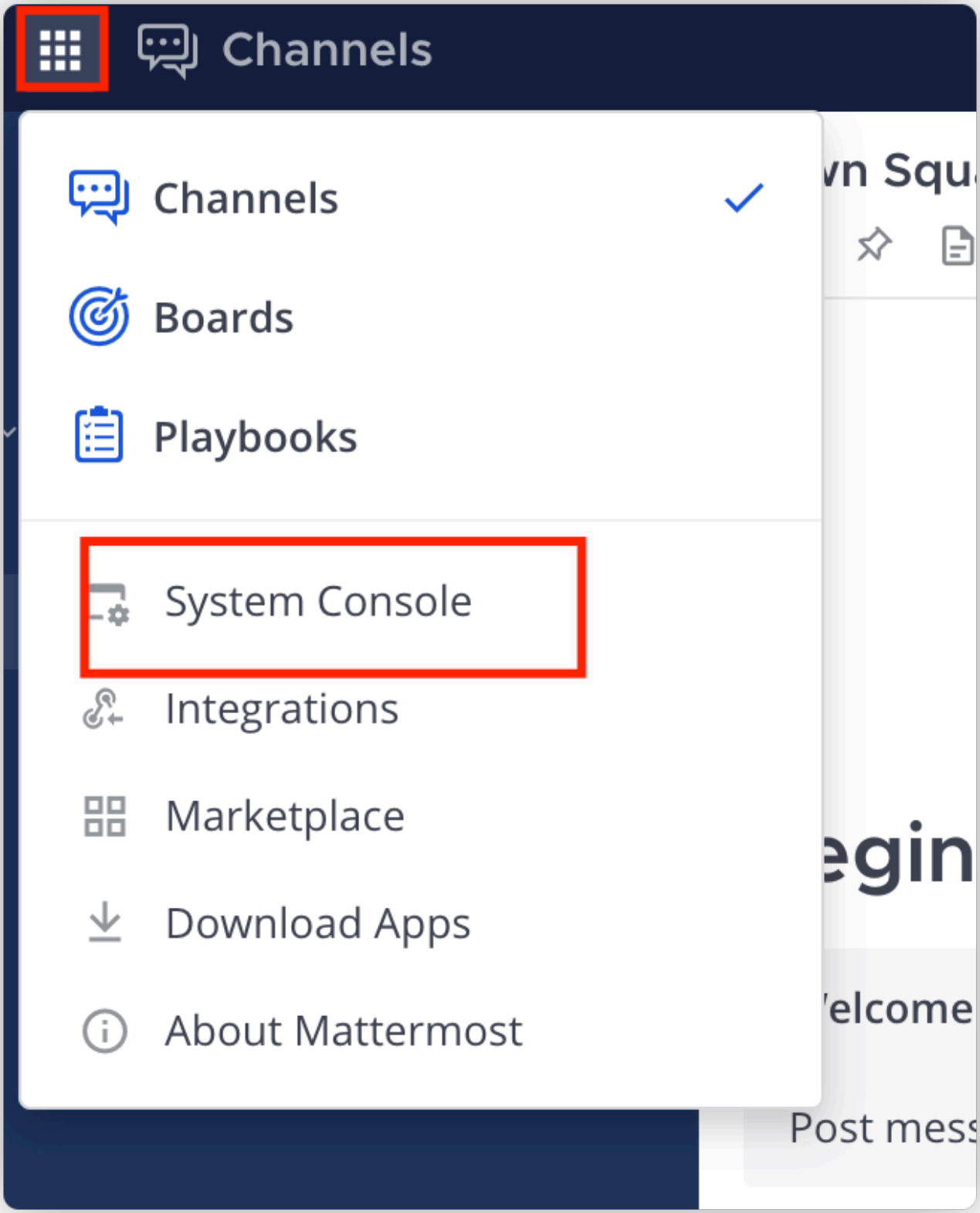
Now you have your administrator account and team chat group. You can invite other people to join.

Version: v3.2.x LTS

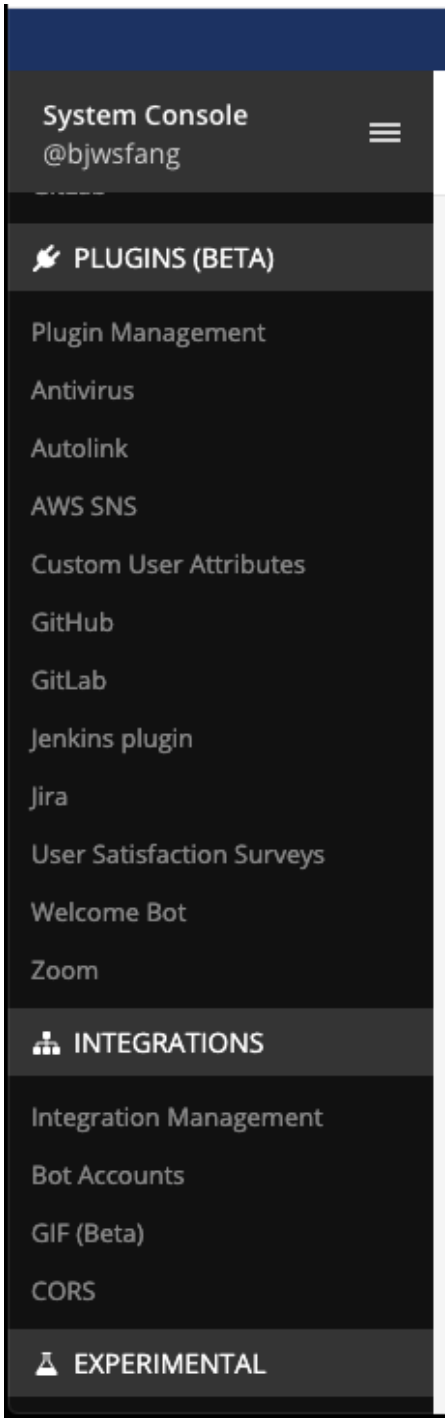
Creating the bot account

Create a bot account in Mattermost.

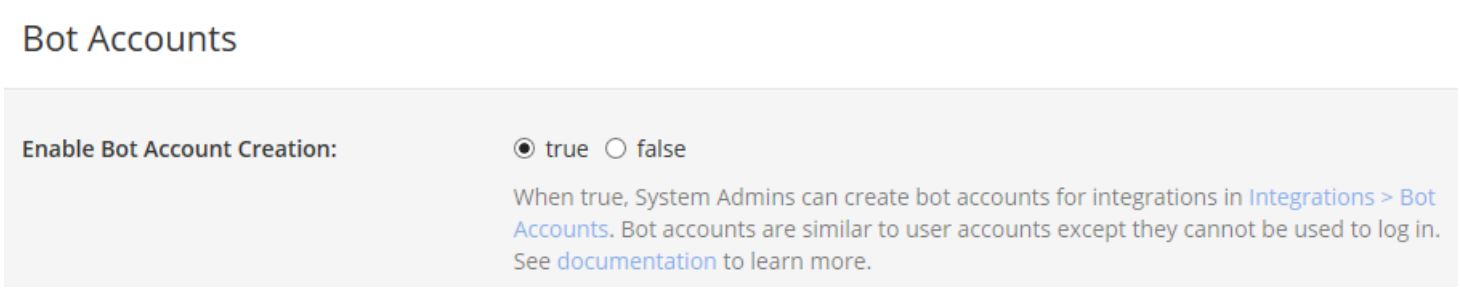
1. Log in to Mattermost with your administrator account.
2. Click Main Menu icon and then click **System Console**.



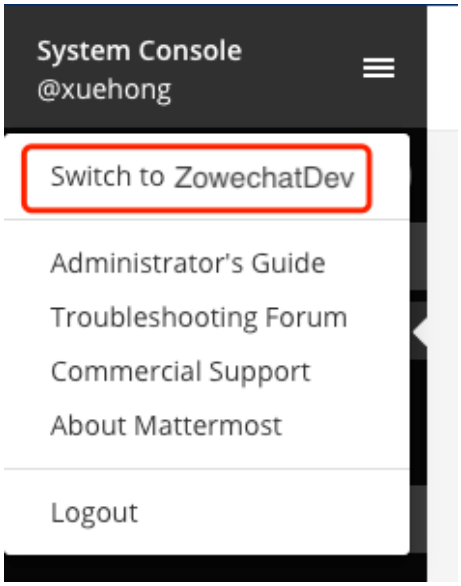
3. Scroll down to **INTEGRATIONS** section and click **Bot Accounts**.



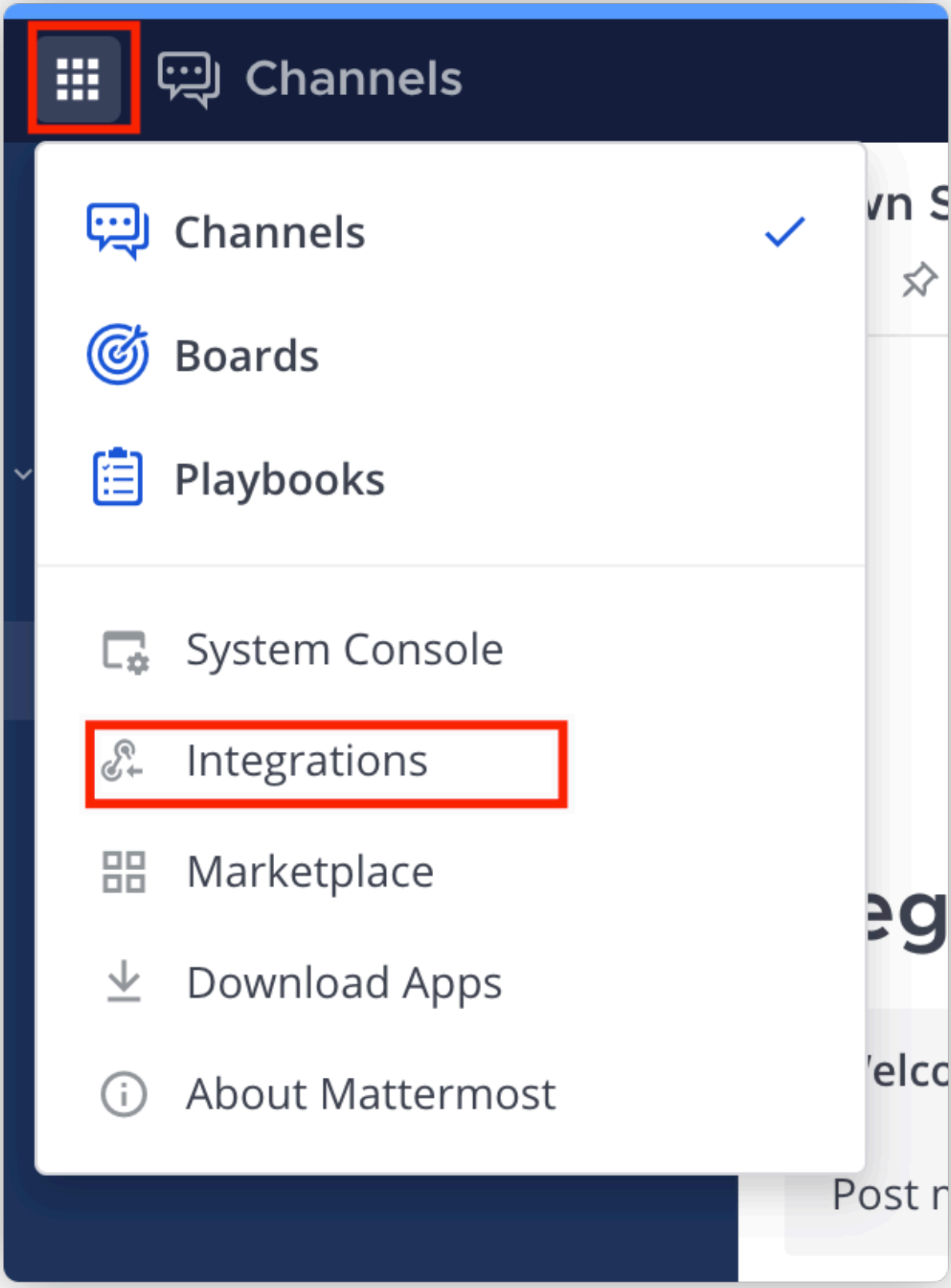
4. Select **true** for **Enable Bot Account Creation**, and click **Save**.



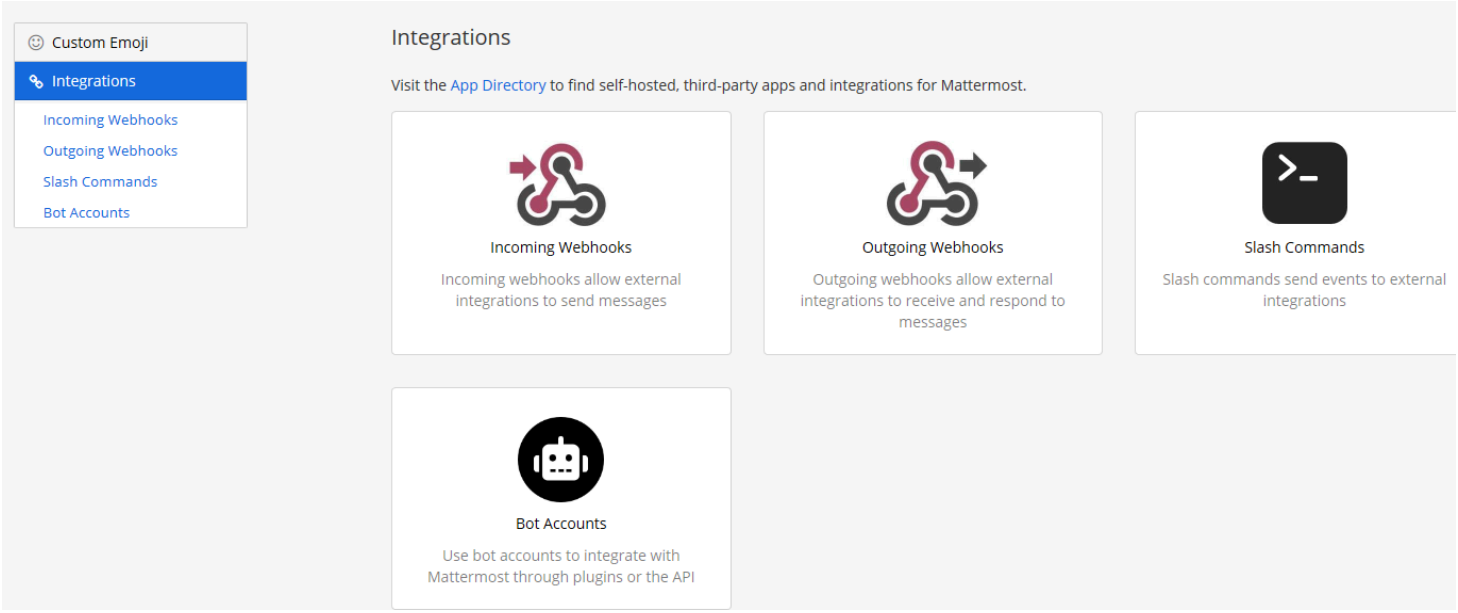
5. Click the Main Menu icon on the System Console, then click **Switch to your team**.



6. Click the Main Menu icon from the main screen of Mattermost, and click **Integrations**.



The following dialog opens.

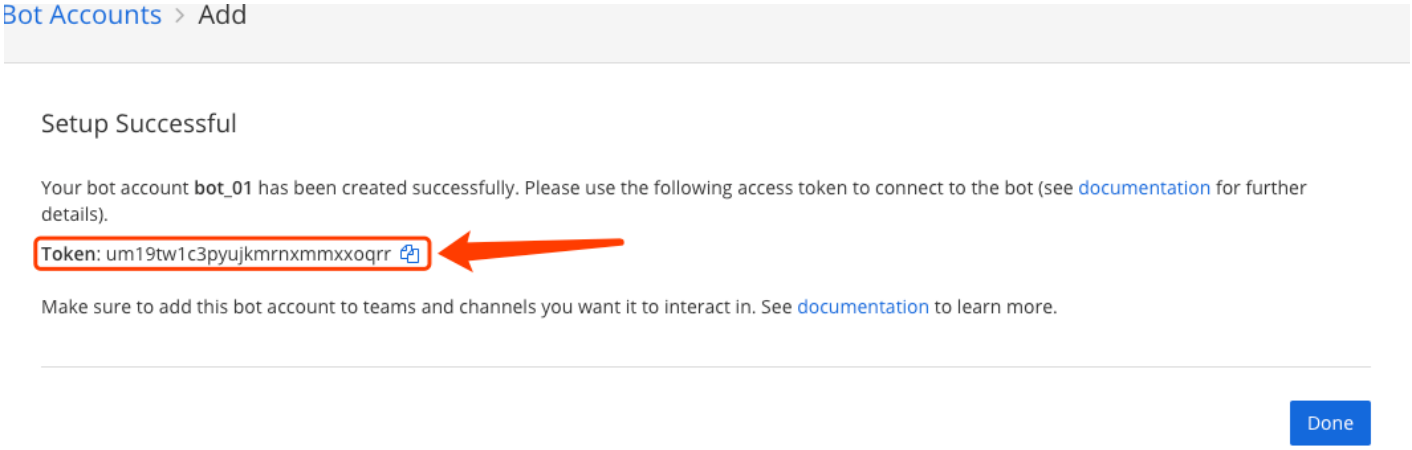


7. Add a new bot account.

   i. Click **Bot Accounts** > **Add Bot Account**.

   ii. Specify bnz for **Username** and System Admin for **Role**.

   iii. Click **Create Bot Account**. A successful notification dialog displays. On this dialog you can find a **Token**.



8. Copy this **Token**.

   You will need this token for integration steps later. Save it well since you will not be able to retrieve it again.

For more information about Bot accounts, see Mattermost Integration Guide - Bot Accounts.

Next steps

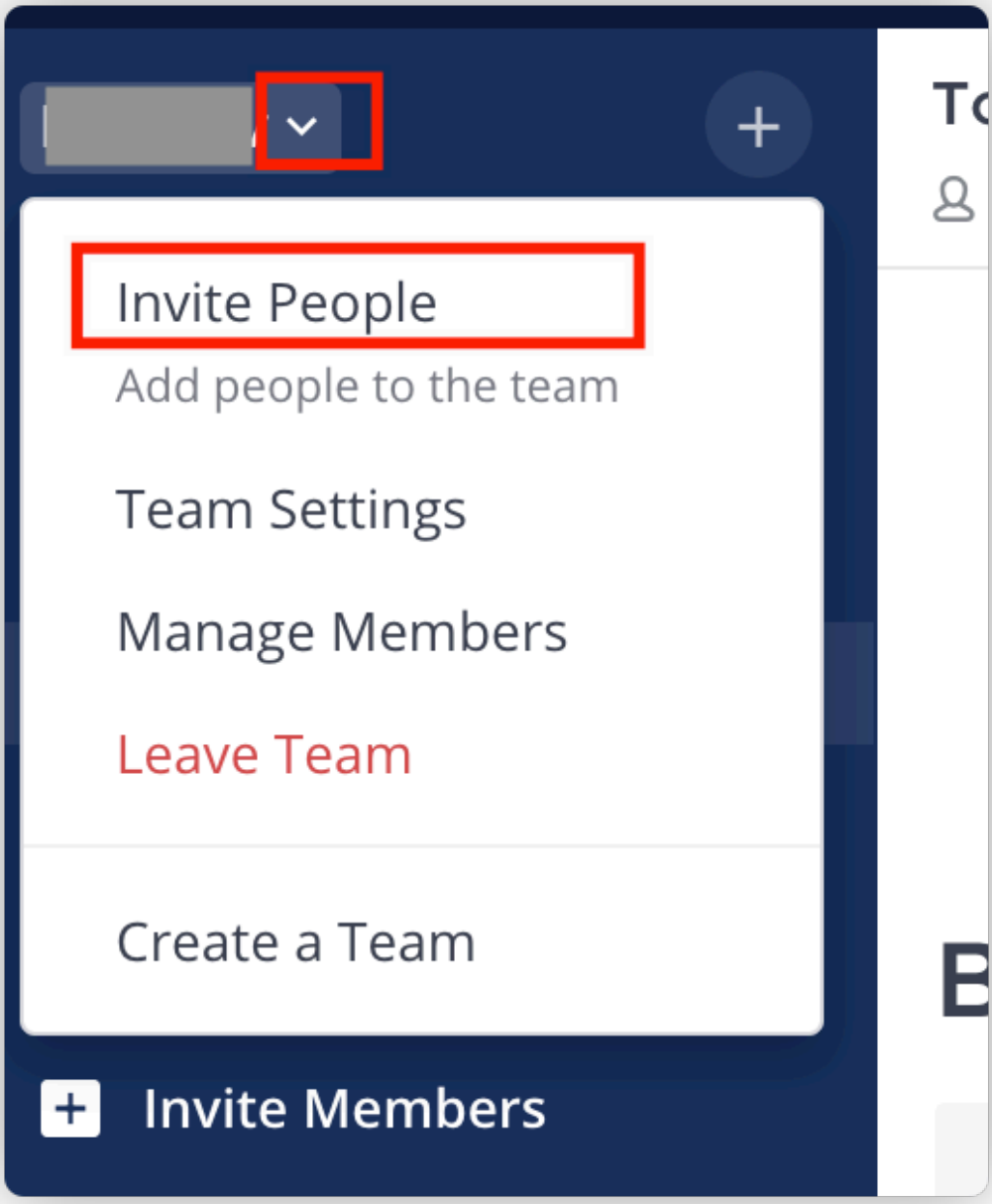
Now you can invite the created bot to your Mattermost team.

Version: v3.2.x LTS

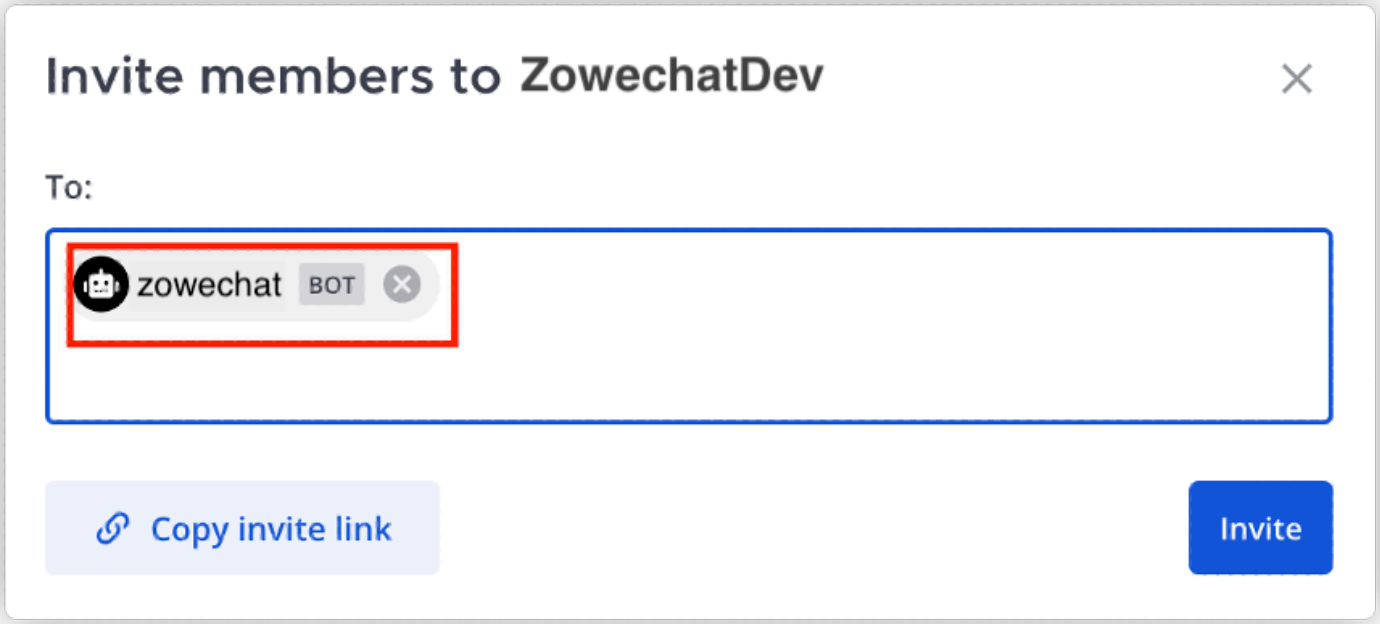
Inviting the created bot to your Mattermost team

Invite your bot user to your team so that you can invite it to your Mattermost channel, and talk with it in the channel.

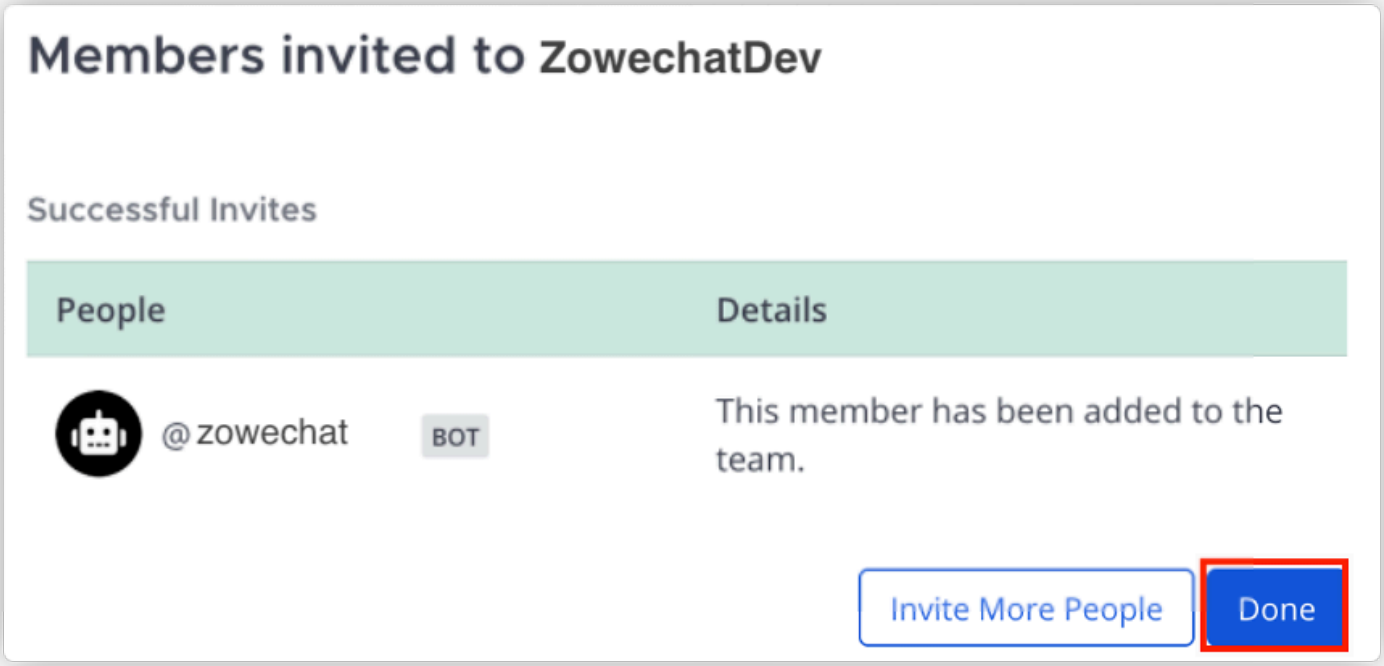
1. Click your username at the top of the navigation panel and click **Invite People**.



2. In the **Invite members to BnzDev** field, search your bot user and select it, then click **Invite** to invite the bot to this team.



3. Click **Done**.



Your bot user is added to your team successfully.

Next steps

Now you can add it to your channels.

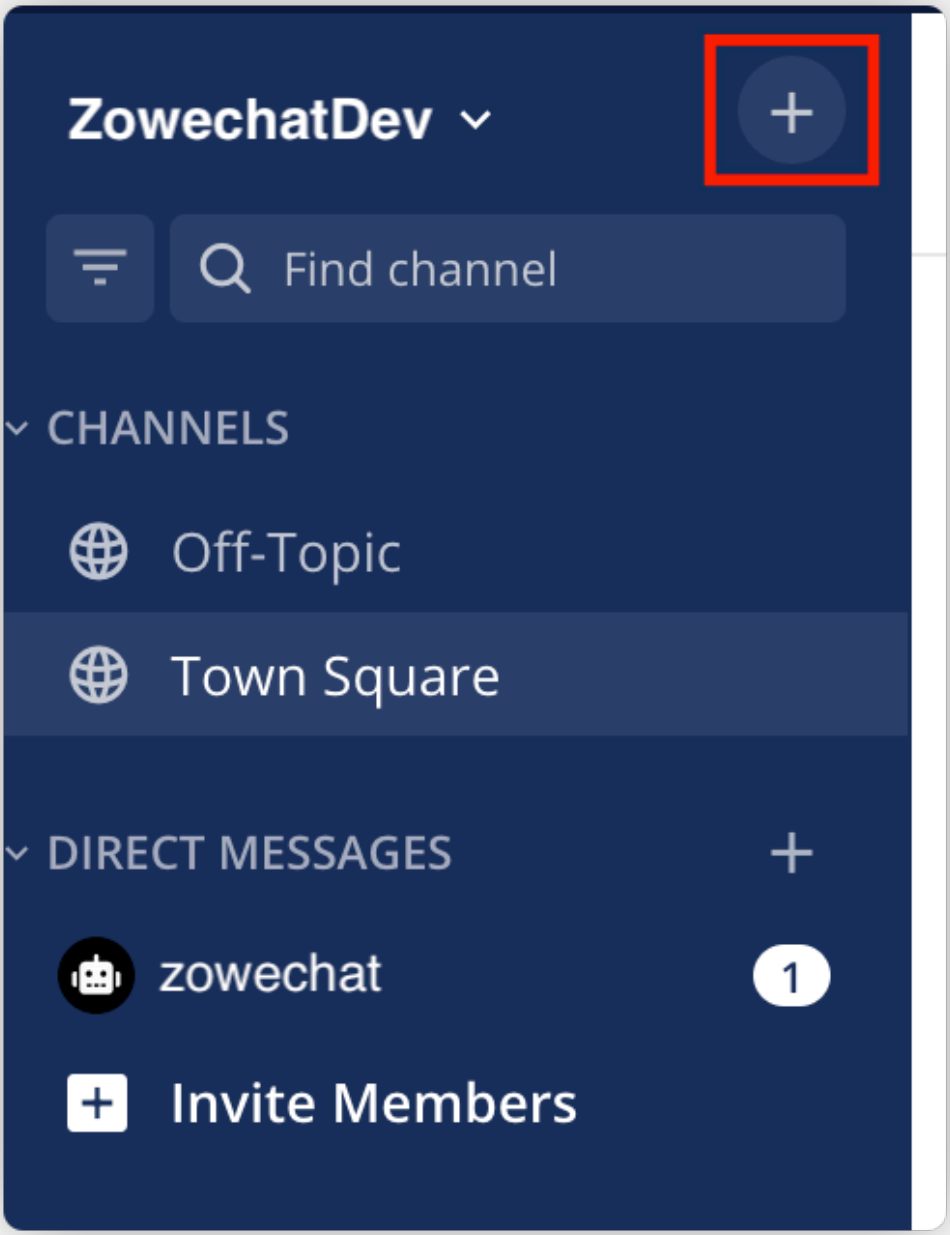
Version: v3.2.x LTS

Inviting the created bot to your Mattermost channel

You can create your own private channel in Mattermost, invite your bot user to your channel by adding new members, and talk with it in the channel.

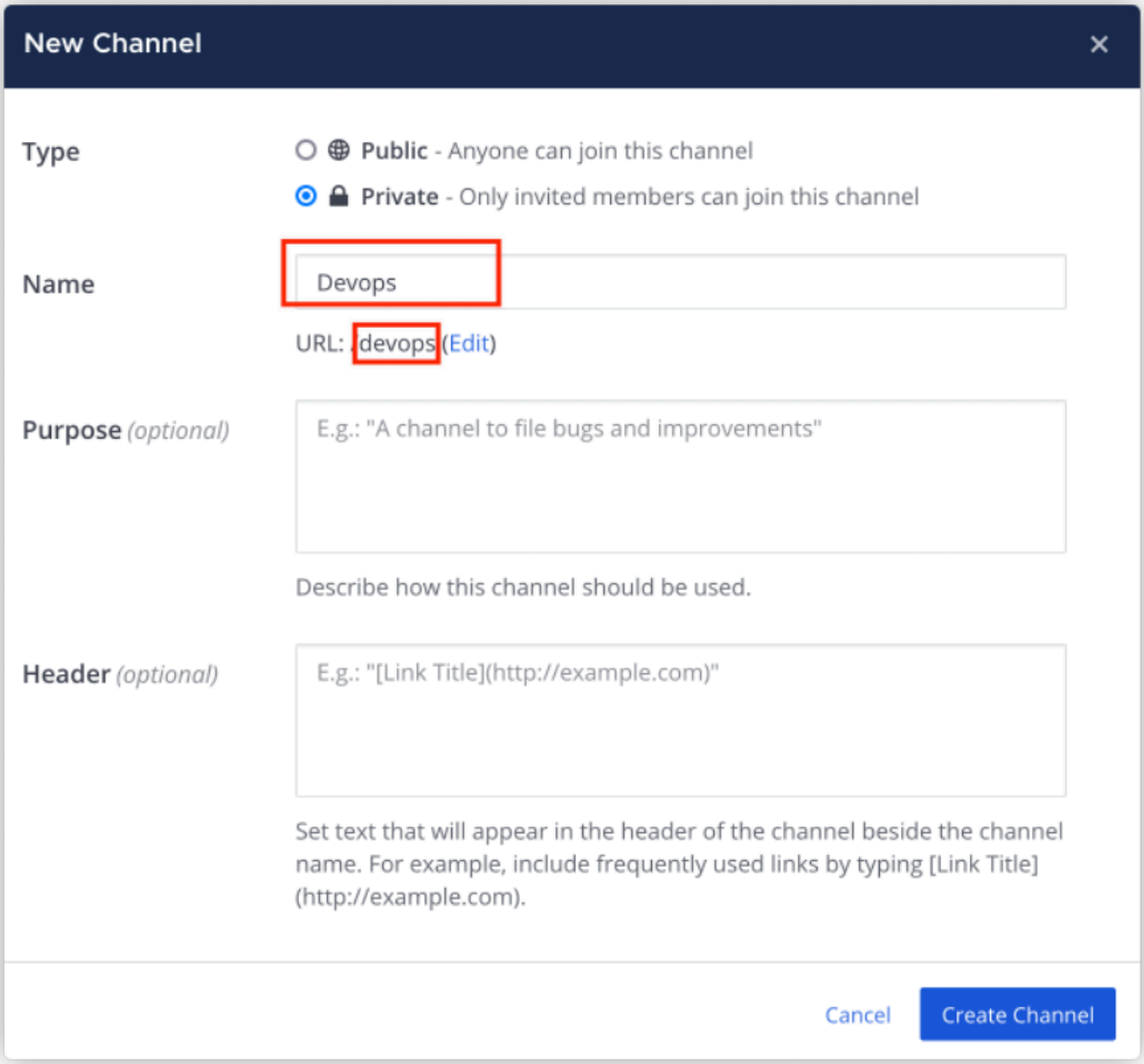
1. Create a private channel.

    i. Click the **+** button to create a new private channel.



    ii. Make sure that you select **Private** as the channel type.

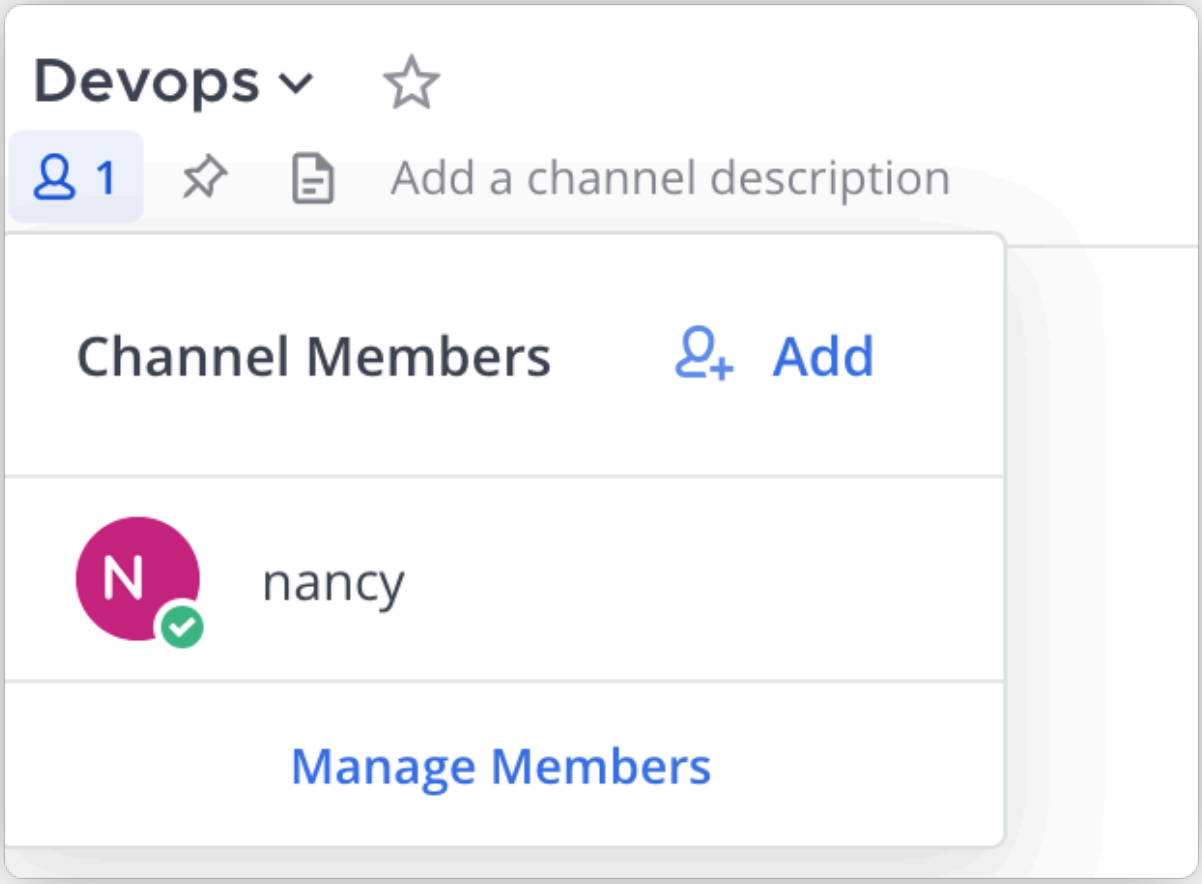
iii. Specify the **Name** of the channel, for example, DevOps.



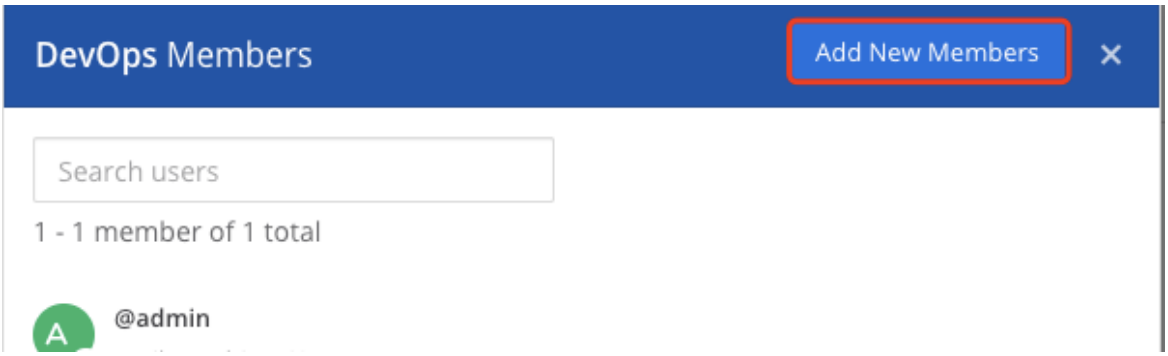
Note: Remember URL under the name. You may use it later when you want to send incident to the channel.

iv. Click **Create New Channel** and your new private channel is created.

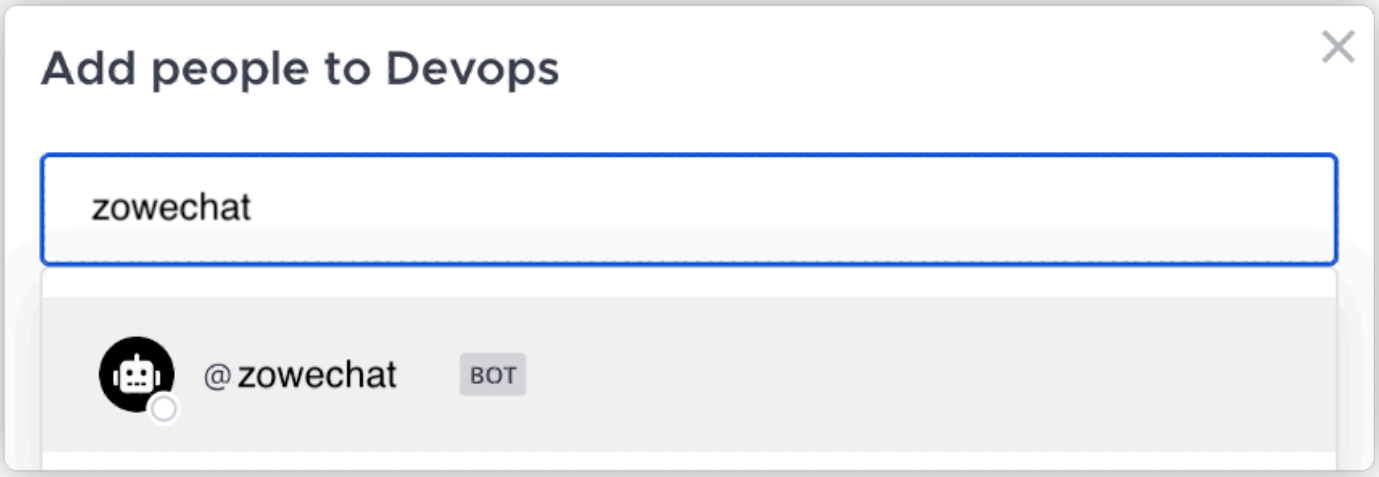
2. On the upper-left corner, click the Members icon and you can see the members that are in this channel. Click **Manage Members**.



3. Click **Add New Members** on the upper-right corner.



4. Enter the name of your bot account to add it to this channel, for example, bnz. You can see bnz in the list. Select it and click **Add**.



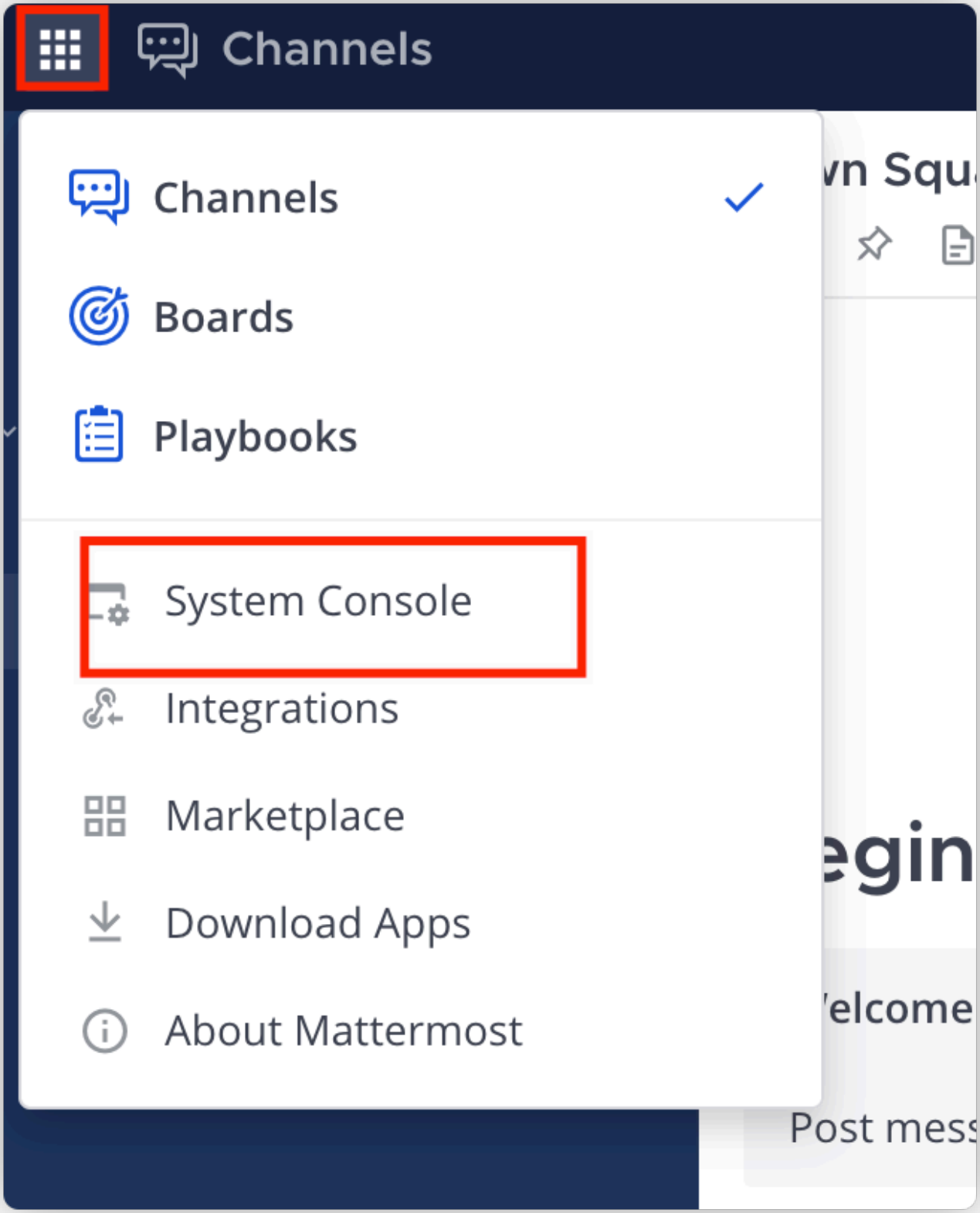
You add your bot account to your channel successfully.

Version: v3.2.x LTS

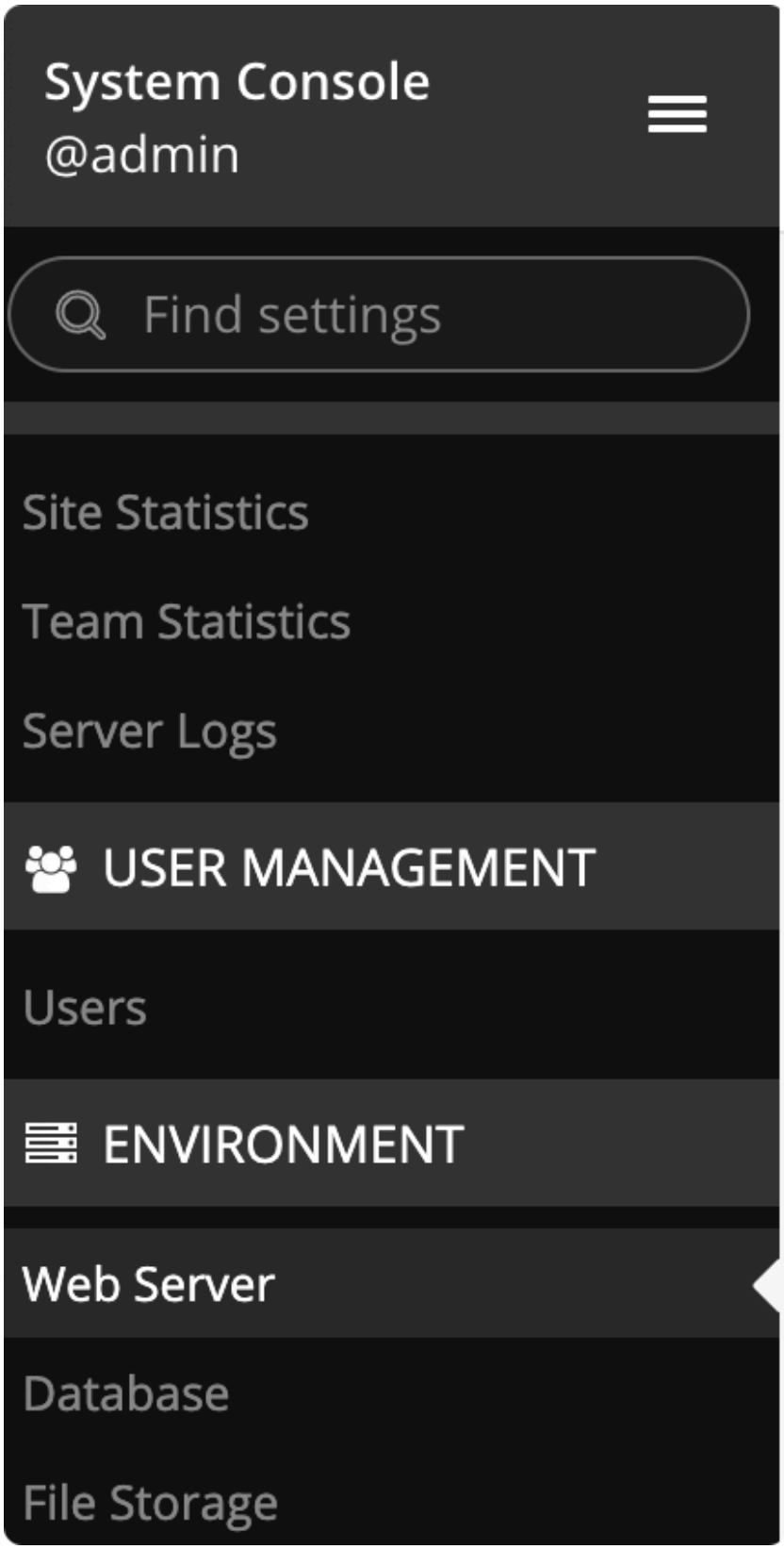
Enabling insecure outgoing connections for mouse navigation

1. Log in to Mattermost with your administrator account.

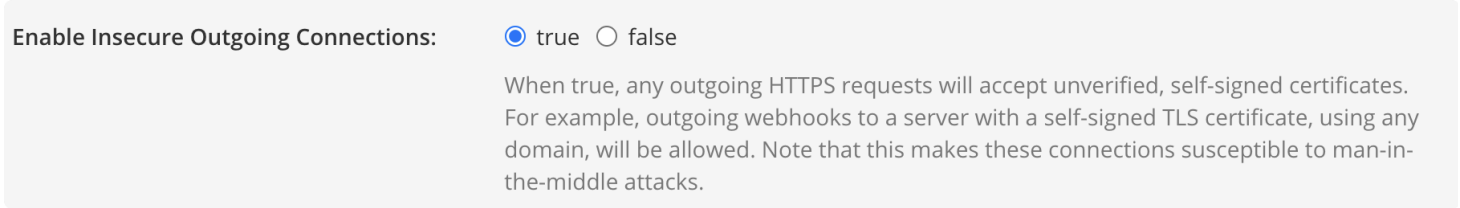
2. Click the Main Menu icon and then click **System Console**.



3. Scroll down to the **ENVIRONMENT** section and click **Web Server**.



4. Select **true** for **Enable Insecure Outgoing Connections**, and click **Save**.



You enable insecure outgoing connections for mouse navigation successfully.

Configuring Microsoft Teams

If you use Microsoft Teams as your chat platform, you need to create a bot app and a bot for Microsoft Teams and configure the messaging endpoint. Take the following steps to configure your Microsoft Teams for Zowe Chat.

1. Creating Microsoft Teams bot app

   Microsoft Teams provides Microsoft Developer Portal to create bot app in the current version. App Studio has been deprecated according to the announcement made by Microsoft Teams.

2. Creating a bot for Microsoft Teams bot app

   Microsoft provides two ways to create a bot, either using Microsoft Bot Framework or Microsoft Azure. You can choose either one of them according to your own environment and requirements.

3. Configuring messaging endpoint for Microsoft Teams

   You need to expose your Zowe Chat via a public HTTPS endpoint so that Microsoft Teams can push messages to it. The steps differ depending on the way you create your bot.

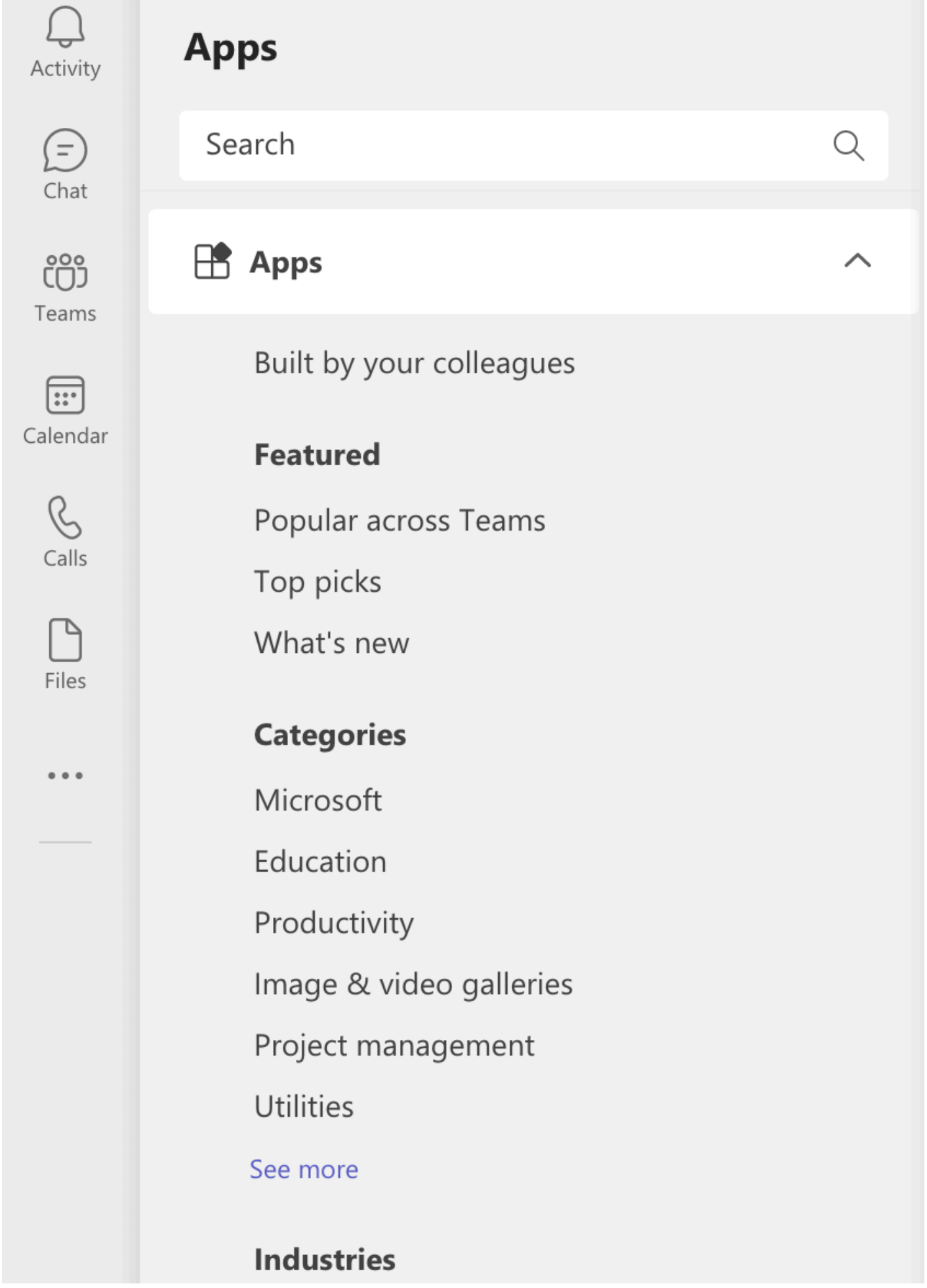
Version: v3.2.x LTS

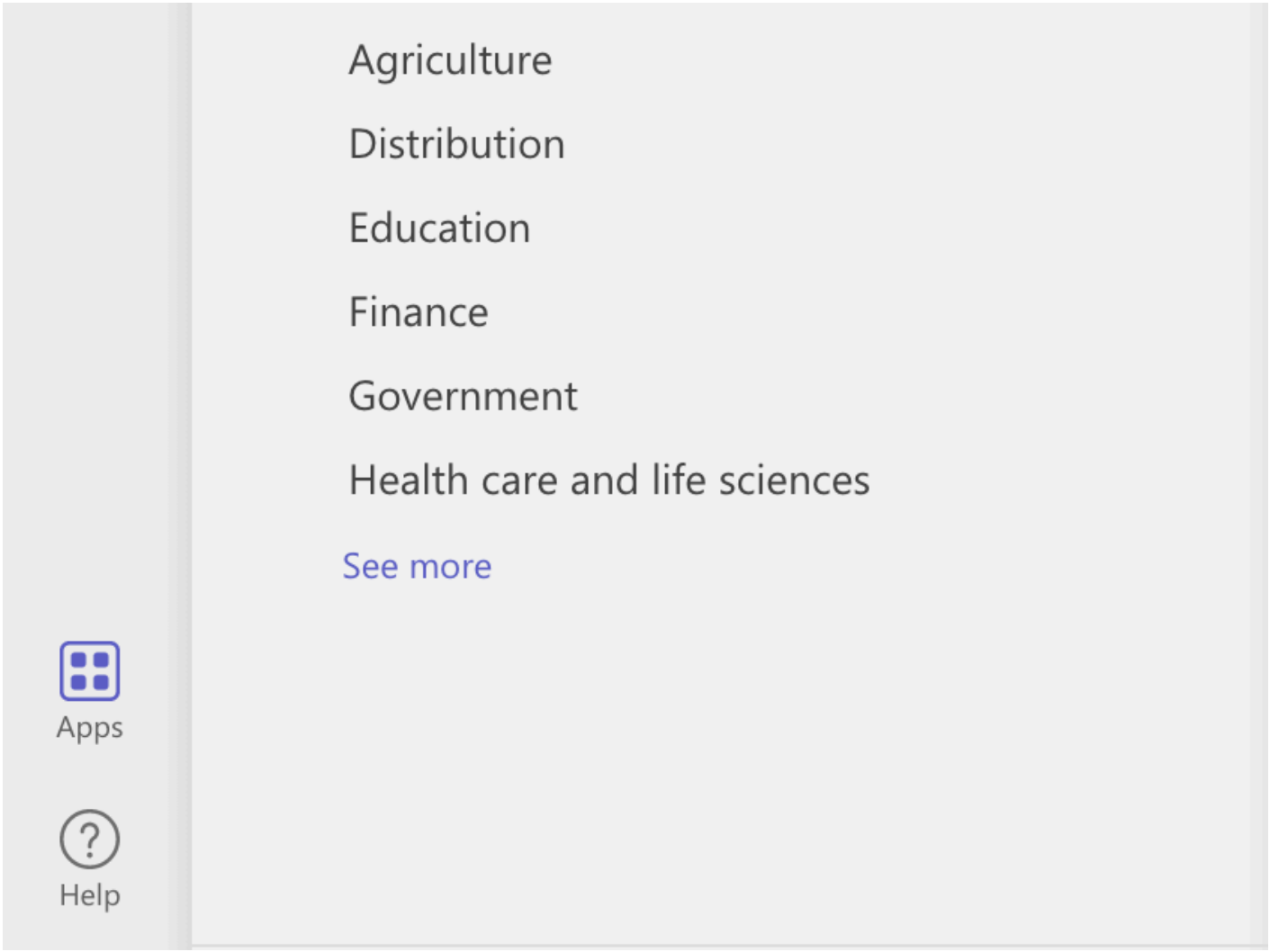
Creating Microsoft Teams bot app with Developer Portal

To create a bot app for Microsoft™ Teams, you need to use the tool Developer Portal to create a new app, specify app details, enable bot capabilities, and add it to your teams.

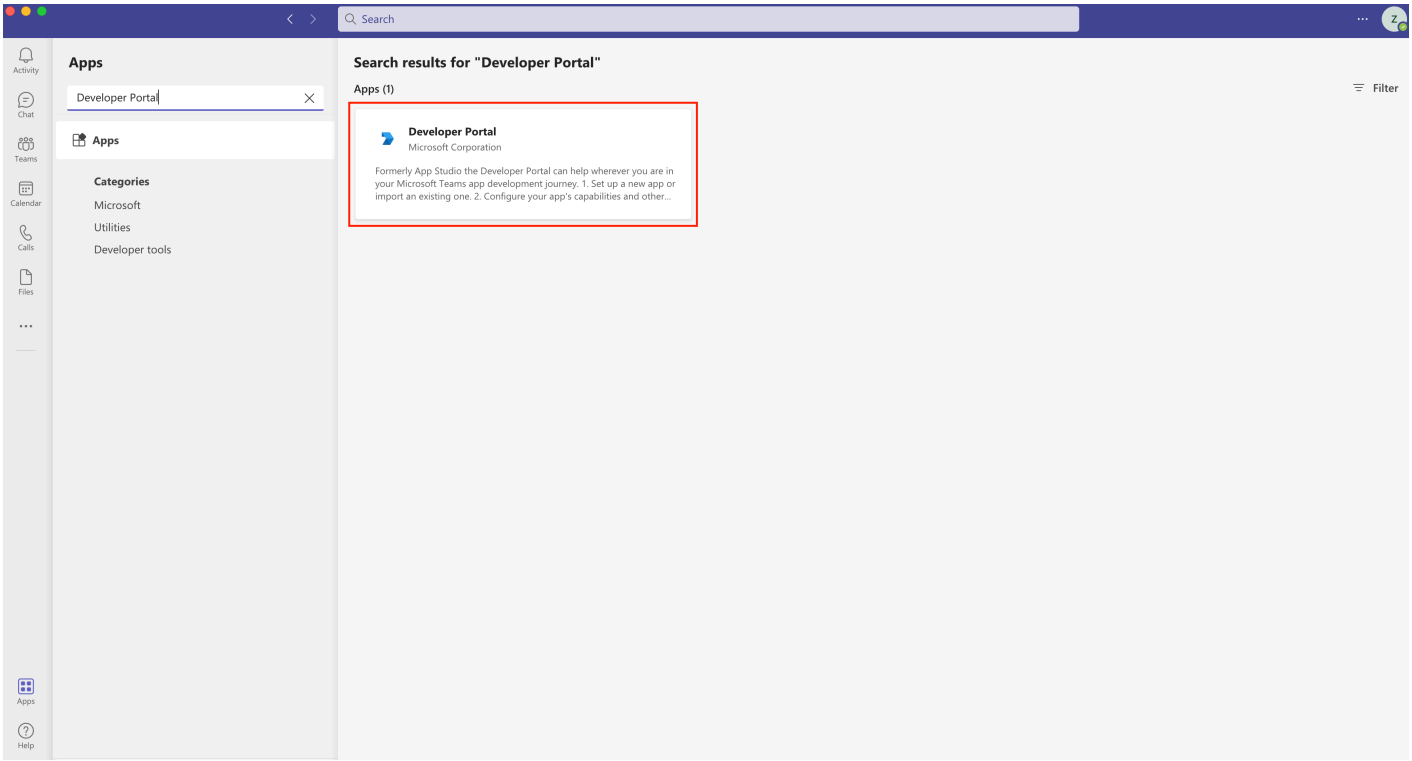
Developer Portal is a Teams app that makes it easy to create or integrate your own Microsoft Teams apps whether you develop custom apps for your enterprise or SaaS applications for teams around the world. It streamlines the creation of the manifest and package for your app and provides several useful tools like the Card Editor. You can find Developer Portal in the Teams store.

1. Find and add Developer Portal to your Microsoft Teams.
    i. Launch and log in your Microsoft Teams client.
    ii. Click the Apps icon at the bottom left of your Microsoft Teams window to open the Apps pane.

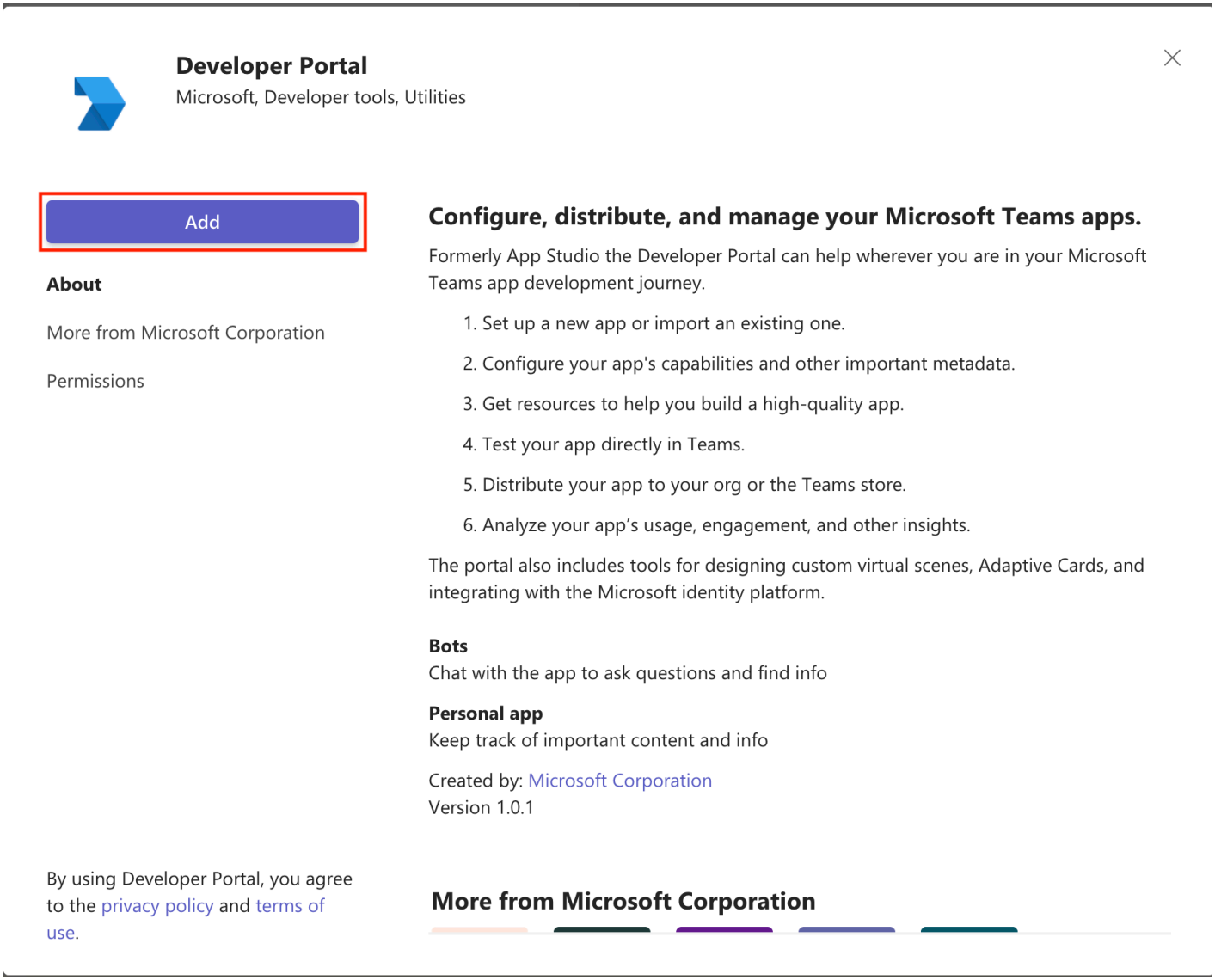

Activity
Chat
Teams
Calendar
Calls
Files
Apps
Search
Apps
Built by your colleagues
Featured
Popular across Teams
Top picks
What's new
Categories
Microsoft
Education
Productivity
Image & video galleries
Project management
Utilities
See more
Industries



iii. Search for Developer Portal with the search bar.



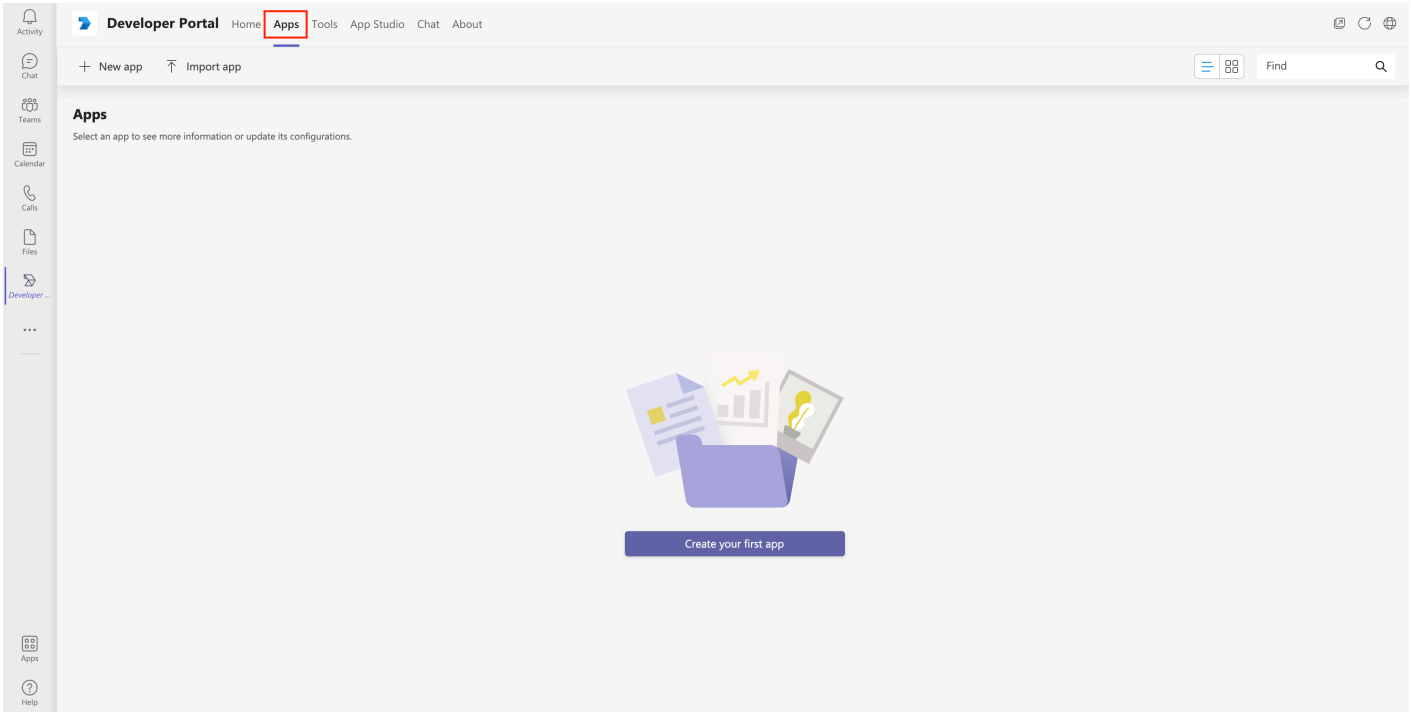
iv. Select Developer Portal and click **Add**.



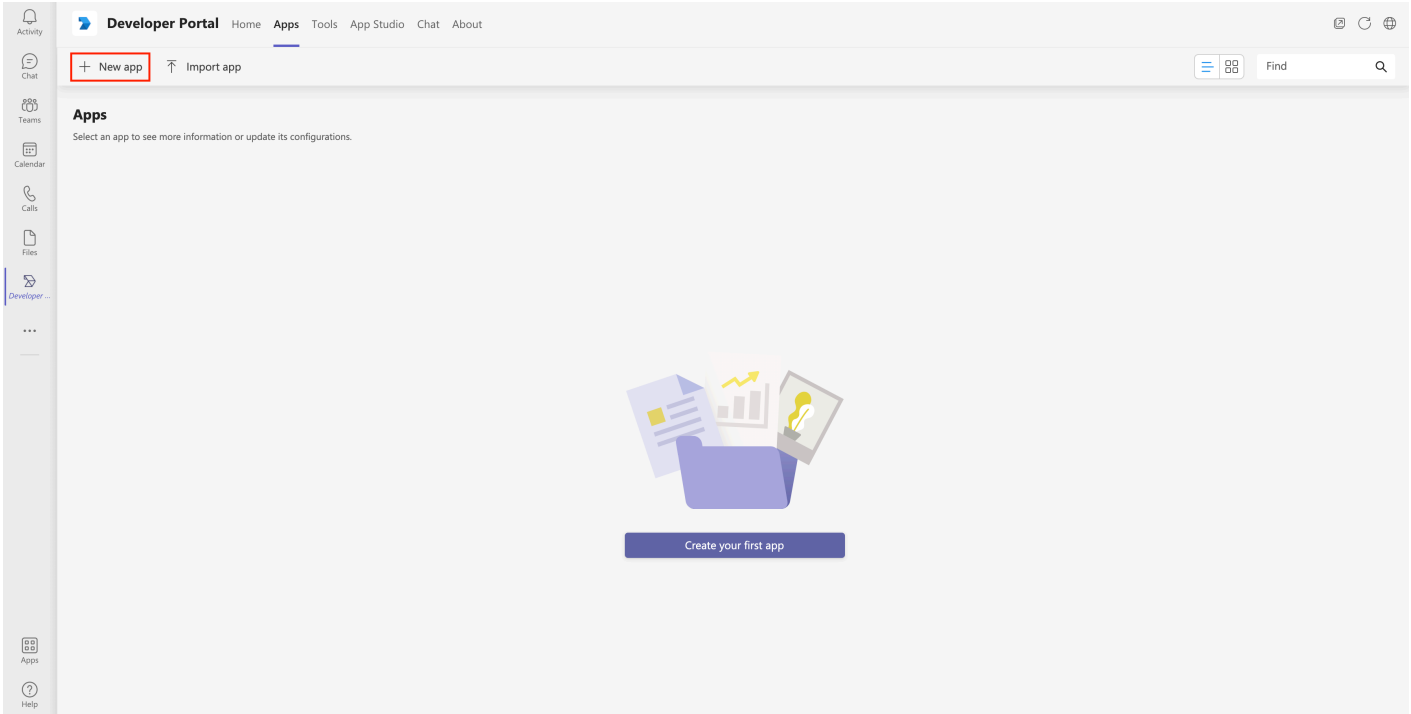
You can see the home page of Developer Portal.

2. Create a new app.

   i. Click the **Apps** icon at the top of the home page of Developer Portal to open the Apps pane.

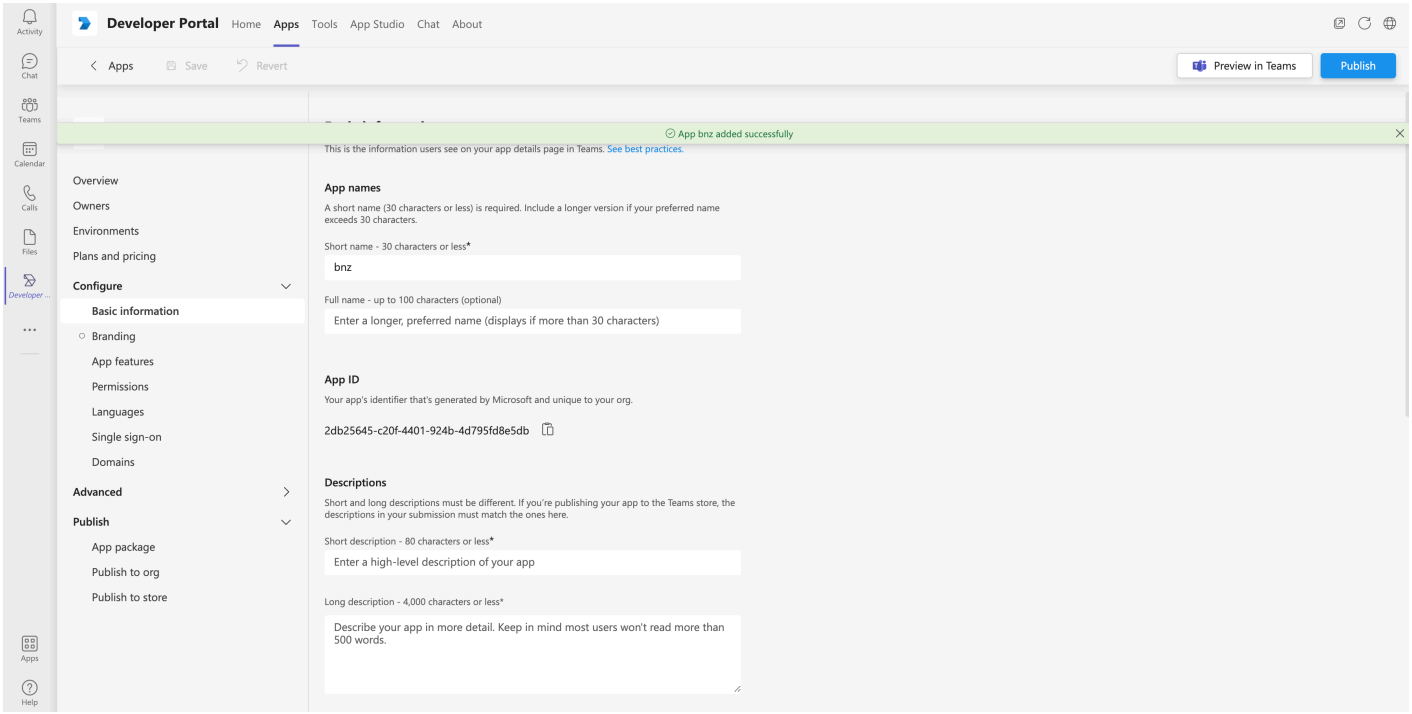


ii. Click the **New app** icon to create a new app.

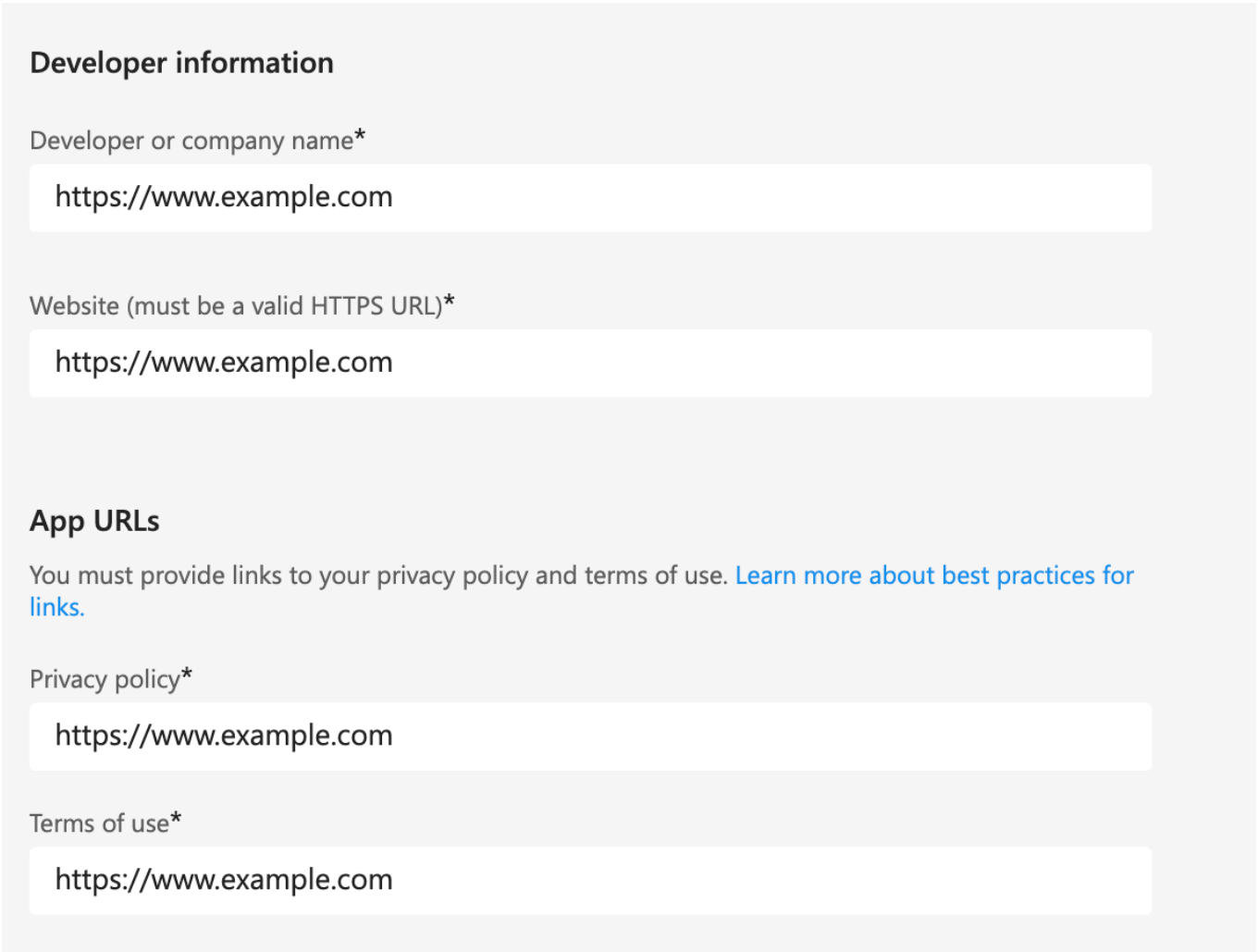


iii. In the prompted dialog, specify a short name for your app that is used for configuration in Zowe Chat as the bot username, and then click **Add**.

iv. Specify the required values for your app, and then click **Save**.

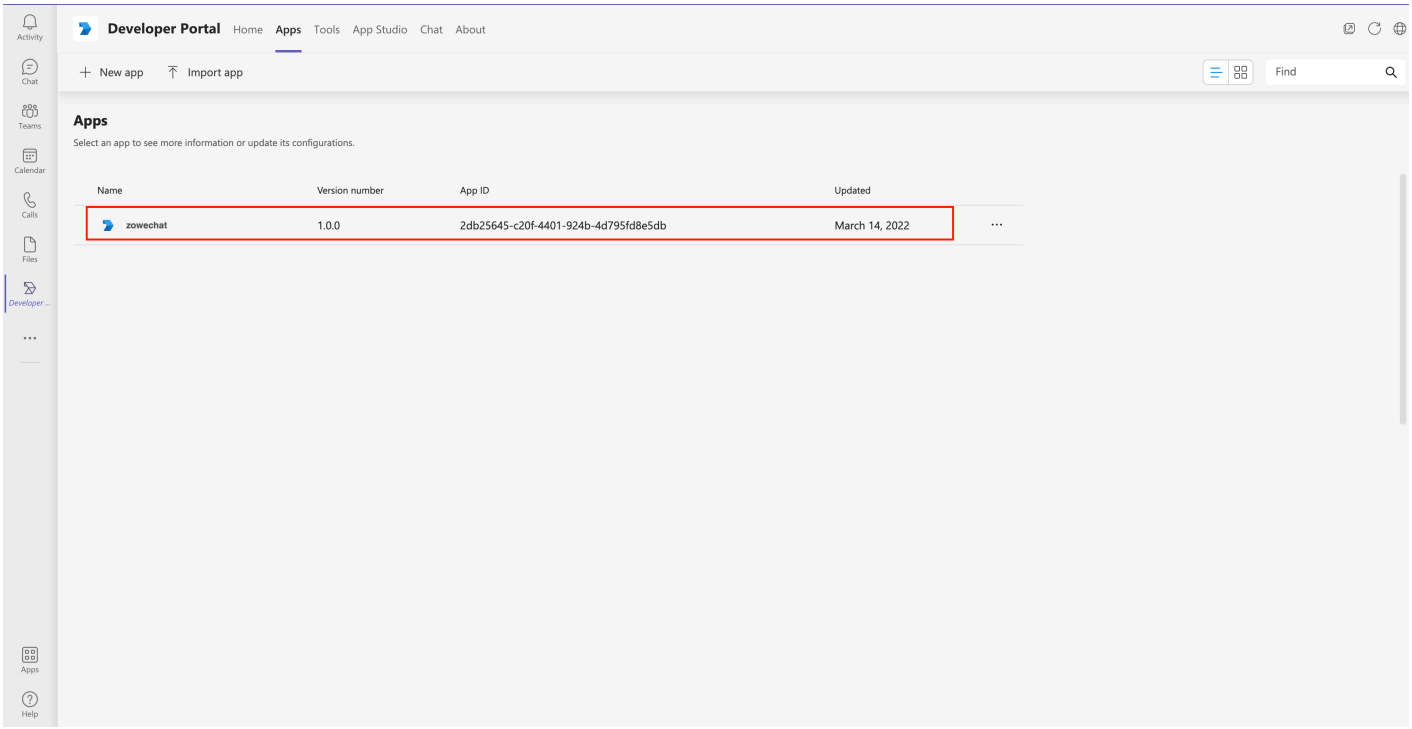


- For **Descriptions**, specify a short description for your app.
- Specify all the required information accordingly.

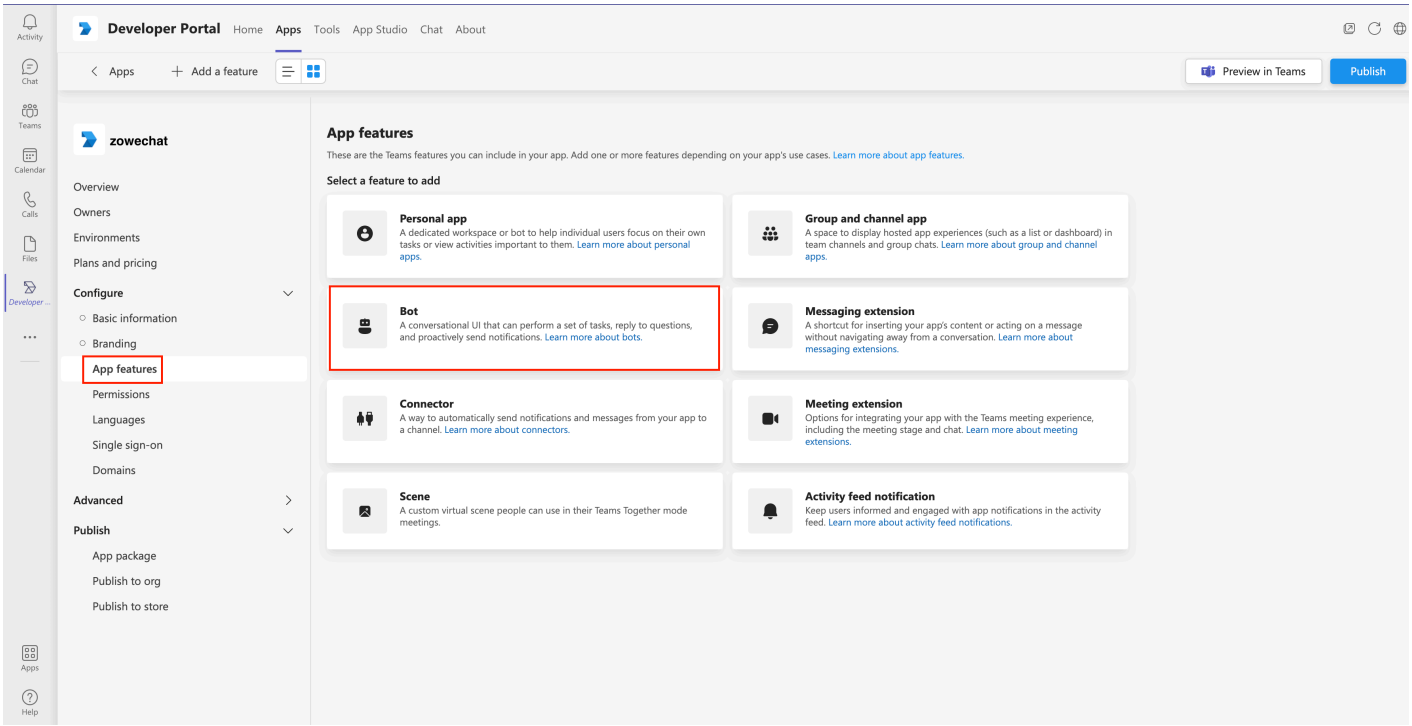


3. Configure your app.

   i. Switch to **Apps** pane and select the app that you created.



   ii. Click the **App features** icon under **Configure**, and select **Bot** in App features pane.



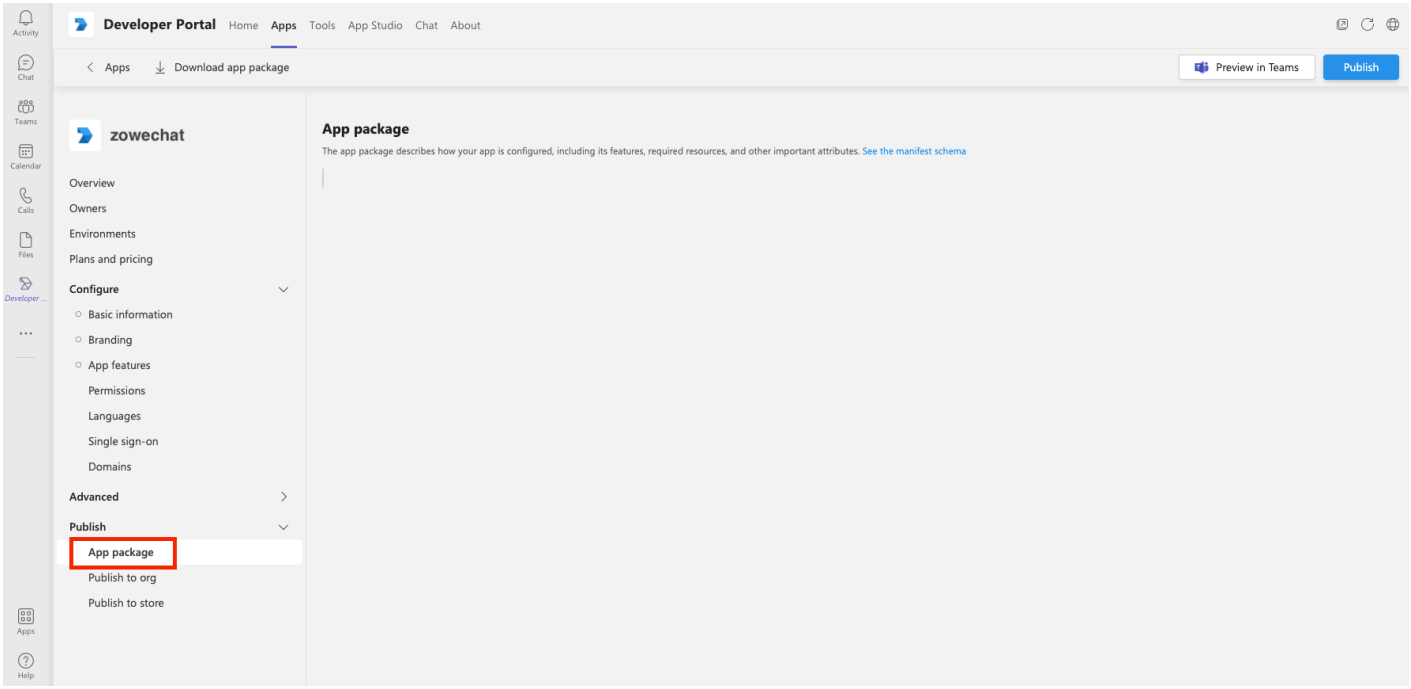
   iii. Select the bot that you created in **Identify your bot** section.

   Select **Personal**, **Team** and **Group Chat** for **Scope** so that you can add the bot app to your teams. Save your settings and you can see your bot in the **Bots** panel.

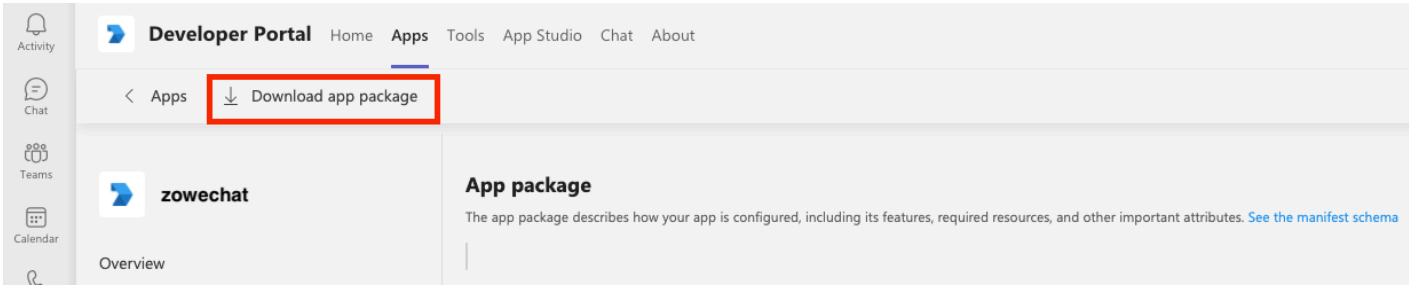
Remember: You need to create a bot if you don't have one. You can either create a bot with Microsoft Bot Framework or with Microsoft Azure. For specific steps, see Creating a bot with Microsoft Bot Framework or Creating a bot with Microsoft Azure.

4. Publish your app.

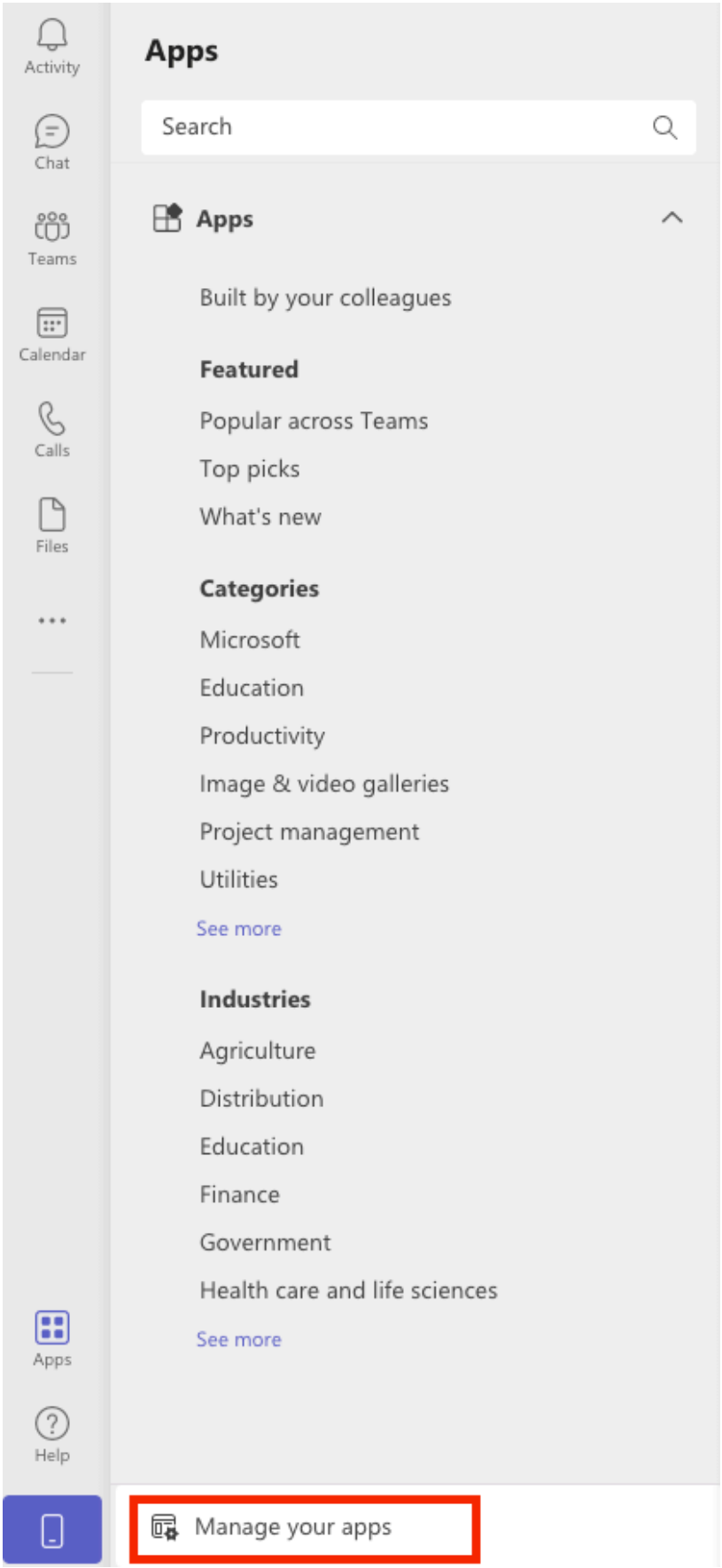
   i. Click the **App package** icon under **Publish**.



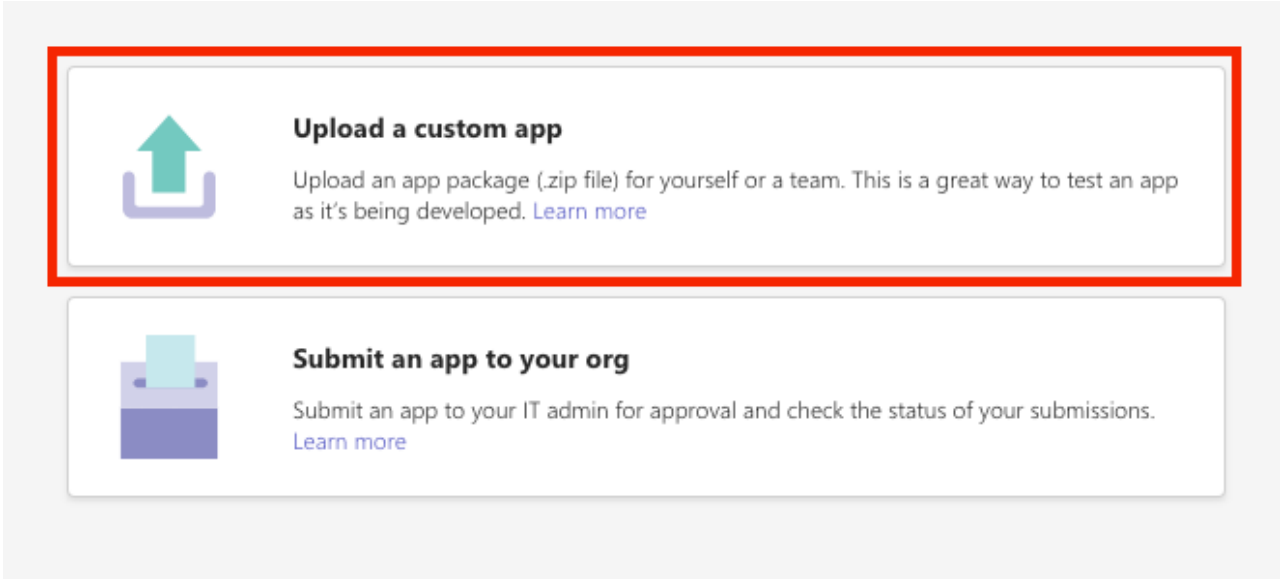
   ii. Click **Download app package** to download your app package.



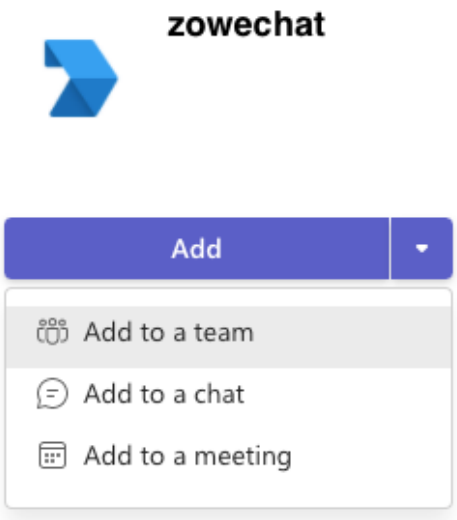
   iii. Click the Apps icon at the bottom left of your Microsoft Teams window, and click **Manage your apps**.



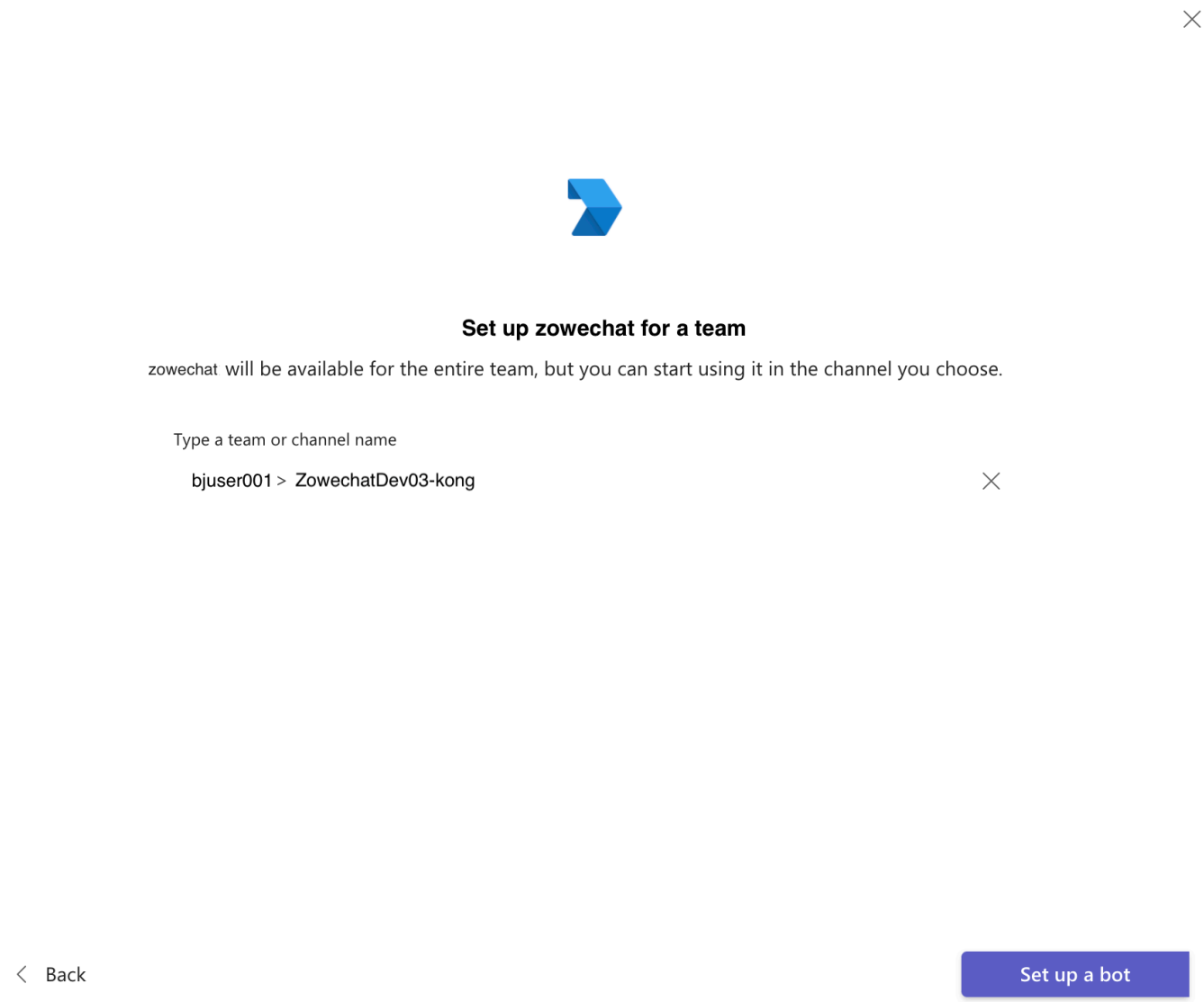
iv. Select **Upload a custom app** to add the app to a team. Upload the app package that you download in substep b.



v. Select **Add to a team** in the drill-down options.

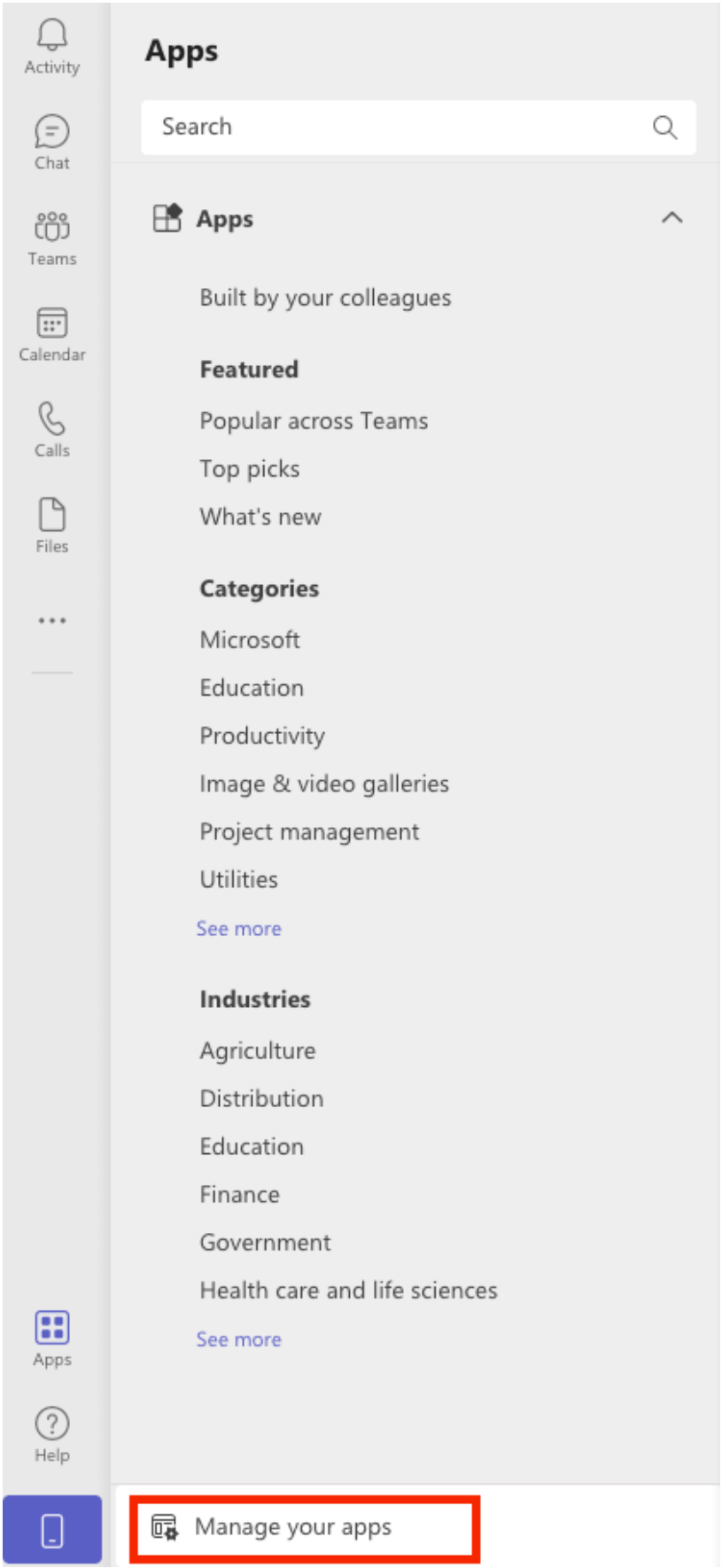


vi. Type or select a team to set up your bot.

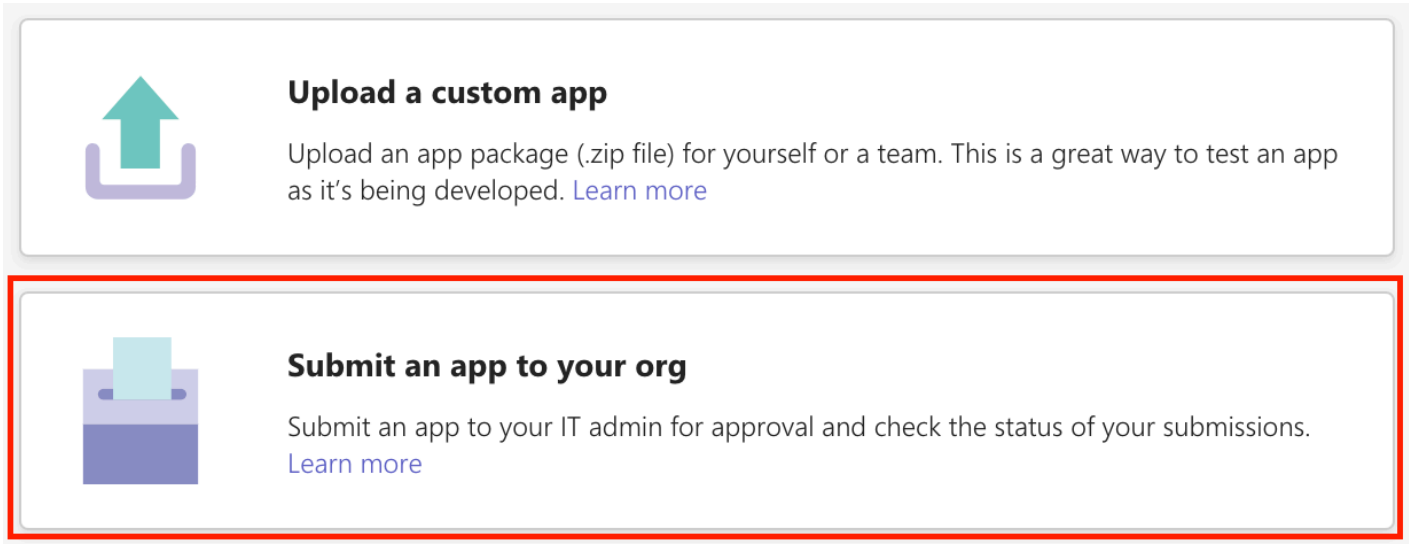


5. Optional: You can also choose to publish your app to your organization's app catalog so that people in your organization can share it.

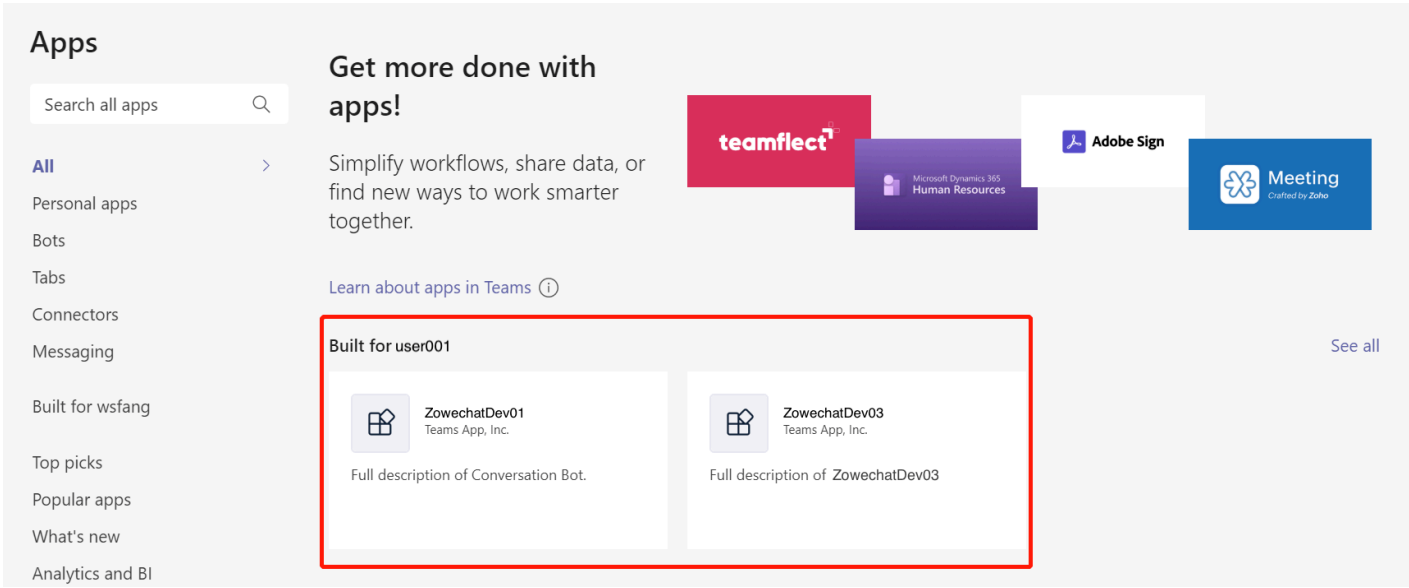
    i. Click the Apps icon at the bottom left of your Microsoft Teams window, and click **Manager your apps**.



ii. Select **Submit an app to your org** to publish your app.



Your app will appear on your Apps homepage when the IT admin of your organization approves.



Now, people in your tenant can see this app and can use it.

You have successfully created a bot app for Microsoft Teams and can talk to it in your teams.

Version: v3.2.x LTS

Creating a bot for Microsoft Teams bot app

Microsoft™ provides two ways to create a bot, either using Microsoft Bot Framework or Microsoft Azure. You can choose either one of them according to your own environment and requirements.

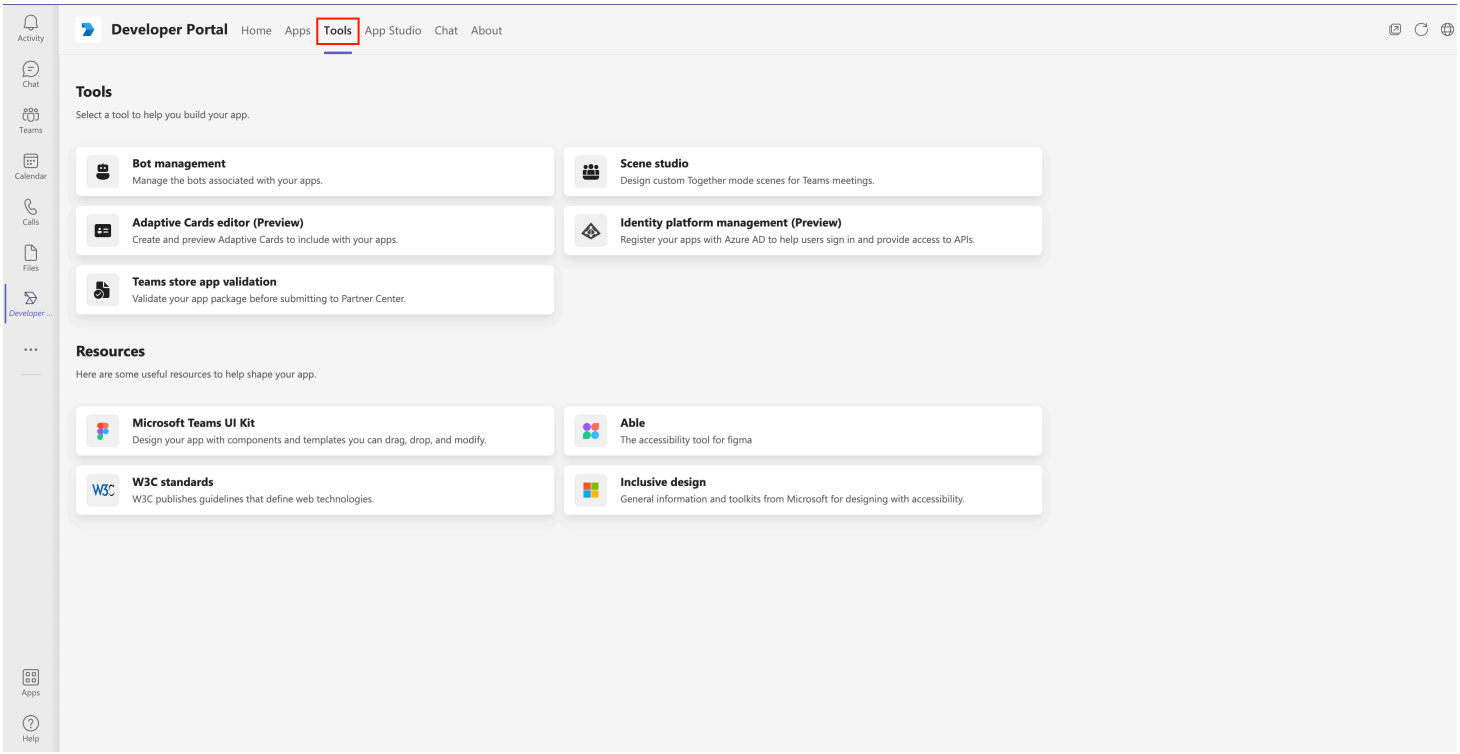
- **Creating a bot with Microsoft Bot Framework**
  You can use the tool Microsoft Developer Portal to create a bot with Microsoft Bot Framework and set it up for your bot app.
- **Creating a bot with Microsoft Azure**
  To create a bot with Microsoft Azure, you need to use Microsoft Azure portal to create a resource with the Bot Channels Registration service, configure the resource, get the bot password, and configure channels.

Version: v3.2.x LTS

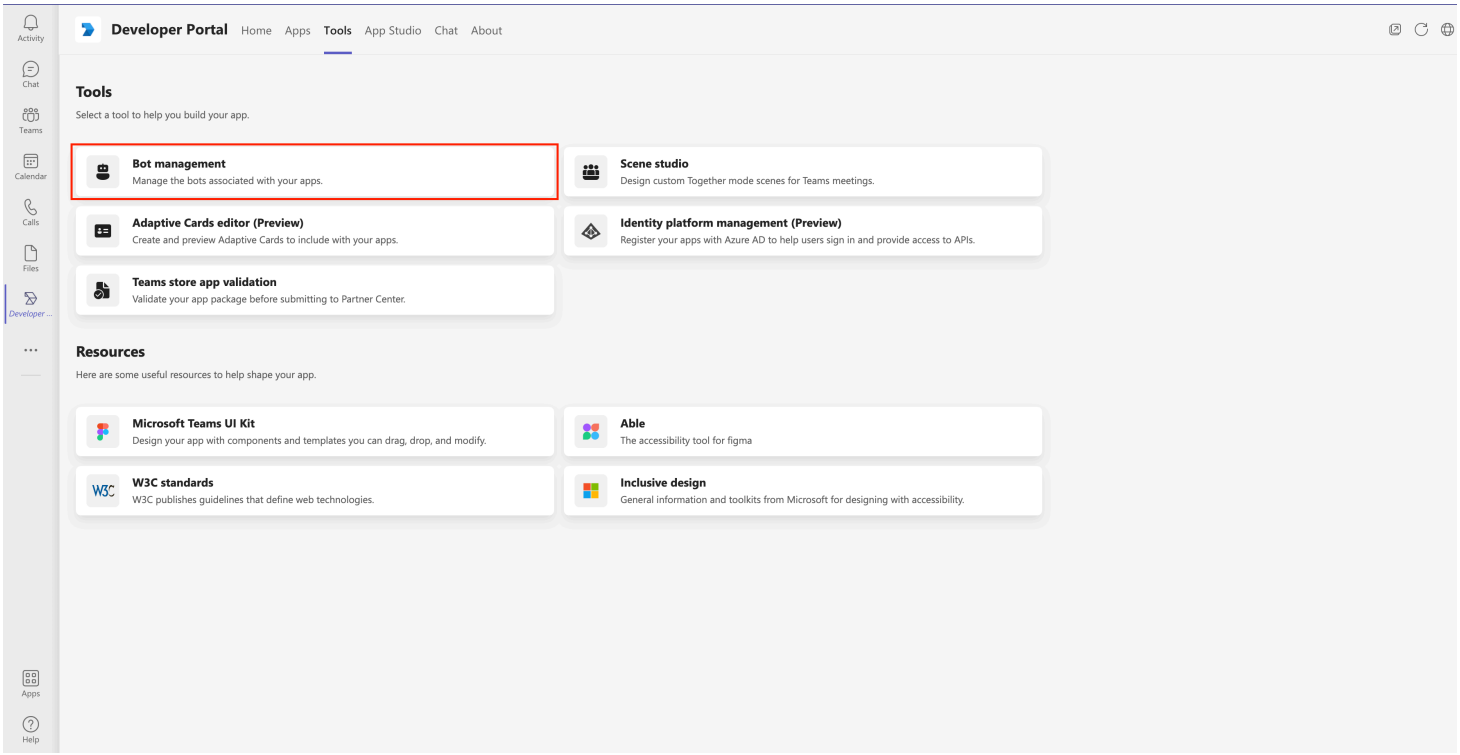
Creating a bot with Microsoft Bot Framework

You can use the tool Microsoft™ Developer Portal to create a bot with Microsoft Bot Framework and set it up for your bot app.

1. Click the **Tools** icon at the top of the home page of Developer Portal to open the Tools pane.

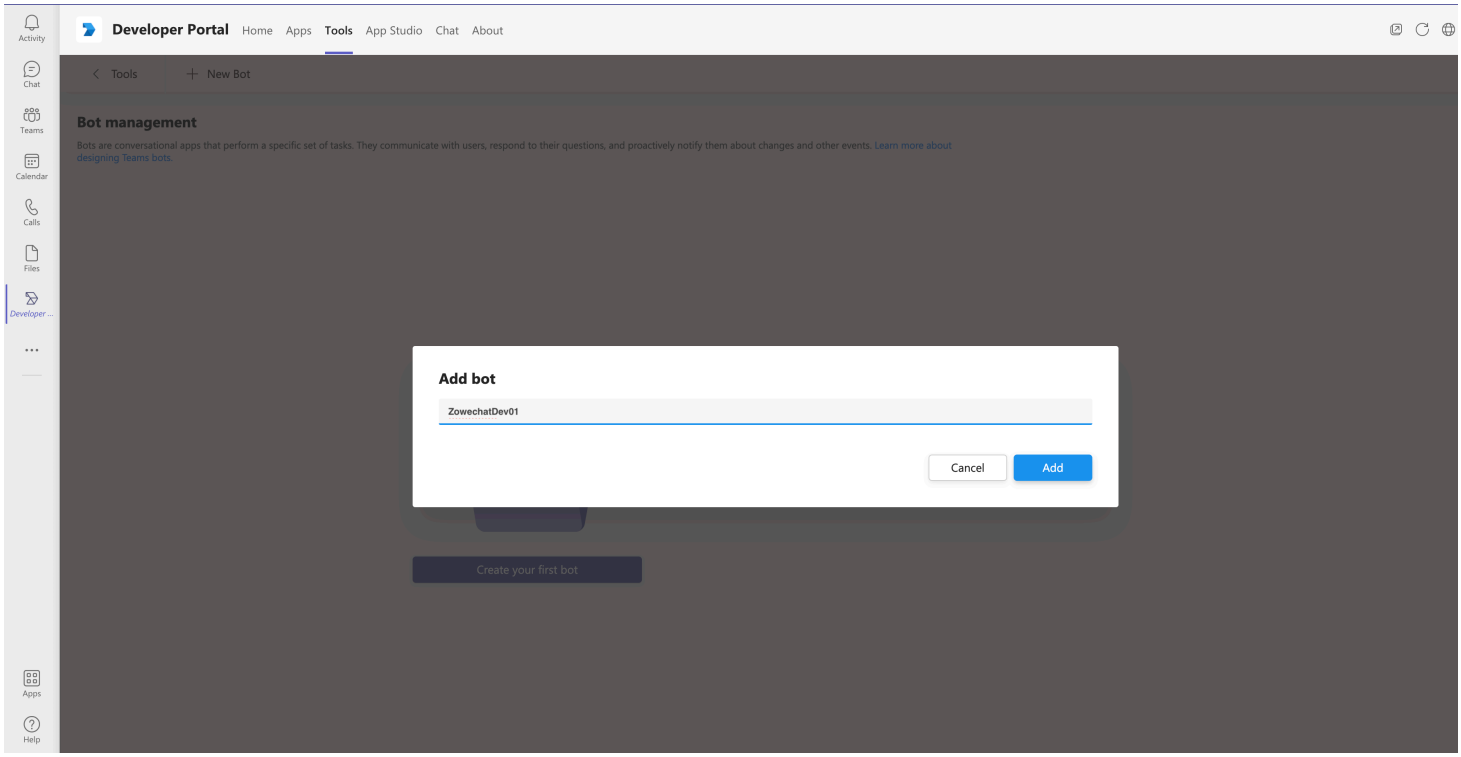


2. Click **Bot management** to create your bot.

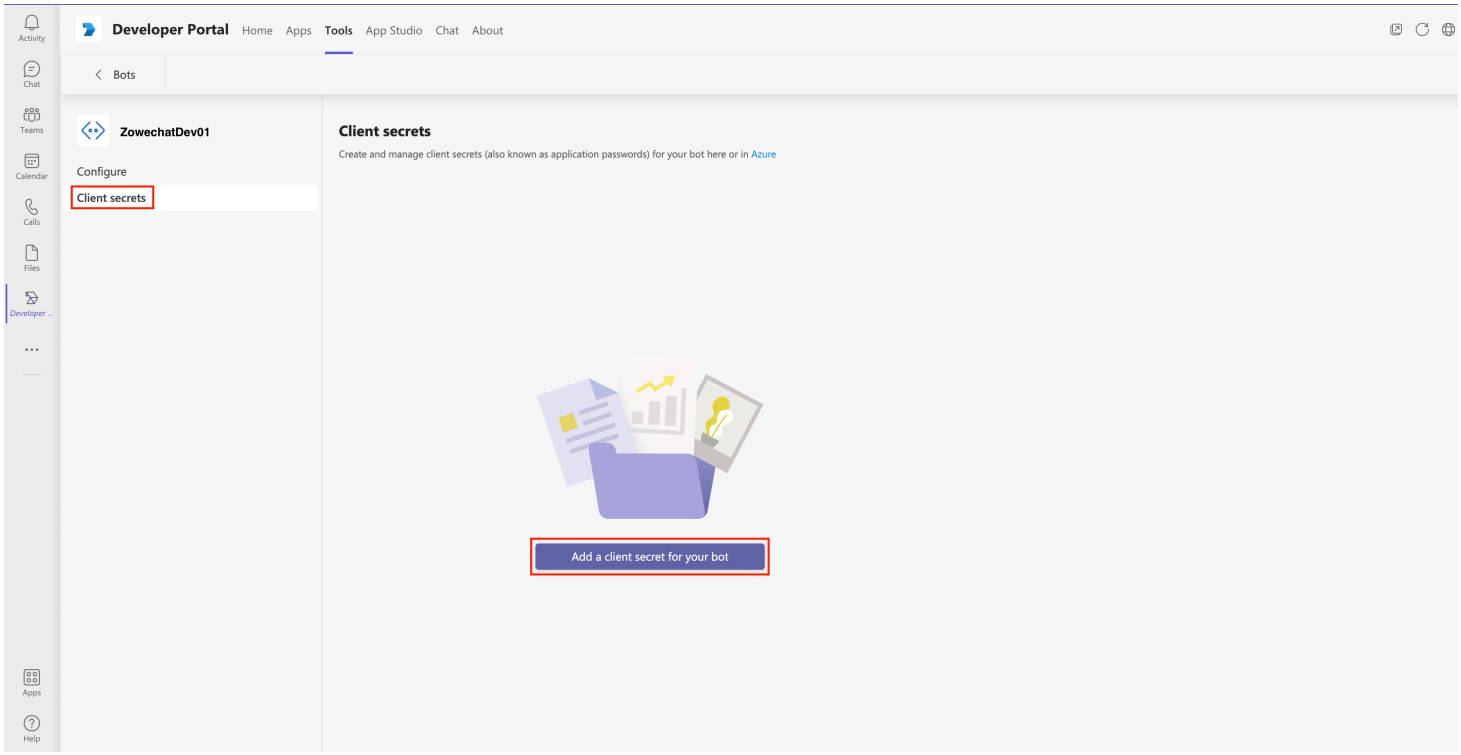


3. Click **New bot** to create a new bot.

4. In the prompted dialog, specify a short name for your bot and then click **Add**.



5. Click **Client secrets** at the left of the Developer Portal, and click **Add a client secret for your bot** to generate a client secret for your bot.



6. Copy the new client secret.

Remember: Save the client secret for later use. You will need it when you configure your Microsoft Teams. The client secret appears only once here.

Your Microsoft Bot Framework bot is successfully created.

You can continue with installing or publishing your bot app in your Microsoft Teams. For specific steps, refer to the step 4 and 5 in Creating Microsoft Teams bot app with Developer Portal.

Version: v3.2.x LTS

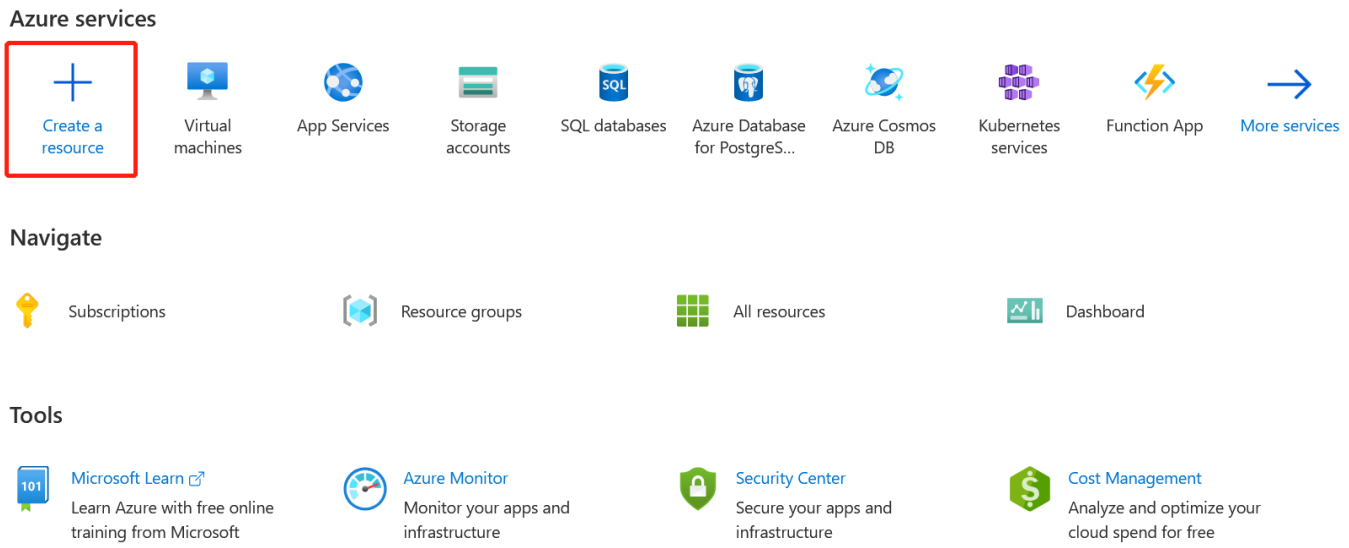
Creating a bot with Microsoft Azure

To create a bot with Microsoft™ Azure, you need to use Microsoft Azure portal to create a resource with the Bot Channels Registration service, configure the resource, get the bot password, and configure channels.

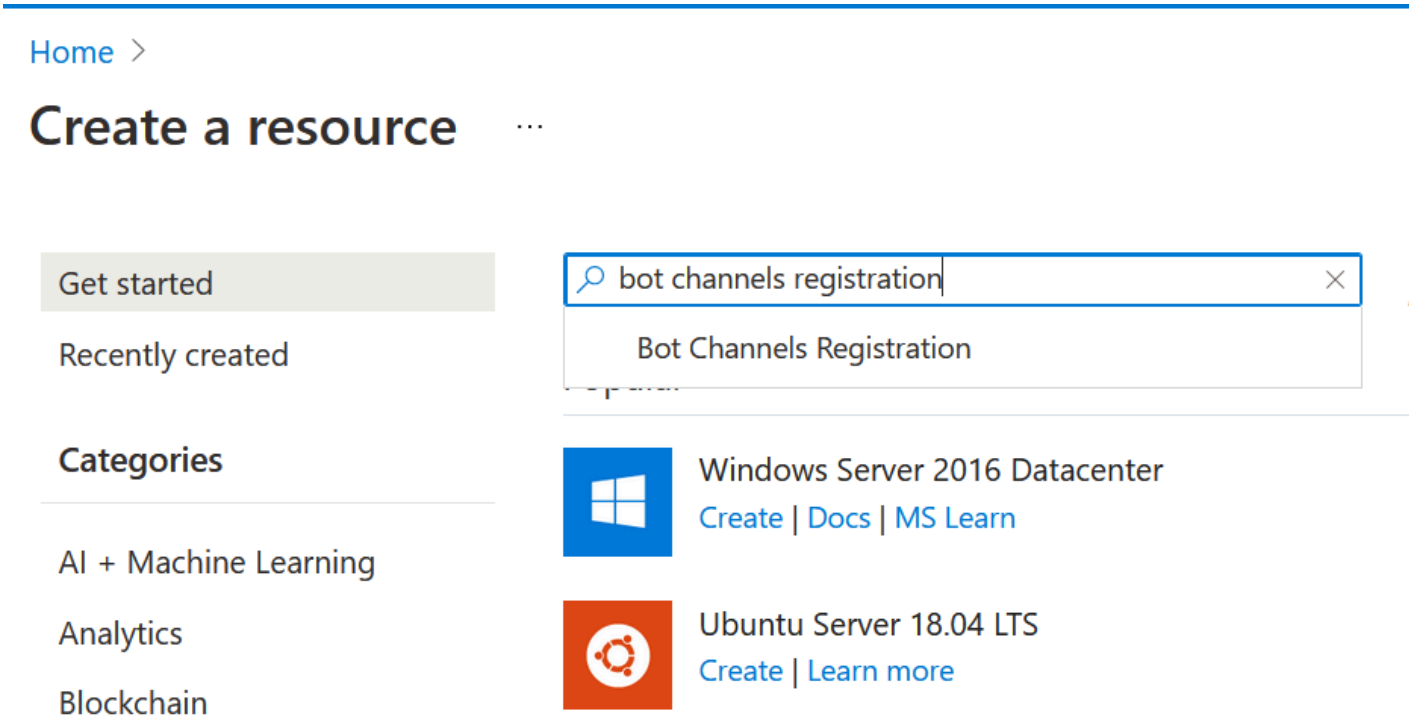
1. Create a new resource.

   i. Launch the Microsoft Azure portal at portal.azure.com.

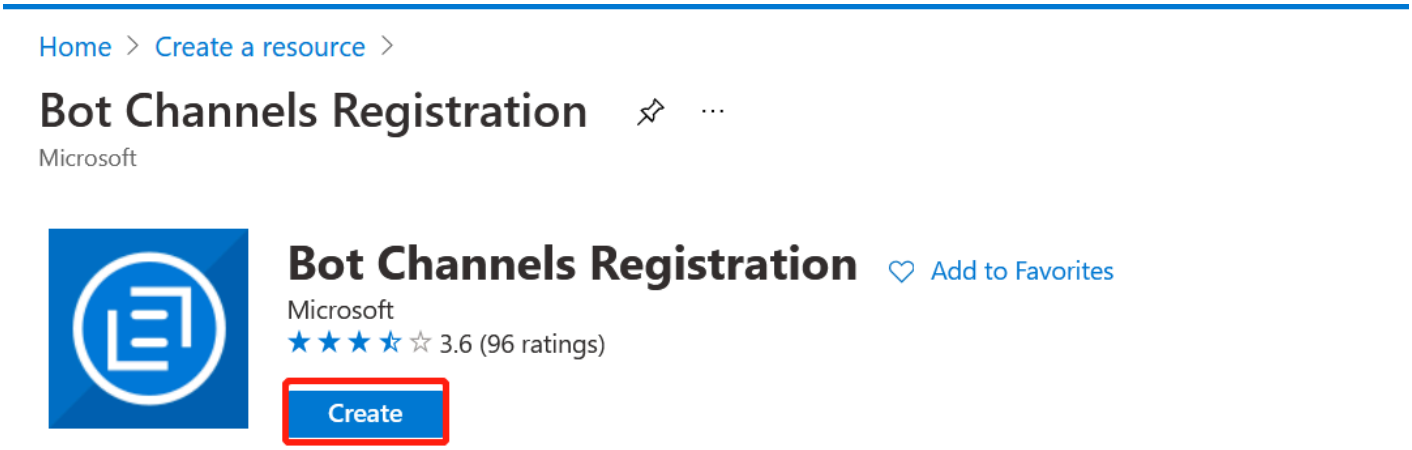
   ii. Click **Create a resource** under **Azure services**.



   iii. Search for **Bot Channels Registration** with the search bar and select it.



iv. Click **Create** to create a new resource.



v. Specify the required values, where

- **Bot handler** is a unique identifier for your bot. You can set it to be your bot name.
- **Resource group** is a container that holds related resources for an Azure solution. You can create a new one if you don't have one.
- **Messaging endpoint** needs to be configured later. You can leave it blank for now.
- **Microsoft App ID and password** is required. Set it as **Auto create App ID and password**. Otherwise, you can create one manually.

vi. Click **Create**.

It takes a while to complete the creating process. You can see a notice in the **Notification** at the upper right of the menu bar.

2. Configure the resource.

i. Click **Go to resource** when you see the notification. You can also check the resource from the portal home page. Click **All resources** and you can see the one you just created. Select it to start configuration.

ii. Select **Configuration** in **Settings**.

iii. Specify the required values for your resource.

a. Check the **Enable Streaming Endpoint** box.
b. To specify the messaging endpoint, you need to do this step after you install Zowe Chat.
c. Click **Apply** to make the settings effective.

iv. To get the bot password, click **Manage** next to **Microsoft App ID**and open the **Certificates & secrets** pane.

a. Click **New client secret** under **Client secrets** and the **Add a client secret** displays.
b. Specify the description for your resource.
c. Set the **Expires** value for **24 months**.
d. Click **Add**. You can see the resource information listed in the table with **Description**, **Expires**, **Value**, and **ID**. **Value** is your bot password. Save it for later use when you configure Zowe Chat. It only appears once here.

Remember: The **Microsoft App ID** is the bot ID in the App Studio of Microsoft Teams. You will need it when you configure your Microsoft Teams in later steps.

3. Configure the channels.

    i. Go back to the resource page, click **Channels** under **Settings**. Now, only Web Chat is listed in the table.

    ii. Click the MS Teams icon under **Add a featured channel**.

    iii. Click **Save** to connect to MS Teams channels.

4. Set up the bot for your bot app in Microsoft Teams.

    i. Open the App Studio tool in your Microsoft Teams client.

    ii. Click your resource that is listed on the pane to open it.

    iii. Click the **Bots** icon under **Capabilities** and click **Edit**.

Home > Edit an app

zowechat
By Author

Capabilities

Complete these steps in order to distribute your app.

1 **Details**

- App details

2 **Capabilities**

- Tabs
- Bots
- Connectors
- Messaging extensions

3 **Finish**

- Languages
- Domains and permissi...
- App Manifest (preview)
- Test and distribute

iv. Select **Connect to a different bot id** and specify with the Microsoft App ID that you have for your Azure bot.

v. Select **Team** for **Scope** so that you can add the bot app to your teams.

vi. Save your settings.

Your Microsoft Azure bot is successfully created.

You can continue with installing or publishing your bot app in your Microsoft Teams.

Version: v3.2.x LTS

Configuring messaging endpoint for Microsoft Teams

You need to expose your Zowe Chat via a public HTTPS endpoint so that Microsoft™ Teams can push messages to it. The steps differ depending on the way you create your bot.

If the IP address of your Zowe Chat server is public, you can use the Chatbot messaging-endpoint URL `<messaging-endpoint.protocol>://<messaging-endpoint.hostName>:<messaging-endpoint.port><messaging-endpoint.basePath>` directly. Otherwise, you must configure your own network firewall or use some proxy servers to make sure that your Microsoft Teams can access the web hook of Zowe Chat server from Internet.

> **NOTE**
>
> You can find the values for protocol, hostName, port, and basePath messaging-endpoint section of the configuration file `<ZOWE_CHAT_HOME>/config/chatServer.yaml`.

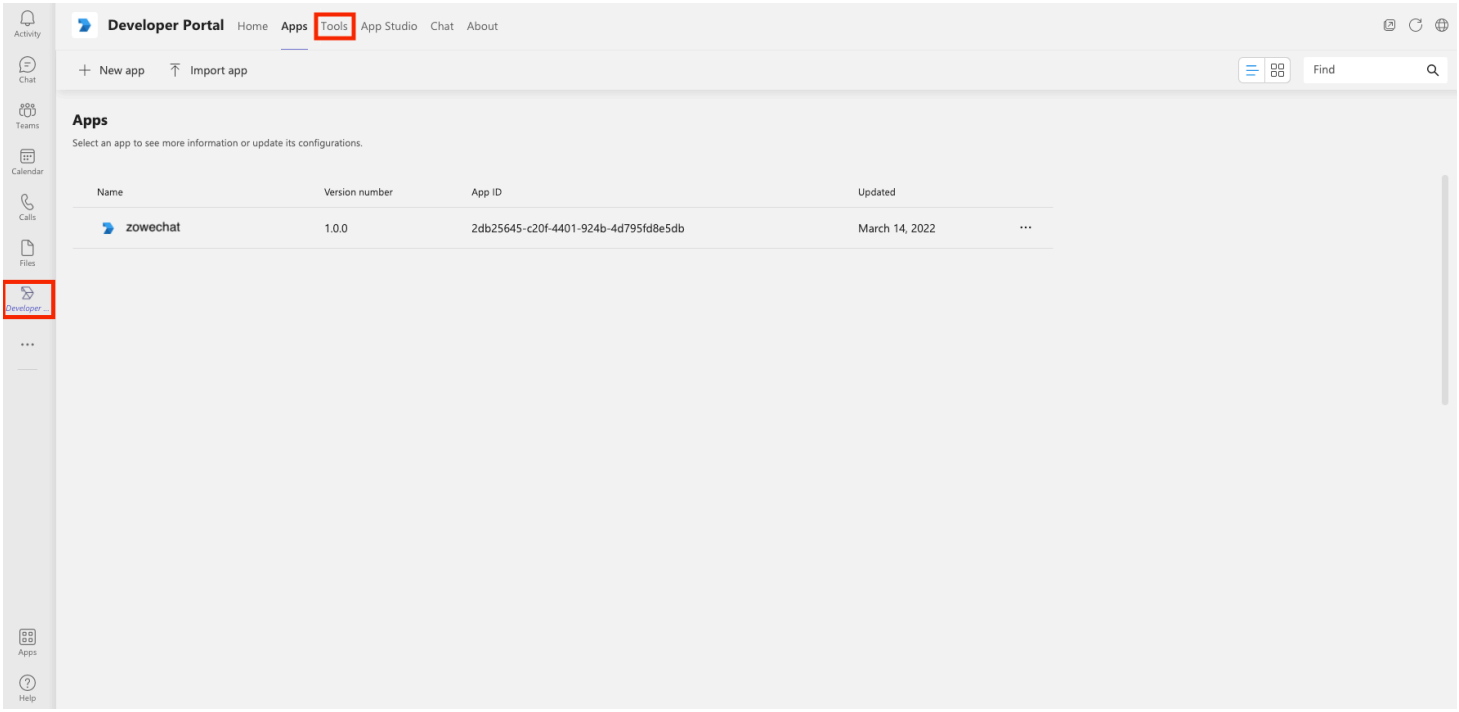
Version: v3.2.x LTS

Configuring messaging endpoint for the Microsoft Bot Framework bot

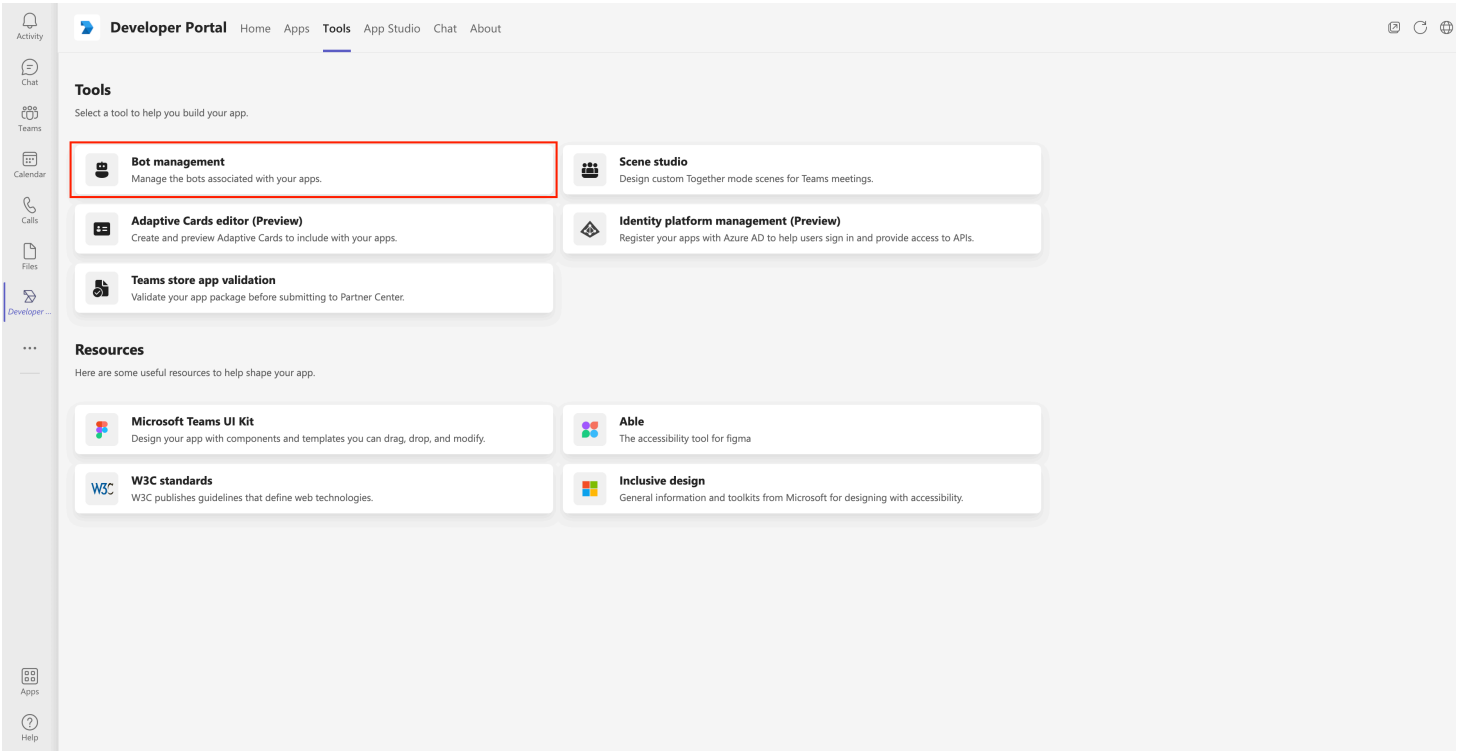
If you create your bot with Microsoft™ Bot Framework, you need to specify the bot endpoint address in Developer Portal to configure the messaging endpoint.

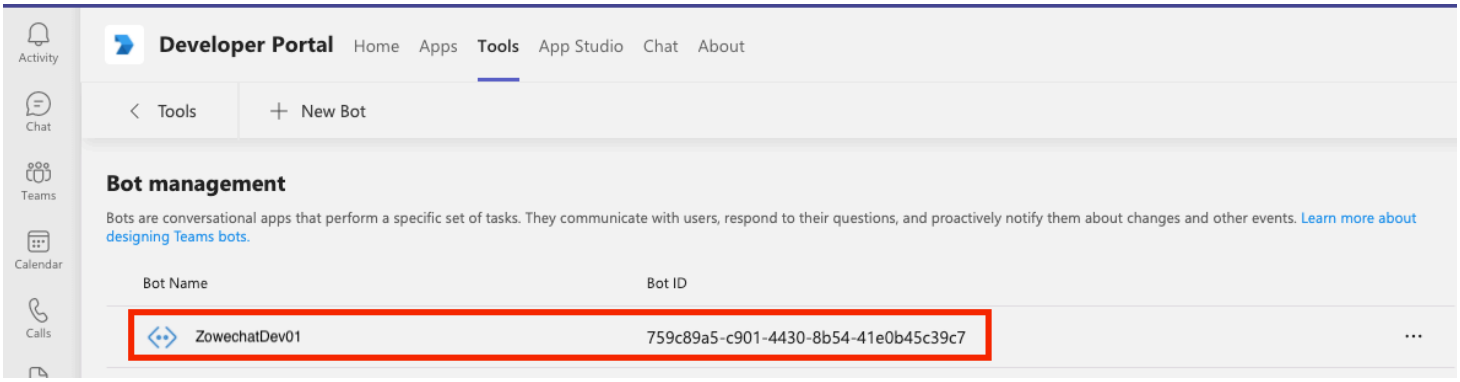
1. Launch and log in your Microsoft Teams client.
2. Click the **Developer Portal** icon

and select **Tools**.

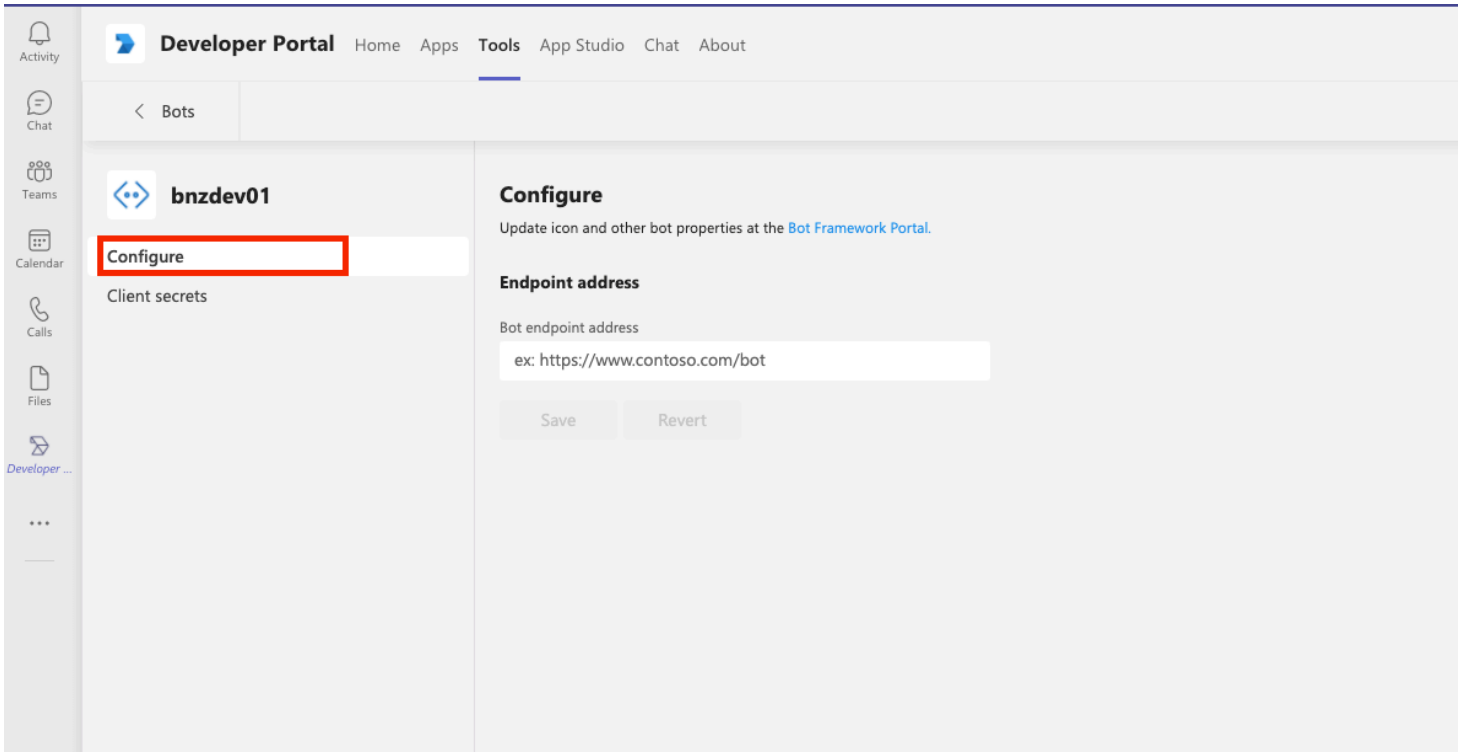


3. Click the **Bot management**. Choose the bot that you created and start editing your bot app.





4. Click **Configure** to configure the messaging endpoint.



5. Specify the **Bot endpoint address** input box under **Endpoint address** with the Zowe Chat web hook URL if it is publicly accessible. Otherwise, you must fill in with your public proxy URL that transmits network payload to Zowe Chat web hook URL.

Your messaging endpoint for Microsoft Bot Framework bot is successfully configured.

Configuring messaging endpoint for the Microsoft Azure bot

If you create your bot with Microsoft™ Azure, you need to specify the messaging endpoint in Microsoft Azure portal to complete the configuration.

1. Launch the Microsoft Azure portal at portal.azure.com.
2. Click **All resources** and select the bot that you created.
3. Select **Configuration** in **Settings**.
4. Specify the **Messaging endpoint** with the Zowe Chat web hook URL if it is publicly accessible. Otherwise, you must fill in with your public proxy URL that transmits network payload to Zowe Chat web hook URL.
5. Verify that the **Enable Streaming Endpoint** box is enabled.
6. Click **Apply** to make the settings effective.

Your messaging endpoint for Microsoft Azure bot is successfully configured.

Version: v3.2.x LTS

Configuring Slack

If you use Slack as your chat platform, you must create and install one Slack App.

1. Creating and installing Slack App

   You must create one Slack App and install it before you can talk with your chat bot in Slack client.

2. Adding your bot user to your Slack channel

   You can add the bot user that you created to your Slack channel in two ways: either mention your bot user directly in the message field or click the link **Add an app** at the beginning of your channel.

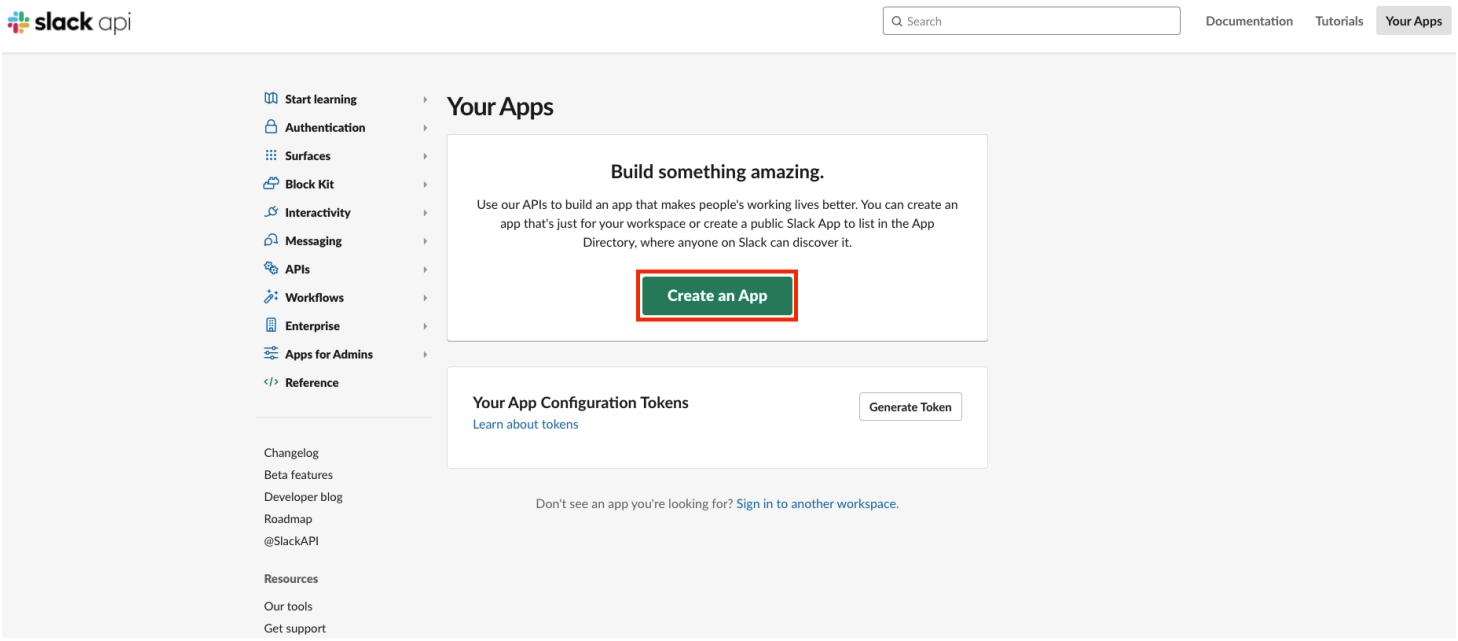
Version: v3.2.x LTS

Creating a new Slack App

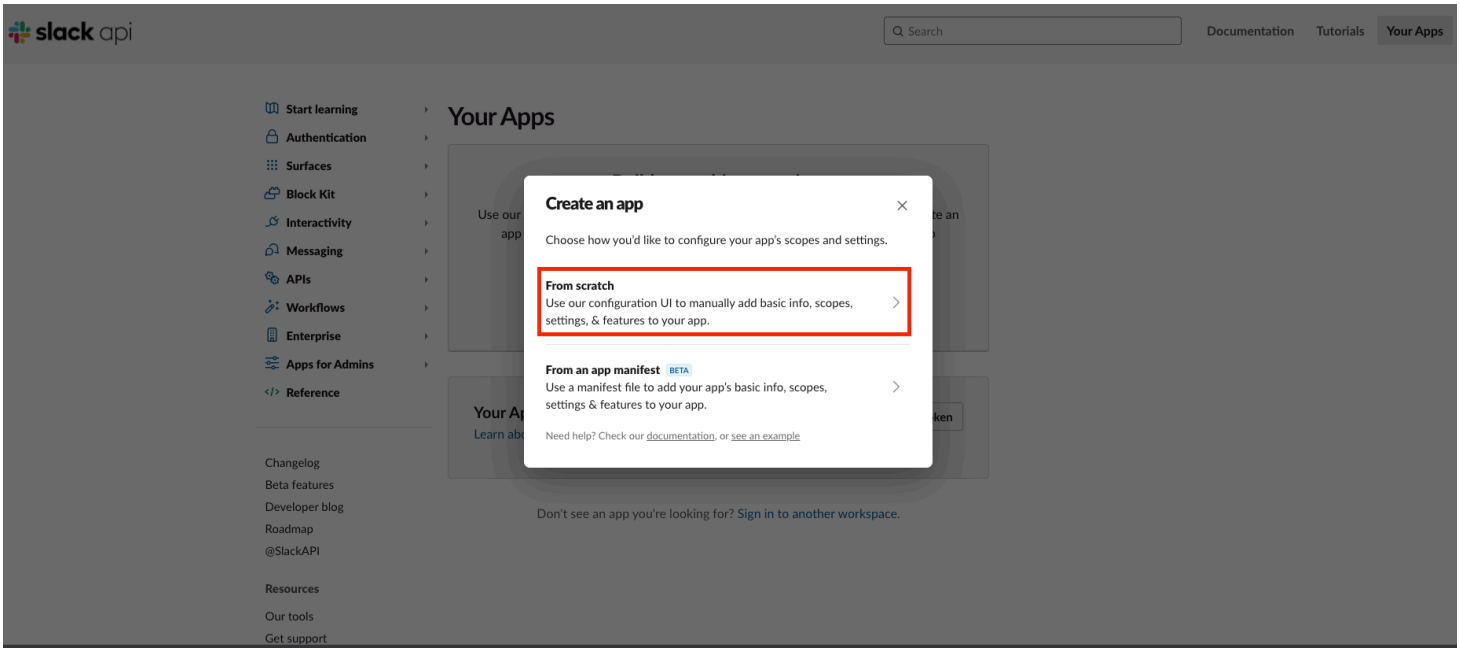
To create a bot app for Slack, you need to use the Slack app dashboard to create a new app and specify app details.

1. Open Slack app dashboard at Slack API.

2. Click **Create App** button.



3. Choose **From scratch**.



4. In the prompted dialog, specify values for the following fields:

   - **App Name**: input your App name, for example, Zowe Chat.
   - **Development Slack Workspace**: input any one of your Slack Workspace.

> **TIP**
>
> You can change the App name at any time.

> **NOTE**
>
> Your workspace may require apps to be approved by admins. You will need to request approval to install it to the workspace or sign into a different workspace.

5. Click the **Create App** button.

Your Slack App is successfully created.

Configuring the Slack App

There are two ways to connect to Slack, over HTTP or using Socket mode. We strongly recommend that you use Socket mode, as you can receive events via a private WebSocket, instead of a direct HTTP subscription to events. If you want to receive events directly over HTTP, you must configure your own network firewall or use some proxy servers to make sure that your Slack application of your Slack workspace in public cloud can access the messaging endpoint of Zowe Chat server from internet. For more information, see https://api.slack.com/apis/connections.

- Connecting to Slack using Socket mode

  You can use Socket mode to connect your app to Slack.

- Connecting to Slack using public HTTP endpoint

  Complete this task after your Zowe Chat server is configured and started.

Version: v3.2.x LTS

Connecting to Slack using Socket mode

You can use Socket mode to connect your app to Slack.

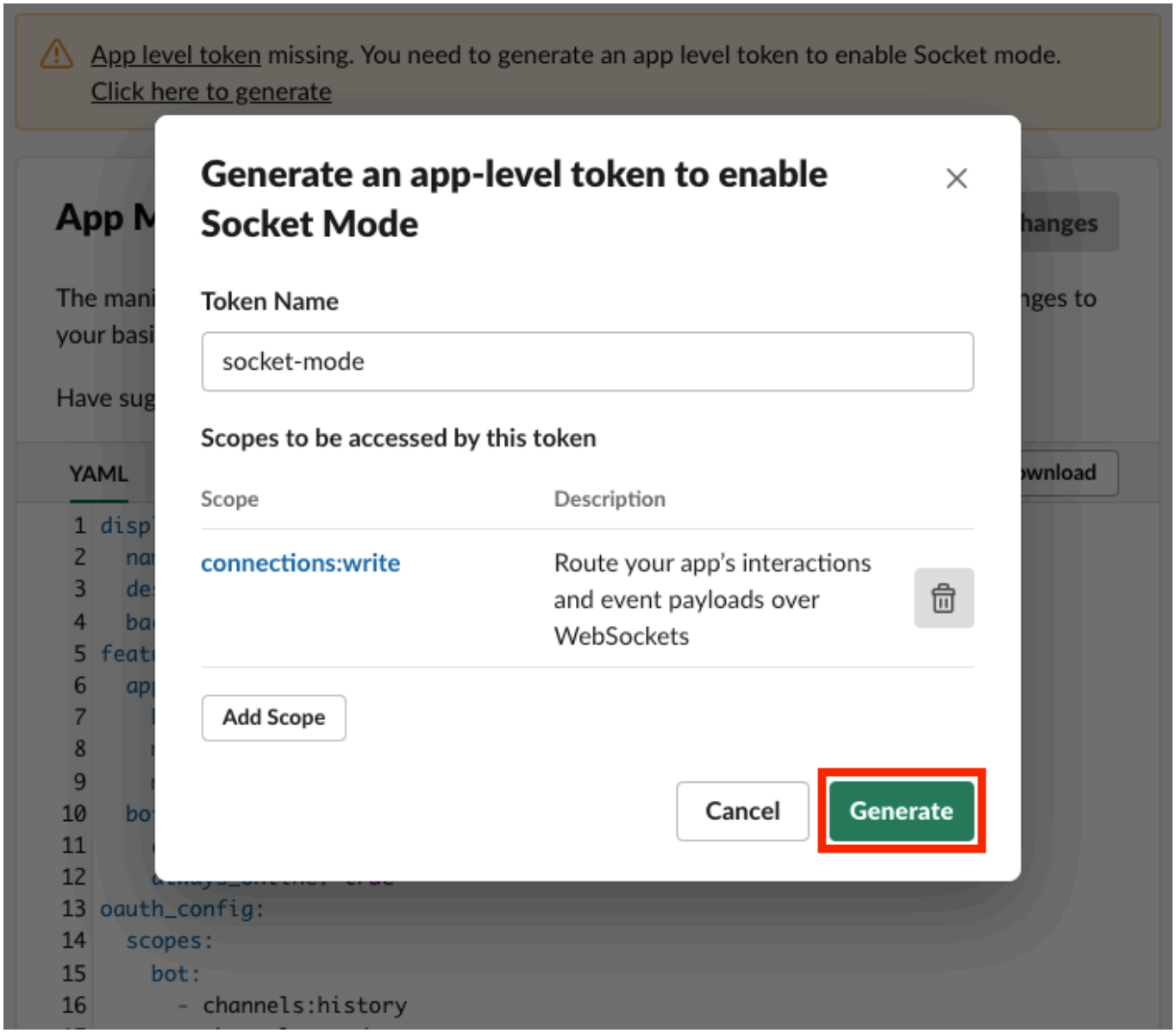
1. Open Slack app dashboard at Slack API.
2. Click the App name that you created.
3. In the left sidebar, click **Features** > **App Manifest** to configure your Slack App.
4. In the text field, fill in the following manifest:

   > **NOTE**
   >
   > You should delete the default manifest, and then fill in the manifest above. This is an example manifest for the current version of Slack. If Slack has new changes and this manifest is out of date, you can refer to https://api.slack.com/reference/manifests#creating_manifests to fill out the manifest.

   In the manifest, specify values for the following fields:

   - `display_information.name`: your app name, for example, Zowe Chat
   - `display_information.description`: your app description, for example, Zowe Chat
   - `features.bot_user.display_name`: your bot name, for example, zowe-chat
5. Click **Save Changes** button, and you will be prompted with a notification asking you to generate an app level token.
6. Click **Click here to generate**, and you will be prompted with a dialog **Generate an app-level token to enable Socket Mode**. Specify values for the following fields:

   - **Token Name**: socket-mode



7. Click **Generate** button and you will be prompted with a dialog **socket-mode**. You will get the token in the dialog. Copy it for the later use. You will need it to configure your Slack in later steps. See Configuring the chat tool - Slack.

8. Click **Done** button.

You have successfully configured your Slack app.

Version: v3.2.x LTS

Connecting to Slack using public HTTP endpoint

Complete this task after your Zowe Chat server is configured and started.

If you are using HTTP endpoint to receive Slack events, you must enable interactivity and configure the event request URL and the interactivity request URL in your Slack App.

If the IP address of your Zowe Chat server is public, you can use the Chatbot messaging endpoint URL `<httpEndpoint.protocol>://<httpEndpoint.hostName>:<httpEndpoint.port><httpEndpoint.basePath>` directly. Otherwise, you must configure your own network firewall or use some proxy servers to make sure that your Slack App of your Slack workspace in public cloud can access the messaging endpoint of Zowe Chat server from Internet.

> **NOTE**
>
> You can find the values for `protocol`, `hostName`, `port`, and `basePath` in the configuration file `<ZOWE_CHAT_HOME>/config/chatTools/slack.yaml`.

1. Open Slack API in your browser.
2. Click your Slack App.

   Remember that you must log in your Slack workspace before you can see your App in Slack.
3. Configure your Slack App.

   i. In the left sidebar of Slack app dashboard, click **Features** > **App Manifest** to configure your Slack App.

   ii. In the text field, fill in the following manifest:.

   :::note:

   You should delete the default manifest, and then fill in the manifest above.

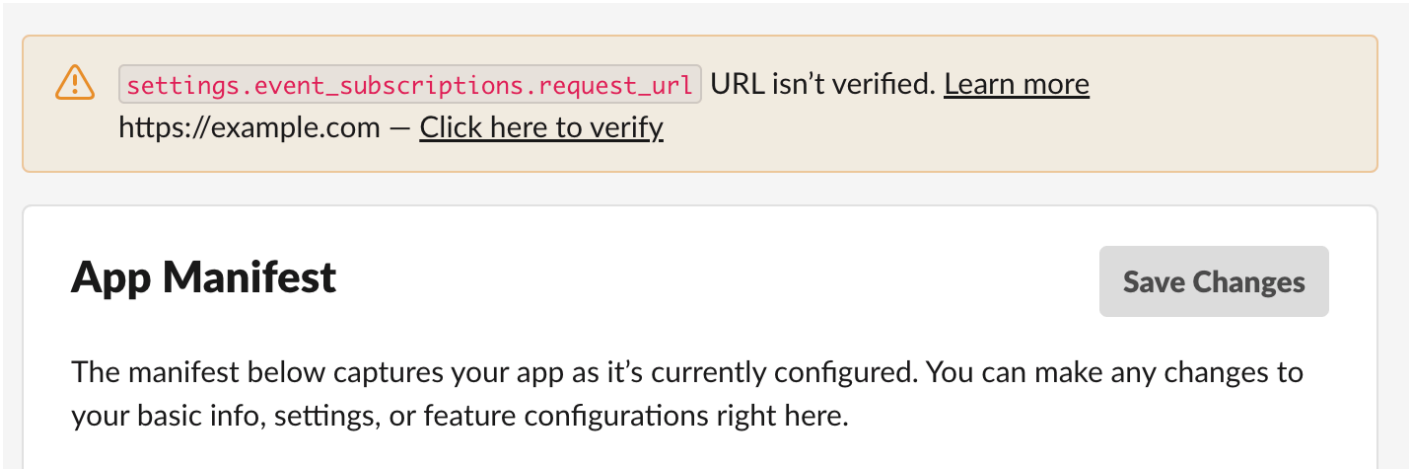
   :::

   In the manifest, specify values for the following fields:

   - `display_information.name`: your app name, for example, Zowe Chat
   - `display_information.description`: your app description, for example, Zowe Chat
   - `features.bot_user.display_name`: your bot name, for example, zowe-chat

   iii. Click **Save Changes**.

   You will be prompted with a notification that the URL is not verified. You can ignore this notification, and configure the request URL after your Zowe Chat server is configured and started.



4. Configure the request URL for the interactivity for your created Slack App. You can do this after your Zowe Chat is configured and started.

    i. In the left sidebar of Slack app dashboard, click **Features** > **Interactivity&Shortcuts**.
    ii. In the request URL input field, use the Zowe Chat messaging-endpoint URL directly if it is publicly accessible. Otherwise, you must fill in with your public proxy URL that transmits network payload to Zowe Chat web hook URL.
    iii. Click **Save Changes**.

5. Configure the request URL for events subscriptions for your created Slack App. You can do this after your Zowe Chat server is configured and started.

    i. In the left sidebar of Slack app dashboard, click **Features** > **Event Subscriptions**.
    ii. In the request URL input field, use the Zowe Chat messaging-endpoint URL directly if it is publicly accessible. Otherwise, you must fill in with your public proxy URL that transmits network payload to Zowe Chat web hook URL.
    iii. Click **Save Changes**.

You have successfully configured your Slack app.

Version: v3.2.x LTS

Installing the Slack App

You must install the Slack App to your workspace before you can talk with your chat bot in Slack client.

1. Install the Slack App.

    i. Request to install the App.

        a. In the left sidebar, click **Settings** > **Install App**.
        b. Click **Request to Install** and you will be prompted with a dialog asking you to add an optional note to the administrator to request an approval. You can add an optional note to the administrator and then wait for the administrator of your workspace to approve. You will receive an email notice as well as a notice from the Slackbot of your Workspace when the approval is done.

    > **NOTE**
    >
    > After you receive a notice, you can refresh your web page. Now you can install your app to your workspace.

    ii. Install the App to Workspace.

        a. Open Slack app dashboard at Slack API when you get the approval.
        b. Click the App name that you created.
        c. In the left sidebar, click **Settings** > **Install APP**.
        d. Click **Install to Workspace** button and you will be switch to a new page.
        e. Click **Allow** button.

    Your Slack App is installed.

2. Get the bot user OAuth token.

    i. In the left sidebar, click **Settings** > **Install App**.

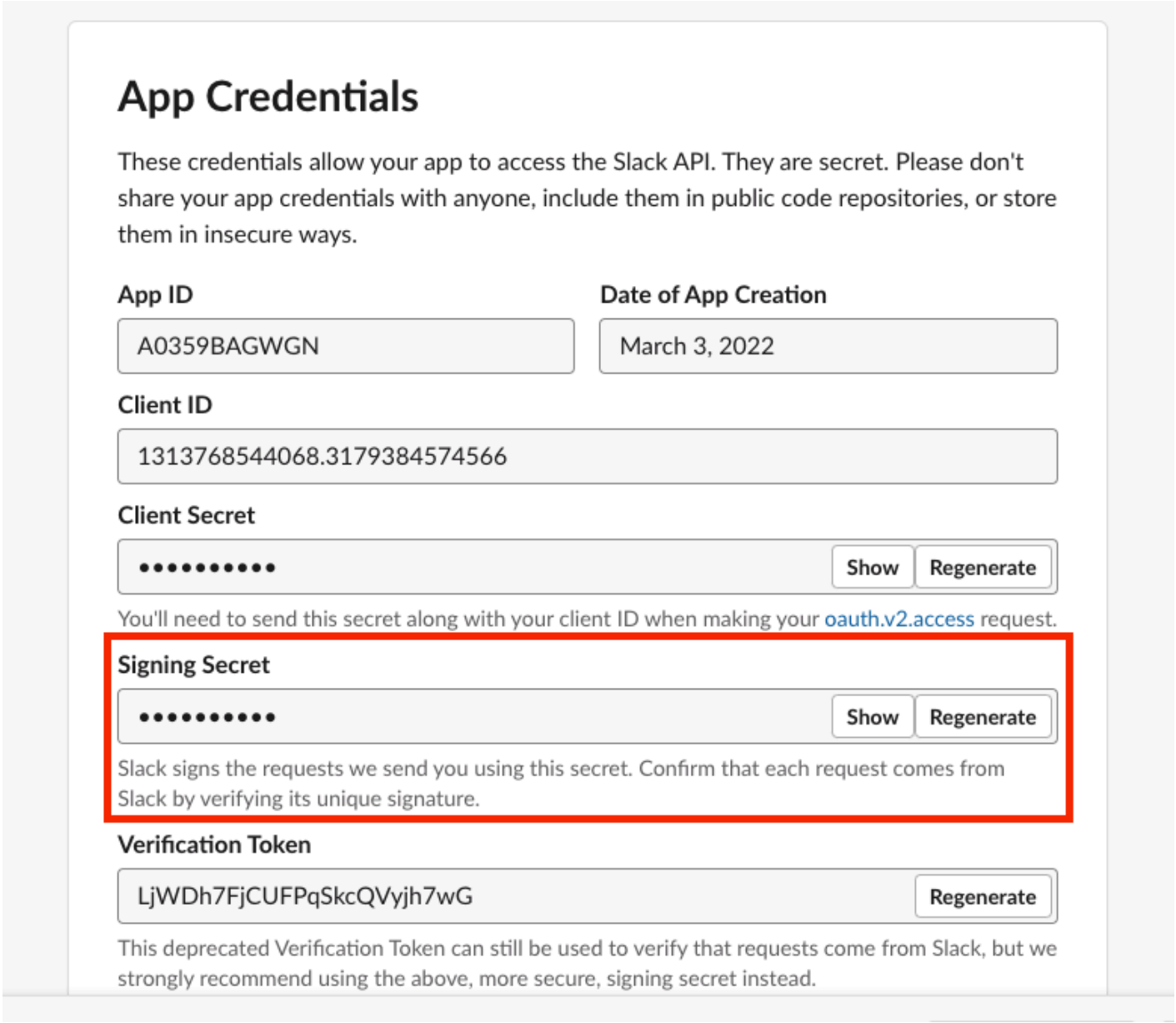
    ii. Find the **Bot User OAuth Token** and click **Copy**.

    Save this token. You will need it to configure your Slack in later steps.s

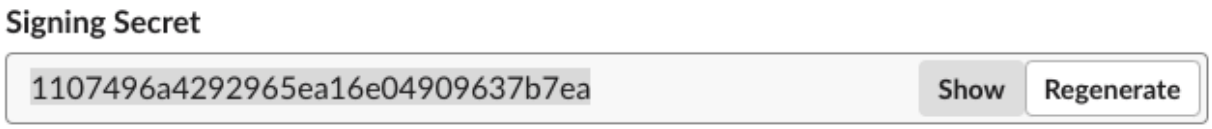
3. Get the signing secret.

    i. In the left sidebar, click **Settings** > **Basic information**.

    ii. Find the **Signing Secret** in **App Credentials** section and click **show**.



iii. Copy this signing secret.



Save this signing secret. You will need it to configure your Slack in later steps.

Version: v3.2.x LTS

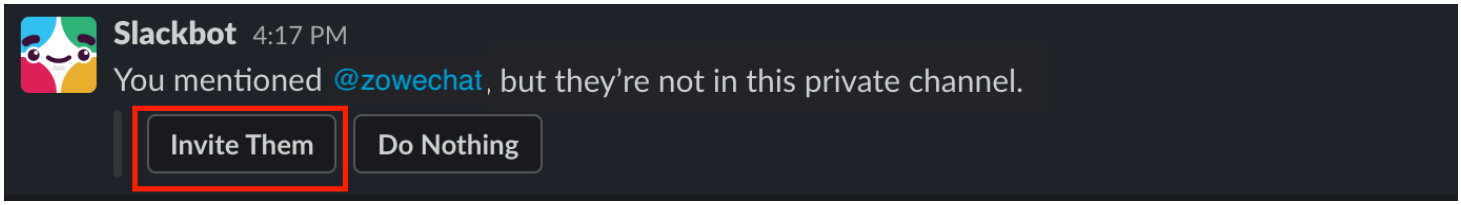
Adding your bot user to your Slack channel

You can add the bot user that you created to your Slack channel in two ways: either mention your bot user directly in the message field or click the link **Add an app** at the beginning of your channel.

Mention your bot user directly

You can mention your bot user directly in the message field.

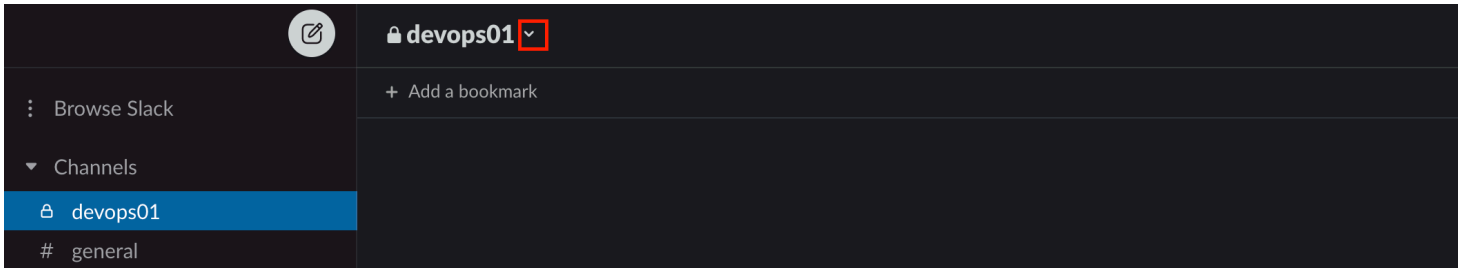
1. Select the channel where you want to invite your Slack App.
2. In the message field, type @ and select the bot name you created, for example, bnz. You can see a **not in channel** notice behind it.
3. Send the message to the channel. You will receive a message from Slackbot to help you invite your bot user to this channel. Click **Invite Them**.



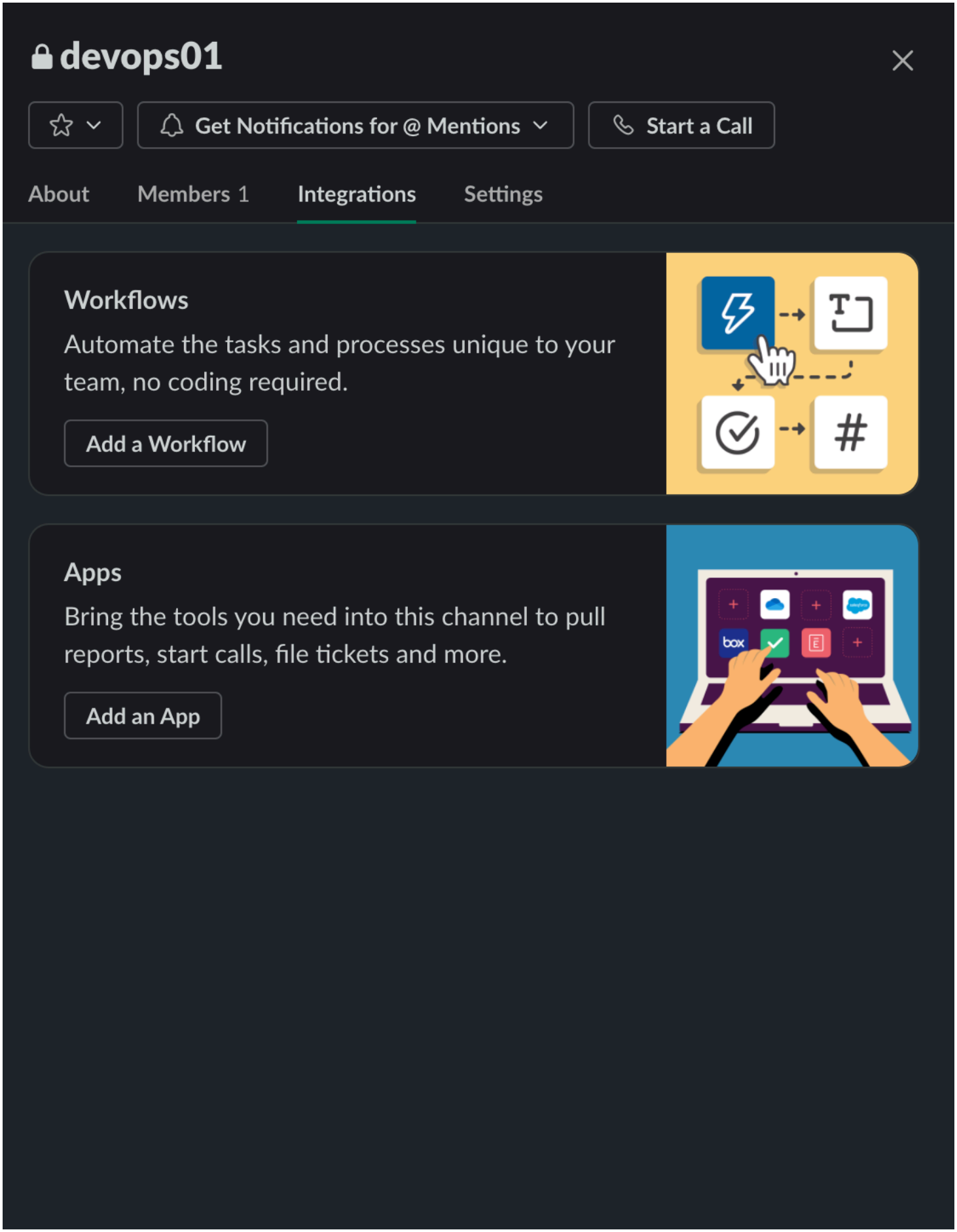
Use the channel link

You can click the link **Add an app** at the beginning of your channel.

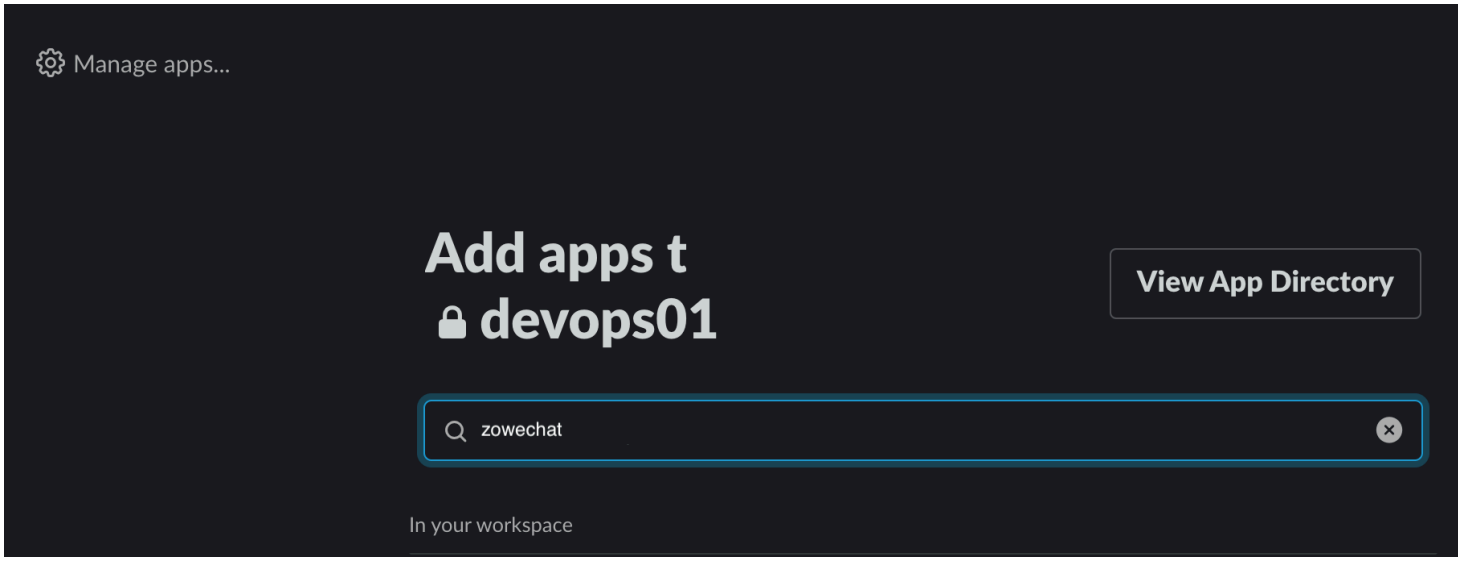
1. Select the channel where you want to invite your Slack App.
2. Click the drill-down box at the top of your channel. Select **Integrations**.



3. You can see the dialog as the image below shows. Click **Add an app**.



4. Search for your app with your app name. Click **Add** when you see it.



You have invited the Zowe Chat app to your Slack channel. You can talk to it now.

Version: v3.2.x LTS

Installing Zowe Chat

You can install Zowe Chat from a local package.

Prerequisites

Before installing Zowe Chat, ensure that your environment meets the system requirements.

Installing

1. Download the Zowe Chat package from Zowe.org. Navigate to **Technical Preview** > **Zowe Chat** section, and select the button to download the Zowe Chat build. You'll get a tar.gz file.
2. Log on to your Linux server.
3. Navigate to the target directory that you want to transfer the Zowe Chat package into or create a new directory.
4. When you are in the directory you want to transfer the Zowe Chat package into, upload it to the directory.
5. Run the command to expand the downloaded package to the target directory.

   This will expand to a file structure similar to the following one.
6. Run the following commands to update your environment variables.
   - Update the Zowe Chat home directory.

     where, *your-chat-package-directory* is the diretory of the Zowe Chat installation package.
   - Update the Zowe Chat plug-in home directory.
   - Update your `PATH` environment variable with your Zowe Chat home directory path.
7. Update the plug-in configuration file `$ZOWE_CHAT_PLUGIN_HOME/plugin.yaml` if necessary.
8. Run the following commands to install local dependencies.
9. Update the following configuration files based on your need.
   - Zowe Chat: `$ZOWE_CHAT_HOME/config/chatServer.yaml`
   - z/OSMF server: `$ZOWE_CHAT_HOME/config/zosmfServer.yaml`
   - Chat tool: `$ZOWE_CHAT_HOME/config/chatTools/<mattermost | msteams | slack>.yaml`

Now you can start the Zowe Chat server.

> **TIP**

If you encounter any issue during the installation, you can check the Zowe Chat server log in the folder `$ZOWE_CHAT_HOME/log/` for troubleshooting.

Version: v3.2.x LTS

Configuring Zowe Chat

To complete the configuration of Zowe Chat, you must complete the individual configuration steps listed below.

1. Configure Zowe Chat server
2. Configure z/OSMF endpoint information
3. Configure chat tool information

Zowe Chat server configuration

You can configure the Zowe Chat server by editing the `chatServer.yaml` configuration file.

1. Go to the Zowe Chat configuration directory by running the following command:

2. Edit the `chatServer.yaml` configuration file. Customize the default values based on your needs, for example, your chat tool.

Zowe Chat z/OSMF endpoint configuration

Zowe Chat is configured to run against a single z/OSMF server. You describe your z/OSMF server information by editing the `zosmfServer.yaml` configuration file.

1. Go to the z/OSMF server configuration directory by running the following command:

2. Edit the `zosmfServer.yaml` configuration file. Customize the default values based on your system .

Chat tool configuration

Zowe Chat's chat tool configuration varies depending on your choice of chat tool.

Slack

- Configuring Zowe Chat with Slack

Microsoft Teams

- Configuring Zowe chat with Microsoft Teams

Mattermost

- Configuring Zowe Chat with Mattermost

Configuring Zowe Chat with Mattermost

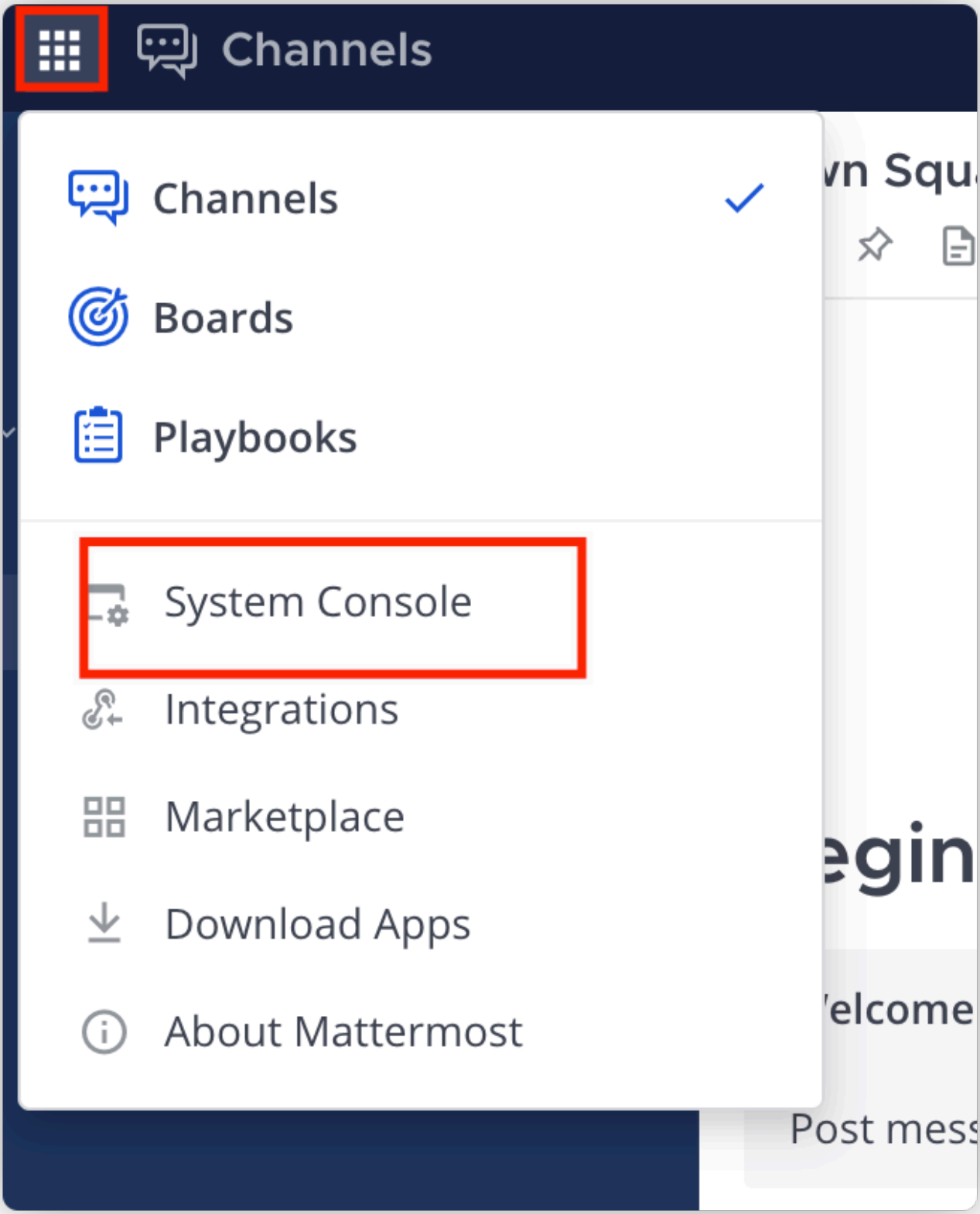
This step is for Mattermost users only. You configure your chat platform by editing the `mattermost.yaml` file.

Prerequisite

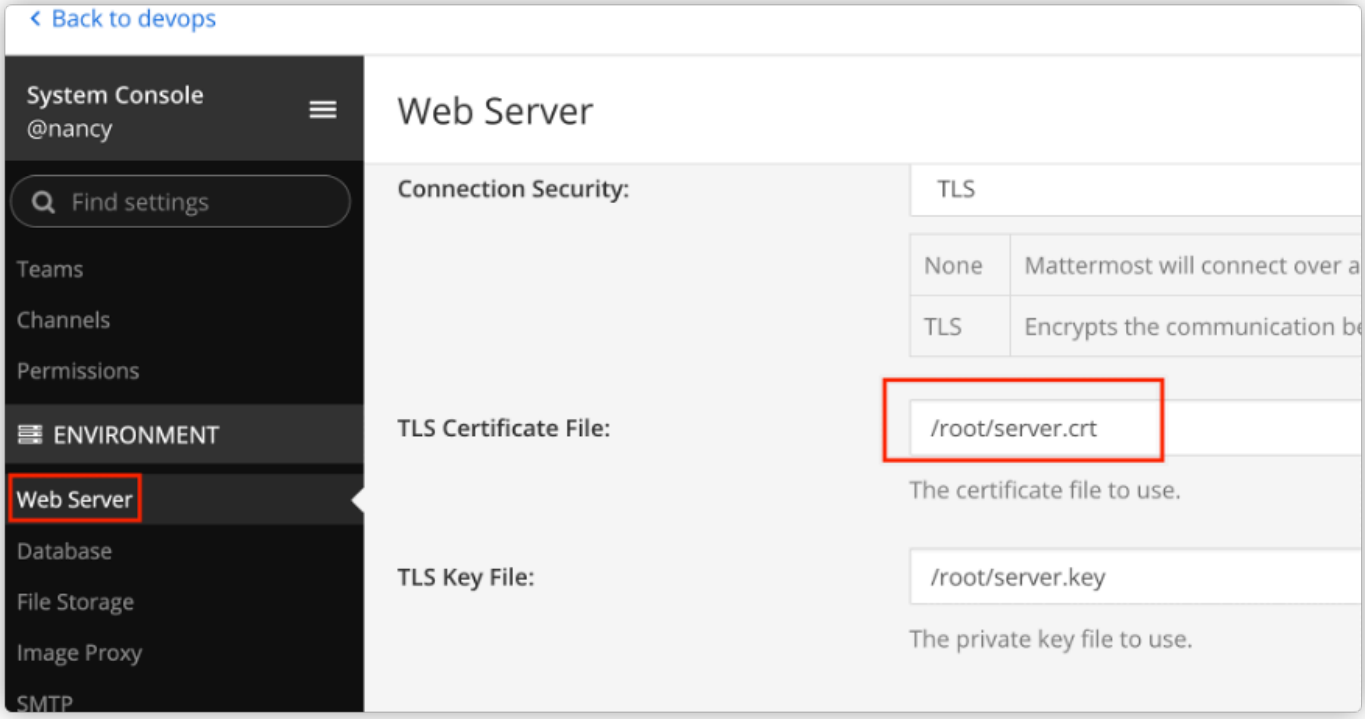
Make sure that you have configured your chat tool when configuring the Zowe Chat server. For details, see Configuring Zowe Chat server.

Configuring Mattermost

1. Go to the Zowe Chat configuration directory.
2. If you enabled TLS on the Mattermost Server when you create an administrator account, you can download the SSL certificate of Mattermost server.
    i. Log in to Mattermost with your administrator account.
    ii. Click Main Menu icon and then click System Console.



iii. Scroll down to **ENVIRONMENT** section and click **Web Server**. Find your certificate according to the path configured in **TLS Certificate File**.



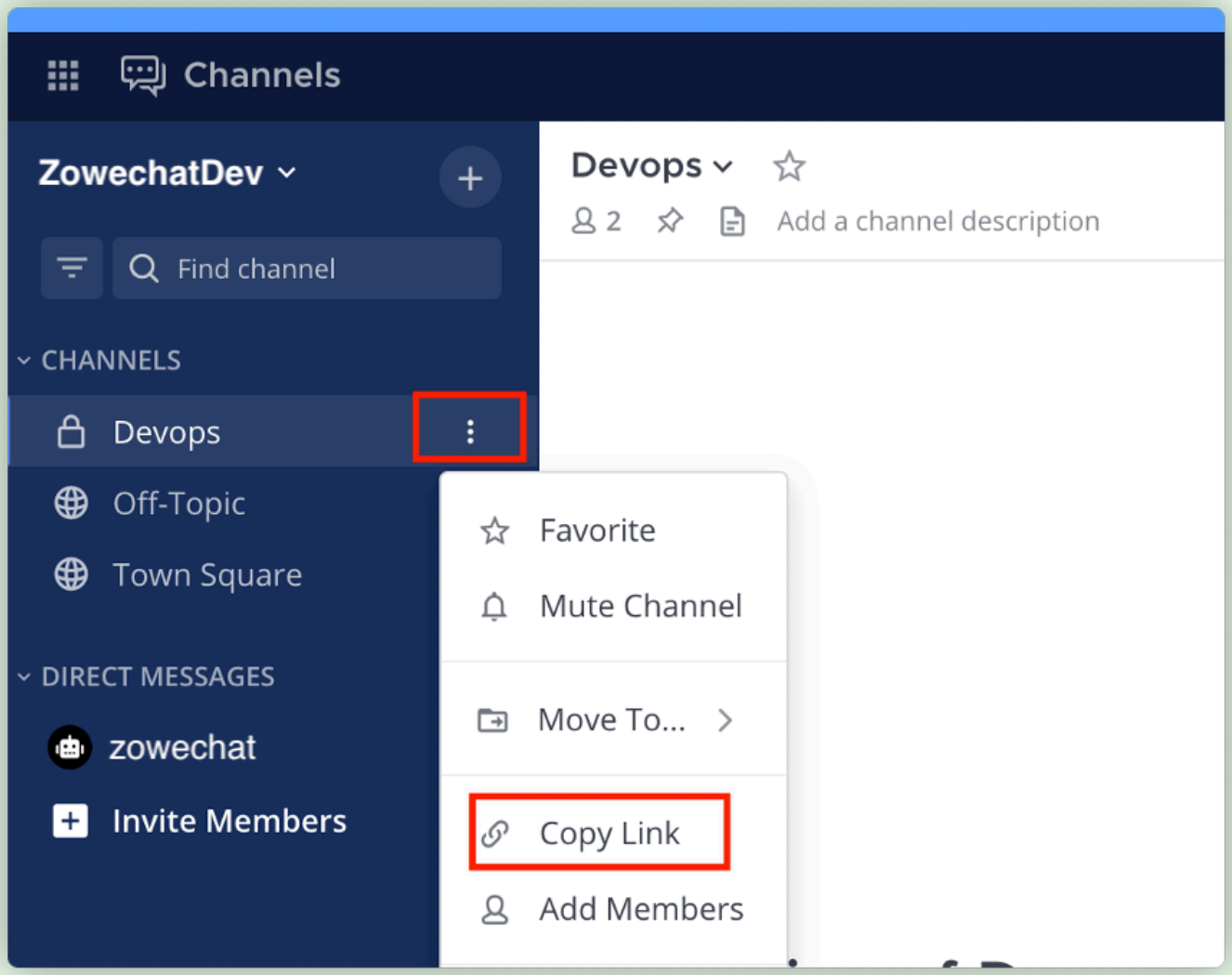
iv. Copy the certificate to your Zowe Chat Server. You can place it in any directory that your Zowe Chat server can access.

3. Edit the `mattermost.yaml` file by cutomizing the following fields:

   - `hostName`: your Mattermost server hostname
   - `tlsCertificate`: the absolute file path of the TLS certificate (PEM) of your Mattermost server if HTTPS protocol is specified.
   - `botAccessToken`: the access token to connect to your bot
   - HTTP endpoint `hostName`: the host name or IP address of your HTTP endpoint

   You can also specify other configurations such as the protocol, port number, team URL, bot user name, and HTTP endpoint of your Mattermost server.

> **TIP**
>
> Team URL is what you got when you create your team. If you don't remember that, you can just select any channel in your team and copy link. Paste the link into a text editor, and then you will find the team URL.


Channels
ZowechatDev
Find channel
CHANNELS
Devops
Off-Topic
Town Square
DIRECT MESSAGES
zowechat
Invite Members
Devops
2
Add a channel description
Favorite
Mute Channel
Move To...
Copy Link
Add Members

Version: v3.2.x LTS

Configuring Zowe Chat with Microsoft Teams

This step is for Microsoft Teams users only. You configure your chat platform by editing the `msteams.yaml` file.

Prerequisite

Make sure that you have configured your chat tool when configuring the Zowe Chat server. For details, see Configuring Zowe Chat server.

Configuring Microsoft Teams

1. Go to the Zowe Chat configuration directory.
2. Edit the `msteams.yaml` file. Replace `<Your Bot ID>`, `<Your bot password>` and `<Your host name>` with values based on your environment.

> **TIP**
>
> You should have saved your bot ID and bot password when you created your bot. For details, see Creating a bot with Microsoft Bot Framework or Creating a bot with Microsoft Azure.

Version: v3.2.x LTS

Configuring Zowe Chat with Slack

This step is for Slack users only. You configure your chat platform by editing the `slack.yaml` file.

Prerequisite

Make sure that you have configured your chat tool when configuring the Zowe Chat server. For details, see Configuring Zowe Chat server.

Configuring Slack

1. Go to the Zowe Chat configuration directory.

2. Edit the `slack.yaml` file. Replace Your_signing_secret and Your_bot_user_OAuth_token. If you use socket mode, you also need to provide your app level token. If you connect Slack over HTTP, you need to configure HTTP endpoint.

   TIP

   - You should have saved the signing secret and bot user OAuth token when you installed the Slack App. For details, see step 2 and 3 in Installing the Slack App.
   - If you use socket mode to connect to Slack, you need to set the **socketMode enabled** as `true` and the **httpEndpoint enabled** as `false` and provide the app level token which you should have saved when you configured the Slack App. For details, see step 7 in Connecting to Slack using Socket mode.
   - If you connect to Slack over HTTP endpoint, you need to set the **socketMode enabled** as `false` and the **httpEndpoint enabled** as `true`. You need to configure the HTTP endpoint, protocol, host name, port number and the basePath that you want to use.

Starting and stopping Zowe Chat

Start or stop Zowe Chat according to your requirement.

Starting Zowe Chat

To start the Zowe Chat server, perform the following steps.

1. On the server where you install Zowe Chat, run the following command:

   ```
   chatsvr start
   ```

2. To verify that the Zowe Chat server is started, run the following command:

   ```
   chatsvr status
   ```

Now you can launch your chat tool client and chat with your bot.

Stopping Zowe Chat

To stop the Zowe Chat server, perform the following steps.

1. On the server where you install Zowe Chat, run the following command:

   ```
   chatsvr stop
   ```

2. To verify that the Zowe Chat server is stopped, run the following command:

   ```
   chatsvr status
   ```

Version: v3.2.x LTS

Uninstalling Zowe Chat

You can uninstall Zowe Chat native installation package by running a command.

1. Stop the Zowe Chat server.
2. Remove the installed Zowe Chat core part by running the following command:
3. Remove all installed Zowe Chat plug-ins by running the following command:
4. Unset and update the following environment variables.
   - `ZOWE_CHAT_HOME`
   - `ZOWE_CHAT_PLUGIN_HOME`
   - `PATH=$PATH:$ZOWE_CHAT_HOME/bin`
5. Verify the uninstallation by launching your chat tool client and verifying that you cannot chat with the bot.

Version: v3.2.x LTS

Using Zowe

Learn how to start using Zowe components, applications, and plug-ins.

Zowe server-side components

- Using Zowe API Mediation Layer
- Using Zowe Desktop
- Configuring the Zowe cross memory server (ZIS)

Zowe client-side components

- Using Zowe CLI
- Using Zowe Explorer plug-in for IntelliJ IDEA
- Using Zowe Explorer for Visual Studio Code
- Using Zowe SDKs

Explore available plug-ins

- Zowe CLI plug-ins
- Zowe Explorer extensions for Visual Studio Code

Incubator components

- Using Zowe Chat (incubator)

Version: v3.2.x LTS

Using Zowe Desktop

You can use the Zowe™ Application Framework to create application plugins for the Zowe Desktop. For more information, see Extending the Zowe Application Framework.

Enabling Server Components for the Desktop

The Zowe Desktop requires the `app-server` Component of Zowe to be enabled. This is set by default, but can be controlled by the Zowe YAML property `components.app-server.enabled` which should be set to `true`.

When this server is running, it will print the message `ZWED0031I` when fully ready.

Navigating the Zowe Desktop

From the Zowe Desktop, you can access Zowe applications.

Accessing the Zowe Desktop

From a supported browser, open the Zowe Desktop at `https://zowe.externalDomains[0]:zowe.externalPort/zlux/ui/v1/` or you can navigate to the direct Desktop URI at `https://zowe.externalDomains[0]:zowe.externalPort/zlux/ui/v1/ZLUX/plugins/org.zowe.zlux.bootstrap/web/index.html`

Where:

- *zowe.externalDomains* is the host on which you are running the Zowe Application Server, its the value that was assigned in the zowe configuration file.
- *zowe.externalPort* is the value of Gateway port that was assigned in the zowe configuration file.

Alternative Desktop access

The above URL can be modified with query parameters for the following purposes:

Action	Query Parameter	Example	Detail
Access Desktop without Gateway proxy	zwed-no-redirect=1	`https://zowe.externalDomains[0]:components.app-server.port/?zwed-no-redirect=1`	When the APIML Gateway is running, the Desktop should be reached through it instead of going to the app-server port directly. The

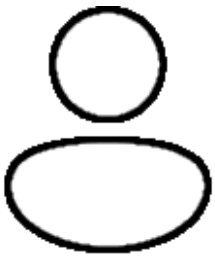
Action	Query Parameter	Example	Detail
			Desktop avoids direct access by redirecting users to the gateway URL when possible. To disable this behavior for direct access, you can use "zwed-no-redirect=1". This is intended for troubleshooting and is not recommended otherwise since some Desktop apps will not work without being accessed via the gateway URL.
Access the Zowe v2 Desktop	use-v2-desktop=true	`https://zowe.externalDomains[0]:zowe.externalPort/zlux/ui/v1/?use-v2-desktop=true`	Zowe V3 includes the Zowe v2 Desktop for ease of transition. By default, the V3 desktop is used but if you have an app that does not yet work on the V3 Desktop, you can use the v2 Desktop through this parameter. The v2 desktop is in maintenance mode and no

Action	Query Parameter	Example	Detail
			longer receives enhancements.

Logging in and out of the Zowe Desktop

1. To log in, enter your TSO credentials in the **Username** and **Password** fields.
2. Press Enter. Upon authentication of your user name and password, the desktop opens.

To log out, click the User icon in the lower right corner and click **Sign Out**.



Changing user password

1. Open the Preferences panel by clicking on the Preferences icon in the bottom right of the desktop.

2. Click the Change Password icon.
3. Fill out the Old Password and New Password fields.
4. Upon successful password change, you will be taken to the desktop.

Updating an expired password

1. Upon logging in with an expired password, a screen will be displayed prompting you to change your password.
2. Enter and confirm your new password in the corresponding fields.
3. Upon successful password change, you will be taken to the desktop.

Pinning applications to the task bar

1. Click the Start menu in the bottom left corner of the home screen.
2. Locate the application you want to pin.
3. Right-click the application icon and select **Pin to taskbar**.

Open application in new tab

1. Click the Start menu in the bottom left corner of the home screen.
2. Locate the application you want to open in new tab.

3. Right-click the application icon and select **Open In New Browser Tab**.

- While opening an application in new tab you can also do the following:
  - You can use url to send data to the application, for example you would specify `https://zowe.externalDomains[0]:zowe.externalPort/zlux/ui/v1/ZLUX/plugins/org.zowe.zlux.bootstrap/web/?pluginId=org.zowe.editor:data:{"type":"openFile","name":"<path of file>"}`
  - You can use url to open application directly on browser with and without credentials using `showLogin` in url.
    a. If `showLogin = true` then you need to login with your credentials before using an application for example. `https://zowe.externalDomains[0]:zowe.externalPort/zlux/ui/v1/ZLUX/plugins/org.zowe.zlux.bootstrap/web/?pluginId=org.zowe.terminal.tn3270&showLogin=true`.
    b. If `showLogin = false` then you can access application directly without login.

Keyboard shortcuts

The following keyboard shortcuts can be used in the Desktop to navigate or perform actions with only the keyboard.

Keyboard Shortcut	Command
CTRL+ALT+M	Open the Zowe launchbar menu. Use the UP/DOWN arrow keys to select an app, RIGHT arrow key to spawn context menu, ENTER to launch app, and ESC to close menu
CTRL+ALT+UP	Maximize active app. Press again to restore
CTRL+ALT+DOWN	Minimize active app. Press again to restore
CTRL+ALT+LEFT (or "<" key)	Switch to next recently active app
CTRL+ALT+RIGHT (or ">" key)	Switch to least recently active app
CTRL+ALT+W	Close active app

Changing application elements size

There are 3 supported ways of changing size within the Desktop.

1. Use your browser's zoom feature (keyboard shortcuts: Ctrl +, Ctrl - for various supported browsers) to change all elements' size. Recommended: 67%

Note: Zoom is highly variable and depends on your display size, resolution, and many other variables so the recommended zoom may not be ideal for you

2. View the Preferences panel (see below section) to change the scale of the Desktop UI: elements like window title bar, app icons, bottom-left start menu, app tool bar etc. and excluding main app content

3. Change an individual application's size via its window handles or minimize/maximize buttons. You can also start an application in full screen mode by right clicking on an application's icon in the taskbar and select "Open in New

Browser Tab"

Tip: Did you know you can use the whole Desktop in full screen mode by using your browser's full screen feature (keyboard shortcuts: F11 for various supported browsers)?

Personalizing the Desktop

1. Click the **Preferences icon** to open the Preferences panel.

2. Click the **Personalization icon** to open the menu.

3. Drag an image into the wallpaper grid, or press the upload button, to upload a new Desktop wallpaper.
4. To set a new theme color, select a color from the palette or hue.
5. Use the lightness swatch bar to adjust the lightness of the color.

- Adjusting the lightness will also change the lightness of secondary text.

6. Select a size (small, medium, or large) to adjust the scale of the Desktop UI.

Changing the desktop language

Use the Languages setting in the Preferences panel to change the desktop language. After you change the language and restart Zowe, desktop menus and text display in the specified language. Applications that support the specified desktop language also display in that language.

1. Click the Preferences icon in the lower right corner.
2. Click **Languages**.
3. In the **Languages** dialog, click a language, and then click **Apply**.
4. When you are prompted, restart Zowe.

Zowe Desktop application plugins

Application plugins are applications that you can use to access the mainframe and to perform various tasks. Zowe's official server download contains some built-in plugins as described below.

Additional plugins can be added to the Desktop, and are packaged and installed as Extensions to Zowe. See here for how to install extensions.

Developers can create application plug-ins to put into extensions, and developers should read the extending guide for more information.

VT Terminal

The VT Terminal plugin provides a user interface that emulates the basic functions of DEC VT family terminals. On the "back end," the plugin and the Zowe Application Server connect to VT compatible hosts, such as z/OS UNIX System Services (USS), using SSH or Telnet.

This terminal display emulator operates as a "Three-Tier" program. Due to web browsers being unable to supply TCP networking that terminals require, this terminal display emulator does not connect directly to your SSH or Telnet server. Instead, the Zowe Application Server acts as a bridge, and uses websockets between it and the browser for terminal communication. As a result, terminal connections only work when the stack of network programs supports websockets and the TN3270 server destination is visible to the Zowe Application Server.

The terminal connection can be customized per-user and saved for future sessions using the connection toolbar of the application. The preferences are stored within the configuration dataservice storage, which can also be used to set instance-wide defaults for multiple users.

API Catalog

The API Catalog plugin lets you view API services that have been discovered by the API Mediation Layer. For more information about the API Mediation Layer, Discovery Service, and API Catalog, see API Mediation Layer Overview.

Editor

With the Zowe Editor you can create, edit, and manage files, folders, and datasets. With files and folders, you can also modify properties such as ownership and tagging. The Editor uses Monaco, a technology shared with the popular Microsoft Visual Studio Code program. As a result, you can benefit from advanced syntax highlighting and a modern editing experience. The editor has more features and customization that you can read about on the Editor user guide.

JES Explorer

Use this application to query JES jobs with filters, and view the related steps, files, and status. You can also purge jobs from this view.

> **NOTE**
>
> z/OSMF is the required authentication provider for JES Explorer.

IP Explorer

With the IP Explorer you can monitor the TCP/IP stacks, view active connections and reserved ports.

MVS Explorer

Most features of the MVS explorer are now incorporated into the "Editor" plug-in listed above, and the community focuses on future enhancements there, but you can still find the MVS Explorer in a Zowe install and use the features found below.

Use this application to browse the MVS™ file system by using a high-level qualifier filter. With the MVS Explorer, you can complete the following tasks:

- List the members of partitioned data sets.
- Create new data sets using attributes or the attributes of an existing data set ("Allocate Like").
- Submit data sets that contain JCL to Job Entry Subsystem (JES).
- Edit sequential data sets and partitioned data set members with basic syntax highlighting and content assist for JCL and REXX.
- Conduct basic validation of record length when editing JCL.
- Delete data sets and members.
- Open data sets in full screen editor mode, which gives you a fully qualified link to that file. The link is then reusable for example in help tickets.

> **NOTE**
>
> z/OSMF is the required authentication provider for MVS Explorer.

USS Explorer

Most features of the USS explorer are now incorporated into the "Editor" plug-in listed above, and the community focuses on future enhancements there, but you can still find the MVS Explorer in a Zowe install and use the features found below.

Use this application to browse the USS files by using a path. With the USS Explorer, you can complete the following tasks:

- List files and folders.
- Create new files and folders.
- Edit files with basic syntax highlighting and content assist for JCL and REXX.
- Delete files and folders.

> **NOTE**
>
> z/OSMF is the required authentication provider for USS Explorer.

Version: v3.2.x LTS

Using the Editor

With the Zowe Editor, you can create and edit the many types of files.

Specifying a highlighting language

1. Click **Language** on the editor menu bar. A dropdown menu will be displayed.
2. From the dropdown, select the desired language. Plain Text will be chosen by default if the automatic language detection is not able to determine the language.

Open a dataset

To open a dataset, follow these steps:

1. From the **File** menu, select Open Datasets. You can also use (ALT+K).
2. In the Dataset field, specify the name of the dataset you want to open.
3. Click **Open**

Deleting a file or folder

1. In the file tree, right-click on a file or folder you want to delete.
2. From the right-click menu, click **Delete**. A warning dialogue will appear.
3. Click **Delete**

Opening a directory

1. From the **File** menu, select **Open Directory**. You can also use (ALT+O).
2. In the Directory field, specify the name of the directory you want to open. For example: `/u/zs1234`
3. Click **Open**

The File Explorer on the left side of the window lists the folders and files in the specified directory. Clicking on a folder expands the tree. Clicking on a file opens a tab that displays the file contents. Double-clicking on a folder will make the active directory the newly specified folder.

Creating a new directory

1. Right-click on a location in the directory tree where you want to create a new directory.
2. From the right-click menu, click **Create a directory...**.
3. Specify a directory name in the Directory Name field.
4. The Path will be set to the location that you initially right-clicked to open the dialogue. You can specify a different location in the Path field.
5. Click **Create**

Creating a new file

To create a new file, complete these steps:

1. From the **File** menu, select **New File**. You can also use (ALT+N).
2. From the **File** menu, select **Save** to save the newly created file. You can also use (Ctrl+S)
3. In the File Name field, specify the file name for the newly created file.
4. Choose an encoding option from the Encoding dropdown menu. The directory will be prefilled if you are creating the new file in an existing folder.
5. Click **Save**
6. To close a file, click the X icon in its tab, double-click on the tab, or use (Alt+W).

Keyboard shortcuts

The following keyboard shortcuts can be used in the editor to navigate or perform actions with only the keyboard.

- TAB/Shift + TAB: Cycle through the menu bar, browsing type, search bar, file tree, and editor component.
  - Individual options within the menu bar and individual nodes within the file tree can be navigated with the arrow keys and ENTER (to select).

Keyboard Shortcut	Command
ALT+K	Open a dataset
ALT+O	Open a directory
ALT+N	Create a new file
ALT+W	Close tab
ALT+W+Shift	Close all tabs
CTRL+S	Save file
ALT+M	Navigate Menu bar (use arrow keys)
ALT+P	Search Bar focus
ALT+1	Primary editing component focus
ALT+R+Shift	Refresh active tab
ALT+PgUp(or <)	Switch to left tab
ALT+PgDown(or >)	Switch to right tab
ALT+B	Show/hide left-hand side file tree

Version: v3.2.x LTS

Using the 3270 Terminal

The 3270 Terminal Display Emulator plug-in provides a user interface that emulates the basic functions of IBM 3270 family terminals. On the back end, the plug-in and the Zowe Application Server connect to any standard TN3270/E server.

This terminal display emulator operates as a three tier program. Due to web browsers being unable to supply TCP networking that terminals require, this terminal display emulator does not connect directly to your TN3270 server. Instead, the Zowe Application Server acts as a bridge, and uses websockets between the server and the browser for terminal communication. As a result, terminal connections only work when the stack of network programs supports websockets and the TN3270 server destination is visible to the Zowe Application Server.

The terminal connection can be customized per user and saved for future sessions using the connection toolbar of the application. The preferences are stored within the configuration dataservice storage, which can also be used to set instance-wide defaults for multiple users.

You can customize the preferences in the yaml configuration via environment variables:

- `ZWED_TN3270_PORT`: port number
- `ZWED_TN3270_SECURITY`: `telnet` or `tls`
- `ZWED_TN3270_HOST`: host name
- `ZWED_TN3270_ROW`: alternate rows
- `ZWED_TN3270_COL`: alternate columns
- `ZWED_TN3270_MOD`: screen mode, following values are supported
  - `1`: 24x80
  - `2`: 32x80
  - `3`: 43x80
  - `4`: 27x132
  - `5`: Dynamic
- `ZWED_TN3270_CODEPAGE`: CCSID, following values are supported
  - `037`, `1047`, `273`, `277`, `278`, `280`, `284`, `290`, `297`, `420`, `424`, `500`, `838`, `870`, `875`, `918`, `924`, `937`, `935`, `930`

Example of environment variables:

Keyboard shortcuts

The terminal bundle that is used by tn3270-ng2 has several keyboard shortcuts to execute common TN3270 emulator functionality. The following Action and shortcut table presents the current list of what function is mapped to which key combination.

Be aware that some browsers intercept key combinations that are common to browsers, such as `Ctrl`+`R` or `Ctrl`+`T`, and that the operating system may also intercept certain combinations such as `Windows`+`R` or `Alt`+`F4`.

Also, be aware that the key combinations listed are only be handled by the terminal if the terminal has focus, which you can determine if the terminal's cursor is visible and blinking or not. To gain focus on the terminal, it is sufficient to click

on the terminal's contents. The difference between focus and not focus may be the difference between `F5` being interpreted as terminal `PF5`, or the browser reloading the page.

Action and Shortcut table

Action	Keyboard Shortcut	Note
Attention	`Ctrl`+`a`	ATTN - Attention key
Back Tab	`Shift`+`Tab`	
Backspace	`Backspace`	
Cent Sign	`Ctrl`+`[`	¢
Clear	`Ctrl`+`Shift`+`z`	
Cursor Down	`ArrowDown`, `NumpadArrowDown`	
Cursor Left	`ArrowLeft`, `NumpadArrowLeft`	
Cursor Right	`ArrowRight`, `NumpadArrowRight`	
Cursor Up	`ArrowUp`, `NumpadArrowUp`	
Delete	`Delete`, `NumpadDelete`	
Dup	`Ctrl`+`d`	DUP
End	`End`, `NumpadEnd`	
Enter	`Enter`, `NumpadEnter`	
Erase End of Field (EOF)	`Ctrl`+`e`	Erases from cursor position to end of field
Erase Field	`Ctrl`+`l`	Erases entire field
Erase Input	`Ctrl`+`i`	Erases contents of all input fields
Erase Word	`Ctrl`+`w`	Erases until next word, including whitespace
Home	`Home`, `NumpadHome`	
Insert	`Insert`, `NumpadInsert`	Toggles insert text mode

Action	Keyboard Shortcut	Note
New Line	`Ctrl` + `Enter`, `Ctrl` + `NumpadEnter`	Moves cursor to field on next row
Null	`Alt` + `n`	Deletes one character
Not Sign	`Ctrl` + `6`	¬
PA1	`Alt` + `1`	
PA2	`Alt` + `2`	
PA3	`Alt` + `3`	
PF01	`F1`	
PF02	`F2`	
PF03	`F3`	
PF04	`F4`	
PF05	`F5`	
PF06	`F6`	
PF07	`F7`	
PF08	`F8`	
PF09	`F9`	
PF10	`F10`	
PF11	`F11`	
PF12	`F12`	
PF13	`Shift` + `F1`	
PF14	`Shift` + `F2`	
PF15	`Shift` + `F3`	
PF16	`Shift` + `F4`	
PF17	`Shift` + `F5`	

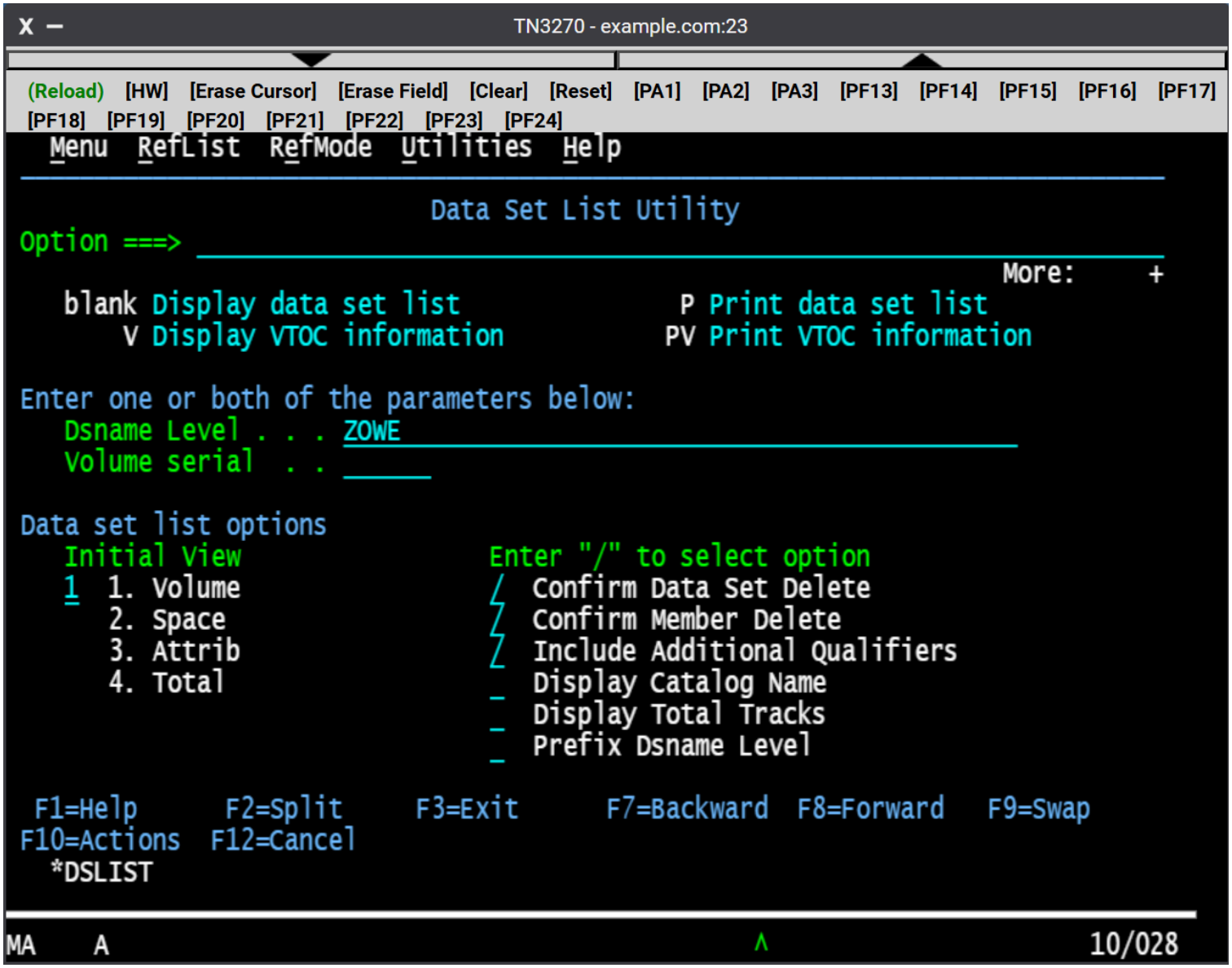
Action	Keyboard Shortcut	Note
PF18	`Shift` + `F6`	
PF19	`Shift` + `F7`	
PF20	`Shift` + `F8`	
PF21	`Shift` + `F9`	
PF22	`Shift` + `F10`	
PF23	`Shift` + `F11`	
PF24	`Shift` + `F12`	
Rapid Left	`Ctrl` + `ArrowLeft`	Move cursor left by 2 positions
Rapid Right	`Ctrl` + `ArrowRight`	Move cursor right by 2 positions
Reset	`Alt` + `r`	Terminal does not lock on bad input, but rejects and auto resets. No use for reset button currently.
Vertical Bar	`Ctrl` + `1`	|
Tab	`Tab`	

Key sequences

Key sequences allow users to define their own key sequences. Each key sequence is a recorded set of keys with the possibility of using the key modifiers (Ctrl, Alt, Shift), function keys (F1, F2, ...) and the combinations (such as Ctrl+E or Shift+F1). The definition is stored in the `_keySequences.json` file.

Default key sequences

- There is a set of predefined key sequences
- Key sequences are accesible via top right menu:



Syntax of the JSON

- All key sequences can be redefined by the user
- Following syntax is required:
  - `keySequences` is an array of individual key sequences
  - `title` displayed in the key sequences menu
  - `description` is hover help for each item in the key sequences menu
  - `keys` is an array of the key strokes
    - `normal` for the "typewriter" keys
    - `special` for the function, modifiers and other special keys
      - The value corresponds to the javascript key code
    - `prompt` is used for user input and this input is pasted on the current cursor position
  - `ctrl`, `alt` and `shift` are key modifiers
  - If you combine `normal`, `special` or `prompt` in one array item, only one action will be made in the order of `normal`, `special` and `prompt`

Example

Review the following demonstration on two simple key sequences:

- **Hello, world**
  - Types `Hello, world` only
- **ISPF command SWAP NEXT**
  - Presses `Home` to get on the command line/input field
  - `Ctrl+E` deletes the input field
    - `Ctrl+E` is predefined in the TN3270 as "EOF - Erase end of field"
  - Types `SWAP NEXT`
  - Hits `Enter`

The corresponding file `_keySequences.json` appears as the following:

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Using Zowe API Mediation Layer

There are numerous ways you can use Zowe API Mediation Layer (API ML). Review this topic and its child pages to learn more about the various ways to use the API Mediation Layer.
For information about the API versioning, see API Catalog and Versioning.

> **TIP**
>
> For testing purposes, it is not necessary to set up certificates when configuring the API Mediation Layer. You can configure Zowe without certificate setup and run Zowe with `zowe.verifyCertificates: DISABLED`.

For production environments, certificates are required. Ensure that certificates for each of the following services are issued by the Certificate Authority (CA) and that all keyrings contain the public part of the certificate for the relevant CA.

- z/OSMF
- Zowe
- The service that is onboarding to Zowe

API Mediation Layer Use Cases

There are two primary use cases for using the API ML:

- To access APIs which have already been onboarded to the Mediation Layer via the API Catalog, and leverage their associated Swagger documentation and code snippets.
- To onboard a REST API service to the API ML to contribute to the Zowe community.

See the following topics for detailed information about how to use the API Mediation Layer:

Using Single Sign On (SSO)

Three authentication methods can be used with single sign on:

- Authenticating with a JWT token
- Authenticating with client certificates
- Authenticating with a Personal Access Token

Using multi-factor authentication

User identity verification can be performed by using multi-factor authentication. For more information, see Using multi-factor authentication (MFA).

API Routing

Various routing options can be used for APIs when using API Mediation Layer:

- Routing requests to REST APIs
- Routing with WebSockets

- Using GraphQL APIs
- MultiTenancy Configuration

Learning more about APIs

API Mediation Layer makes it possible to view API information is a variety of ways:

- Obtaining information about API Services
- Using Swagger "Try it out" in the API Catalog
- Using Swagger Code Snippets in the API Catalog

Administrating APIs

- Using Static API services refresh in the API Catalog
- Onboarding a REST API service with the YAML Wizard

Using the Caching Service

As an API developer, you can use the Caching Service as a storage solution to enable resource sharing between service instances, thereby ensuring High Availability of services. For details, see Using the Caching service.

Using API Catalog

There are various options for using the API Catalog:

- Viewing Service Information abd API Documentation in the API Catalog
- Changing an expired password via API Catalog

Additional use case when using API Mediation Layer

- SMF records

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Information roadmap for Zowe API Mediation Layer

This roadmap outlines information resources that are applicable to the various user roles who are interested in Zowe API Mediation Layer. These resources provide information about various subject areas, such as learning basic skills, installation, developing, and troubleshooting for Zowe API Mediation Layer.

The following definition of skill levels about Zowe assist you with gathering the most relevant resources for you.

- Beginner: You're starting out and want to learn the fundamentals.
- Intermediate: You have some experience but want to learn more in-depth skills.
- Advanced: You have lots of experience and are looking to learn about specialized topics.

Fundamentals

> Zowe skill level: Beginner

- **Zowe API Mediation Layer overview**

  New to API Mediation Layer? This overview topic introduces the key features, main components, benefits, and architecture of the API Mediation Layer.

- **Architecture**

  Review the Zowe architecture to understand how the API Mediation Layer works in the Zowe framework.

Installing

> Zowe skill level: Beginner

- **System requirements**

  Review this topic to ensure that your system meets the requirements for installing the API Mediation Layer. The API Mediation Layer is one of the server-side components.

- **Planning**

  This article includes details about planning for installation, the Zowe z/OS launch process, and information about the Zowe runtime directory, instance directory, and keystore directory.

- **Installing API Mediation Layer**

  This article provides an overview of the essential steps involved in installing the API Mediation Layer.

Configuring and updating

> Zowe skill level: Intermediate

- **Configuring API Mediation Layer**

  - Advanced API Mediation Layer features configuration

    This article is for system programmers who want to configure advanced features of the API Mediation Layer, such as the Gateway retry policy, connection limits, Gateway timeouts, and other advanced features.

Using Zowe API Mediation Layer

> Zowe skill level: Intermediate

- **Using API Mediation Layer**

  Learn how to use the API Catalog to view what services are running in the API Mediation Layer. Through the API Catalog, you can also view associated API documentation corresponding to a service, descriptive information about the service, and the current state of the service.

- **Blog: Introducing “Try it out” functionality in the Zowe API Mediation Layer**

  This blog describes one key functionality of the Zowe API Mediation Layer to validate that services are returning the expected responses.

- **Docs: Zowe API reference guide**

  Discover and learn about Zowe APIs that you can use.

Onboarding APIs

> Zowe skill level: Advanced

- **Extend Zowe API Mediation Layer**

  Learn how you can extend the Zowe API Mediation Layer. Extenders make it possible to build and onboard additional API services to the API ML microservices ecosystem. REST APIs can register to the API Mediation Layer, which makes them available in the API Catalog, and for routing through the API Gateway.

- **Onboarding overview**

  This article provides details about onboarding a REST API service to the Zowe API Mediation Layer.

- **Zowe API ML repository**

  To start working with the code immediately, check out this code repository.

Security

> Zowe skill level: Advanced

- **API Mediation Layer Security**

  This article describes how API ML uses Transport Layer Security (TLS). Use this guide to familiarize yourself with the API ML security concepts.

- **Zowe API Mediation Layer Single Sign On Overview**

  This article provides an overview of the API ML single-sign-on feature, the principle participants in the SSO process, and links to detailed Zowe SSO documentation.

- **Blog: The ZAAS Client: a library for the API Mediation Layer**

  This blog introduces you to Zowe Authentication and Authorization Service (ZAAS) Client — a library that contains methods for retrieval of JWT tokens, PassTickets, as well as verifying JTW token information.

- **Blog: Single-Sign-On to z/OS REST APIs with Zowe**

  This blog takes a deeper dive into the SSO feature of API ML.

- **Blog: Zowe client certificate authentication**

- **Blog: CLI and Client Certificates

Contributing to Zowe API Mediation Layer

> Zowe skill level: Advanced

- **Contributing guidelines**

  This document is a summary of conventions and best practices for development within Zowe API Mediation Layer.

- **Conformance Program**

  This topic introduces the Zowe Conformance Program. Conformance provides Independent Software Vendors (ISVs), System Integrators (SIs), and end users greater confidence that their software will behave as expected. As vendors, you are invited to submit conformance testing results for review and approval by the Open Mainframe Project. If your company provides software based on Zowe CLI, you are encouraged to get certified today.

- **Blog: Zowe Conformance Program Explained**

  This blog describes the Conformance Program in more details.

Troubleshooting and support

- **Troubleshooting API ML**

  Learn about the tools and techniques that are available to help you troubleshoot and resolve problems. You can also find a list of common issues about Zowe API ML.

- **Error Message Codes**

  Use the message code references and the corresponding reasons and actions to help troubleshoot issues.

- **Sumit an issue**

  If you have an issue that is specific to Zowe API Mediation Layer, you can submit an issue against the `api-layer` repo.

Community resources

- **Slack channel**

  Join the #zowe-api Slack channel to ask questions about Zowe API ML, propose new ideas, and interact with the Zowe community.

- **Zowe API ML squad meetings**

  You can join one of the Zowe API ML squad meetings to get involved.

- **Zowe Blogs on Medium**

  Read a series of blogs about Zowe on Medium to explore use cases, best practices, and more.

- **Community Forums**

  Look for discussion on Zowe topics on the Open Mainframe Project Community Forums.

Version: v3.2.x LTS

Using Zowe API ML Single Sign On

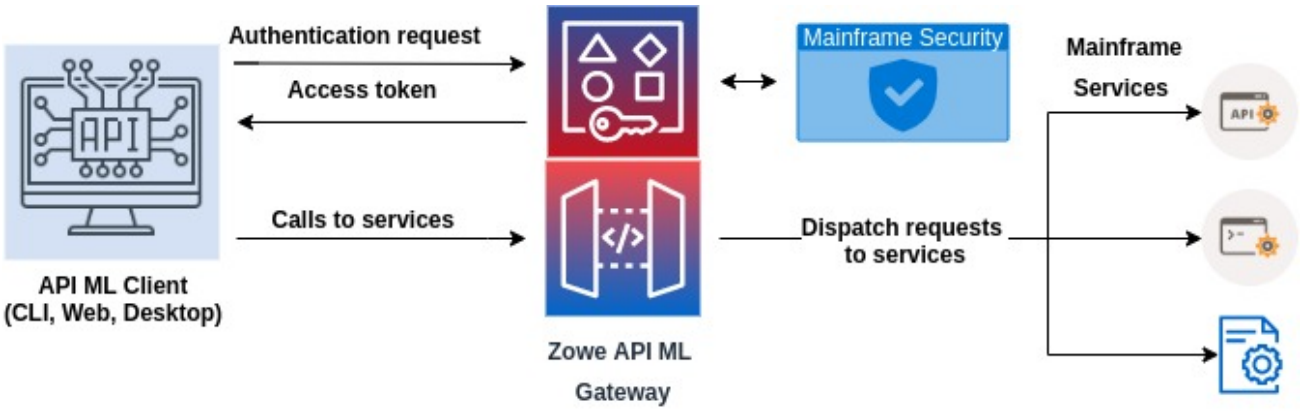
You can extend Zowe and utilize Zowe Single Sign On (SSO) provided by Zowe API Mediation Layer (API ML) to enhance system security and improve the user experience.

> **REQUIRED ROLES: SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR**

This article provides an overview of the API ML single sign on feature, the principle participants in the SSO process, and links to detailed Zowe SSO documentation. Zowe Single Sign On is based on single-user authentication which produces an access token that represents the user in communication with z/OS services accessible through the API Mediation Layer. The access token is issued by the Zowe Authentication and Authorization Service (ZAAS), which is part of API ML. ZAAS issues an access token based on valid z/OS credentials. This token can be validated by any component participating in SSO.

> **NOTE**
>
> Currently, API ML can provide SSO only in a single security domain.

The following diagram illustrates the interactions between the general participants in the single sign on process.



There are two main types of components that participate in Zowe SSO through API ML:

- Zowe API ML client
  - This type of component is user-facing and can obtain user credentials through a user interface (web, CLI, desktop).
  - A Zowe API ML client calls API services through API ML.
  - An example of such clients are Zowe CLI or Zowe Desktop.
- API service accessed via Zowe API ML
  - A service that is registered to API ML and is accessed through the API ML Gateway.
  - Services are protected by an access token or PassTicket.
  - The access token or PassTicket can be validated by the called API service.

The following sections describe what is necessary to utilize SSO for both types of components.

Zowe API ML client

- The Zowe API ML client needs to obtain an access token via the `/login` endpoint of ZAAS by providing z/OS credentials.
- A client can call the ZAAS `/query` endpoint to validate the token and get information from the token. This is useful when the API client has the token but does not store the associated data such as the user ID.
- The API client needs to provide the access token to API services in the form of a Secure HttpOnly cookie with the name `apimlAuthenticationToken`, or in the `Authorization: Bearer` HTTP header as described in Authenticated Request.

API service accessed via Zowe API ML

This section describes the requirements that an API service needs to satisfy to adopt a Zowe SSO access token.

- The token received by the API ML Gateway is first validated and then may be passed directly to the service. Alternatively, the API ML Gateway can exchange the token for a PassTicket if the API service is configured to expect a PassTicket.
- The API service should validate the token. It can use ZAAS Client or directly call the `query` endpoint.
- The API service can extract information about the user ID by calling the ZAAS `/query` endpoint.
- The alternative is to validate the signature of the JWT token using the public key of the token issuer (e.g. the API ML Gateway). The API service needs to have the API ML Gateway certificate along with the full CA certification chain in the API service truststore.

> **NOTE**
>
> The REST API of ZAAS can easily be called from a Java application using the ZAAS Client.

Existing services that cannot be modified

If you have a service that cannot be changed to adopt the Zowe authentication token, the service can utilize Zowe SSO if the API service is able to handle PassTickets.

For more information, see Enabling single sign on for extending services via PassTicket configuration.

Further resources

- Accessing multiple services with SSO
- Enabling single sign on for clients via JSON Web Token (JWT) configuration

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Authenticating with a JSON Web Token (JWT)

> **REQUIRED ROLES: SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR**

One user authentication method available in Zowe is via JSON Web Token (JWT), whereby a token can be provided by a specialized service, which can then be used to provide authentication information.

When a client authenticates with API Mediation Layer, the client receives the JWT which can then be used for further authentication. If z/OSMF is configured as the authentication provider and the client already received a JWT produced by z/OSMF, it is possible to reuse this token within API ML for authentication.

This article describes how services in the Zowe API ecosystem are expected to accept and use JWTs so that API clients have a stadardized experience.

> **TIP**
>
> For more information about authenticating with JWTs, see the Medium blog post Single-Sign-On to z/OS REST APIs with Zowe.

By default, JWTs are produced by z/OSMF and the API Mediation Layer only serves as a proxy. For information about how to change who and how tokens are produced, see Authentication Providers within Enable Single Sign On for Clients.

JWT-based Login Flow and Request/Response Format

The following sequence describes how authentication through JWTs works:

First, The API client obtains a JWT by using the POST method on the `/auth/login` endpoint of the API service that requires a valid user ID and password.

Secondly, the API client stores the JWT or cookie and sends the token with every request as a cookie with the name `apimlAuthenticationToken`.

Obtaining a JWT

To obtain a JWT, call the endpoint with the credentials for either basic authentication or the client certificate.

- The full path for API ML is: `/gateway/api/v1/auth/login`, the full URL could have the format: `https://hostname:port/gateway/api/v1/auth/login`.
- Credentials are provided in the JSON request or in Basic Authentication. The JSON request example looks like:
- Successful login returns RC `204`, and an empty body with the token in the `apimlAuthenticationToken` cookie.
- Failed authentication returns RC `401` without `WWW-Authenticate`.

Example:

The following output describes the status of the JWT:

Making an authenticated request

You can send a JWT with a request in two ways:

- Allow the API client to pass the JWT as a cookie header.
- Pass the JWT in the `Authorization: Bearer` header.

> **TIP**
>
> The first option (using a cookie header) is recommended for web browsers with the attributes `Secure` and `HttpOnly`. Browsers store and send cookies automatically. Cookies are present on all requests, including those coming from DOM elements, and are compatible with web mechanisms such as CORS, SSE, or WebSockets.
>
> Cookies are more diffcult to support in non-web applications. Headers, such as `Authorization: Bearer`, can be used in non-web applications. Such headers, however, are difficult to use and secure in a web browser. The web application needs to store these headers and attach these headers to all requests where headers are required.

Allow the API client to pass the JWT as a cookie header

One option to send a JWT with the request is for the API client to pass the JWT as a cookie header with the name `apimlAuthenticationToken`:

Example:

Pass the JWT in the `Authorization: Bearer` header

A second option to send a JWT with the request is to pass the JWT in the `Authorization: Bearer` header.

Example:

Validating JWTs

The API client does not need to validate tokens. API services must perform token validation themselves. If the API client receives a token from another source and needs to validate the JWT, or needs to check details in the token, such as user ID expiration, then the client can use the `/auth/query` endpoint provided by the service.

The JSON response contains the following fields:

- `creation`
- `expiration`
- `userId`

These fields correspond to `iss`, `exp`, and `sub` JWT claims. The timestamps are in ISO 8601 format.

Execute the following curl command to validate the existing JWT, and to retrieve the contents of the token:

The following output describes the status of the JWT:

Refreshing the JWT

API Clients can refresh the existing token to prolong the validity period.

Use the `auth/refresh` endpoint to prolong the validity period of the token.

The `auth/refresh` endpoint generates a new token for the user based on the valid JWT. The full path of the `auth/refresh` endpoint appears as the following URL:

The new token overwrites the old cookie with a Set-Cookie header. As part of the process, the old token becomes invalidated and is no longer usable.

> **NOTES:**
>
> - The endpoint is disabled by default. For more information, see Enable JWT endpoint.
> - The endpoint is protected by a client certificate.
> - The refresh request requires the token in one of the following formats:
>   - Cookie named `apimlAuthenticationToken`.
>   - Bearer authentication

For more information, see the OpenAPI documentation of the API Mediation Layer in the API Catalog.

The following request receives a valid JWT and returns the new valid JWT. As such, the expiration time is reset.

The following output describes the status of the JWT:

Token format

The JWT must contain the unencrypted claims `sub`, `iat`, `exp`, `iss`, and `jti`. Specifically, the `sub` is the z/OS user ID, and `iss` is the name of the service that issued the JWT.

> **NOTE**
>
> For more information about JWT formatting, see the paragraph 4.1 Registered Claim Names in the Internet Engineering Task Force (IETF) memo that describes JSON Web Tokens.

The JWT must use the RS256 signature algorithm. The secret used to sign the JWT is an asymmetric key generated during installation.

Example:

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Authenticating with client certificates

REQUIRED ROLES: SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR

Authentication for integration with API Mediation Layer (API ML) can also be performed by the client when the service endpoint is called through the API ML Gateway with client certificates. Client certificates in Zowe follow the X.509 standard which provide secure communication of networks and authenticates the identity of a user, device, or server.

X.509 client certification must be enabled and configured. For details about this configuration, see Enabling single sign on for clients via client certificate configuration.

NOTES:

- When calling the login endpoint with basic authentication credentials, as well as with client certificate, the basic authentication credentials take precedence and the client certificate is ignored.
- If you are calling a specific endpoint on one of the onboarded services, API Mediation Layer ignores Basic authentication. In this case, the Basic authentication is not part of the authenticated request.

For details about how authentication by means of client certificates is performed in the Gateway, see How the Gateway resolves authentication later in this article.

Configure your z/OS system to support client certificate authentication for specific users

Register the client certificate with the user IDs in your ESM.

The following commands show options for both the internal API ML mapper and ZSS.

NOTE

If using the internal API ML mapper (default from Zowe v3) and the MAP / CERTMAP option with distinguished name filters, use the `CHCKCERT` or equivalent command on the certificate to use the same order and format of the certificate's distinguished name as displayed.

RACF

Click here for an example command in RACF.

Use the following example if you are using the internal API ML mapper:

Activate the `DIGTNMAP` class:

Create the mapping for the user and a distinguished name filter:

- `<userid>`
  Specifies the userid that the certificate maps to.
- `<subject's-distinguished-name-filter>`
  Specifies the subject name from the user's certificate.
- `<label>`
  Specifies the name (label) to use for reference purposes.

Alternatively, if you disabled the internal API ML mapper, use the following command to add the certificate to a userid:

Use the following example if you are using ZSS:

> **TIP**
> To disable the API ML mapper, ensure that you set the parameter `components.gateway.apiml.security.useInternalMapper` to `false`.

ACF2

Click here for an example command in ACF2.

Use the following example if you are using the internal API ML mapper:

Create the mapping for the user and a distinguished name filter:

- `<recid>`
  Specifies the record ID that uniquely identifies a particular record.
- `<subject's-distinguished-name-filter>`
  Specifies the subject name from the user's certificate.
- `<label>`
  Specifies the name (label) to use for reference purposes.
- `<userid>`
  Specifies the userid that the certificate maps to.

Alternatively, if you disabled the internal API ML mapper, use the following command to add the certificate to a userid:

Use the following example if you are using ZSS:

Top Secret

Click here for an example command in Top Secret.

Use the following example if you are using the internal API ML mapper:

Create the mapping for the user and a distinguished name filter:

- `<userid>`
  Specifies the userid that the certificate maps to.
- `<recid>`
  Specifies the record ID that uniquely identifies a particular record.
- `<subject's-distinguished-name-filter>`
  Specifies the subject name from the user's certificate.

Alternatively, if you disabled the internal API ML mapper, use the following command to add the certificate to an ACID:

> **INFO**
>
> ACID refers to an Accessor ID which is used by Top Secret to manage users and their permissions. For more information, see ACIDs in the Top Secret documentation.

Use the following example if you are using ZSS:

Additional details are likely described in your security system documentation.

> **NOTES**
>
> - The alternative ESM map commands allow mapping a certificate to a user without adding the X.509 certificate to the ESM database. While this approach is more convenient, it could be considered less secure than adding the certificate to the ACID, which offers better control and protection.
> - Ensure that you have the Issuer certificate imported in the truststore or in the SAF keyring. Alternatively, you can generate these certificates in SAF.
> - Ensure that the client certificate has the following `Extended Key Usage` metadata:
>   `OID: 1.3.6.1.5.5.7.3.2`
>   This metadata can be used for TLS client authentication.

Validate the client certificate functionality

To validate that the client certificate functionality works properly, call the login endpoint with the certificate that was set up using the steps in Configure your z/OS system to support client certificate authentication for a specific user described previously in this article.

Validate using *CURL*, a command line utility that runs on Linux based systems:

Example:

- **cert**
  Specifies the certificate location
- **key**
  Path to the private key

- **7554**
  This value is a place holder. Replace this value with the configured API Gateway port in the instance

x.509 Client Certificate authentication is correctly configured if the result of the request is HTTP 200 with an `apimlAuthenticationToken` cookie generated.

Your Zowe instance is configured to accept x.509 client certificates authentication.

Java sample application

Note: This code sample requires JDK 17 or a newer version.

You can find a Java sample application in the Zowe API Layer repository. This sample can help you get started with client certificate authentication.

To run the application, see Run Client Certificate Authentication Sample in the Zowe API Layer repository.

How the Gateway resolves authentication

When sending a request to a service with a client certificate, the Gateway performs the following process to resolve authentication:

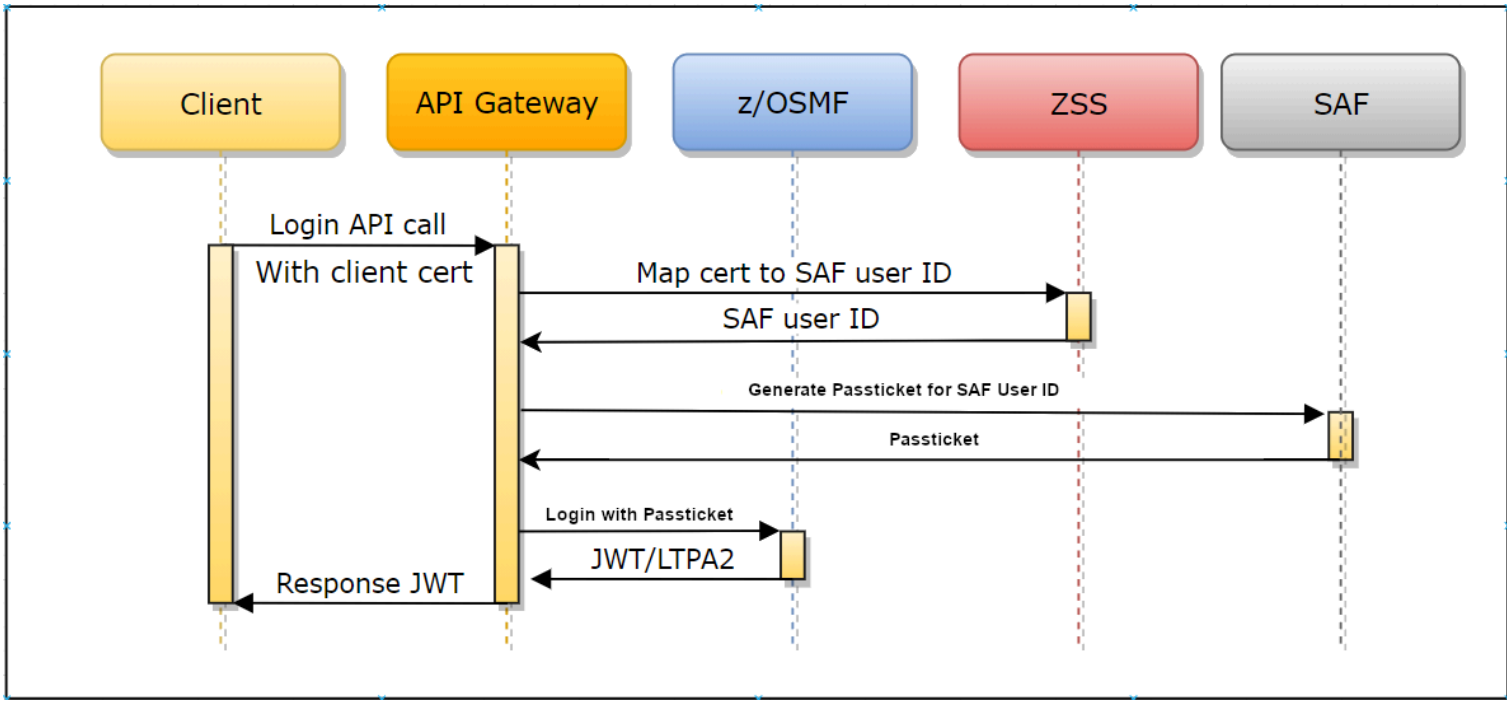
1. The client calls the service endpoint through the API ML Gateway with the client certificate.
2. The client certificate is verified as a valid TLS client certificate against the trusted certificate authorities (CAs) of the Gateway.
3. The certificate is checked against the CA in the Zowe keyring. If the certificate is valid, the security service (eg RACF MAP) then checks to see if the certificate is mapped to a userid. .
4. If the id is authenticated and authorized, the downstream service can use the id for authentication to the downstream service.

When sending a request to the login endpoint with a client certificate, the Gateway performs the following process to exchange the client certificate for an authentication token:

1. The client calls the API ML Gateway login endpoint with the client certificate.
2. The client certificate is verified to ensure this is a valid TLS client certificate against the trusted CAs of the Gateway.
3. The public part of the provided client certificate is verified against SAF. SAF subsequently returns a user ID that owns this certificate.
4. The Gateway then performs the login of the mapped user and returns a valid JWT token.

> **NOTES:**
>
> - As of Zowe release 3.0.0, the Internal API ML Mapper is the default API that provides this mapping between the public part of the client certificate and SAF user ID. Alternatively, you can use Z Secure Services (ZSS) to provide this API for API ML, with the noted exception when using ACF2, although we recommend using the internal API ML mapper.
> - For information about ZSS, see the section Zowe runtime in the Zowe server-side installation overview.

The following diagram shows how routing works with ZSS, in the case where the ZSS API is used for the identity mapping.



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Authenticating with a Personal Access Token

REQUIRED ROLES: SYSTEM PROGRAMMER, SECURITY ADMINISTRATOR

You can use API Mediation Layer to generate, validate, and invalidate a **Personal Access Token (PAT)** that can enable access to tools such as VCS without having to use credentials of a specific person. The use of PAT does not require storing mainframe credentials as part of the automation configuration on a server during application development on z/OS. Additionally, using a PAT makes it possible to limit access to specific services and users by means of token revocation when using a token.

To enable the Personal Access Token functionality read: Enable Personal Access Token

Gateway APIs are available to both users as well as security administrators. APIs for users can accomplish the following functions:

User APIs

- Generate a token
- Validate a token
- Invalidate a specific token
- Invalidate all tokens

APIs for security administrators are protected by SAF resource checking and can accomplish the following functions:

Security Administrator APIs

- Invalidate all tokens for a user
- Invalidate all tokens for a service
- Evict non-relevant tokens and rules

NOTES

- An SMF record can be issued when a Personal Access Token is generated. For more information, see SMF records issued by API ML.
- To enable Personal Access Token support when using the Caching Service, **Infinispan** is the required storage solution. Infinispan is part of Zowe installation. No additional software or installation is required when using this storage solution.

For detailed information about using the Personal Access Token as part of single sign on, see the section Using the Personal Access Token to authenticate later in this article.

TIP

For additional information, see the Medium blog post Personal Access Tokens for the Zowe API Mediation Layer.

User APIs

Generate a token

A user can create the Personal Access Token by calling the following REST API endpoint through the Gateway:

`POST /auth/access-token/generate`

The full path of the `/auth/access-token/generate` endpoint appears as: `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/access-token/generate`.

The request requires the body in the following format:

- **validity**
  Specifies the expiration time of the token. The maximum threshold is 90 days.
- **scopes**
  Specifies the access limits on a service level. This parameter introduces a higher level of security in some aspects. Users are required to provide a scope. If no service is specified, it is not possible to authenticate using the token.

When creation is successful, the response to the request is a body containing the PAT with a status code of `200`. When creation fails, the user receives a status code of `401`.

Validate a token

The user can validate the Personal Access Token by calling the following REST API endpoint through the Gateway:

`POST /auth/access-token/validate`

The full path of the `/auth/access-token/validate` endpoint appears as `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/access-token/validate`.

The request requires the body in the following format:

> **NOTE**
> The user has the option of calling this API to validate the token, however, validation is also automatically performed by the API ML.

When validation is successful, the response to the request is an empty body with a status code of `204`. When validation fails, the user receives a status code of `401`.

Invalidate a specific token

The user can invalidate the Personal Access Token by calling the following REST API endpoint through the Gateway:

`DELETE /auth/access-token/revoke`

The full path of the `/auth/access-token/revoke` endpoint appears as `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/access-token/revoke`.

The request requires the body in the following format:

When the `/auth/access-token/revoke` endpoint is called, the provided hash of the PAT is stored in the cache by the Caching Service under the `invalidTokens` key. As such, the token is invalidated. Access to these entries is protected by the API ML client certificate.

When invalidation is successful, the response to the request is an empty body with a status code of `204`. When invalidation fails, the user receives a status code of `401`.

Invalidate all tokens

The user can invalidate all Personal Access Tokens by calling the following REST API endpoint through the Gateway:

`DELETE /auth/access-token/revoke/tokens`

The full path of the `/auth/access-token/revoke/tokens` endpoint appears as `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/access-token/revoke/tokens`.

The body can optionally provide a timestamp as part of the request. Use the following format for the body:

If the body is not provided, the timestamp value defaults to the current date.

When the `/auth/access-token/revoke/tokens` endpoint is called, the provided user rule is stored in the cache by the Caching Service under the `invalidUsers` key. As such, all of the tokens of the user are invalidated. Access to these entries is protected by the client certificate of the API ML.

When invalidation is successful, the response to the request is an empty body with a status code of `204`. When invalidation fails, the user receives a status code of `401`.

Security Administrator APIs

Invalidate all tokens for a user

If a security breech is suspected, the security administrator can invalidate all the tokens based on criteria as established by **rules**. Such criteria define the level of access control and can restrict access in advance. Rule based access restriction can be applied by either user ID or service scopes.

> **NOTE**
>
> *Rules* are entries used to revoke the tokens either by users or by services. Such rule entries for services appear in the following format:

Rule entries for users appear in the following format:

The Security Administrator with specific access to SAF resources can invalidate all tokens bound to a specific user by calling the following REST API endpoint through the Gateway:

`DELETE /auth/access-token/revoke/tokens/users`

The full path of the `/auth/access-token/revoke/tokens/users` endpoint appears as `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/access-token/revoke/tokens/users`.

The request requires the body in the following format:

- **userId**
  Specifies the user the revocation is applied to.

- **timestamp**
  Specifies the date of revocation (the default value is the current time) in milliseconds. The timestamp is used to specify that tokens created before the date specified in the timestamp are invalidated. As such, any subsequent tokens created after that date are not affected by the user rule.

By calling this endpoint, the user rule is stored in the cache by the Caching Service under the `invalidUsers` key.

When invalidation is successful, the response to the request is an empty body with a status code of `204`. When invalidation fails, the user receives a status code of `401`.

Invalidate all tokens for a service

A security administrator who has specific access to SAF resources can invalidate all tokens bound to a specific service by calling the following REST API endpoint through the Gateway:

`DELETE /auth/access-token/revoke/tokens/scope`

The full path of the `/auth/access-token/revoke/tokens/scope` endpoint appears as `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/access-token/revoke/tokens/scope`.

The request requires the body in the following format:

Invalidation of all tokens is possible by using rules based on service scopes.

- **serviceId**
  Specifies the service to which the revocation should be applied (e.g. APPL IDs).

- **timestamp**
  Specifies the date of revocation (the default value is the current time) in milliseconds. A timestamp is used to state that tokens created before the date specified in the timestamp are invalidated. As such, any subsequent tokens created after that date are not affected by the service rule.

Calling this endpoint stores the service rule in the cache by the Caching Service under the `invalidScopes` key.

When invalidation is successful, the response to the request is an empty body with a status code of `204`. When invalidation fails, the user receives a status code of `401`.

Evict non-relevant tokens and rules

The Security Administrator with specific access to SAF resources can evict non-relevant invalidated tokens and rules from the cache by calling the following REST API endpoint through the Gateway:

`DELETE /auth/access-token/evict`

The full path of the `/auth/access-token/evict` endpoint appears as `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/access-token/evict`.

The `/auth/access-token/evict` endpoint evicts all invalidated tokens which were expired and all the rules related to the expired tokens.

The main purpose of the eviction API is to ensure that the size of the cache does not grow unbounded. The token verification process requires processing of all rules, including those which may no longer be applicable. As such, verification processing may result in needless associated costs if there are stored rules which are no longer relevant.

When eviction is successful, the response to the request is an empty body with a status code of `204`. When eviction fails due to lack of permissions, the administrator receives a status code of `403`.

Using the Personal Access Token to authenticate

There are four ways the API client can use the Personal Access Token to authenticate as part of the Single Sign On in which a service is specified in the scopes at the time when the token is issued:

- Using the `Authorization: Bearer` request header.

  Example:

- Using a Secure HttpOnly cookie with the name `apimlAuthenticationToken`.

  Example:

- Using a Secure HttpOnly cookie with the name `personalAccessToken`.

  Example:

- Using a request header with the name `PRIVATE-TOKEN`.

  Example:

In these examples, the API client is authenticated.

If the API client tries to authenticate with a service that is not defined in the token scopes, the `X-Zowe-Auth-Failure` error header is set and passed to the southbound service. The error message contains a message that the provided authentication is not valid.

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Authenticating with OIDC

> **REQUIRED ROLES: SYSTEM ADMINISTRATOR, SECURITY ADMINISTRATOR**

The OpenID Connect (OIDC) protocol adds an identity layer on top of the OAuth2 Authorization protocol.

OIDC authentication, together with the z/OS Identity Propagation mechanism, is the foundation of the API Mediation Layer (API ML) Identity Federation. In this article, OIDC is often referred to as the provider, while the token-related functionality is actually provided by the OAuth2 component of the OIDC implementation.

You can configure Zowe API ML to authenticate users by accepting Access Tokens issued by an external OIDC provider. This configuration is useful in advanced deployments of Zowe where client applications need to access mainframe as well as enterprise/distributed systems while simultaneously offering single sign-on (SSO) across system boundaries.

This article details the API ML OIDC authentication functionality, and describes how to configure the OIDC Authentication feature.

> **NOTE**
>
> There is a limitation with respect to performing authentication using Z Secure Services (ZSS) with ACF2 systems. If you are using ACF2, use the recommended internal API ML mapper described in the API ML OIDC configuration section.

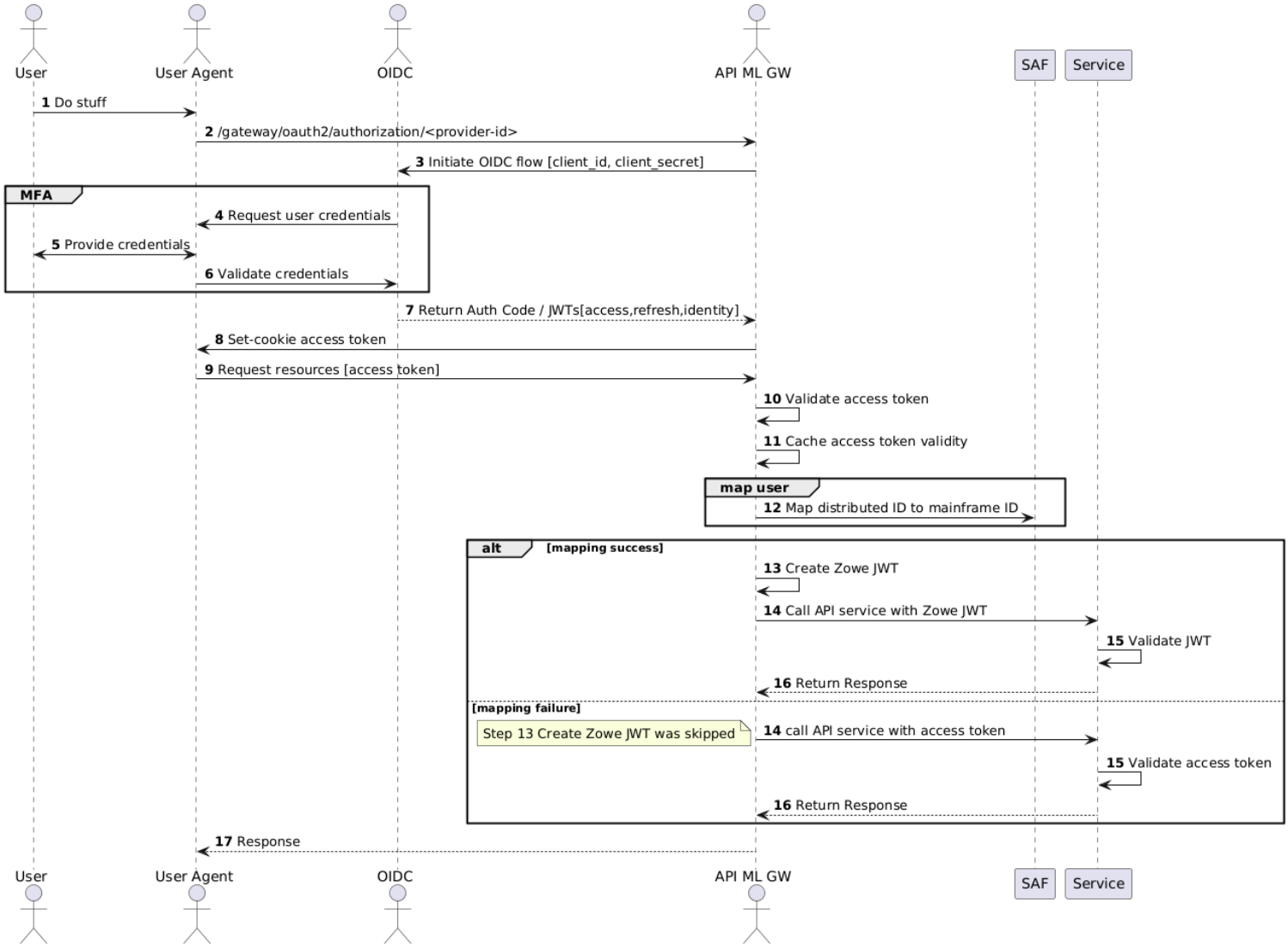
- Usage
- Authentication flow
- Prerequisites
  - ESM configuration
- API ML configuration
  - OIDC client configuration
  - OIDC resource server configuration
- Troubleshooting

Usage

API ML functions as an OIDC client application, enabling users to initiate the OIDC authentication flow. After successful user login, the OIDC provider grants the client application a JWT Access Token along with a JWT Identity Token. The access token is then returned to the user agent in the "apimlAuthenticationToken" cookie. The user agent can pass this Access Token with subsequent requests to mainframe services routed through the API ML Gateway. The API ML Gateway then validates the OIDC Access Token. If the token is valid, the user identity from that token is mapped to the mainframe identity of the user. The API ML Gateway can then create mainframe user credentials (e.g. JWT, PassTicket) according to the service's authentication schema configuration or forward a valid OIDC access token if the user is not mapped. The request is routed to the target API services with correct mainframe user credentials.

Authentication Flow

The following diagram illustrates the interactions between the participants of the OIDC based API ML authentication process.



Workflow description between OICD participants

1. The user accesses the agent.
2. The user agent requests the client application without valid authentication or an access token.
3. The client redirects the user agent to the login end-point of the distributed OIDC provider.
4. The user is asked to provide valid credentials (authentication factors).
5. The user provides credentials.
6. The agent sends these credentials to the OIDC provider for validation.
7. After successful validation of all authentication factors, the OIDC provider grants the client an Access Token.
8. The client application replies with an access token in the `set-cookie` header.
9. The user agent can then request from API ML Gateway the needed mainframe resources presenting the access token in the request.
10. The Gateway validates the access token in one of two ways:

    i. By cryptographically validating the token using the public key retrieved from the authorization server's JSON Web Key Set (JWKS) endpoint, matching the token's key ID with the key IDs provided.

(`components.gateway.apiml.security.oidc.validationType: JWK`).

Notes:

- The URL to the specific authorization server's JWKS endpoint should be set using the property `components.gateway.apiml.security.oidc.jwks.uri`.
- The interval can be set using the property `components.gateway.apiml.security.oidc.jwks.refreshInternalHours`. (The default value is one hour.)

ii. By querying the `UserInfo` endpoint to verify the token's validity and retrieve user information (`components.gateway.apiml.security.oidc.validationType: endpoint`).

Note: The URL to the specific authorization server's `UserInfo` endpoint should be set using the property `components.gateway.apiml.security.oidc.userInfo.uri`.

11. The Gateway caches the valid access token.
12. The Gateway maps the distributed identity from the access token to the z/OS identity.

When user mapping exists

13. The API ML Gateway generates mainframe user credentials (Zowe JWT, SAF IDT, or PassTicket) which are expected by the target mainframe service.
14. Calls the API with credentials.
15. Services validates generated mainframe credentials.
16. The requested data is returned.
17. The requested data is returned to the user agent.

When user mapping does not exist

14. The API ML Gateway calls the requested mainframe service/s with the access token in the `OIDC-token` header.
15. The service validates the `OIDC-token`.
16. The requested data is returned.
17. The requested data is returned to the user agent.

Prerequisites

Ensure that the following prerequisites are met:

- Users who require access to mainframe resources using OIDC authentication have a mainframe identity managed by SAF/ESM.
- SAF/ESM is configured with mapping between the mainframe and distributed user identities. For details, see the section ESM configuration in this topic.
- If you are using Zowe release 2.14 or a later release, ensure that the API ML Gateway is configured to use the internal mapper functionality. For information about enabling the API ML mapper, see Configure internal API ML mapper. Alternatively, enable ZSS in the Zowe installation, however using the internal mapper is the recommended method. ZSS is enabled by default.

OIDC provider prerequisites

- **Client Application configuration in the OIDC provider**

  Depending on the OIDC provider and client application capabilities, configuration of the OIDC provider varies. For example, web applications with a secure server side component can use `code grant authorization flow` and can be granted a Refresh Token, whereas a Single Page Application running entirely in the User Agent (browser) is more limited regarding its security capabilities.

  > **TIP**
  > Consult your OIDC provider documentation for options and requirements available for your type of client application.

- **Users have been assigned to the Client Application**

  To access mainframe resources, users with a distributed authentication must either be directly assigned by the OIDC provider to the client application, or must be part of group which is allowed to work with the client application.

ESM configuration prerequisites

The user identity mapping is defined as a distributed user identity mapping filter, which is maintained by the System Authorization Facility (SAF) / External Security Manager (ESM). A distributed identity consists of two parts:

1. A distributed identity name
2. A trusted registry which governs that identity

Administrators can use the installed ESM functionality to create, delete, list, and query a distributed identity mapping filter or filters.

Ensure that all the security configuration prerequisites are met by following the steps described in configure the main Zowe server to use distributed identity mapping.

Use the commands specific to your ESM to create a distributed identity mapping filter.

> **NOTE**
> User specified parameters are presented in the section Parameters in the ESM commands.

For RACF

<details>
<summary>Click here for RACF configuration details.</summary>

For more details about the RACMAP command, see RACMAP command.
</details>

For Top Secret

<details>
<summary>Click here for Top Secret configuration details.</summary>
</details>

For more details about mapping a distributed identity username and a distributed registry name to a Top Secret ACID, see IDMAP Keyword - Implement z/OS Identity Propagation Mapping.

For ACF2

Click here for ACF2 configuration details.

For more details about mapping a distributed user to a logonid, see IDMAP User Profile Data Records.

Parameters in the ESM commands

- **userid**
  Specifies the ESM user id.
- **distributed-identity-user-name**
  Specifies the user ID for distributed-identity-registry.
- **distributed-identity-registry-name**
  Specifies the registry value under which the user is defined in the ESM.
- **label-name**
  Specifies the name for the distributed-identity mapping filter.

  Example for RACF:

Alternatively, API ML provides a Zowe CLI plug-in to help administrators generate a JCL for creating the mapping filter specific for the ESM installed on the target mainframe system. These JCLs can be submitted on the corresponding ESM to create a distributed identity mapping filter.

For details about how to use the plug-in tool to set up mapping in the ESM of your z/OS system, see the Identity Federation CLI plug-in documentation.

API ML OIDC configuration

OIDC client configuration

The Gateway service can be configured to provide OIDC client functionality and initiate the OIDC authentication flow to obtain an access token. Provide the following configuration in your zowe.yaml file:

- **provider-id**
  The ID of the Identity provider. Currently supported options are `okta` and `entra`.
- **components.gateway.spring.security.oauth2.client.registration.<provider-id>.issuer**
  The URL of the Token issuer.
  Example: `https://dev-okta.com/oauth2`.
- **components.gateway.spring.security.oauth2.client.registration.<provider-id>.clientId**
  The Client application ID.

- **components.gateway.spring.security.oauth2.client.registration.<provider-id>.clientSecret**
  The Client application secret.
- **components.gateway.spring.security.oauth2.client.provider.<provider-id>.authorizationUri**
  The URL for the authorization request.
- **components.gateway.spring.security.oauth2.client.provider.<provider-id>.tokenUri**
  The URL to obtain the token.
- **components.gateway.spring.security.oauth2.client.provider.<provider-id>.userInfoUri**
  The URL to retrieve user information.
- **components.gateway.spring.security.oauth2.client.provider.<provider-id>.userNameAttribute**
  The JWT attribute to locate the user ID.
- **components.gateway.spring.security.oauth2.client.provider.<provider-id>.jwkSetUri**
  The URL to retrieve the JSON Web Key Set.

> **TIP**
>
> Consult your OIDC provider documentation for options and requirements available for your type of client application.

OIDC resource server configuration

Use the following procedure to enable the feature to use an OIDC Access Token as the method of authentication for the API Mediation Layer Gateway.

> **TIP**
>
> You can leverage the Zowe CLI Identity Federation (IDF) Plug-in for Zowe CLI to extend Zowe CLI to make it easier to map mainframe users with an identity provided by an external identity provider. This plug-in is designed to work with the ESMs: IBM RACF, Broadcom ACF2, and Broadcom Top Secret.
>
> For more information about the Zowe CLI Identity Federation Plug-in, see the README file in the api-layer repo.

In the zowe.yaml file, configure the following properties:

- **components.gateway.apiml.security.oidc.enabled**
  Set the value to `true` to enable OIDC resource server functionality for authentication.

- **components.gateway.apiml.security.oidc.registry**
  Specifies the SAF registry used to group the identities recognized as having OIDC identity mapping. The registry name is the string used during the creation of the mapping between the distributed and mainframe user identities. For more information, see **distributed-identity-registry-name** value used in the ESM configuration.

- **components.gateway.apiml.security.oidc.validationType**
  Specifies the validation type for OIDC authentication functionality, which is set to `JWK` by default. To enable access token validation using a remote endpoint, set this property to `endpoint`. When set to `endpoint`, the Gateway uses the URI sepecified in the property `userInfo` to validate access tokens.

  - For `endpoint` validation type, configure following options

- **components.gateway.apiml.security.oidc.userInfo.uri**
  Specifies the URI obtained from the authorization server's metadata where the Gateway queries the userInfo endpoint for access token validation.

- For `JWK` validation type, configure following options

  - **components.gateway.apiml.security.oidc.jwks.uri**
    Specifies the URI obtained from the authorization server's metadata where the Gateway will query for the JWK used to sign and verify the access tokens.
  - **components.gateway.apiml.security.oidc.jwks.refreshInternalHours**
    (Optional) Specifies the frequency in hours to refresh the JWK keys from the OIDC provider. Defaults to one hour.

Example for OKTA:

Troubleshooting

API ML fails to validate the OIDC access token with the Distributed Identity Provider

Symptom
The Gateway log contains the following ERROR message:
`Failed to validate the OIDC access token. Unexpected response: XXX.`

- ***XXX***
  is the HTTP status code returned by the Identity Provider.

Explanation
The HTTP code is one of the 40X variants that provides the reason for the failure.

Solution

Correct the Gateway configuration according to the code returned by the OIDC Identity Provider.

The access token validation fails with HTTP error

Symptom

The OIDC provider returns an HTTP 40x error code.

Explanation

The client application is not properly configured in the API ML Gateway.

Solution
Check that the URL `components.gateway.apiml.security.oidc.jwks.uri` contains the key for OIDC token validation. If `oidc.validationType` is set to `endpoint`, ensure that the `components.gateway.apiml.security.oidc.userInfo.uri` is properly configured and valid.

> **TIP**

API ML Gateway exposes a validate token operation which is suitable during the OIDC setup. The call to the endpoint `/gateway/api/v1/auth/oidc-token/validate` verifies if the OIDC token is trusted by API ML. Note that the Gateway service does not perform the mapping request to the ESM when the `/gateway/api/v1/auth/oidc-token/validate` endpoint is called.

Use the following curl command to make a REST request with the OIDC token to the validate token endpoint:

An HTTP `204` code is returned if the validation passes. Failure to validate returns an HTTP `40x` error.

AZURE ENTRA ID OIDC NOTES:

API ML uses the `sub` claim of the ID Token to identify the user, and to map to the mainframe account. Note that the structure of the `sub` claim varies between the Azure token and the OKTA ID token:

- The Azure token `sub` is an alphanumeric value.
  For more information, see the topic *Use claims to reliably identify a user* in the Microsoft Learn documentation.
- The OKTA ID token has an email in the `sub` claim.

For more information about Entra ID token format see *ID token claims reference* in the Microsoft documentation.

Version: v3.2.x LTS

Using multi-factor authentication (MFA)

Zowe offers the option to use multi-factor authentication (MFA) systems, which require users to provide multiple authentication factors during logon to verify the user's identity. When using multi-factor authentication, it is necessary that each authentication factor be from a separate category of credential types. While multi-factor authentication is supported by Zowe, there are limitations for this feature to function properly. This topic explains the limitations of using MFA in Zowe and recommendations to address these limitations.

The Zowe API Mediation Layer, Zowe App Framework, and all apps present in the SMP/E or convenience builds support out-of-band MFA. Users are required to enter an MFA assigned token or passcode into the password field of the Desktop login screen or authentication to the API Catalog.

Alternatively, a user can access one of the authentication endpoints such as `/gateway/auth/login` within the API Mediation Layer or via App-servers `/auth` REST API endpoint.

When using MFA with Zowe CLI or the API ML Catalog, users are required to log in with their mainframe user name and MFA token.

Prerequisite

If you use z/OSMF as your authentication provider, ensure that you meet the following prerequisite to use MFA with Zowe CLI or API ML Catalog:

- z/OSMF APAR for MFA must be installed on the system. For more information, see this APAR in IBM Support.

Known Limitations and Recommendations

Unintentional Reuse of MFA Token

When z/OSMF is used as a security provider, it is possible to reuse MFA tokens, whereby it is possible to receive a JWT token based on previously used MFA token. This presents a security risk.

This issue can be resolved by configuring z/OSMF to work properly with API ML. For details about how to make the changes to z/OSMF settings, see the section Disable Chache in z/OSMF in the article *Configuring z/OSMF*.

No Notification when Additional Input is Required

Neither Zowe CLI nor API Catalog issue a notification when a user is required to provide additional input. This can occur in cases such as when a user signon attempt triggers the requirements of a **New Pin** or **Next Token**. The user must resolve this situation outside of Zowe. Depending on the current authentication factor enabled (RSA SecurID or RADIUS), the user can use TSO console or MFA Self-service facilities.

We recommend you first try to access self-service facilities and resolve the issue there. If you are unable to access your self-service facilities, contact your system administrator.

> **TIPS:**

- For more information about how to manage multi-factor authentication credentials in AAM, see Configure the Global Factor for Enterprise Multi-Factor Authentication with IBM RACF in the Advanced Authentication Mainframe 2.0 Broadcom documentation.
- For more information about how to manage multi-factor authentication credentials in IBM Z MFA, see IBM Z Multi-Factor Authentication.
- Additionally, Zowe API ML can be configured to accept OIDC/OAuth2 user authentication tokens. In this particular case, MFA support is built into the OIDC provider system. This support alternative does not rely on the mainframe MFA technology, but is equally secure.
- For more information about different ways to sign on with the RADIUS credentials, see Sign On When Using RADIUS Credentials with IBM RACF.

Token Expiration when Stored in the Authorization Dialog in "Try it out"

When using the API Catalog, you have the option to use the "Try it out" functionality to test a protected endpoint. In this case, you are given the option to provide and store MFA credentials in the Authorization dialog. As the MFA token has a short lifetime, we do not recommend storing your MFA token when using this feature.

You can, however, continue to use your credentials in the Authorization dialog when you set a fixed password, rather than using an MFA token. Alternatively, you can store your credentials in the Authorization dialog if your account is configured to bypass MFA mode. In this case, authentication is performed through the mainframe credentials of the user.

Version: v3.2.x LTS

Routing requests to REST APIs

API consumers can access any services onboarded to the API Mediation Layer through a single port. In this context, 'service' refers to one or more instances that share the same API and are onboarded under the same service Id. Some services provide versioned APIs, while other services provide an unversioned API. From the consumer side, the API Mediation Layer takes care of situations in which one instance is down and/or ditributing the load between different instances of a service.

Types of services include both versioned and nonversioned services:

- **Versioned services**
  Routing with service ID and version

- **Nonversioned services**
  Using only the service ID

Under certain conditions it is possible to route to a specific instance of service.

Terminology

- **Service**

  - A service provides one or more APIs, and is identified by a service ID. Note that sometimes the term "service name" is used to mean the service ID.
  - The default service ID is provided by the service developer in the service configuration file.
  - A system administrator can replace the service ID with a deployment environment specific name using additional configuration that is external to the service deployment unit. Most often, configuration is performed in a JAR or WAR file.
  - Services are deployed using one or more service instances, which share the same service ID and implementation.

- **URI (Uniform Resource Identifier)**

  The URI is a string of characters used to identify a resource. Each URI must point to a single corresponding resource that does not require any additional information, such as HTTP headers.

Basic Routing

The basic method of routing is based on the service ID. For services that have multiple versions of an API, the secondary parameter is the version of the API that the user wants to reach.

API ML Routing to the Versioned service

The URI identifies the resource, but does not identify the instance of the service as unique when multiple instances of the same service are provided, such as when a service is running in high-availability (HA) mode. To get to a specific instance, it is necessary to access the instance with a specific API ML configuration and header X-Instance-Id.

In addition to the basic Zuul routing, the Zowe API Gateway supports versioning in which the user can specify a major version. The Gateway routes a request only to an instance that provides the specified major version of the API.

- The `/api/` prefix is used for REST APIs.
- The prefix `/ui/` applies to web UIs
- The prefix `/ws/` applies to WebSockets
- The prefix `/graphql/` applies to the GraphQL API

The URL expected by the API Gateway has the following format:

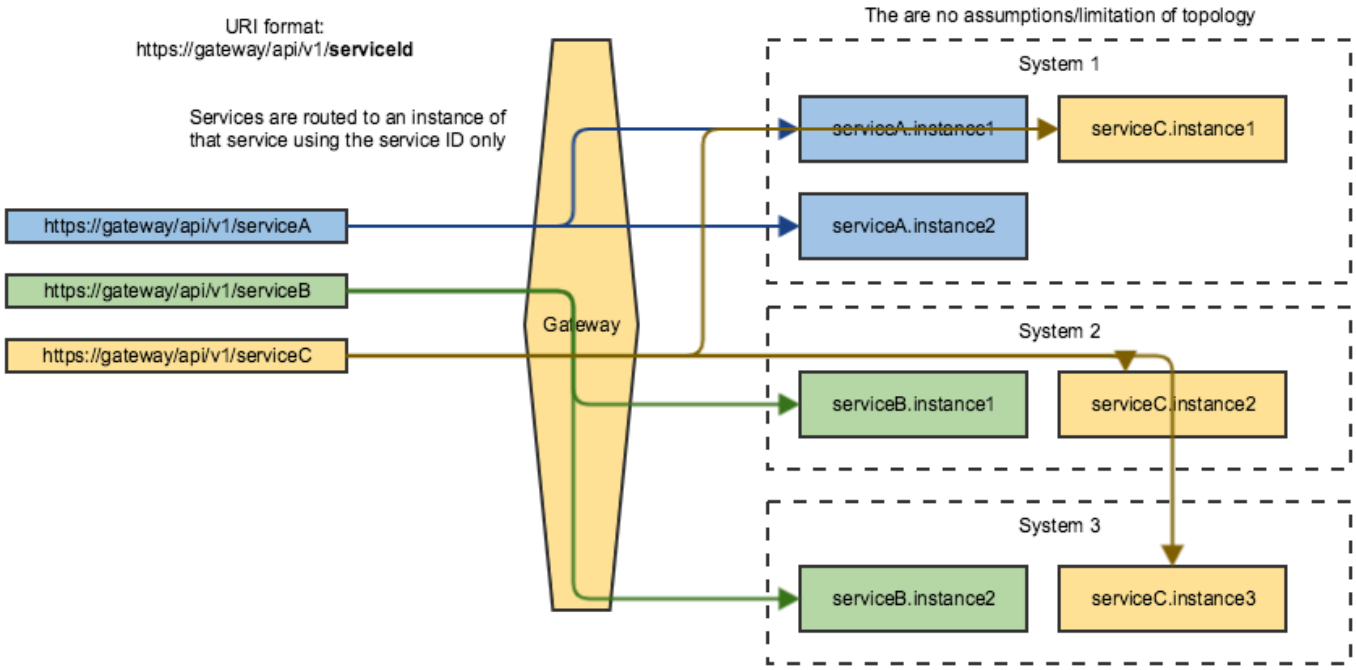
`https://{gatewayHost}:{port}/{serviceId}/api/v{majorVersion}/{resource}`

Example:

The following address shows the original URL of a resource exposed by a service:

The following address shows the API Gateway URL of the resource:

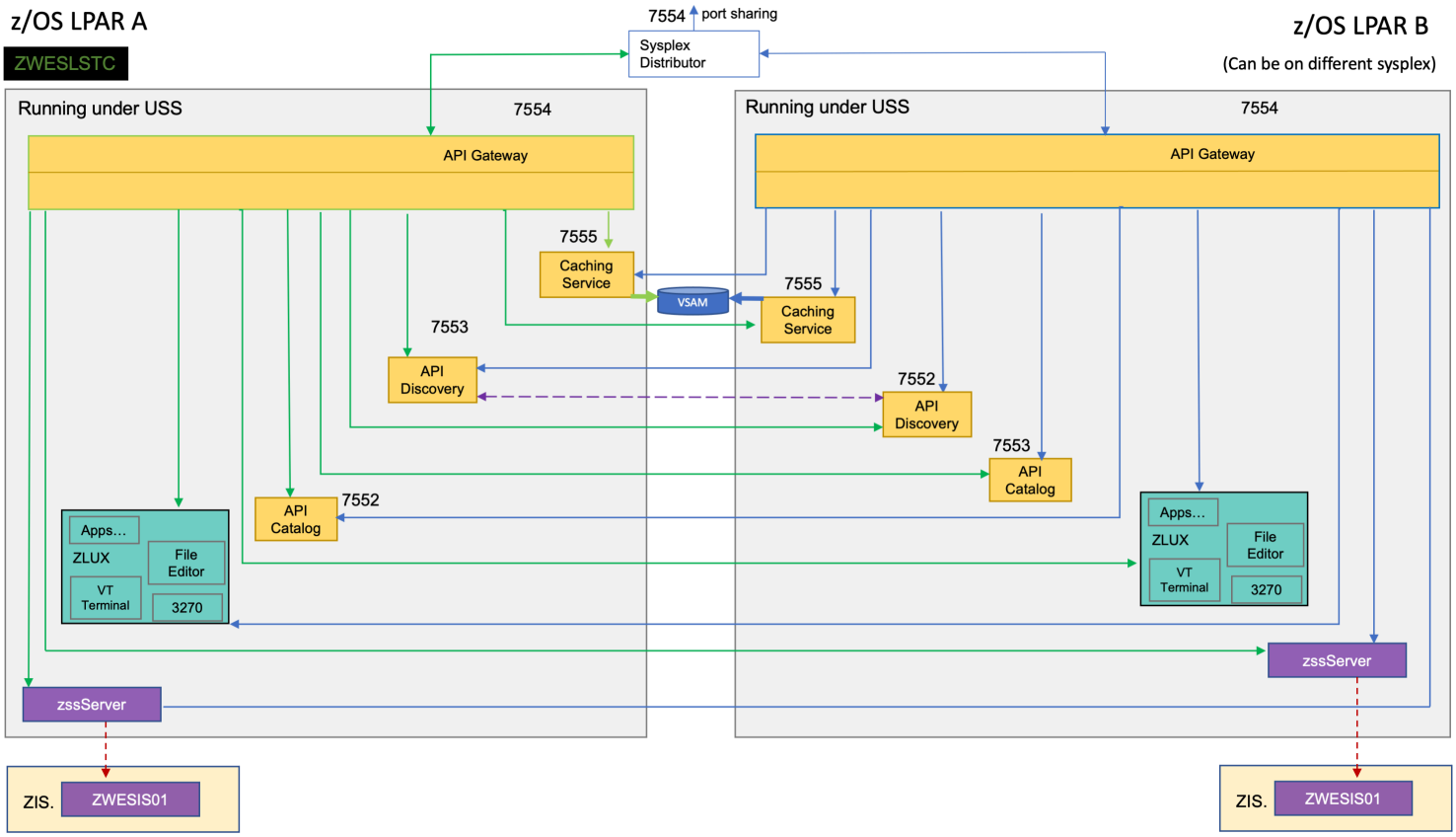
The following diagram illustrates how basic routing works:



Implementation details for routing

Zowe architecture with high availability enablement on Sysplex

The following diagram illustrates the difference in locations of Zowe components when deploying Zowe into a Sysplex with high availability enabled as opposed to running all components on a single z/OS system.



Zowe has a high availability feature built-in. To enable this feature, you can define the `haInstances` section in your YAML configuration file.

The preceding diagram shows that `ZWESLSTC` started two Zowe instances running on two separate LPARs. These LPARs can be on the same or different sysplexes.

- Sysplex distributor port sharing enables the API Gateway 7554 ports to be shared, which makes it possible for incoming requests to be routed to either the Gateway on LPAR A or LPAR B.
- The discovery servers on each LPAR communicate with each other and share their registered instances, which allows the API Gateway on LPAR A to dispatch APIs to components either on its own LPAR, or alternatively to components on LPAR B. As indicated in the diagram, each component has two input lines: one from the API Gateway on its own LPAR, and one from the Gateway on the other LPAR. When one of the LPARs goes down, the other LPAR remains operating within the sysplex, thereby providing high availability to clients that connect through the shared port irrespective of which Zowe instance is serving the API requests.

The `zowe.yaml` file can be configured to start Zowe instances on more than two LPARS, and also to start more than one Zowe instance on a single LPAR, thereby providing a grid cluster of Zowe components that can meet availability and scalability requirements.

The configuration entries of each LPAR in the `zowe.yaml` file control which components are started. This configuration mechanism makes it possible to start just the desktop and API Mediation Layer on the first LPAR, and start all of the Zowe components on the second LPAR. Because the desktop on the first LPAR is available to the gateway of the second LPAR, all desktop traffic is routed to the second LPAR.

The caching services for each Zowe instance, whether on the same LPAR, or distributed across the sysplex, are connected to each other by the same shared VSAM data set. This arrangement allows state sharing so that each instance behaves similarly to the user irrespective of where their request is routed.

To learn more about Zowe with high availability enablement, see Configuring Sysplex for high availability.

API Versioning

Service instances provide one or more different API versions. One important assumption is that one service instance does not provide two versions with the same major version. No assumptions are made regarding which versions are provided and how. As such, an instance can provide only one version and that another version is provided by a different instance, and other services can have instances that provide multiple versions.

The API user specifies only the major version in the URI. The API Catalog needs to differentiate between different *full versions* internally and be able to return a specific full version or return documentation for the highest version of the specified major version that is supported by all running services.

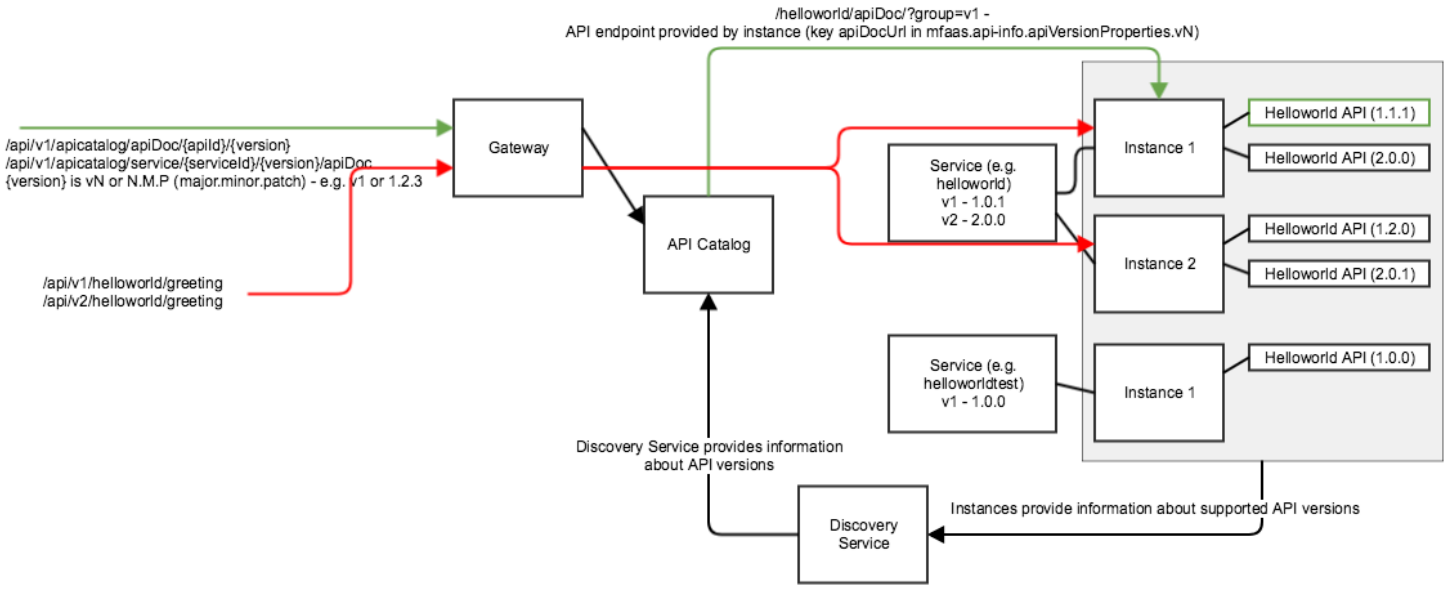
Guidelines

- The version of the API is not dependent on the product release.
- Two last versions are supported.
- **Major version**
  This version is specified by the user of the API in the URI, and increased only when a backward incompatible change is introduced. This circumstance is rare because the REST APIs should be designed to allow extensibility.
- **Minor version**
  This version is not specified in the URI but the user should know what is it. It is important to display the correct level of documentation. The minor version is increased when the API is extended with a new feature (if you use a new resource available in v1.2, the request fails on v1.1). If there are multiple instances of the services that have different minor versions, the service together will state that the lowest minor version is available.

Example:

Instance A provide v1.3 and v2.2. Instance B was not yet upgraded and provides v1.2 and v2.1. Subsequently, the service provides v1.2 and v2.1.

- **Patch version**
  The Patch version is not specified in the URI and does not indicate a difference in the API. A patch version is used only when the API documentation is patched or a bug was fixed with no change in the API.


/helloworld/apiDoc/?group=v1 -
API endpoint provided by instance (key apiDocUrl in mfaas.api-info.apiVersionProperties.vN)
/api/v1/apicatalog/apiDoc/{apiId}/{version}
/api/v1/apicatalog/service/{serviceId}/{version}/apiDoc
{version} is vN or N.M.P (major.minor.patch) - e.g. v1 or 1.2.3
/api/v1/helloworld/greeting
/api/v2/helloworld/greeting
Gateway
API Catalog
Service (e.g. helloworld)
v1 - 1.0.1
v2 - 2.0.0
Service (e.g. helloworldtest)
v1 - 1.0.0
Instance 1
Instance 2
Instance 1
Helloworld API (1.1.1)
Helloworld API (2.0.0)
Helloworld API (1.2.0)
Helloworld API (2.0.1)
Helloworld API (1.0.0)
Discovery Service provides information about API versions
Discovery Service
Instances provide information about supported API versions

Version: v3.2.x LTS

Routing with WebSockets

In WebSocket routing, the API ML Gateway acts as both a WebSocket server for the client requesting this connection, and as a WebSocket client.

The following schema describes the interactions between client-side and server-side components where the Gateway has a double role as both client and server.

> **TIP**
>
> We recommend that clients implement a ping-like mechanism to maintain the opened WebSocket sessions and not rely on the web browser to perform this action.

- Security and Authentication
- Subprotocols
- High availability
- Idle Timeout
- Diagnostics
- Limitations

Security and Authentication

The API Gateway usually uses TLS with the `wss` protocol. Services that use TLS enable the API Gateway to use `wss` to access these services. Services that do not use TLS require the API Gateway to use the `ws` protocol without TLS. The API Gateway also supports basic authentication via WebSocket.

Subprotocols

In addition to plain WebSocket support, API Mediation Layer also supports WebSocket subprotocols. Currently, only STOMP v1.2 and STOMP v1.1 are supported and tested.

> **NOTE**
>
> It is possible to update the list of currently supported WebSocket subprotocols. Update the API Gateway configuration using the environment variable `SERVER_WEBSOCKET_SUPPORTEDPROTOCOLS` with the value of comma-separated subprotocol names. Support for additional subprotocols is not guaranteed as these subprotocols are not being tested.

Example:

High availability

In the high availability scenario, a WebSocket session is established between client and a selected Gateway. This session is then tied to this instance for its entire duration.

Idle Timeout

The WebSocket client on the API ML Gateway has a default Idle timeout of one hour. If a WebSocket session between the Gateway WebSocket Client and the Service's WebSocket Server is inactive for the entire period, the connection is closed.

To customize this setting, set the following property in zowe.yaml:

> **NOTE**
>
> This setting is global for the API ML Gateway.

Diagnostics

The list of active routed WebSocket sessions is available at the Actuator endpoint `websockets`. On `localhost`, it is available at https://localhost:10010/application/websockets.

The actuator endpoint is enabled with debugging enabled in the API ML Gateway.

Limitations

Different HTTP status code errors may result. The WebSocket session starts before the session starts between the Gateway and the service. When a failure occurs when connecting to a service, the WebSocket session terminates with the WebSocket close code and a description of the failure that occurred between the Gateway and the Service rather than an HTTP error code.

Version: v3.2.x LTS

Using GraphQL APIs

GraphQL is a query language for APIs that provides descriptions of the data in your APIs, and allows for specific queries to facilitate API development. Routing for such APIs is possible within the Zowe ecosystem, however at the present time, Zowe itself does not provide any GraphQL APIs.

For more information about configuring routing to API ML, see the following articles:

- Implementing routing to the Gateway
- Routing Requests to REST API

> **TIP**
>
> - For information about how to use GraphQL, see GraphQL Best Practices in the GraphQL product documentation.
> - For information about how to use HTTP to deliver the GraphQL interface, see Serving over HTTP in the GraphQL product documentation.

Difference between GraphQL APIs and traditional REST APIs

REST APIs operate on the principle of resource-based endpoints. Each endpoint in a REST API corresponds to a specific resource (like a user or product), and the type of request (`GET`, `POST`, `PUT`, `DELETE`) dictates the operation performed on that resource. This approach leads to a straightforward and uniform interface but often results in the over-fetching or under-fetching of data. Over-fetching occurs when the fixed data structure of an endpoint returns more information than the client needs, while under-fetching happens when the client must make additional requests to gather all the necessary data. Additionally, REST APIs rely heavily on HTTP status codes for error handling and utilize standard HTTP methods for caching and statelessness.

By contrast, GraphQL offers a more flexible and efficient way of working with data. Unlike REST, which uses multiple endpoints, GraphQL uses a single endpoint through which clients can make versatile queries. These queries are tailored to retrieve exactly the data required, eliminating over-fetching and under-fetching issues inherent in REST. GraphQL's strongly typed system, defined by a schema, ensures that the data conforms to a specific structure, providing a contract between the server and client. This approach simplifies data retrieval for complex, nested data and allows for more precise error handling within the responses. However, GraphQL's flexibility can lead to more complex queries and demands careful consideration regarding performance, especially in designing how queries are resolved on the server side.

Routing to GraphQL example

The following routing example applies only to services extending API ML that provide GraphQL APIs.

Use the following format to map to a GraphQL API:

Example:

routes:

- gatewayUrl: "api/v1/graphql" serviceUrl: "/graphql"

In this example, the service has a service ID of `helloworldservice` that exposes the following endpoints:

- **GraphQL** `https://gateway/helloworldservice/api/v1/graphql` routed to `https://hwServiceHost:port/graphql/`

where:

- The gatewayUrl is matched against the prefix of the URL path used at the Gateway `https://gateway/urlPath`
  - `urlPath` is `serviceId/prefix/resourcePath`.
- The service ID is used to find the service host and port.
- The `serviceUrl` is used to prefix the `resourcePath` at the service host.

> **NOTE**
>
> The service ID is not included in the routing metadata. Instead, the service ID is in the basic Eureka metadata.

How GraphQL Works

GraphQL operates through the type system you define for your data and uses the following structure:

- **Schema Definition**
  Define a 'schema' or a model of the data that can be queried through the API. This schema acts as a contract between the client and the server.
- **Query**
  Clients send queries to your GraphQL server. These queries specify what data the client needs.

- **Resolving Queries**
  The server processes these queries according to the schema and returns the appropriate results.

Key Concepts of GraphQL

- **Queries and Mutations**
  In GraphQL, queries are used for reading data, while mutations are used for writing data. This clear separation makes understanding and maintaining the API simpler.
- **Real-time Data with Subscriptions**
  GraphQL supports subscriptions, which allow clients to subscribe to real-time updates, essential for dynamic content applications.
- **Strongly Typed**
  GraphQL APIs are strongly typed so that every operation is checked and validated against the schema, leading to more reliable and predictable APIs.

Displaying GraphQL in API Catalog

Since Zowe v3, it is possible to configure the service to display an interactive documentation UI inside the API Catalog services' detail page.

This capability is enabled in the API Catalog by default. It requires the service to onboard to the Discovery Service with `apiml.apiInfo.api-<version>.graphqlUrl` set to the endpoint where the service exposes the GraphQL API.

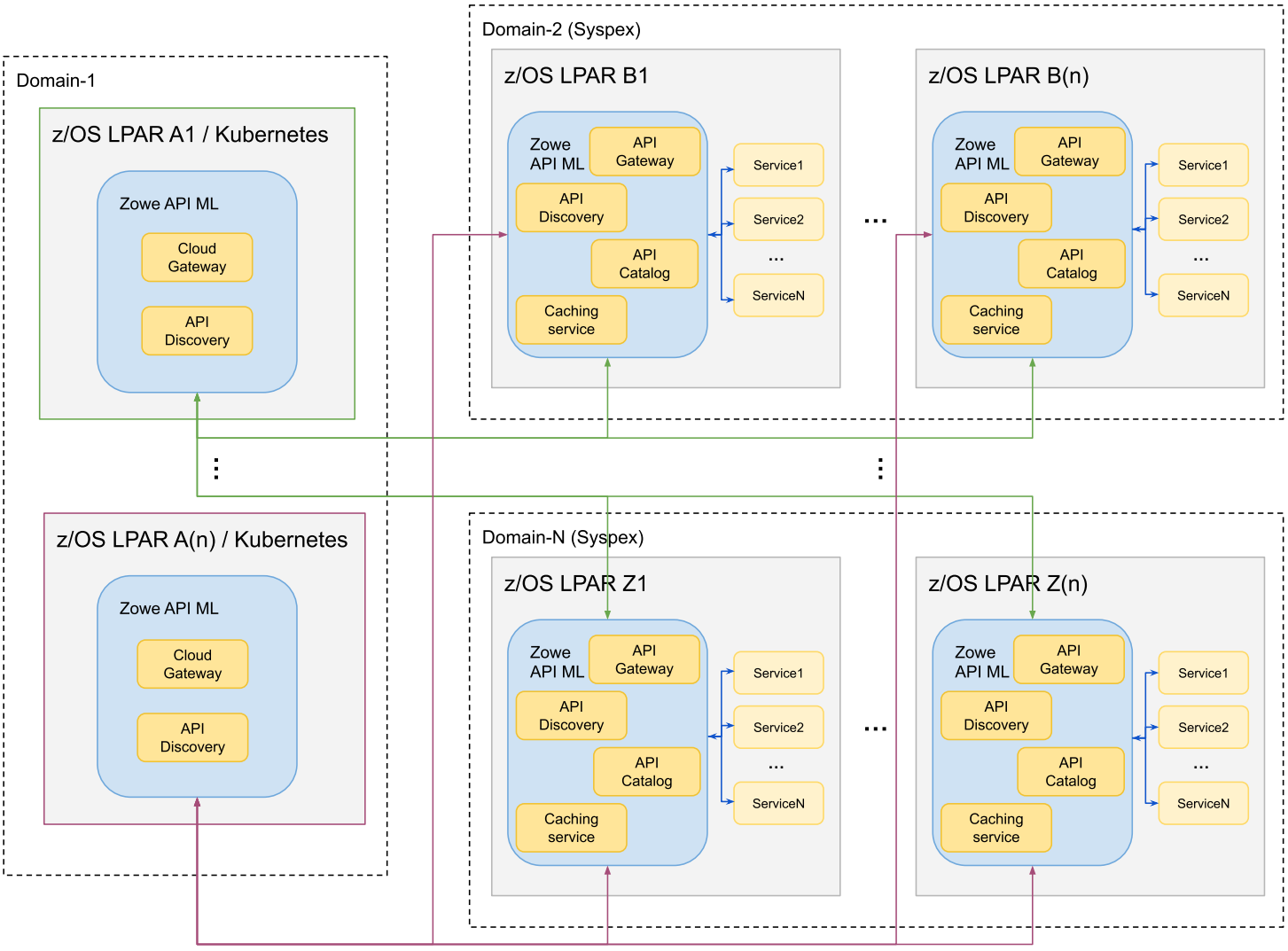
Version: v3.2.x LTS

Multitenancy Configuration

Zowe supports management of multiple tenants, whereby different tenants can serve different purposes or different customers. The use case for multi-tenant support is when a service provider manages sysplexes/monoplexes for multiple customers. This configuration makes it possible to have a single access point for all customers, and properly route and authenticate across different domains.

Overview of API MLs

The following diagram illustrates communication between the API Mediation Layers and Zowe in multiple domains. Note that some API MLs may be running in a sysplex (HA), while others may be in a monoplex (non-HA).



The diagram illustrates a Multitenacy environment where the API MLs in Domain(2-N) are registered to API ML in Domain-1. The API ML in Domain-1 may be running on z/OS, or off z/OS, for example in Kubernetes. This API ML serves as a single point of access to all API Mediation Layers registered in this and, by extension, to all services registered in those API MLs.

The API MLs in Domain(2-N) are installed on z/OS systems with the standard Zowe API ML running either in HA (sysplex) or non-HA (monoplex). These API MLs are registered to API ML in Domain-1.

Multitenancy component enablement settings

In the multitenancy environment, certain Zowe components may be enabled, while others may be disabled. The multitenancy environment expects one API ML (for example API ML in Domain-1) that handles the discovery and registration as well as routing to the other API MLs (API MLs in Domain(2-N)) installed in any other specific domains.

Onboarding a Gateway service in one domain to the Discovery service of API ML in another domain

A Gateway from any domain can onboard Gateways of any other domains. Onboarding this service can be achieved similar to additional registrations of the Gateway. This section describes the dynamic configuration of the yaml file and environment variables, and how to validate successful configuration.

- Dynamic configuration via zowe.yaml
- Dynamic configuration via Environment variables

Dynamic configuration via zowe.yaml

1. In zowe.yml, set the following property for the Gateway of API MLs in Domain(2-N) to dynamically onboard to the Discovery service of API ML in Domain-1:

   `components.gateway.apiml.service.additionalRegistration`

Use the following example as a template for how to set the value of this property in zowe.yaml.

Example:

> **NOTES:**
>
> - Ensure that each API ML instance is defined in a separated record. Do not combine multiple API ML instances in a single record. In the case of a high availability setup, the value `discoveryServiceUrls` may contain multiple URLs.
> - We highly recommend to provide all available Discovery URLs in the value `discoveryServiceUrls`.
> - Always provide the direct address to the system. Do not use the DVIPA address. Using this DVIPA address could lead to unexpected behaviour.
> - Use hostnames `sys1` and `sys2` for the LPAR in the sysplex.

2. (Optional) Configure the Gateway to forward client certificates.
   Use this step to enable the domain(2-N) Gateway to use this client certificate for authentication.
   Set the `certificatesUrl` property to ensure that only Gateway-forwarded certificates are used for client certificate authentication. This URL returns a certificate chain from the Gateway.

Dynamic configuration via Environment variables

The list of additional registrations is extracted from environment variables. You can define a list of objects by following YML -> Environment translation rules.

The previous example can be substituted with the following variables:

- **#**
  `#` in `ZWE_CONFIGS_APIML_SERVICE_ADDITIONALREGISTRATION_#_*` specifies the ID of API ML instance.

> ⓘ **NOTES:**
>
> - Ensure that each API ML instance is defined in a separated record. Do not combine multiple API ML instances in a single record. In the case of a high availability setup, the value `discoveryServiceUrls` may contain multiple URLs. We highly recommend to provide all available Discovery URLs in the value `discoveryServiceUrls`.
> - Always provide the direct address to the system. Do not use the DVIPA address. Using this address could lead to unexpected behaviour.
> - Use hostnames `sys1` and `sys2` for the LPAR in the sysplex.

This Zowe configuration transforms the zowe.yaml configuration file into the environment variables described previously.

Validating successful configuration

The corresponding Gateway service in domain(2-N) should appear in the Eureka console of the Discovery service in the domain-1 API ML.

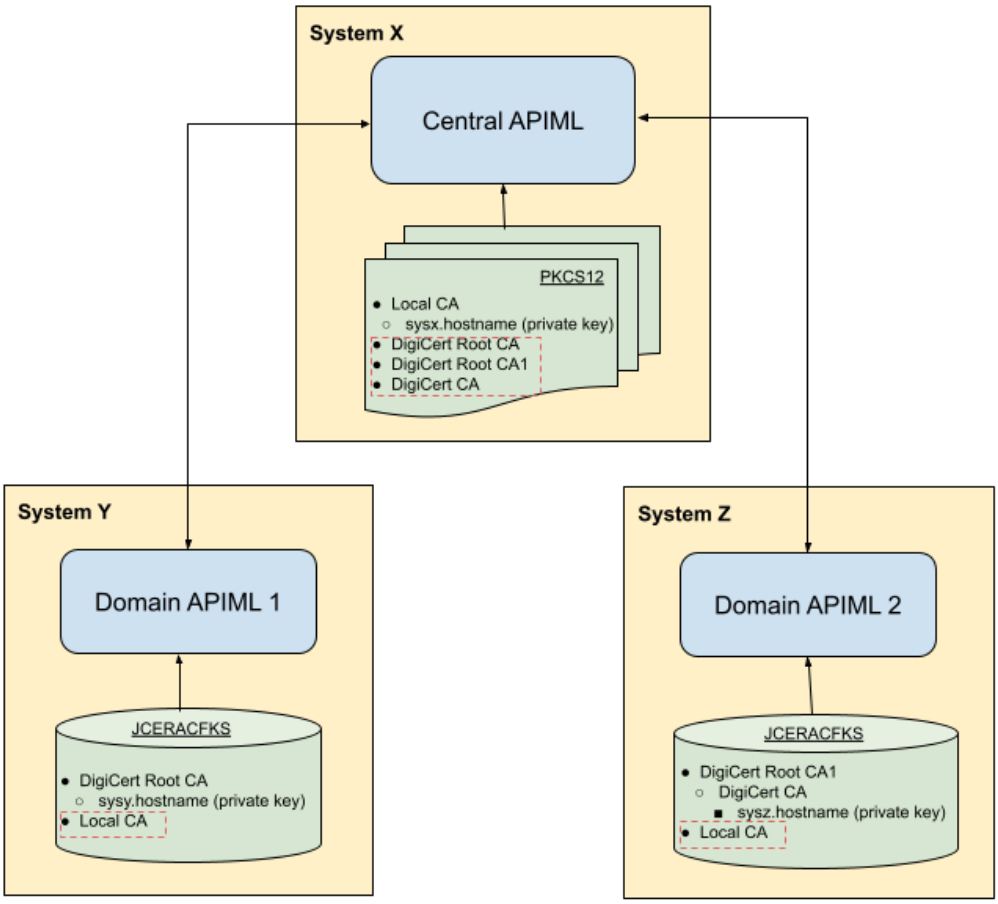
To see details of all instances of the ‘GATEWAY’ application, perform a **GET** call on the following endpoint of the Discovery service in domain-1 API ML:

Establishing a trust relationship between the API MLs

For routing to work in a multitenancy configuration, as represented in the previous diagram where "Domain API ML 2" and "Domain API ML 3" are registered to "Domain API ML 1", "Domain API ML 1" must trust "Domain API ML 2" and "Domain API ML 3". This trust is required for successful registration into the Discovery Service component of Domain API ML 1.

To accept routed requests, "Domain API ML 2" and "Domain API ML 3" must trust the "Domain API ML 1" Gateway where Domains API ML 2 and 3 are registered to. It is necessary that the root and, if applicable, intermediate public certificates are shared between these domain API Mediation Layers.

The following diagram shows the relationship between the API MLs.



As illustrated in this example diagram, The API MLs are installed on systems X, Y, and Z.

To establish secure communications, "Domain API ML 2" and "Domain API ML 3" use different private keys signed with different public keys. These API MLs do not trust each other.

In multitenancy set up, in order for all API MLs to register with "Domain API ML 1", it is necessary that "Domain API ML 1" has all public keys from the certificate chains of all registered API MLs:

- DigiCert Root CA
- DigiCert Root CA1
- DigiCert CA

These public keys are required for the "Domain API ML 1" to establish trust with "Domain API ML 2" and "Domain API ML 3".

"Domain API ML 1" uses a private key which is signed by the local CA public key for secure communication.

"Domain API ML 2" and "Domain API ML 3" require a local CA public key to accept routing requests from "Domain API ML 1". Without these local CA public keys "Domain API ML 1" requests will not be trusted by the registered API MLs. All added certificates are indicated in the diagram inside the red dashed lines.

Commands to establish trust between the API MLs

The following commands are examples of establishing a trust relationship between API MLs in Multitenancy Configuration for both PKCS12 certificates and when using keyrings.

1. Import the root and, if applicable, the intermediate public key certificate of registered "Domain API ML 2" and "Domain API ML 3" API MLs running on systems Y and Z into the truststore of the "Domain API ML 1" running on system X.

   - **PKCS12**

     <details>
     <summary>Click here for an example of keytool commands for PKCS12 certificates.</summary>

     For PKCS12 certificates, use the following example of keytool commands:

     ```
     keytool -import -file sysy/keystore/local_ca/local_ca.cer -alias gateway_sysy -keystore sysx/keystore/localhost/localhost.truststore.p12
     ```

     ```
     keytool -import -file sysz/keystore/local_ca/local_ca.cer -alias gateway_sysz -keystore sysx/keystore/localhost/localhost.truststore.p12
     ```
     </details>

   - **Keyring**

   For keyrings, use the following examples of commands specific to your ESM to add certificates from the dataset and connect these certificates to the keyring used by the "Domain APIML 1":

   <details>
   <summary>Click here for command details for RACF.</summary>

   - **For RACF:**

     Verify:
   </details>

   <details>
   <summary>Click here for command details for ACF2.</summary>

   - **For ACF2:**

     Verify:
   </details>

   <details>
   <summary>Click here for command details for Top Secret.</summary>

   - **For Top Secret:**

     Verify:
   </details>

2. Import root and, if applicable, intermediate public key certificates of the API ML running on system X into the truststore of the API MLs running on systems Y and Z.

   - **PKCS12**

     Click here for example keytool commands for PKCS12 certificates.

     For PKCS12 certificates, use the following example of the keytool commands:

     ```
     keytool -import -file x/keystore/local_ca/local_ca.cer -alias gateway_x -keystore y/keystore/localhost/localhost.truststore.p12
     ```

     ```
     keytool -import -file x/keystore/local_ca/local_ca.cer -alias gateway_x -keystore z/keystore/localhost/localhost.truststore.p12
     ```

   - **Keyring**

   For keyring certificates, use the following examples of commands specific to your ESM to add certificates from the dataset, and connect these certificates to the keyrings used by registered API MLs:

   Click here for command details for RACF.

   - **For RACF:**

     Verify:

   Click here for details for ACF2.

   - **For ACF2:**

     Verify:

   Click here for command details for Top Secret.

   - **For Top Secret:**

     Verify:

You completed certificates setup for multitenancy configuration, whereby registered API MLs can trust the API ML where they are registered and vice versa.

Using the `/registry` endpoint in the Central Cloud Gateway

The `/registry` endpoint provides information about services onboarded to all registered Gateways. This section describes the configuration, authentication, authorization, example of requests, and responses when using the `/registry` endpoint. The `/registry` endpoint provides information about services onboarded to all registered Gateways. This section describes the configuration, authentication, authorization, example of requests, and responses when using the `/registry` endpoint.

Configuration for `/registry`

The `/registry` endpoint is disabled by default. Use the configuration property `apiml.gateway.registry.enabled=true` or environment variable `APIML_GATEWAY_REGISTRY_ENABLED=TRUE` to enable this feature. The `/registry` endpoint is disabled by default. Use the configuration property `apiml.gateway.registry.enabled=true` or environment variable `APIML_GATEWAY_REGISTRY_ENABLED=TRUE` to enable this feature.

Authentication for `/registry`

The `/registry` endpoint is authenticated by the client certificate. The Gateway accepts certificates that are trusted. The username is obtained from the common name of the client certificate.

Unsuccessful authentication returns a 401 error code.

Authorization with `/registry`

Only users configured by the following environment variable are allowed to use the `/registry` endpoint.

`APIML_SECURITY_X509_REGISTRY_ALLOWEDUSERS=USER1,user2,User3`

This parameter makes it possible to set multiple users as a comma-separated list.

Unsuccessful authorization returns a 403 error code.

Requests with `/registry`

There are two endpoints that provide information about services registered to the API ML. One endpoint is for all APIMLs, and the other endpoint is for the specific APIML. Choose from the following **GET** calls:

- **`GET /gateway/api/v1/registry`**
  This request lists services in all API MLs.
- **`GET /gateway/api/v1/registry/{apimlId}`**
  This request lists services in the API ML of the specific apimlId given.
- **`GET /gateway/api/v1/registry/{apimlId}?apiId={apiId}&serviceId={serviceId}`**
  This request gets the specific service from the API ML in the specific apimlId.

Response with `/registry`

<details>
<summary>Click here for an example of the response with /registry</summary>
</details>

Example:

Response with `/registry{apimlId}`

This response should contain information about all services in an API ML with the specific apimlId.

Click here for an example response

Example:

- `GET /gateway/api/v1/registry/apiml2`

Response with `GET /gateway/api/v1/registry/{apimlId}?apiId={apiId}&serviceId={serviceId}`

This response should contain information about a specific service in an APIML with the specific apimlId.

Click here for an example response

Example:

- `GET /gateway/api/v1/registry/apiml2?apiId=zowe.apiml.gateway&serviceId=catalog`

Validating successful configuration with `/registry`

Use the `/registry` endpoint to validate successful configuration. The response should contain all the API MLs represented by `apimlId`, and information about onboarded services.

Troubleshooting multitenancy configuration

ZWESG100W

Cannot receive information about services on API Gateway with apimlId 'apiml1' because: Received fatal alert: certificate_unknown; nested exception is javax.net.ssl.SSLHandshakeException: Received fatal alert: certificate_unknown

Reason
Cannot connect to the Gateway service.

Action
Make sure that the external Gateway service is running and the truststore of the both Gateways contains the corresponding certificate.

Version: v3.2.x LTS

Obtaining Information about API Services

As an API Mediation Layer user, information about API services can be obtained for various purposes. The following list presents some of the use cases for using the API Mediation Layer:

- To display available services based on a particular criterion (API ID, hostname, or custom metadata)
- To locate a specific API service based on one or more specific criteria (for example the API ID)
- To obtain information that permits routing through the API Gateway such as *baseUrl* or *basePath*
- To obtain information about an API service, the service APIs, or instances of the service

This article provides further detail about each of these use cases.

- Obtaining Information about API Services
  - Using API ID in API ML to locate APIs in different instances
  - Protecting Service Information
  - Using API Endpoints
    - Obtaining Information about a Specific Service
    - Obtaining Information about All Services
    - Obtaining Information about All Services with a Specific API ID
    - Response Format

Using API ID in API ML to locate APIs in different instances

The *API ID* uniquely identifies the API in API ML. The API ID can be used to locate the same APIs that are provided by different service instances. The API developer defines this ID.

Protecting Service Information

Information about API services is considered sensitive as it contains partial information about the internal topology of the mainframe system. As such, this information should be made accessible only by authorized users and services.

Access to this information requires authentication using mainframe credentials, as well as verification of access to resources through SAF. The resource class and resource is defined in the `ZWESECUR` job. Dor more information about `ZWESECUR` job, see Addresing z/OS requrements for Zowe.

The security administrator needs to permit READ access to the `APIML.SERVICES` resource in the `ZOWE` resource class to access the information about API services.

In IBM RACF, access to service information is specified in the following parameter:

In Top Secret:

In ACF2:

The API Gateway can be configured to check for SAF resource authorization in several ways. For more information, see SAF Resource Checking.

Using API Endpoints

Obtaining Information about a Specific Service

Use the following method to get information about a specific service:

`GET /gateway/api/v1/services/{serviceId}`

where:

- **`{serviceId}`** is the service ID of the API service (Example: `apicatalog`)

This method returns a JSON response that describes the service. For more information, see Response Format.

Obtaining Information about All Services

Use the following method to get information about all services:

`GET /gateway/api/v1/services`

This method returns a JSON response with a list of all services. For more information, see Response Format.

Obtaining Information about All Services with a Specific API ID

Use the following method to get information about all services with a specific API ID:

`GET /gateway/api/v1/services?apiId={apiId}`

where:

- **`{apiId}`** is the API ID that represents required API (e.g. `zowe.apiml.apicatalog`)

This method returns a JSON response with a list of services provided by a specified API ID. For more information, see Response Format.

Response Format

This section provides basic information about the structure of the response. The full reference on the field in the response is presented in the API Catalog.

The `apiml` section provides information about the following points:

- The service in the `service` subsection is displayed.
- The APIs that are provided by the service in the `apiInfo` section. This section presents each major API version that is provided by at least one instance. For each major version, the lowest minor version is displayed.
- The authentication methods that are supported by all instances are displayed.

API clients can use this information to locate the API based on API ID. `baseUrl` or `basePath` are used to access the API through the API Gateway.

The `instances` section contains more details about the instances of the service. An API service can provide more application specific details in `customMetadata` that can be used by API clients. Do not use information in this section for use cases that API Gateway supports, such as routing or load balancing.

Example:

Version: v3.2.x LTS

Using Swagger "Try it out" in the API Catalog

The API Catalog makes it possible for users to call service APIs through the **Try it out** functionality. There are 2 types of endpoints:

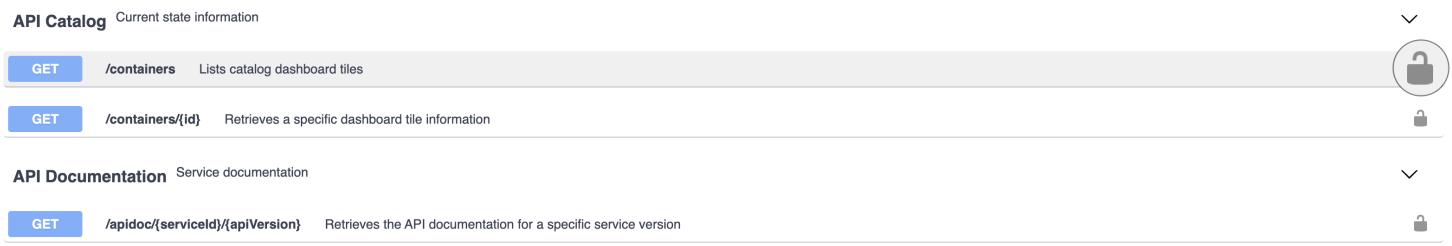
- **Public endpoints**

  Endpoints that are accessible without entering user credentials.

- **Protected endpoints**

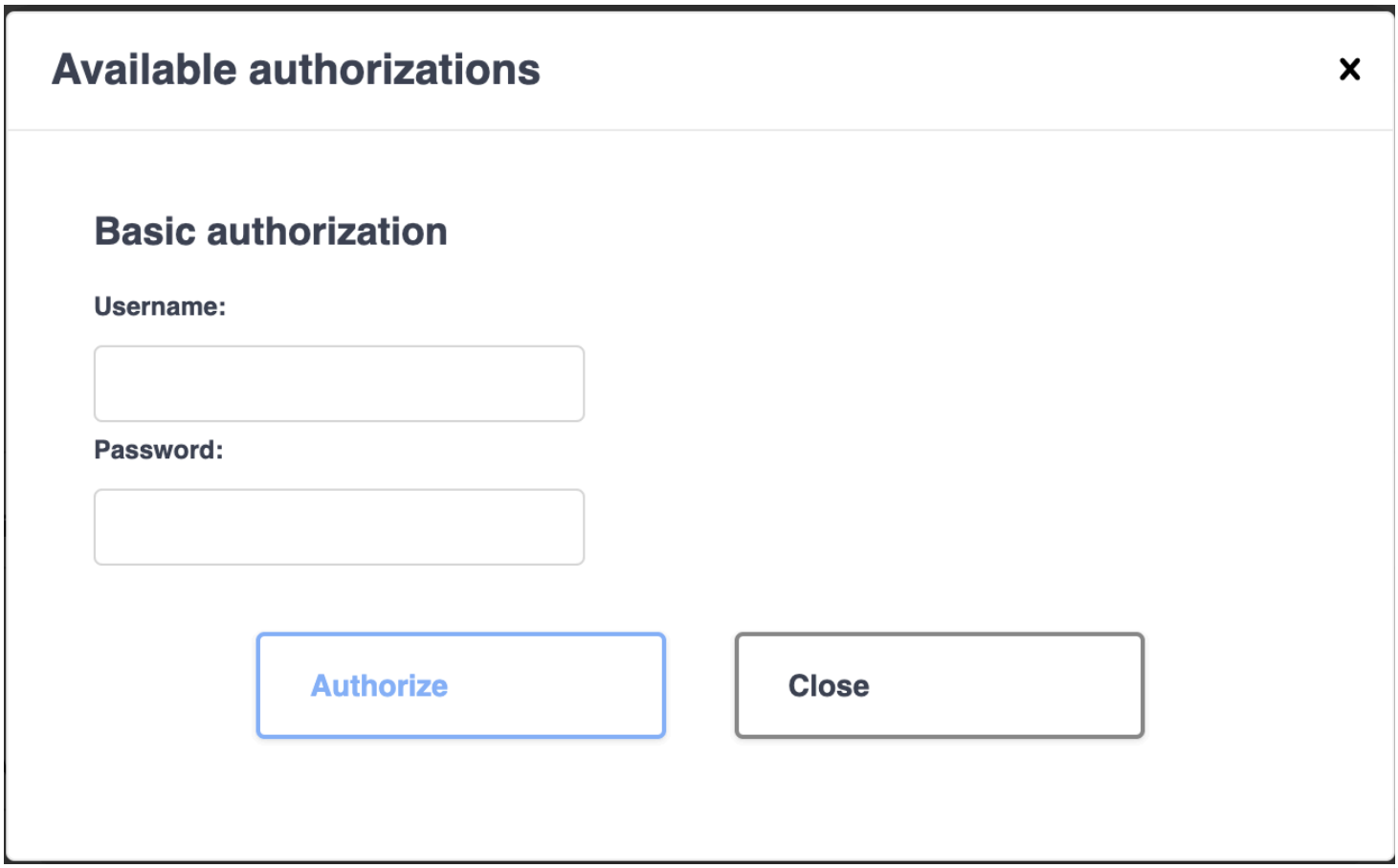
  Endpoints that are only accessible by entering user credentials. These endpoints are marked with a lock icon.

  Example:



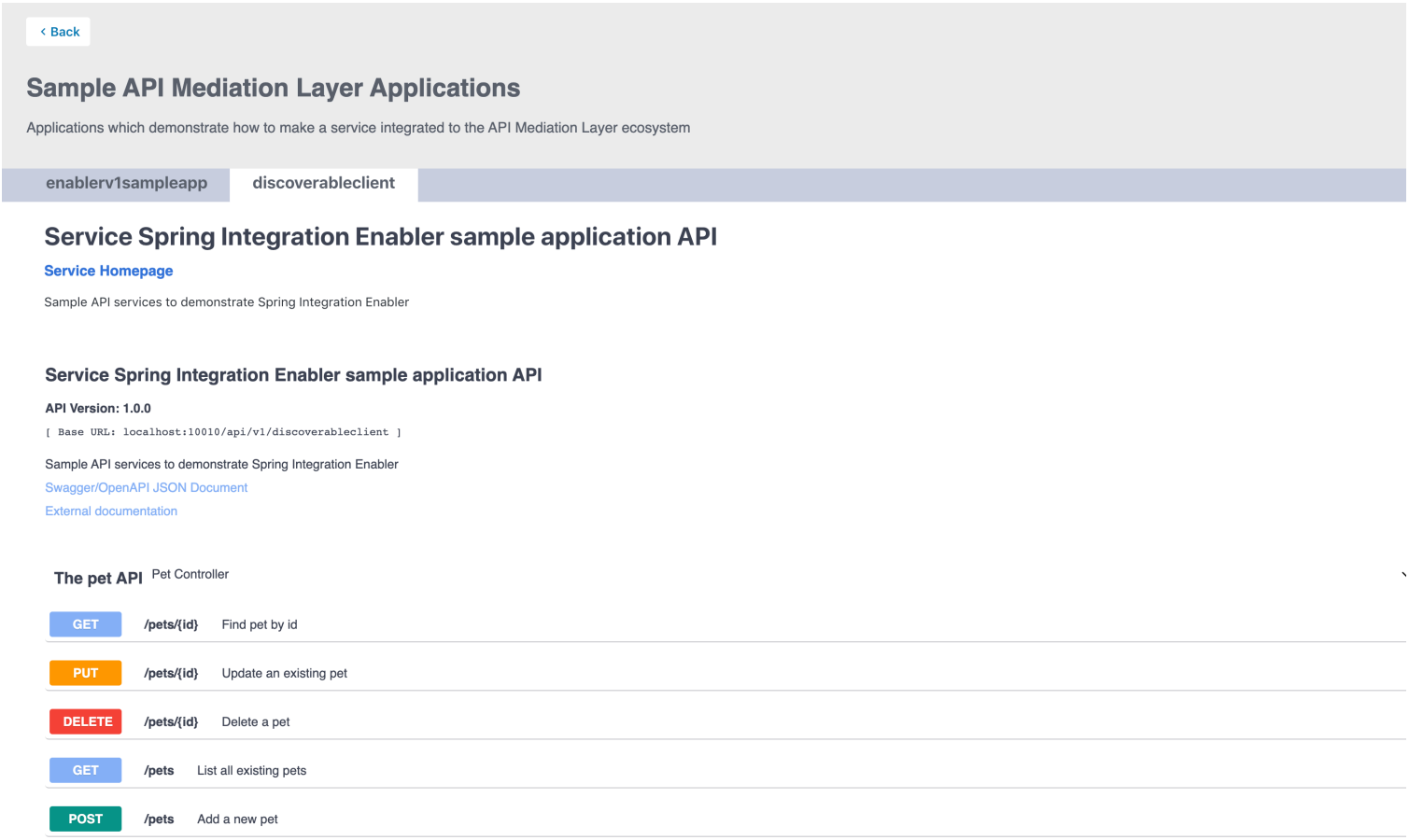
  Before making requests to protected endpoints, authorize your session by clicking the lock icon and complete the required information in the Authorization modal:

  Example:



To demonstrate **Try it out**, we use the example of the Swagger Petstore.

Example:

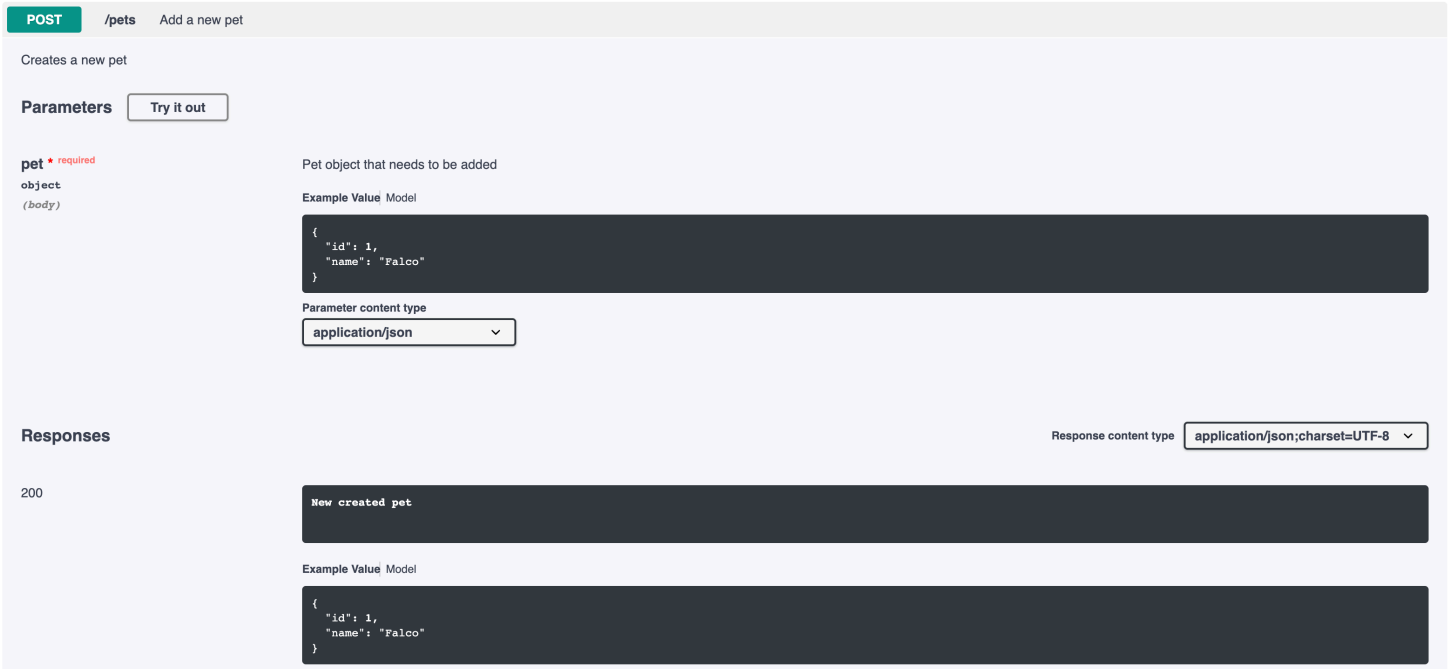


Make a request

Follow this procedure to make a request.

1. Expand the **POST Pet** endpoint.
2. Click **Try it out**.

   Example:

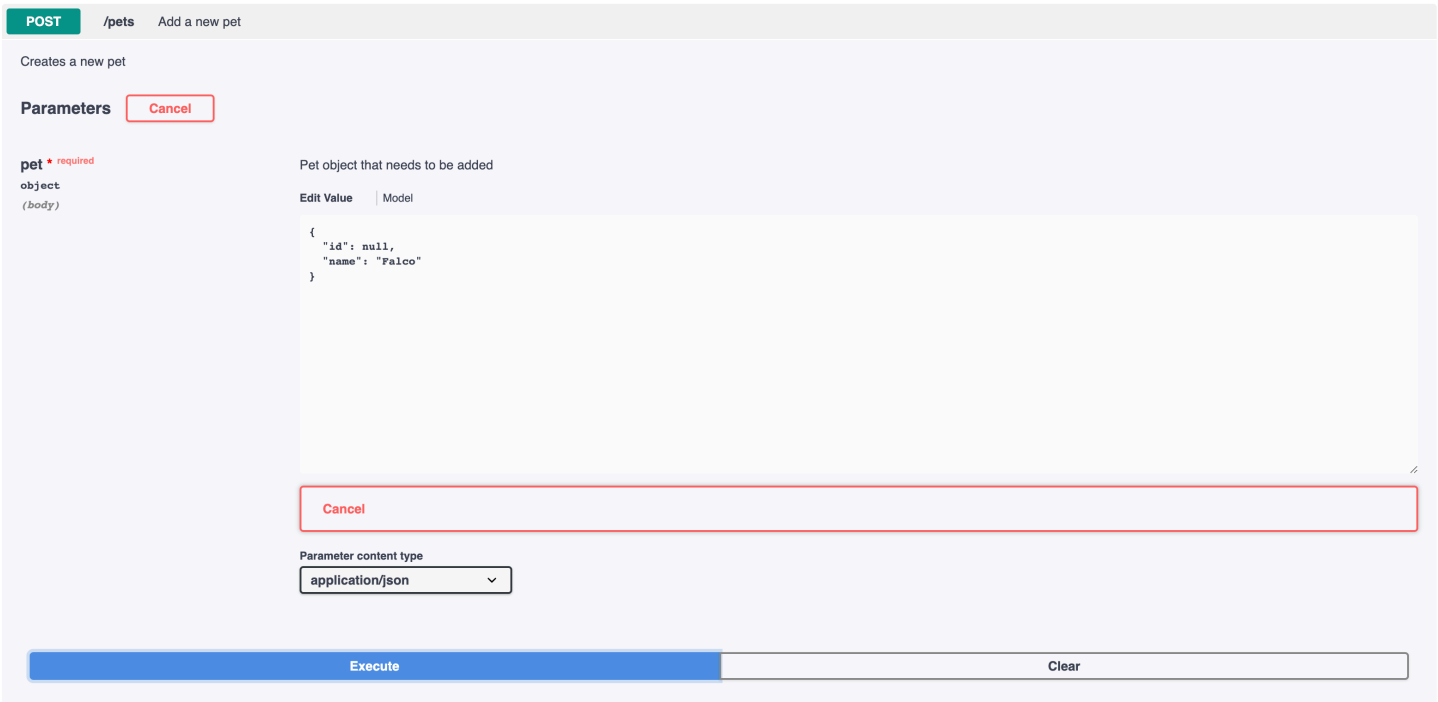


After you click **Try it out**, the example value in the **Request Body** field becomes editable.

3. In the **Example Value** field, change the first `id` value to a random value. Change the second `name` value to a value of your choice, such as the name of a pet.

4. Click **Execute**.

   Example:



The API Catalog Swagger UI submits the request and shows the *curl* that was submitted. The Responses section shows the response.

Example:

Responses

Response content type: application/json;charset=UTF-8

Curl

```
curl -X POST "https://localhost:10010/api/v1/discoverableclient/pets" -H "accept: application/json;charset=UTF-8" -H "Content-Type: application/json" -d "{ \"id\": null, \"name\": \"Falco\"}"
```

Request URL

```
https://localhost:10010/api/v1/discoverableclient/pets
```

Server response

201

Response body

Download

```
{
  "id": 6,
  "name": "Falco"
}
```

Version: v3.2.x LTS

Using Swagger Code Snippets in the API Catalog

As part of the *Try it out* functionality, the API Catalog provides **Code Snippets** in different languages for each service API operation. The following languages are supported:

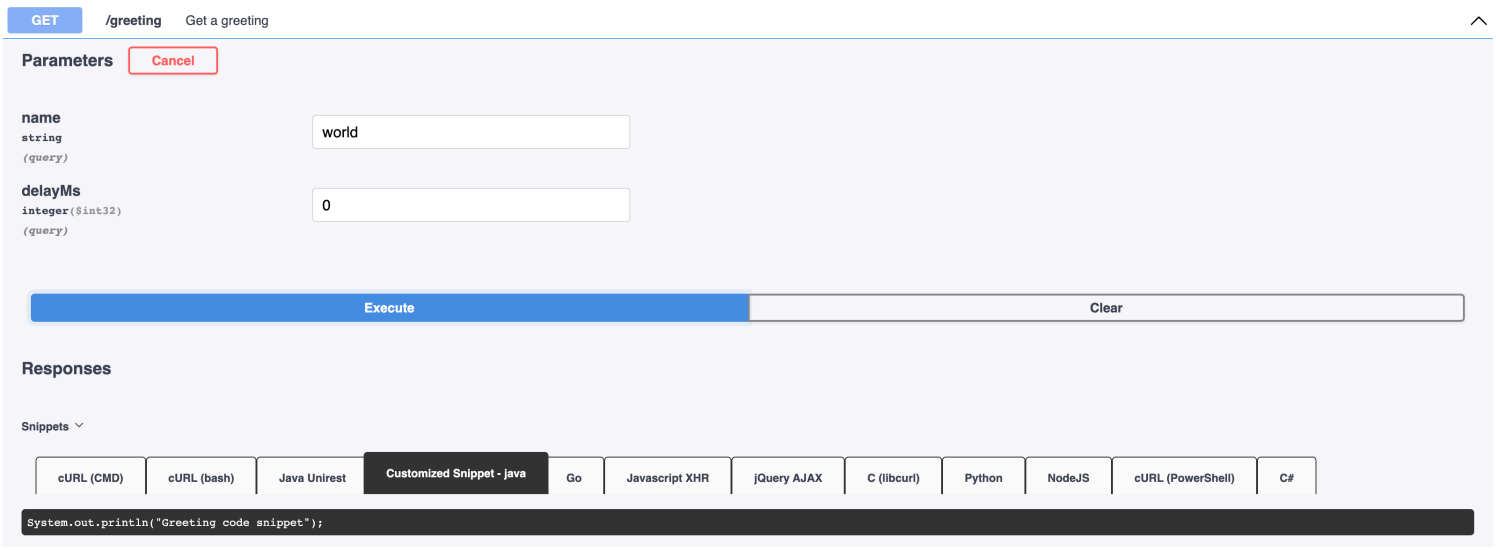
- C
- C#
- Go
- Java
- JavaScript
- Node.js
- PHP
- Python
- cURL

Each of these languages supports a specific HTTP Snippet library (i.e. Java Unirest, Java okhttp etc.).

The basic code snippets provide REST API call samples. To show to the user the real usage of the SDKs, the service onboarder can specify a customized snippet as part of the service configuration:

Example:

Example:



Generate the code snippets

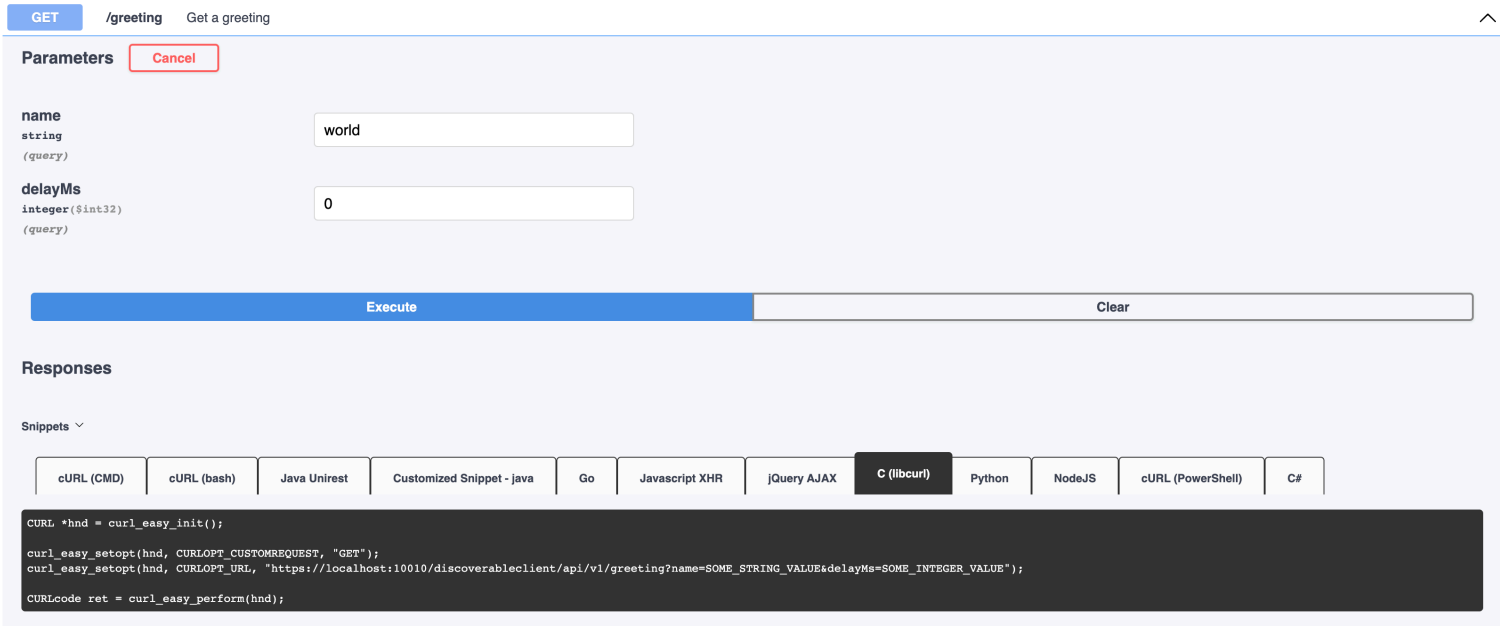
Use the following procedure to generate code snippets:

Click **Try it out** and execute the request, as described in the previous section.

The API Catalog generates the basic code snippets, shown under the code snippet tab. If the service onboarder has also provided customized code snippets, these snippets are displayed in the snippet bar under a title prefixed with

`Customized`.

Example:

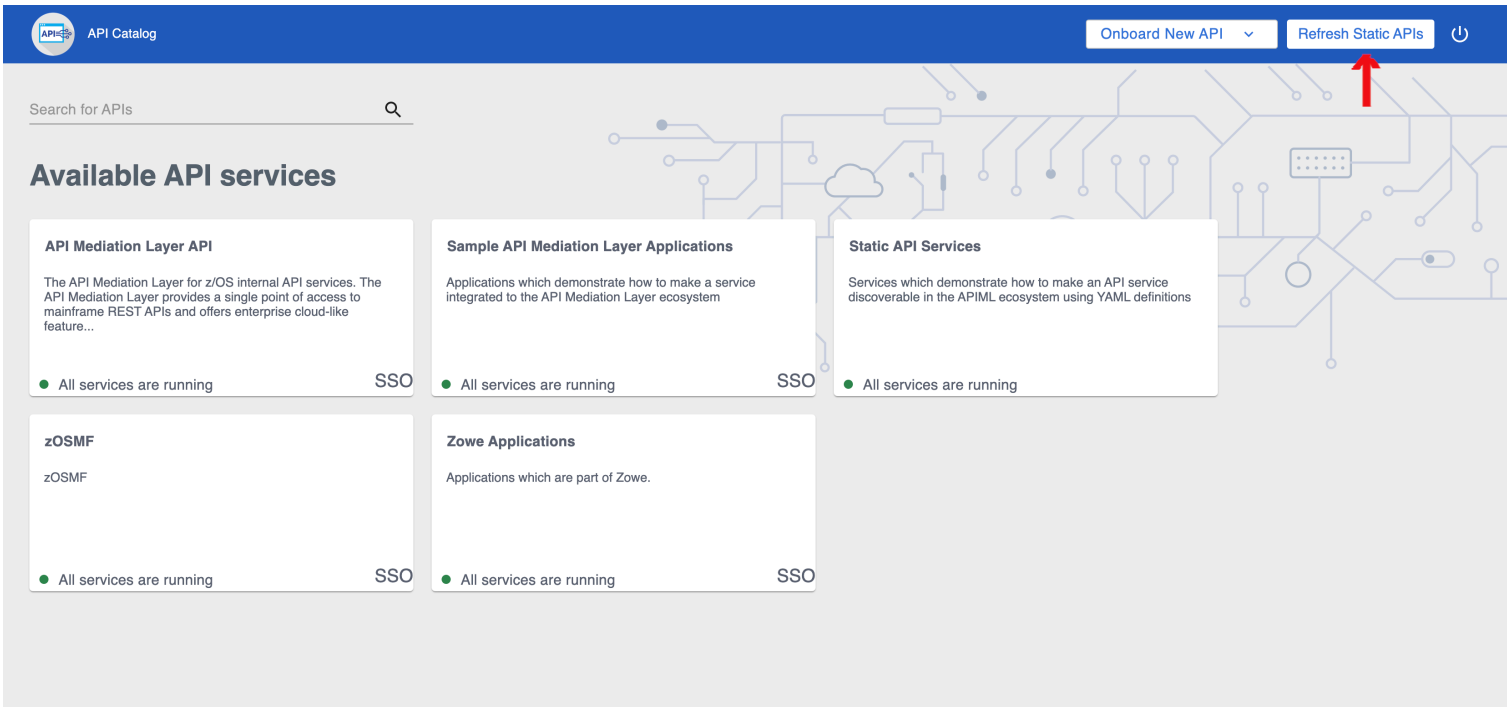


Version: v3.2.x LTS

Using Static API services refresh in the API Catalog

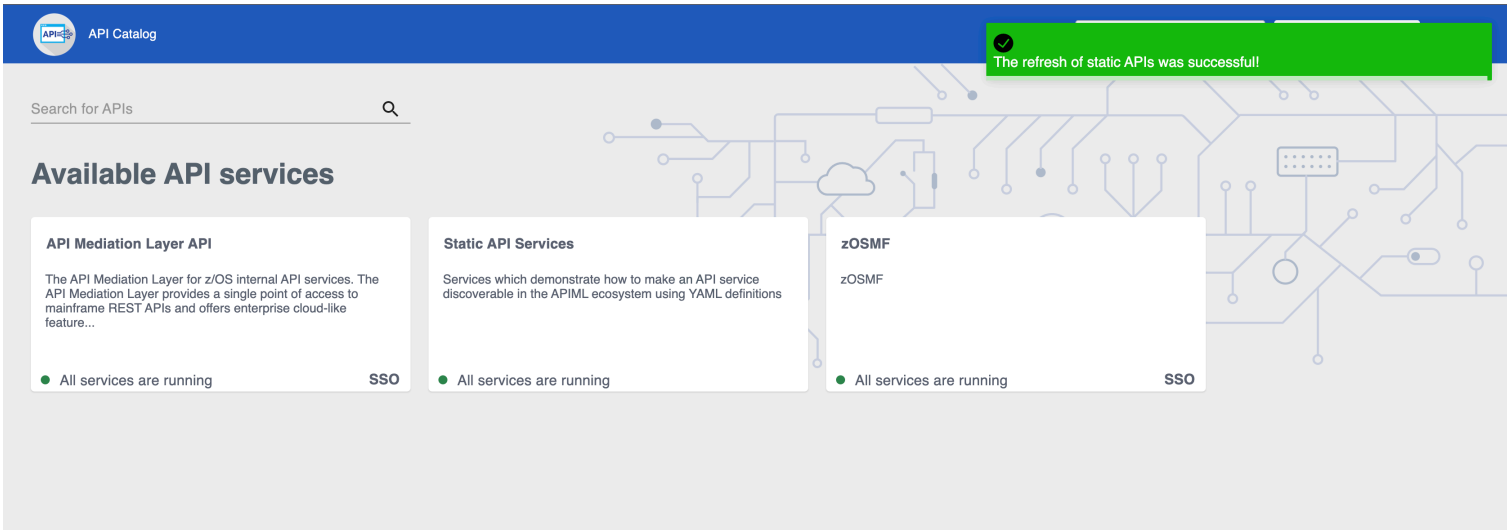
The API Catalog enables users to manually refresh static service APIs. Use the **Refresh Static APIs** option if you change a static service API and want these changes to be visible in the API Catalog without restarting the Discovery Service.

Example:



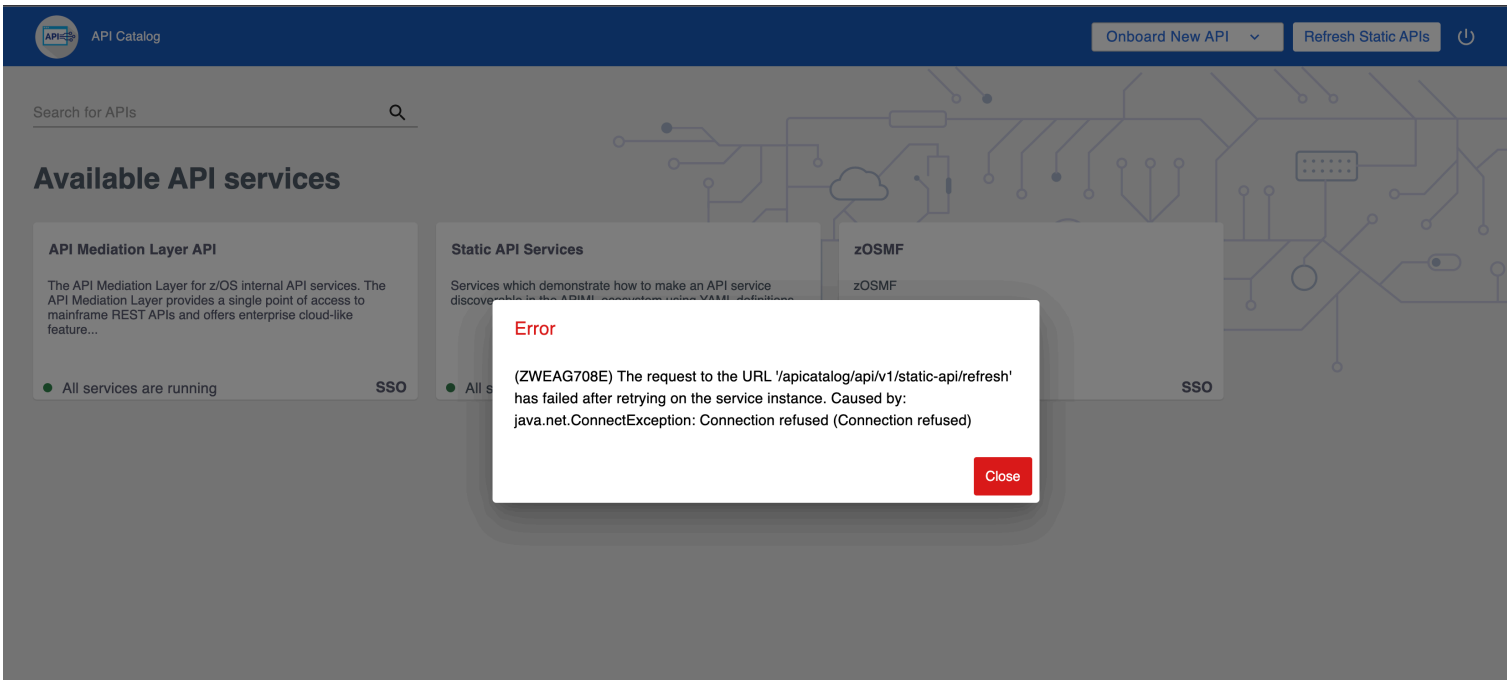
To refresh the status of a static service, click the **Refresh** option located in the upper right-hand side of the API Catalog UI. Successful requests return a pop-up notification that displays the message, `The refresh of static APIs was successful!`.

Example:



If the request fails, a dialog appears with an error message that describes the cause of the fail.

Example:



NOTE

The manual **Refresh Static APIs** option applies only to static service APIs. Changes to the status of services that are onboarded to allow for dynamic discovery require a restart of the specific services where changes are applied. It is not necessary to restart the API Catalog or the Discovery Service.

Version: v3.2.x LTS

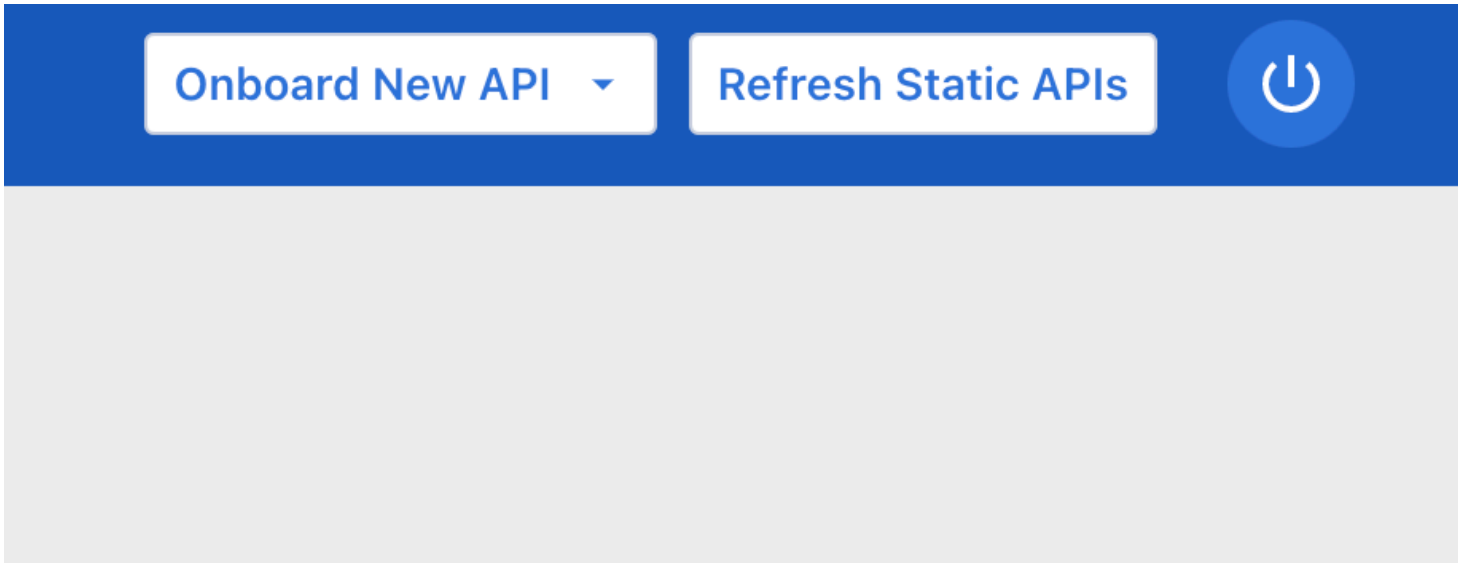
Onboarding a REST API service with the YAML Wizard

As an API developer, you can use the Yaml Onboarding Wizard to simplify the process of onboarding new REST API services to the Zowe API Mediation Layer. The wizard offers a walkthrough of the required steps to create a correct configuration file which is used to set the application properties and Eureka metadata.

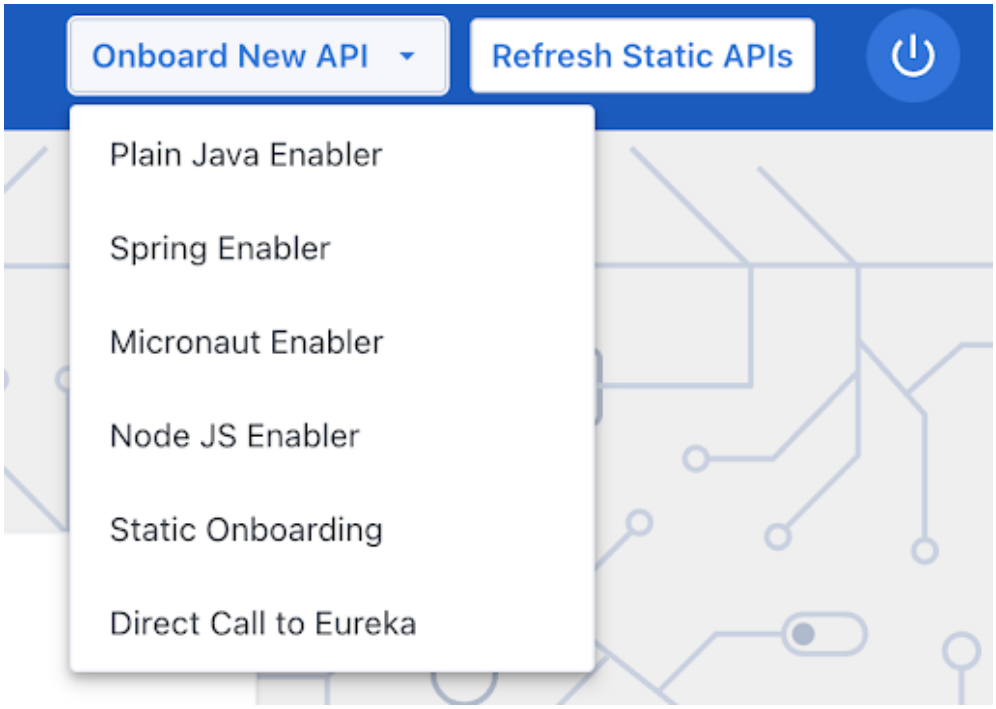
Onboarding your REST service with the Wizard

Use the following procedure to onboard your REST service with the Wizard.

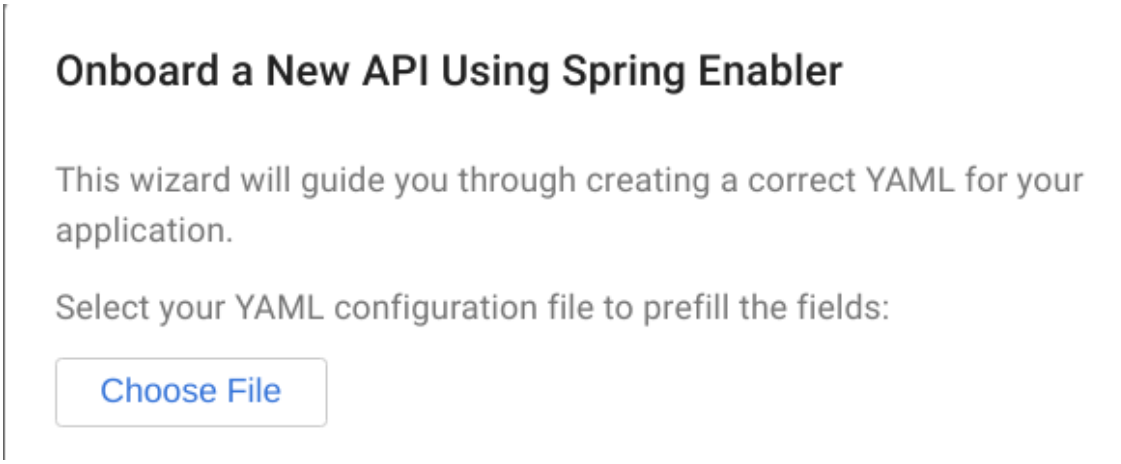
1. In the dashboard of the API Catalog, click the **Onboard New API** dropdown located in the navbar.



2. Choose the type of onboarding according to your preference (static or via enablers).

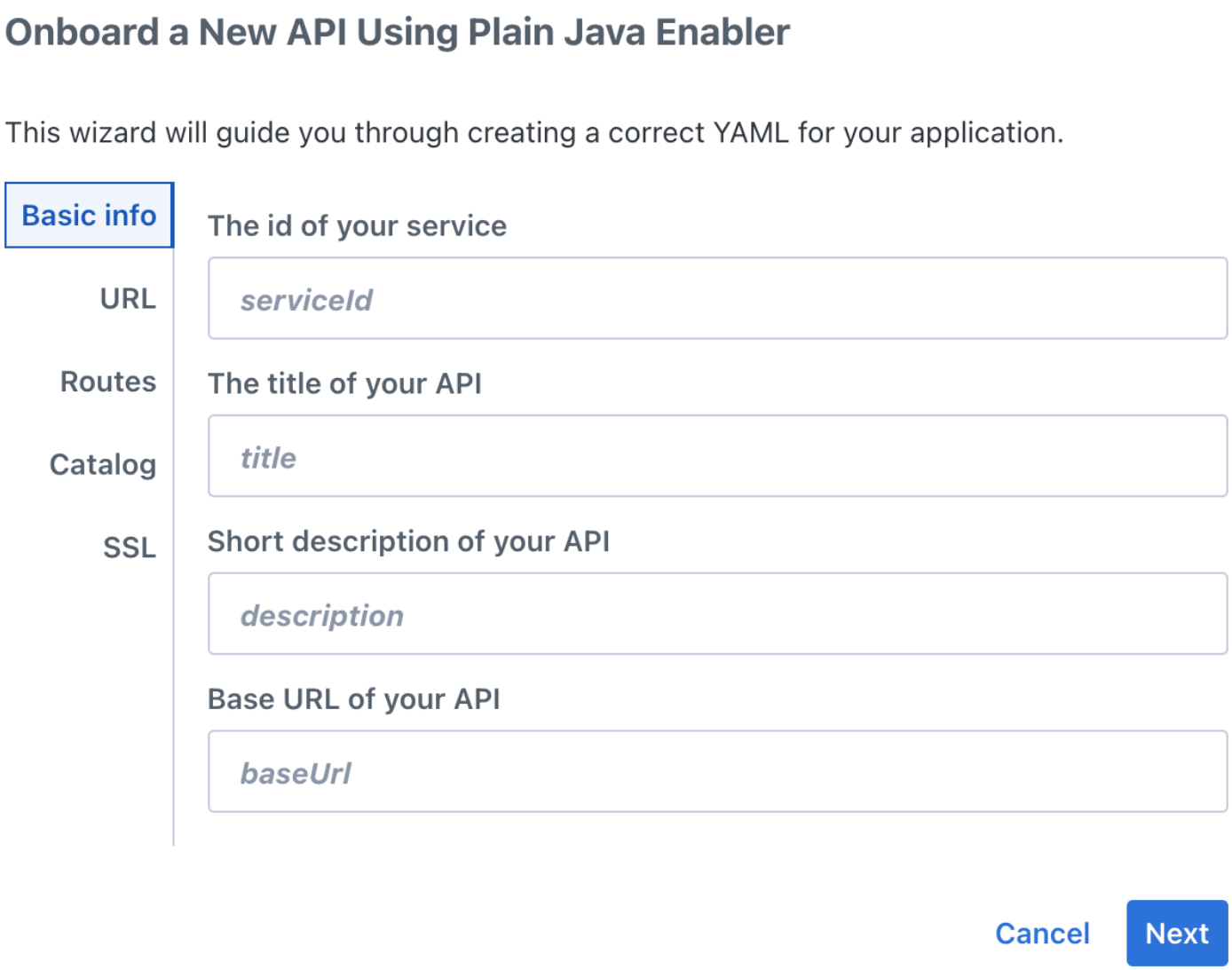


3. (Optional) To prefill the fields, click **Choose File** to upload a complete or partial YAML file. The YAML file is validated and the form fields are populated.



4. Fill in the input fields according to your service specifications.

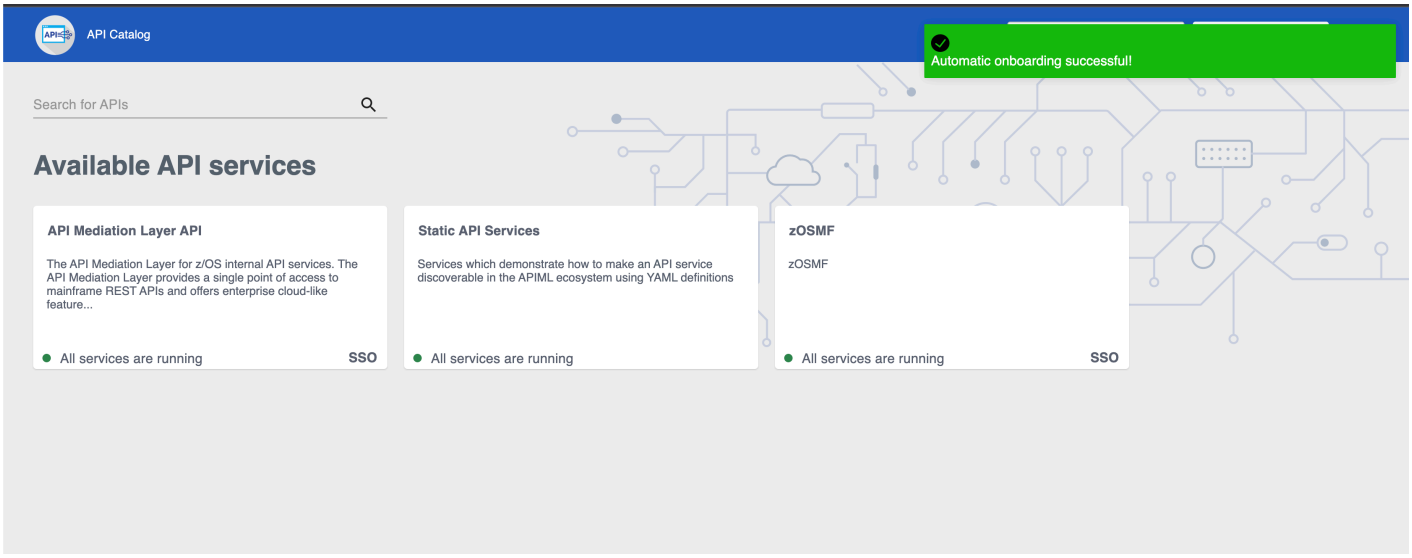
5. Address each of the categories in the dialog dropdown.



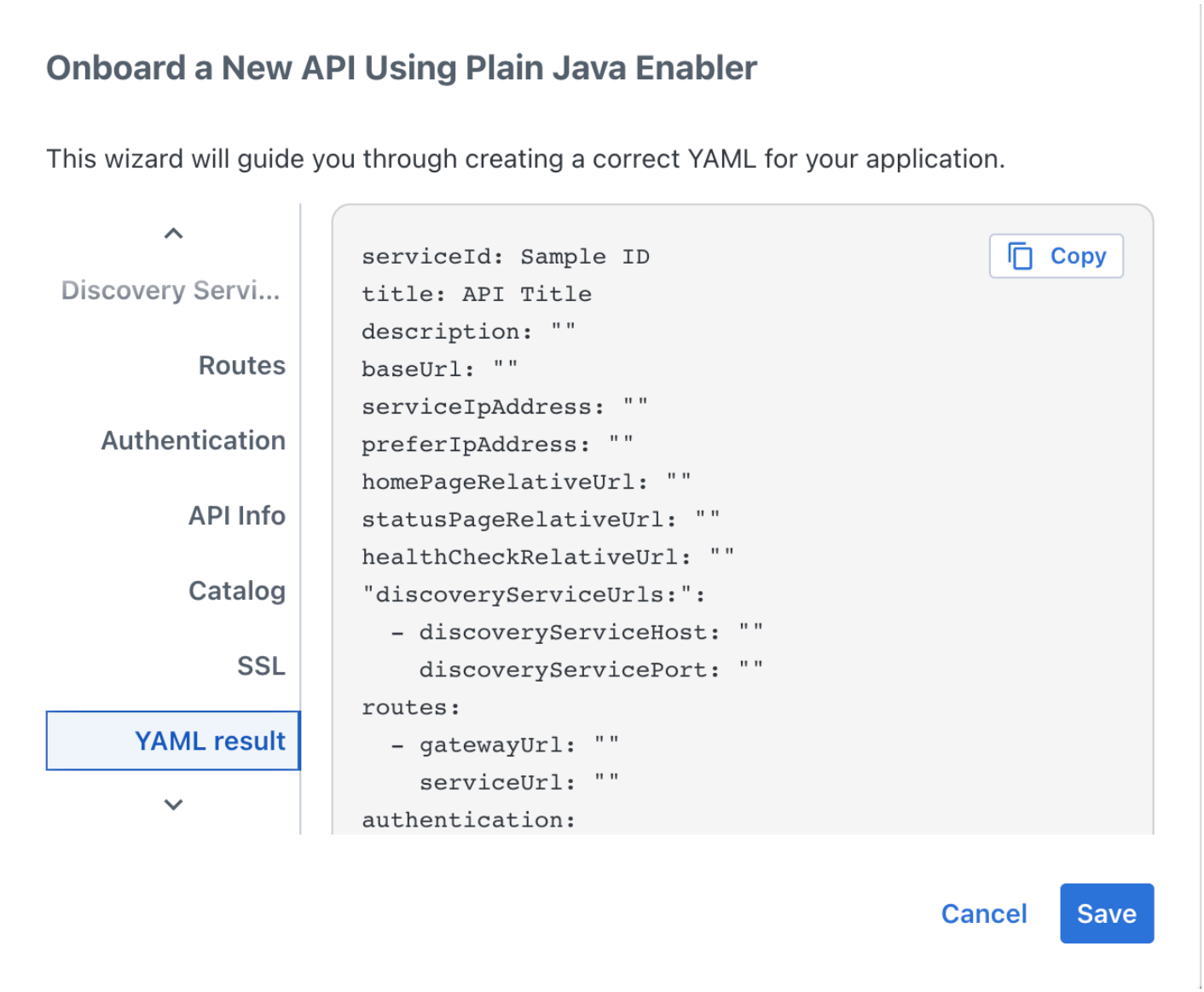
6. Click **Save** to apply your changes.

7. Validate successful onboarding with the following step according to your onboarding method.

   - For static onboarding, the following validation message appears after successful onboarding:



   - For onboarding using an enabler, click **Copy** to save the generated yaml file to your clipboard. Then paste this yaml file in your project's service-configuration.yml file.



If you see your service in the list of API Catalog available services, you have onboarded your service successfully.

Version: v3.2.x LTS

Using the Caching Service

As an API developer, you can use the Caching Service as a storage solution to enable resource sharing between service instances, thereby ensuring High Availability of services. The Caching Service makes it possible to store, retrieve, and delete data associated with keys. The Caching Service is designed to make resource sharing possible for services that cannot be made stateless by using following backends:

- Using Infinispan that is part of Caching Service
- Using Redis running off-platform
- {Deprecated} Using VSAM
- {Development Use Only} Using InMemory

> **NOTE**
>
> In the current implementation of the Caching Service, Infinispan is recommended for the storage of key/value pairs for production, as it has the best performance characteristics without additional services.

The Caching Service is available only for internal Zowe applications, and is not exposed to the internet. The Caching service supports a hot-reload scenario in which a client service requests all available service data.

- Using the Caching Service
  - Architecture
  - Storage methods
    - Infinispan (recommended)
    - VSAM (deprecated)
    - Redis
    - InMemory
  - How to start the Service
  - Methods to use the Caching Service API
  - Configuration properties
  - Authentication
    - Direct calls
    - Routed calls through API Gateway

Architecture

A precondition to provide for High Availability of all components within Zowe is the requirement that these components be either stateless, or for the resources of the service, to be offloaded to a location accessible by all instances of the service. This condition also applies to recently started instances. Some services, however, are not and cannot be stateless. The Caching Service is designed for these types of services.

REST APIs make it possible to create, delete, and update key-value pairs in the cache. Other APIs read a specific key-value pair or all key-value pairs in the cache.

Information from cached APIs is stored as a JSON in the following format:

Storage methods

The Caching Service supports the following storage solutions, which provide the option to add custom implementation.

For information about configuring your storage method for the Caching Service for high availability, see Configuring the Caching Service for high availability.

Infinispan (recommended)

Infinispan is a storage solution that can also run on the z/OS platform. It can store data structures in key-value pairs, has high-availability support, and is highly performant.

For more information about the Infinispan storage access method, see Using Infinispan as a storage solution through the Caching service.

VSAM (deprecated)

VSAM can be used to organize records into four types of data sets: key-sequenced, entry-sequenced, linear, or relative record. Use VSAM as the storage solution for production. VSAM is used primarily for applications and is not used for source programs, JCL, or executable modules. ISPF cannot be used to display or edit VSAM files.

For more information about the VSAM storage access method, see Using VSAM as a storage solution through the Caching Service

Redis

Redis is a common storage solution that runs outside of the z/OS platform. It can store data structures in key-value pairs, has high-availability support, and is highly performant.

For more information about the Redis storage access method, see Using Redis as a storage solution through the Caching Service.

InMemory

The InMemory storage method is a method suitable for testing and integration verification. Be sure not to use InMemory storage in production. The key/value pairs are stored only in the memory of a single instance of the service. As such, the key/value pairs do not persist.

How to start the Service

By default, the Caching Service starts along with the other Zowe components. To prevent the Caching Service from starting, set `components.caching-service.enabled` to `false` in `zowe.yaml`.

Methods to use the Caching Service API

To apply a method to the Caching Service, use the following API path:

`/cachingservice/api/v1/cache/${path-params-as-needed}`

Use the following methods with the Caching Service API:

- **`POST /cache`**
  Creates a new key in the Cache
- **`GET /cache`**
  Returns all key/value pairs for specific service
- **`PUT /cache/{key}`**
  Updates the existing value for the given key
- **`GET /cache/{key}`**
  Returns the existing value for the given key
- **`DELETE /cache/{key}`**
  Deletes a key/value pair

Configuration properties

The Caching Service uses the standard `application.yml` structure for configuration. The service is built on top of the Spring enabler. As such, it dynamically registers to the API Mediation Layer. The service appears in the API Catalog under the tile, "Zowe Applications".

- **`caching.storage.size`**
  This property limits the size of the Caching Service. In the VSAM and InMemory implementations, this property represents the number of records stored before the eviction strategy is initiated. The default value is `100`.
  Note: Different implementations may implement this property differently.
- **`caching.storage.evictionStrategy`**
  This parameter specifies service behavior when the limit of records is reached. The default value is `Reject`.

  where:

  - **reject**
    rejects the new item with the HTTP status code `507` when the service reaches the configured maximum number
  - **removeOldest**
    removes the oldest item in the cache when the service reaches the configured maximum number

> **NOTE**
> - For more information about how to configure the Caching Service in the `application.yml`, see Add API Onboarding Configuration.
> - When using VSAM, ensure that you set the additional configuration parameters. For more information about setting these parameters, see Using VSAM as a storage solution through the Caching Service.

Authentication

Direct calls

The Caching Service requires TLS mutual authentication. This verifies authenticity of the client. Calls without a valid client certificate generate a `403` response code: `Forbidden`. This requirement is disabled when `VERIFY_CERTIFICATES=false` in `zowe-certificates.env` configuration file.

The call must have a header `X-Certificate-DistinguishedName` containing information about the certificate's distinguished name. This header is added by the API Gateway. For a direct call, this header needs to be added manually. Calls without this header produce a `401` response code: `Unauthorized`.

Routed calls through API Gateway

Caching service registers with the following authentication scheme to Discovery service:

The result is that the Gateway attempts mutual authentication with the Client. If authentication is succesful, the Client's certificate information is propogated to `X-Certificate-` headers. With this scheme, the Gateway uses its server/client certificate for the routed call to the Caching Service.

Version: v3.2.x LTS

Viewing Service Information and API Documentation in the API Catalog

Use the API Catalog to view services, API documentation, descriptive information about the service, the current state of the service, service endpoints, and detailed descriptions of these endpoints.

> **NOTE**
>
> Verify that your service is running. At least one started and registered instance with the Discovery Service is needed for your service to be visible in the API Catalog.

Follow these steps:

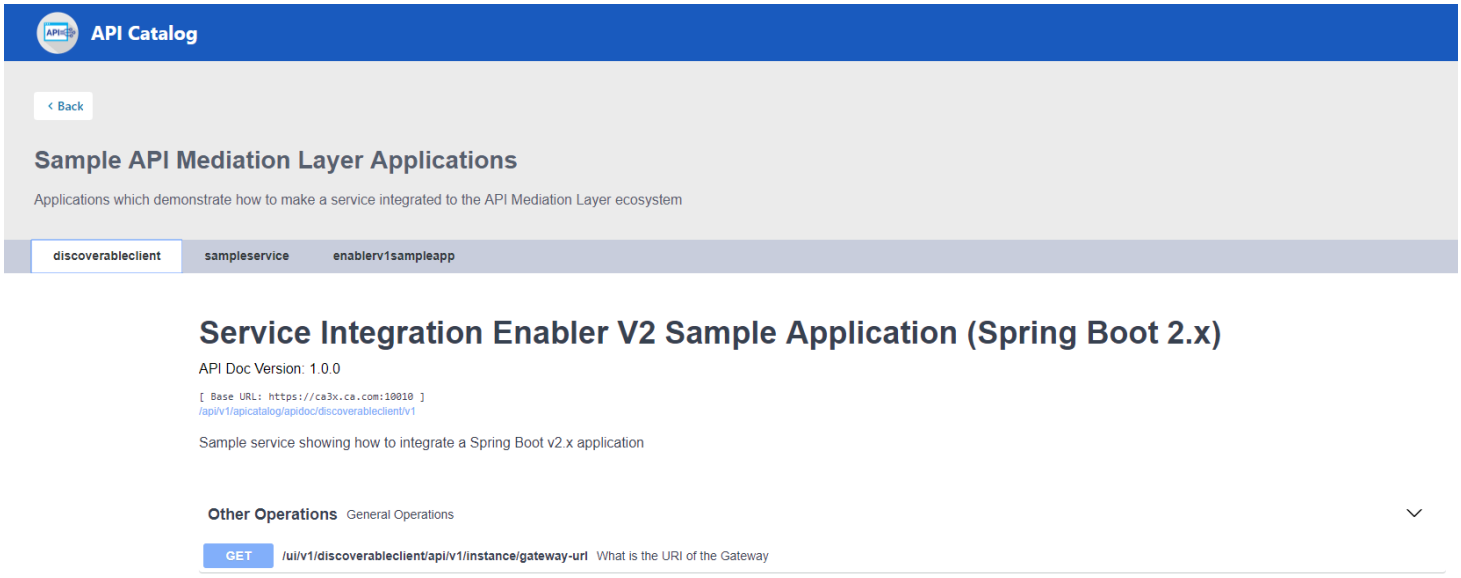
1. Use the search bar to find the service that you are looking for. Services that belong to the same product family are displayed on the same tile.

   Example: `Sample Applications, Endevor, SDK Application`

2. Click the tile to view header information, the registered services under that family ID, and API documentation for that service.

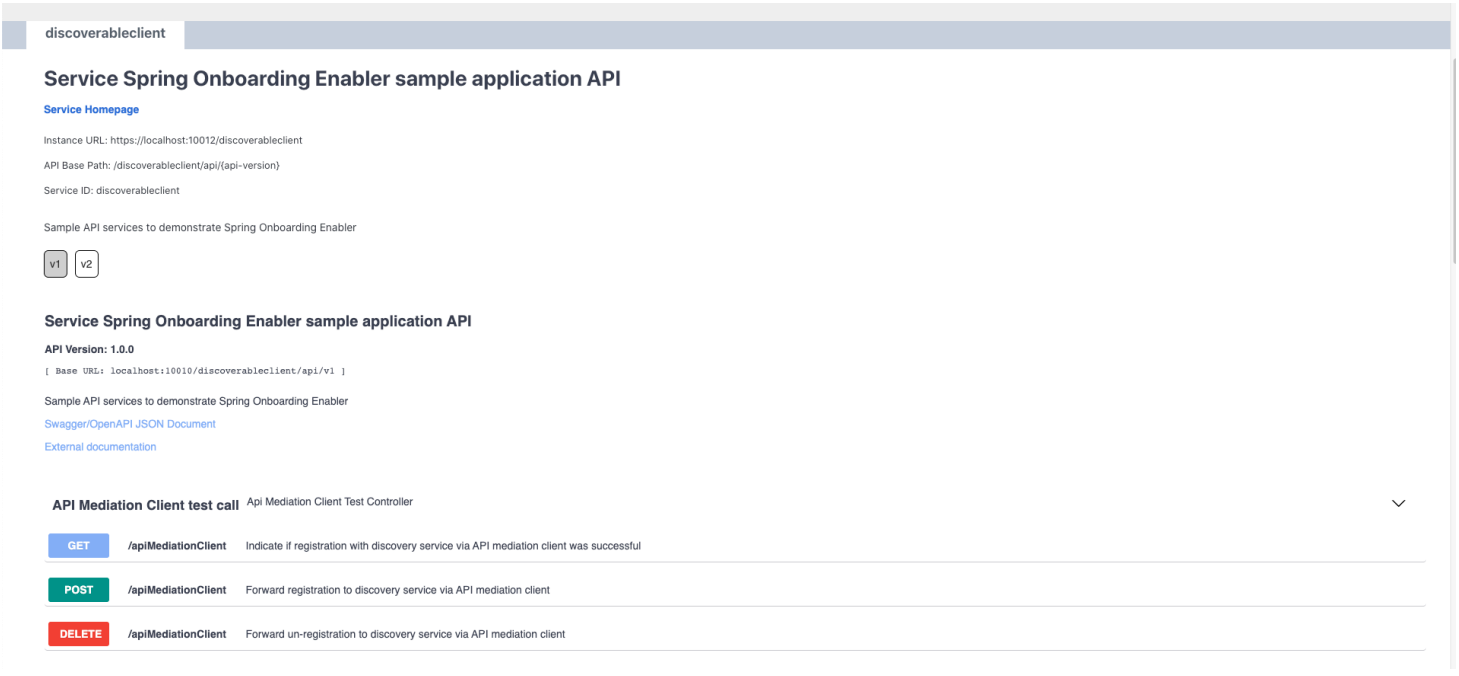
   > **NOTES:**
   >
   > - The state of the service is indicated in the service tile on the dashboard page. If no instances of the service are currently running, the tile displays a message that no services are running.
   > - At least one instance of a service must be started and registered with the Discovery Service for it to be visible in the API Catalog. If the service that you are onboarding is running, and the corresponding API documentation is displayed, this API documentation is cached and remains visible even when the service and all service instances stop.
   > - Descriptive information about the service and a link to the home page of the service are displayed.

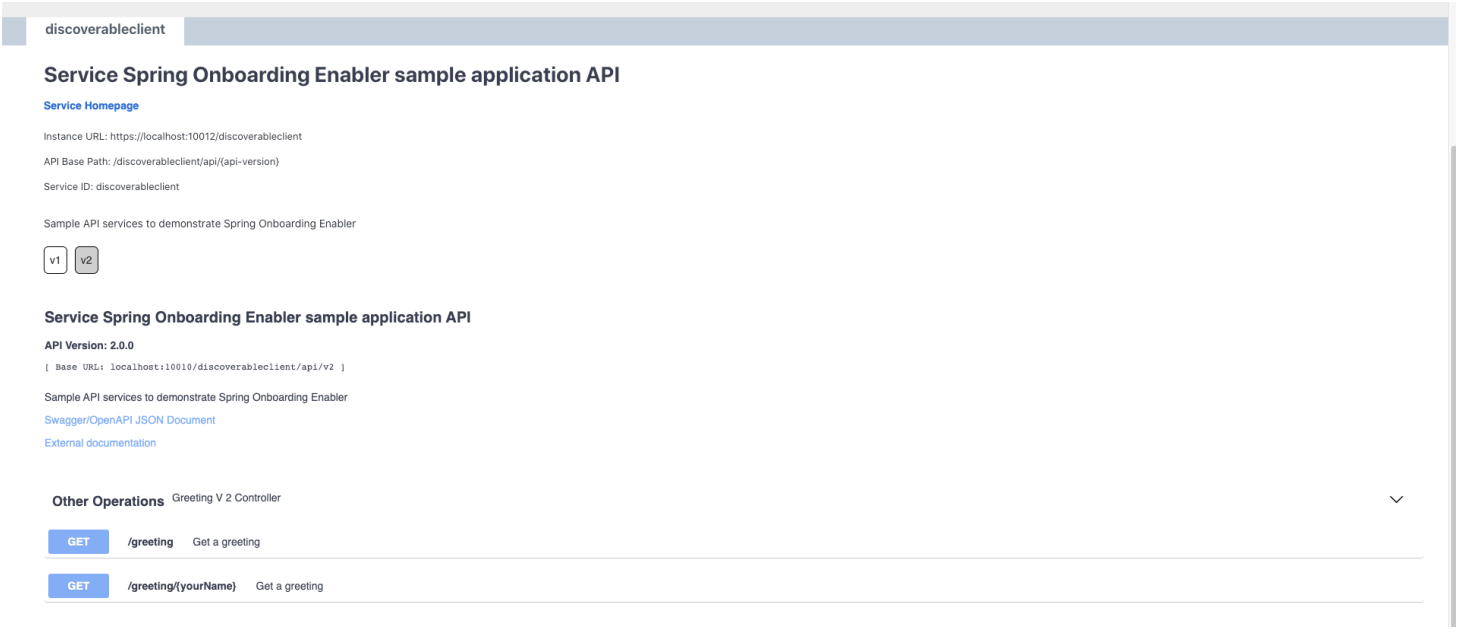
   Example:



3. Select the version (**v1**, **v2**) to view the documentation of a specific API version.

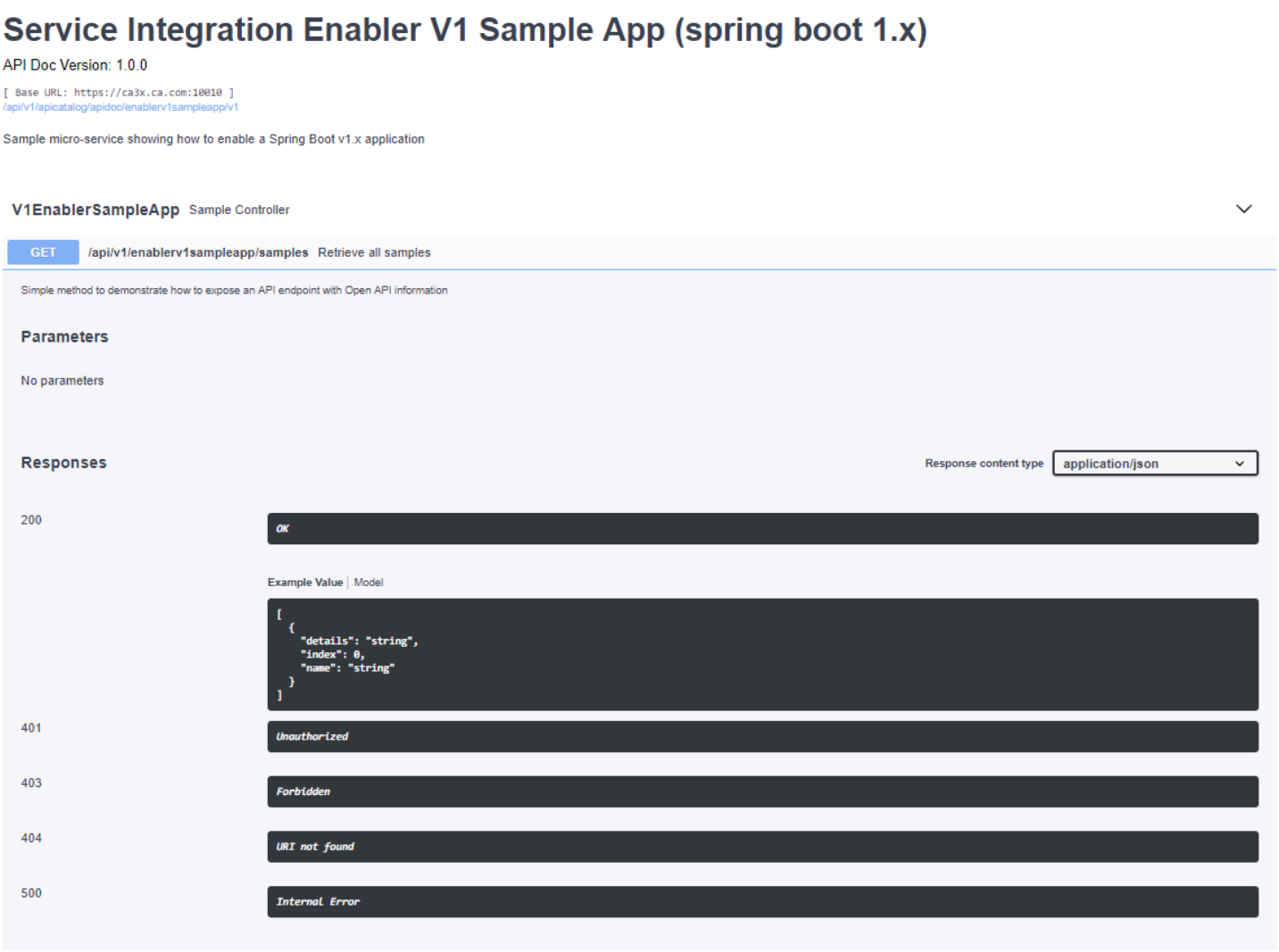
   Example:





4. Expand the endpoint panel to see a detailed summary with responses and parameters of each endpoint, the endpoint description, and the full structure of the endpoint.

   Example:



NOTES:

- If a lock icon is visible on the right side of the endpoint panel, the endpoint requires authentication.
- The structure of the endpoint is displayed relative to the base URL.
- The URL path of the abbreviated endpoint relative to the base URL is displayed in the following format:

Example:

`/{yourServiceId}/api/v1/{endpointName}`

The path of the full URL that includes the base URL is also displayed in the following format:

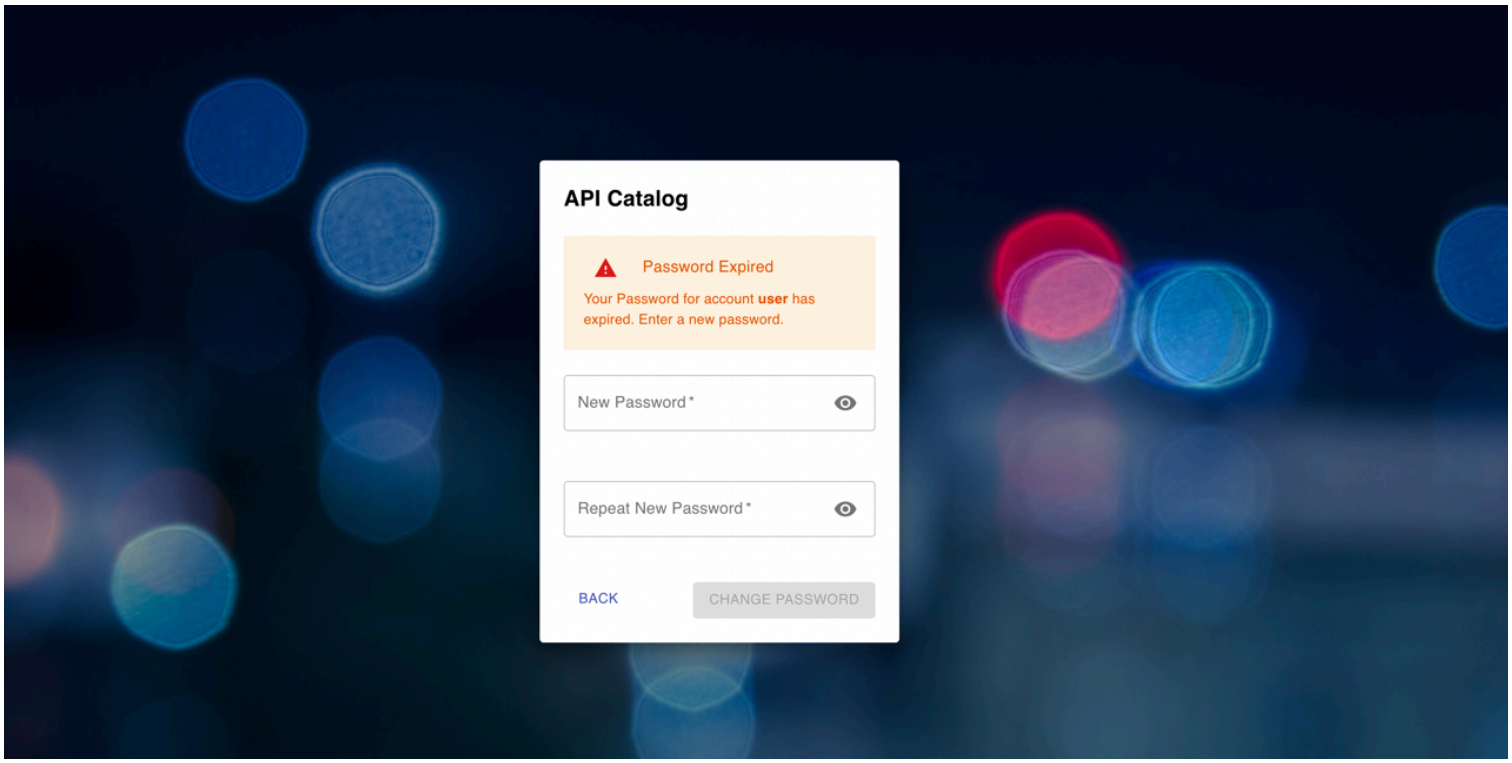
`https://hostName:basePort/{yourServiceId}/api/v1/{endpointName}`

Both links target the same endpoint location.

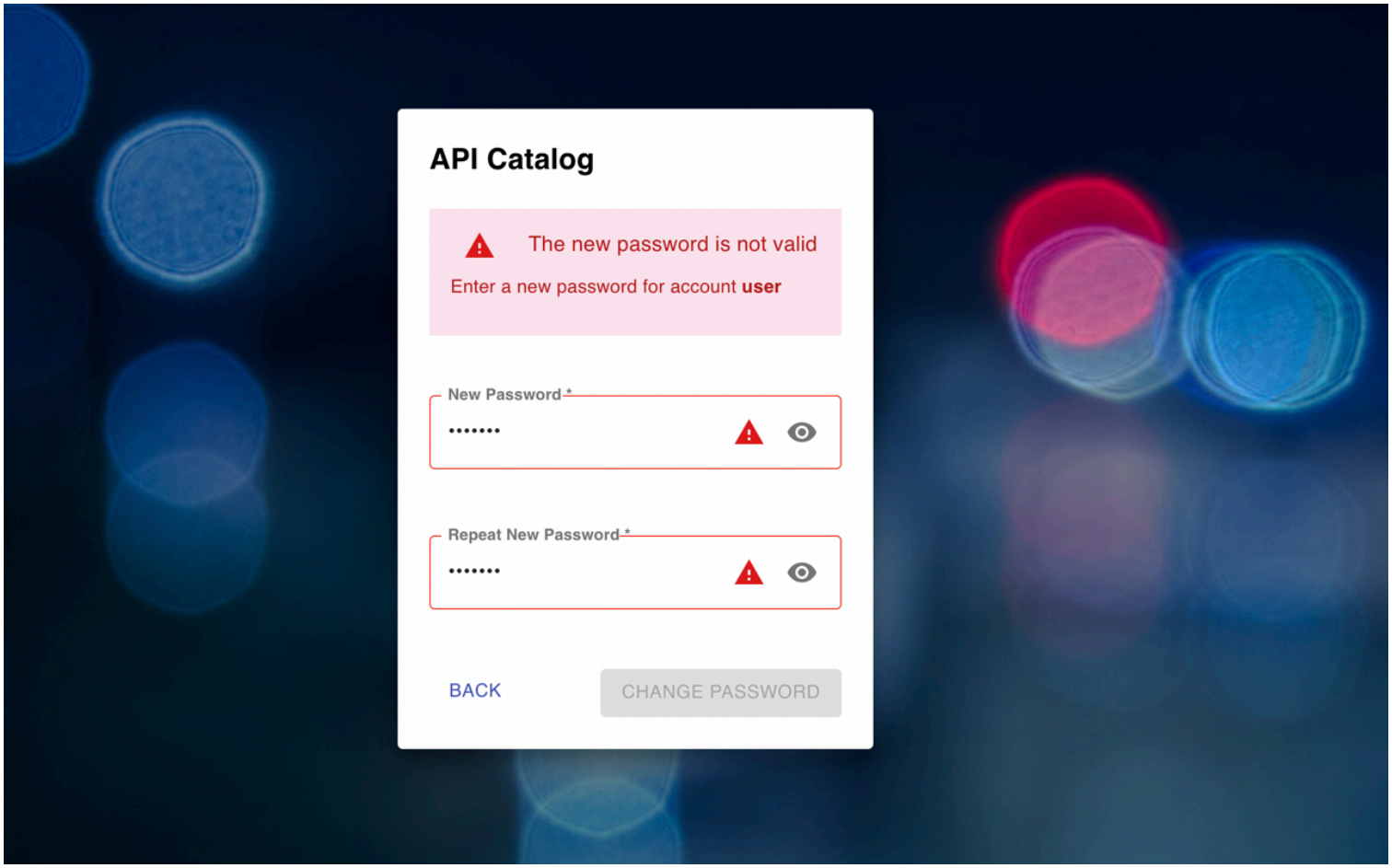
Version: v3.2.x LTS

Changing an expired password via API Catalog

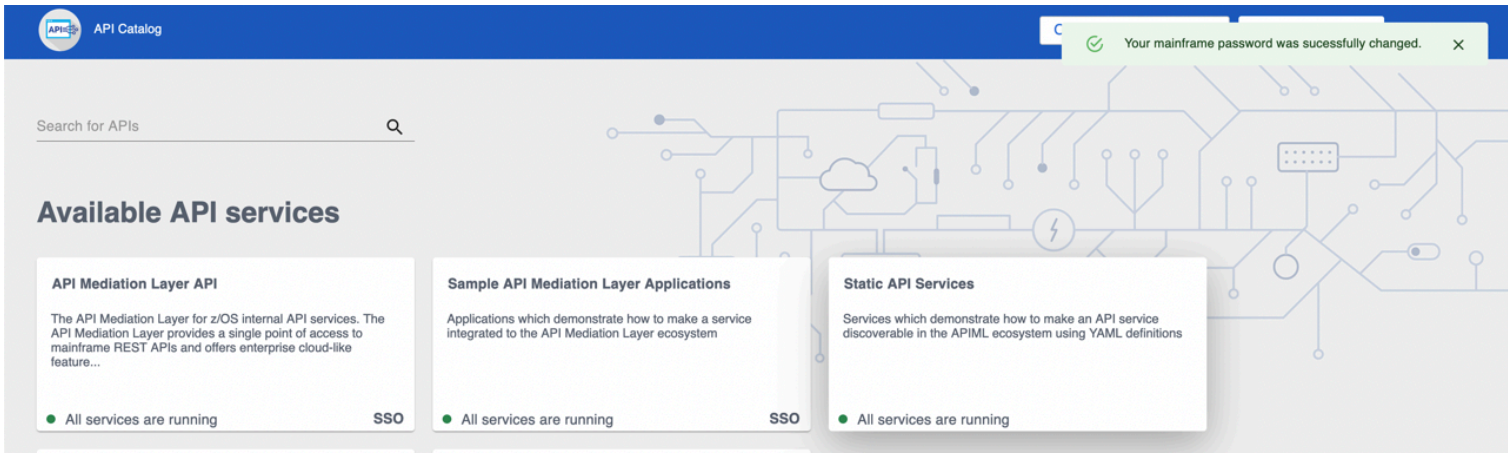
In case of expiration of a mainframe password, the API Catalog, when using SAF as authentication provider offers the possibility to set a new password. When your password expires, you are prompted with a form and a warning message:



You can now insert a new password. In order to submit the request for password change, you need to repeat the new password to prevent the risk of a typo. It is possible that your mainframe installation has specific rules for passwords, such as length, and special characters. When the submitted password does not meet these requirements, an error messag is issued with the chance to insert another new password.



After you repeat the new password, you are able to request the change again. The number of retries depends on the security manager setup of your zOS.



Once you successfully change the password, you are informed with a green pop-up message indicating `Your mainframe password was successfully changed`. You can now use the new password for authentication.

Version: v3.2.x LTS

Updating user password

You can use Zowe API ML to update a mainframe password. The mainframe password change is possible through the Gateway REST API.

> **NOTE**
>
> This feature is also available in the API Catalog. For more information about how to update the mainframe password via API Catalog, see Change expired password via API Catalog.

To use the password updating functionality in the REST API, add the parameter `newPassword` on the login endpoint `/gateway/api/v1/auth/login` in a `POST` call to this endpoint.

The Gateway service returns a valid JWT with the response code `204` as a result of successful password change. The user is then authenticated and can consume APIs through the Gateway. A response code of `401` is thrown if it is not possible to change the password for any reason.

Use the following request body format in the `POST` REST call against the URL `/gateway/api/v1/auth/login`:

> **NOTE**
>
> A common practice is to set a limit to the number of password changes permissible in the ESM. This value is set by the parameter `MINCHANGE` for `PASSWORD`. The password can be changed once. Subsequently, it is necessary to wait the specified time period before the password can be changed again.

Example:

`MINCHANGE=120`

- **120**
  Specifies the number of days before the password can be reset

> **NOTE**
>
> The SAF authentication provider provides details about the expired password, and therefore enables the API Catalog to ask for password change. The z/OSMF authentication provider does not provide this functionality. Password changes are only possible through the REST API.

Version: v3.2.x LTS

SMF records

API Mediation Layer can issue SMF type 83, 230, or 231 security-related audit records. You can use SMF records to assist with auditing events when a Personal Access Token is created.

To enable this functionality on your Zowe instance, see the configuration procedure.

It is possible to customize some predefined values in the SMF record. For more information, see the full list of configurable parameters.

Note: Record type 83 is a RACF processing record. This record type can be replaced by other SMF types depending on the ESM:

- ACF2 - SMF type 230
- TSS - SMF type 231

Configure the main Zowe server to issue SMF records

This security configuration is necessary for API ML to be able to issue SMF records. A user running the API Gateway must have *read* access to the RACF general resource `IRR.RAUDITX` in the `FACILITY` class. To set up this security configuration, submit the `ZWESECUR` JCL member. For users upgrading from version 1.18 and lower, use the configuration steps that correspond to the ESM.

To check whether you already have the auditing profile defined, issue the following command and review the output to confirm that the profile exists and that the user `ZWESVUSR` who runs the `ZWESLSTC` started task has `READ` access to this profile.

- If you use RACF, issue the following command:
- If you use Top Secret, issue the following command:
- If you use ACF2, issue the following commands:

If the user `ZWESVUSR` who runs the `ZWESLSTC` started task does not have `READ` access to this profile, follow the procedure that corresponds to your ESM:

- If you use RACF, update permission in the `FACILITY` class.

  Follow these steps:

  i. Add user `ZWESVUSR` permission to `READ`.

  ii. Activate changes.

- If you use Top Secret, add user `ZWESVUSR` permission to `READ`. Issue the following command:
- If you use ACF2, add user `ZWESVUSR` permission to `READ`. Issue the following commands:

SMF record configurable parameters

The following list of parameters can be used to modify the default SMF record values. Default values for these parameters can be overwritten in `zowe.yaml`. For more information, see how to configure rauditx parameters.

Parameter	Description	Type	Default value
rauditx.fmid	FMID of the product or component issuing the SMF record	string	AZWE001
rauditx.component	Name of the product or component issuing the SMF record	string	ZOWE
rauditx.subtype	SMF type 83 record subtype assigned to the component. For more information, see description of subtypes	integer	2
rauditx.event	Event code. For more information, see description of event codes	integer	2
rauditx.qualifier.success	Event Code Qualifier for success. The value can be between 0 and 255	integer	0
rauditx.qualifier.failed	Event Code Qualifier for failure. The value can be between 0 and 255	integer	1

Configure rauditx parameters

Use the following procedure to change the `rauditx.fmid` parameter. This procedure can be applied to any SMF record configurable parameters.

Follow these steps:

1. Open the `zowe.yaml` configuration file.
2. Find or add the property `zowe.environments.RAUDITX_FMID` and set your desired value.
3. Restart Zowe.

Version: v3.2.x LTS

Using Zowe CLI

In this section, learn how to use Zowe CLI, including how to connect to the mainframe, manage profiles, integrate with the API Mediation Layer, and more.

You can use the CLI interactively from a command window on any computer on which it is installed, or run it in a container or automation environment.

> **TIP**
>
> Text colors could be difficult to read in some terminals. If this is the case, we suggest either adjusting the terminal settings, or setting the `FORCE_COLOR` environment variable to `0`. For other accessibility options, check the accessibility settings for your operating system or terminal.

Supported platforms

CPU architecture

- x64
- Apple Silicon (M1+)

Operating systems

- MacOS 10.15+
- Unix-like:
  - CentOS 8+
  - Debian 11+
  - Red Hat Enterprise Linux (RHEL) 8+
  - Ubuntu 20.04+
- Windows 10+

Package/resource managers

- NodeJS LTS versions
- npm versions applicable to NodeJS LTS versions
- pnpm
- Yarn

> **SHARE YOUR FEEDBACK**
>
> Using Zowe CLI on z/OS Unix Systems Services is not supported at this time. If you would like to use it on USS in the future, show your interest by voting for the enhancement in the Zowe CLI GitHub repository.

Version: v3.2.x LTS

Zowe CLI authentication methods

Zowe CLI supports multiple authentication methods including basic authentication, tokens for single sign-on, client certificates, and multi-factor authentication.

Configure the authentication method you want to use across multiple mainframe services in a base profile stored in your configuration file.

> **NOTES**
>
> - To apply your authentication method to a specific service, define the authentication type in the service profile of your choice.
> - If you switch to a different authentication type, remove the previous authentication method from the profile it was stored in before.

Using basic authentication

The advantage of basic authentication (using a username and password) is the simplicity of set up: In most cases you can use Zowe CLI (or Zowe Explorer) to connect to mainframe services without additional configuration on the server. Other authentication methods would likely require further configuration.

Basic authentication is the default authentication method defined in the default base profile when you issue the `zowe config init` command in Zowe CLI to create your team configuration.

If you change your authentication method and want to switch back to using basic authentication:

1. Use a text editor to update the `zowe.config.json` file to define the authentication as basic authentication (see the highlighted lines) in the base profile:

   > **NOTE**
   >
   > The base profile name (see Line 1) can be different in your configuration file. The preceding example shows the default name for a project team config. The default for a global team config is `global_base`. To check your base profile name, issue the `zowe config list defaults` command in the command terminal.

2. For Zowe CLI, issue commands to set the values for `user` and `password` in the end user's personal computer:

   Zowe CLI prompts for these values and masks them as they are typed. By default, these values are stored in the PC's secure vault.

   If you are using a **global** team configuration file (located in your home directory), add `--global-config` to the end of the command.

Using a token for Single Sign-On (SSO)

SSO lets you use a single token to access all your mainframe services through API Mediation Layer. Tokens provide more security because they have limited lifespans and can be immediately revoked when needed.

SSO is configured with Zowe API ML, which generates an authentication token to access the mainframe. To log in to API ML, use either a username and password or a client certificate. To use a service through API ML, update its service profile to include its API base path.

Logging in with username and password

Provide your username and password to generate a token and log in to API ML:

1. Log in to API ML:

   For users who do not have a base profile that has been used to log into API ML, this creates a new base profile that is set as the default base profile in your configuration file.

   For users who have a default base profile already used to log into API ML, this updates the existing default base profile with a new token.

2. When prompted, enter the following information:

   - Host
   - Port for the API ML instance
   - Username
   - Password (can be a PIN concatenated with a second factor for MFA)

   A base profile is created or updated with your token, which is stored on your computer in place of a username and password:

   With token authentication set in your base profile, you can omit your username and password when you issue commands.

   If you do not want to store the token on your PC, append the `--show-token` option to the `login` command in Step 1. This returns the token value in your terminal for you to use on subsequent commands.

   If you already created a base profile, you might not be prompted for the host and port.

3. If you do not have a profile for the service, respond to Zowe CLI prompts for connection information to create a profile for the service.

   > **TIP**
   >
   > - To establish a base path, see instructions for Zowe team configuration or Zowe V1 profiles.

   If you already have a profile in your configuration for the service you want to connect to, use a text editor to open the applicable configuration file and replace the `port` property with a `basePath` property to enable the use of API ML.

   A profile with a port number:

A profile with a base path:

If you use the `--show-token` option with the `login` command in Step 1, you must manually supply the token on each command using the `--token-value` option. For example:

- `data-set <searchPattern>`

  Specifies the data set search criteria (for example, `<IBMUSER.*>`)

- `--token-value <123>`

  Specifies the token value supplied in Step 2.

> **NOTES**
>
> - Tokens expire after a period of time defined by your security administrator. When a token expires, you must log in to API ML again to get a new token.
> - If you omit connection details from a service profile, such as a `zosmf` profile, the CLI uses the information from your base profile.
> - You can choose to specify all connection details on a service profile and connect directly to the service. Routing through API ML is not required.

Logging in with a client certificate

Use a client certificate to generate a token and log in to API ML:

- `--host <APIML Host>`

  Specifies the API ML host.

- `--port <APIML Port>`

  Specifies the API ML port.

- `--cert-file <PEM Public Certificate Path>`

  Specifies the path for the PEM public certificate.

- `--cert-key-file <PEM Private Key File Path>`

  Specifies the path to the PEM private key.

Zowe CLI obtains a security token from API ML and adds that token to the base profile in the applicable configuration file.

> **NOTE**
>
> If you have multiple types of configuration files and base profiles, see How configuration files and profiles work together to learn which configuration and profile would be used to store the API ML token. To learn how to log in or out of a base profile, see Specifying a base profile.

Logging out

Log out to remove the token from your base profile and prompt the API ML to invalidate the token:

This command sends a request to the API ML to invalidate the token. Log in again to obtain a new token.

If you used the `--show-token` option and never stored your token in profile, add `--token-value <123>` (where `<123>` is the value of the token) to this command to invalidate the token.

Accessing a service through API ML

To access mainframe services with SSO through API ML using the token in your base profile, use the `basePath` property in your service profile to indicate the base path of the API on the API ML instance that you want to access.

To establish a base path, see instructions for Zowe team configuration.

> **NOTE**
>
> Ensure that you *do not* provide username, password, host, or port directly on the service commands or profiles. Supplying those options causes the CLI to ignore the API ML token in your base profile and access the service directly.

Specifying a base path with Zowe team configuration

Use the following steps to specify a base path with Zowe team configuration:

1. Note the complete path for a service registered to API ML.

   For example:

   The format of base paths can vary based on how API ML is configured at your site.

2. Using the example in Step 1, access the API ML instance by creating or updating a service profile, or issuing a command, with the base path value of `<yourServiceId>/api/v1`. Your service profile uses the token and credentials stored in your default base profile.

   To create or update a service profile with the preceding base path in a **project** team configuration file:

   If you are using a **global** team configuration file (located in your home directory), add `--global-config` to the end of the command.

   Commands issued with this profile are routed through API ML to access an appropriate instance of your service.

Specifying a base path with Zowe V1 profiles

See the Integrating with API Mediation Layer Zowe V1 documentation.

Using client certificates

Certificates are a long lasting type of authentication, rather than a password or token that can expire in hours, days, or months. A certificate is authenticated by matching a public and private key.

To use a client certificate for authentication:

1. Specify the path to the certificate file in the relevant profile :

   - `<certPath>`

     Specifies the location on your computer where the certificate is stored.

   If you are using a **global** team configuration file (located in your home directory), add `--global-config` to the end of the command.

2. Configure the file path to the private key:

   - `<certKeyPath>`

   Specifies the location on your computer where the private key is stored.

> **TIP**
> Add the `--secure` option to the preceding commands to avoid saving certificate file paths as plain text in your configuration file.

Using multi-factor authentication (MFA)

MFA adds an extra layer of security because it requires users to supply their password and an additional verification method.

In Zowe, MFA can apply to basic authentication and single sign-on when logging in with username and password.

It is important to understand how MFA functions at your site in order to set it up. Typically, a user needs an authenticator app to obtain a temporary code that is typically appended to, or replaces, the password. The system administrator must configure the application so it is set up for a Zowe user.

> **NOTE**
> MFA codes are different from SSO tokens. SSO tokens are an alternative to passwords and last longer than a temporary MFA code, which is combined with a password.

Version: v3.2.x LTS

Displaying help

Zowe CLI has a command-line help system that details the commands, actions, and options available in the product.

Top-level help

To view top-level help, open a command-line and issue the following command:

- An example of the Zowe CLI response:

Alternatively, to display a full list of all available commands:

> **TIP**
>
> All Zowe CLI commands begin with `zowe`.

Group, action, and object help

Append the global `--help` option to learn about a specific command group, action, or object.

For example, issue the following command to learn about the `create` action in the `zos-files` group:

Launching local web help

Launch an interactive form of help content in a web browser. When you issue the following command, web help is custom-generated to include commands for all of your currently installed plug-ins:

> **TIP**
>
> Append `--help-web` to a specific command or action to launch directly into the appropriate web help page.

Viewing web help in other ways

There are several methods to view Zowe CLI web help:

- Use a web browser
- Extract from a ZIP file
- Download a PDF file

Version: v3.2.x LTS

How command precedence works

You can provide your mainframe connection details (username, password, etc.) to Zowe CLI in several ways. Zowe CLI abides by a *command option order of precedence* that provides flexibility when issuing commands and writing scripts.

When you issue a command, the CLI *searches* for your command arguments in the following order:

1. **Options** that you specify on individual commands.
2. **Environment variables** that you define in the computer's operating system.

   For more information, see Using environment variables.
3. **Service profiles** that you create (that is, a z/OSMF profile or another mainframe service).
4. **Base profiles** that you create. These can contain credentials for use with multiple services and/or an API ML login token.
5. **Default option value**.

Command precedence in action

If you omit an option from the command line, Zowe CLI searches for an **environment variable** that contains a value for the option. If no environment variable exists, the CLI checks your **service profiles** for the value. If necessary, the CLI then searches **base profiles**, which provide values to service profiles to avoid specifying the same options (such as a username and password) in multiple service profiles.

> **NOTE**
>
> If you do not provide a value using one of these methods, the default value is used. If a required option value is not located, a syntax error message such as `Missing Positional Argument` or `Missing Option` displays.

Version: v3.2.x LTS

Understanding core command groups

Zowe CLI contains command groups that focus on specific business processes.

Zowe CLI commands are organized in a hierarchical structure. Command groups contain actions that let you perform actions on specific objects. For each action that you perform on an object, you can specify options that affect the operation of the command.

For example, the `zos-files` command group can let you perform actions on data sets such as `create`, `edit`, `rename`, and more.

Review the following Zowe CLI command groups to understand the actions available to them.

auth

The `auth` command group lets you connect to the Zowe API Mediation Layer authentication service and obtain a token, or disconnect from the authentication service and revoke the token.

> **NOTE**
>
> For more information about `auth` syntax, actions, and options, open Zowe CLI and issue the following command:

config

The `config` command group lets you manage project and global team configurations, and JSON projects; and convert profiles (service profiles and base profiles) to team configs.

> **NOTE**
>
> For more information about `config` syntax, actions, and options, open Zowe CLI and issue the following command:

daemon

The `daemon` command groups let you perform operations that control the daemon-mode functionality of the Zowe CLI. Daemon-mode runs the CLI command processor as a background process to improve performance.

> **NOTE**
>
> For more information about `daemon` syntax, actions, and options, open Zowe CLI and issue the following command:

> **IMPORTANT**

> Using daemon mode contains various limitations and configuration requirements, depending on the operating system where the daemon is running. For more information, see **Preparing for installation** in Using daemon mode.

plugins

The `plugins` command group lets you install and manage third-party plug-ins for the product. Plug-ins extend the functionality of Zowe CLI in the form of new commands.

With the `plugins` command group, you can perform the following tasks:

- Install or uninstall third-party plug-ins.
- Display a list of installed plug-ins.
- Validate that a plug-in integrates with the base product properly.

> **NOTE**
>
> For more information about `plugins` syntax, actions, and options, open Zowe CLI and issue the following command:

provisioning

The `provisioning` command group lets you perform IBM z/OSMF provisioning tasks with templates and provisioned instances from Zowe CLI.

With the `provisioning` command group, you can perform the following tasks:

- Provision cloud instances using z/OSMF Software Services templates.
- List information about the available z/OSMF Service Catalog published templates and the templates that you used to publish cloud instances.
- List summary information about the templates that you used to provision cloud instances. You can filter the information by application (for example, DB2 and CICS) and by the external name of the provisioned instances.
- List detail information about the variables used (and their corresponding values) on named, published cloud instances.

> **NOTE**
>
> For more information about `provisioning` syntax, actions, and options, open Zowe CLI and issue the following command:

zos-console

The `zos-console` command group lets you issue commands to the z/OS console by establishing an extended Multiple Console Support (MCS) console.

With the `zos-console` command group, you can perform the following tasks:

> **IMPORTANT**
>
> Before you issue z/OS console commands with Zowe CLI, security administrators should ensure that they provide access to commands that are appropriate for your organization.

- Issue commands to the z/OS console.
- Collect command responses and continue to collect solicited command responses on demand.

> **NOTE**
>
> For more information about `zos-console` syntax, actions, and options, open Zowe CLI and issue the following command:

zos-files

The `zos-files` command group lets you interact with data sets on z/OS systems.

With the `zos-files` command group, you can perform the following tasks:

- Create partitioned data sets (PDS) with members, physical sequential data sets (PS), and other types of data sets from templates. You can specify options to customize the data sets you create.
- Download mainframe data sets and edit them locally in your preferred Integrated Development Environment (IDE).
- Upload local files to mainframe data sets.
- List available mainframe data sets.
- Interact with VSAM data sets directly, or invoke Access Methods Services (IDCAMS) to work with VSAM data sets.

> **NOTE**
>
> For more information about `zos-files` syntax, actions, and options, open Zowe CLI and issue the following command:

zos-jobs

The `zos-jobs` command group lets you submit jobs and interact with jobs on z/OS systems.

With the `zos-jobs` command group, you can perform the following tasks:

- Submit jobs from JCL that reside on the mainframe or a local file.
- List jobs and spool files for a job.
- View the status of a job or view a spool file from a job.

> **NOTE**

> For more information about `zos-jobs` syntax, actions, and options, open Zowe CLI and issue the following command:

zos-logs

The `zos-logs` command group retrieves the z/OS operations logs.

With the `zos-logs` command group, you can perform the following task:

- List z/OS operations logs within a specified time frame.

> **NOTE**
>
> For more information about `zos-logs` syntax, actions, and options, open Zowe CLI and issue the following command:

zos-ssh

The `zos-ssh` command group lets you issue Unix System Services shell commands by establishing an SSH connection to an SSH server. The zos-ssh command group was previously named `zos-uss`.

With the `zos-ssh` command group, you can perform the following task:

> **IMPORTANT**
>
> Before you issue z/OS UNIX System Services commands with Zowe CLI, security administrators must provide access for your user ID to login via SSH.

- Issue z/OS UNIX System Services shell commands over an SSH connection and stream back the response.

> **NOTE**
>
> For more information about `zos-ssh` syntax, actions, and options, open Zowe CLI and issue the following command:

zos-tso

The `zos-tso` command group lets you issue TSO commands and interact with TSO address spaces on z/OS systems.

With the `zos-tso` command group, you can perform the following tasks:

- Execute REXX scripts
- Create a TSO address space and issue TSO commands to the address space.
- Review TSO command response data in Zowe CLI.

> **NOTE**
>
> For more information about `zos-tso` syntax, actions, and options, open Zowe CLI and issue the following command:

zos-workflows

The `zos-workflows` command group lets you create and manage z/OSMF workflows on a z/OS system.

With the `zos-workflows` command group, you can perform the following tasks:

- Create or register a z/OSMF workflow based on the properties on a z/OS system.
- Start a z/OSMF workflow on a z/OS system.
- Delete or remove a z/OSMF workflow from a z/OS system.
- List the z/OSMF workflows for a system or sysplex.

> **NOTE**
>
> For more information about `zos-workflows` syntax, actions, and options, open Zowe CLI and issue the following command:

zosmf

The `zosmf` command group lets you work with Zowe CLI profiles and get general information about z/OSMF.

With the `zosmf` command group, you can perform the following tasks:

- Verify that your profiles are set up correctly to communicate with z/OSMF on your system. For more information, see Testing connections to z/OSMF.
- Get information about the current z/OSMF version, host, port, and plug-ins installed on your system.

> **NOTE**
>
> For more information about `zosmf` syntax, actions, and options, open Zowe CLI and issue the following command:

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Issuing your first command

Typically, users rely on team configuration to connect to the mainframe and issue commands.

But if you have just installed Zowe CLI and have not yet configured your profiles, you can provide all connection options directly in the command line to access a service.

For example, issue the following command to list all data sets under the name `ibmuser` on the specified system:

- If you omit username, password, host, or port, and a value cannot be found in your configuration, Zowe CLI prompts you to enter a value.

However, this is not the most efficient way to communicate with the mainframe. To avoid having to enter connection details with every command repeatedly, use team profiles.

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Team configurations

Zowe CLI is configured through the use of **profiles** stored and managed in configuration files.

Types of configuration files

Both team and user configurations can be applied either *globally* or *per project*, as described in the following definitions:

- A **team configuration file** stores *team profiles* and is used by a group of people who need the same properties to run commands.
    - The most frequently used configuration type due to its versatility and efficient maintenance.
- A **user configuration file** stores *user profiles* and is used for one person who needs their own unique properties to run commands.
    - The necessity for user configuration is rare, and setting up a user configuration should not be a priority unless there is a specific need for one.
- A **project configuration file** resides in a directory of your choice. It contains project *team profiles* and project *user profiles*.
    - Zowe CLI commands executed within that directory use the profiles from the project configuration. Similarly, when the directory is opened as a Visual Studio Code workspace, Zowe Explorer uses the project config for profiles.
- A **global configuration file** resides in the `ZOWE_CLI_HOME` directory (YourUserHomeDirectory/.zowe, by default). It contains global *team profiles* and global *user profiles*.
    - Global config profiles are used for any Zowe CLI command regardless of the directory in which the command is run. The profiles are always available in Zowe Explorer regardless of the location of the current Visual Studio Code workspace.

Zowe CLI profile types

Configuration files are made up of multiple profiles that can be used by Zowe CLI. These profiles contain credentials and/or settings that are applied by the commands issued in the CLI.

- **Service profiles** let you store connection information for specific mainframe service, such as IBM z/OSMF. Plug-ins can introduce other service profile types to a configuration file, such as the `cics` profile to connect to IBM CICS.
- **Base profiles** let you store connection information for use with one or more services. Depending on your configuration file type, the base profile can be either a `global_base` or `project_base` profile. Typically, there is only one base profile in a configuration file.

  Service profiles can pull information from a base profile as needed, so that you can specify a common username and password only once. A base profile can optionally store tokens to connect to the Zowe API Mediation Layer, which improves security by enabling Multi-Factor Authentication (MFA) and Single Sign-on (SSO).

- **Parent profiles** let you nest service profiles that share some of the same properties and values into groups. There can be multiple parent profiles within a configuration file. This makes it possible to define shared properties (for example, hostname or credentials) only once in your configuration file, rather than duplicating values for each service profile. Parent profiles and nested service profiles are useful when your configuration uses multiple kinds of authentication or if your configuration is used to connect to multiple hosts.

Updating secure credentials

To change an existing username or password used by a team config profile, use the `zowe config secure` command for a quick update:

1. Open the Zowe CLI command prompt.

2. To update values for secure fields in a **project team** configuration file:

   To update values for secure fields in a **global team** configuration file:

   Prompts request new values for all secure fields defined in the configuration file. In most cases, these properties include a username or password, but some users may include other fields, such as a token value or connection properties.

3. Respond to prompts as needed. Press `Enter` to leave the value unchanged.

   New values are saved in the secure credential store. After the last secure value is submitted, the user returns to the system command prompt.

For more ways to secure credentials in config profiles, see Managing credential security.

Benefits of team configuration

Team configuration can make the initial setup of Zowe CLI more efficient by making service connection details easier to share and maintain within your organization.

Consider the following benefits of using team configuration for roles across your dev team:

- For a **team leader**, or Dev-Ops advocate, **sharing global team configurations** managed from one location, such as a software change management system. This allows multiple team members to use the same configurations stored in a repository or server.
- For a Dev-Ops advocate or **team leader**, quickly **onboarding new application developers** by sharing the configuration file that your team uses with the new team member.
- For an **application developer** in a small shop where you have the dual roles of application developer *and* a Dev-Ops advocate, having the **flexibility to create team or user configurations** that are most suitable for your needs.
- For a team member or **application developer**, efficiently managing **connection details in one location**.

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Editing team configurations

After you initialize team configuration, the newly created team profiles need additional details before they can be shared and applied in your environment. This could include information such as a port number or user credentials.

You might also need to modify the configuration file to create new profiles for accessing mainframe services.

Adding, modifying team profiles

To define additional mainframe services and other profiles in an existing global team configuration file:

1. Open the `~/.zowe/zowe.config.json` file in a text editor or an IDE (such as Visual Studio Code) on your computer.
2. Edit the file by adding to or modifying the profiles listed in the profiles object.

   Each profile contains connection and other frequently needed information for accessing various mainframe services, as in the following example:

Available service profile types

A profile contains all, or most, of the information you need to connect to a specific mainframe service. Your configuration can have multiple profiles, and these can consist of different profile *types* and even different *kinds* of a particular profile type, depending on the connection information.

There are three basic profile types:

- service profiles
- base profiles
- parent profiles

You can learn more about how service, base, and parent profiles work in Zowe CLI profile types.

Core z/OS service profiles

The three z/OS services that Zowe CLI and Zowe Explorer profiles connect to:

- **z/OSMF** profiles connect with the IBM z/OS Management Facility service.
- **TSO** profiles connect with the Time Sharing Option service.
- **SSH** profiles connect with the Secure Shell service.

Zowe CLI plug-in service profiles

Other kinds of *service profiles* can be used to configure connections for Zowe CLI plug-ins. A *base profile*, on the other hand, contains connection data that can be shared across multiple service profiles.

To determine the types of plug-in service profiles that can be used in Zowe CLI configuration, refer to the tables on this page or check the Zowe CLI plug-in command groups listed in the Zowe web help. Most group names match the plug-in

profile name.

Profile properties

Every profile in a configuration file includes specific information, such as properties and their values, to communicate with its respective mainframe service. The values for properties are defined by your specific connection information.

The available properties for z/OS services and Zowe-conformant plug-ins profiles are listed in the following tables:

base

Property	Description	Allowed
host	Host name of service on the mainframe.	string
port	Port number of service on the mainframe.	number
user	User name to authenticate to service on the mainframe.	string
password	Password to authenticate to service on the mainframe.	string
rejectUnauthorized	Reject self-signed certificates. **Default**: `true`	**boolean**: `true` `false`
tokenType	The type of token to get and use for the API. Omit this option to use the default token type, which is provided by `zowe auth login`.	string
tokenValue	The value of the token to pass to the API.	string
certFile	The file path to a certificate file to use for authentication. Note: The CLI does not support certificate files that require a password. For more information, see PEM certificate files.	string
certKeyFile	The file path to a certificate key file to use for authentication	string

ca7

Property	Description	Allowed
host	Host name of the CA7 API service that is running on the mainframe system.	string
port	Port for the CA7 API service that is running on the mainframe system.	number

Property	Description	Allowed
user	User name for authenticating connections to the CA7 API service that is running on the mainframe system.	string
password	Password for authenticating connections to the CA7 API service that is running on the mainframe system.	string
basePath	The base path for your API Mediation Layer instance. Specify this option to prepend the base path to all resources when making REST requests. Do not specify this option if you are not using an API Mediation Layer.	string
protocol	Specifies protocol to use for CA7 connection.	**string**: `http` `https`
rejectUnauthorized	Reject self-signed certificates. **Default**: `true`	**boolean**: `true` `false`

cics

Property	Description	Allowed
host	The CMCI server host name	string
port	The CMCI server port **Default**: `1490`	number
user	Your username to connect to CICS	string
password	Your password to connect to CICS	string
regionName	The name of the CICS region name to interact with	string
cicsPlex	The name of the CICSPlex to interact with	string
rejectUnauthorized	Reject self-signed certificates. **Default**: `true`	**boolean**: `true` `false`
protocol	Specifies CMCI protocol. **Default**: `https`	**string**: `http` `https`

db2

Property	Description	Allowed
host	The Db2 server host name	string
port	The Db2 server port number	number
user	The Db2 user ID (may be the same as the TSO login)	string
password	The Db2 password (may be the same as the TSO password)	string
database	The name of the database	string
sslFile	Path to the root CA Certificate file	string

dbm-db2

Property	Description	Allowed
host	Specifies the DBM Data Service REST API server host name or TCP/IP address to use.	string
port	Specifies the DBM Data Service REST API server TCP/IP port number. **Default**: `7300`	number
user	Specifies the mainframe user name that you want to use to connect to the mainframe systems during execution of the Zowe CLI commands. This user name can be the same as your TSO login ID.	string
password	Specifies the mainframe password for the user name that is used to connect to the mainframe systems during execution of the CLI commands. This password can be the same as your TSO password.	string
protocol	Specifies the communication protocol between zowe dbm-db2 client and DBM Data Service. **Default**: `https`	**string**: `http` `https`
rejectUnauthorized	Determines whether the dbm-db2 command is accepted or rejected when a self-signed certificate is returned by the DBM Data Service. **Default**: `true`	**boolean**: `true` `false`
environmentList	Specifies a string of one or more entries consisting of a Db2 subsystem ID and a DBM Data Service REST API server host name or TCP/IP address. Use a comma to separate entries. The same Db2 subsystem can be used in multiple DBM Data Service environments. For more information about configuring the DBM Data	object

Property	Description	Allowed

	Service, see the Database Management Solutions for Db2 for z/OS documentation.
	
	▼ **Default**:
	
	{
	"ssid1": "env1@host1:port1",
	"ssid2": "env2@host2:port2"
	}	

jobCards	Specifies a string array of z/OS JCL JOB statements.
	
	▼ **Default**:
	
	//DB2DVOPS JOB CLASS=A,
	// MSGCLASS=X
		array

workDatasetPrefix	Specifies the prefix (high-level qualifier) in z/OS work data set names. **Default**: `${user}.dbmdb2`	string

deleteWorkDatasets	Specifies whether to delete work data sets on a mainframe after the request is fulfilled.
	
	Default: `true`
		boolean:
		`true`
		`false`

overwriteOutputFiles	Specifies whether to overwrite output files if they exist.
	
	Default: `false`
		boolean:
		`true`
		`false`

authid	Specifies the primary Db2 authorization ID that is used to establish a connection between Db2 and a process. **Default**: `${user}`	string
sqlid	Specifies the authorization ID that is used in generated SET CURRENT SQLID statements. **Default**: `${user}`	string

Property	Description	Allowed
terminationCharacter	Specifies the SQL termination character to use in DDL generation when the default termination character conflicts with the SQL statements that are used in triggers, XML indexes, and routines (external SQL functions and native SQL stored procedures). The default termination character is a semi-colon (;). You cannot specify a comma, double quote, single quote, left or right parentheses, or an underscore. **Default**: `;`	string
basePath	The base path for your API Mediation Layer instance. Specify this option to prepend the base path to all DBM DS resources when making REST requests. Do not specify this option if you are not using an API Mediation Layer.	string

dbm-db2-options

Property	Description	Allowed
authid	Specifies the primary Db2 authorization ID that is used to establish a connection between Db2 and a process.	string
changeSet	Specifies the creator and name of an existing RC/Migrator global change set that changes Db2 objects during a command execution. Format: <change-set-creator.change-set-name> For more information about global change services, see the RC/Migrator documentation. Note: If change-set and change-set-file are both specified, specifications in change-set-file take precedence.	string
changeSetValues	Specifies the global change specifications that modify Db2 object attributes during a command execution. Format: <object-attribute> <from-value> <to-value> The <object-attribute> consists of four characters. The first two characters identify the object type. The last two characters identify the specific attribute. Wildcard characters are supported in <from-value> and <to-value>. If the same <object-attribute> is specified multiple times, the first occurrence takes precedence.	array

Property	Description	Allowed
	For a full list of attributes, see Global Change Set Attributes in the RC/Migrator documentation. Example: The following example demonstrates changes to the table schema (creator) and tablespace names: TBCR TEST% PROD% TBTS TESTTS% PRODTS% Note: - If change-set and change-set-file are both specified, specifications in change-set-file take precedence. - The changeSetValues options-profile option has the same behavior as the change-set-file command option. ▼ **Default**: -- DDL changes for a table with dependent objects. -- Note: Replace CHANGEME with your database name. ALDB * CHANGEME ALCR * ${user} TBTC * ${user} IXTC * ${user} VWTC * ${user} VWFS * ${user} SYTC * ${user} ASTC * ${user} TGSC * ${user} TGOW * ${user} TGTC * ${user} TGTO * ${user} TGQU * ${user} TGFS * ${user} TGQS * ${user} SQSC * ${user} RTSC * ${user} RTPO * ${user} RTQU * ${user}	

deleteWorkDatasets	Specifies whether to delete work data sets on a mainframe after the request is fulfilled.	**boolean**:
		`true`
		`false`

Property	Description	Allowed
description	Specifies a 1- to 25-character description for the RC/Migrator compare strategy.	string
id	Specifies the 1- to 8-character name of the RC/Migrator compare strategy that is created on the target Db2 subsystem during a command execution. Format: The name must begin with a non-numeric character and contain the following characters only: uppercase letters from A to Z, numbers from 0 to 9, and special characters $, #, and @.	string
jobCards	Specifies a string array of z/OS JCL JOB statements.	array
matchSet	Specifies the creator and name of an existing RC/Migrator automapping mask set. Matching is used to pair objects in a DDL file to objects that are defined on a Db2 subsystem. Matching determines whether the `change-set` or `rule-set` options are applied. Format: <match-set-creator.match-set-name> For more information about mask services, see the RC/Migrator documentation. Note: If `--match-set` and `--match-set-file` are both specified, specifications in match-set-file take precedence.	string
matchSetValues	Specifies the mapping mask specifications. Matching is used to pair objects in a DDL file to objects that are defined on a Db2 subsystem. For example, a mask specification can account for different schema naming patterns across environments. Matching determines whether the `change-set` or `rule-set` options are applied. Format: <object-type> <source-name-mask> <target-name-mask>; STOGROUP <name> <name> DATABASE <name> <name> TABLESPACE <database.name> <database.name> TABLE <schema.name> <schema.name> INDEX <schema.name> <schema.name> VIEW <schema.name> <schema.name> SYNONYM <schema.name> <schema.name> ALIAS <schema.name> <schema.name> TRIGGER <schema.name> <schema.name> SEQUENCE <schema.name> <schema.name> FUNCTION <schema.name[.version]> <schema.name[.version]>	array

Property	Description	Allowed
	PROCEDURE <schema.name[.version]> <schema.name[.version]> Note: - <name> must be between 1 and 128 characters. For DATABASE and TABLESPACE, <name> must be between 1 and 8 characters. - <schema> must be between 1 and 128 characters. - <version> must be between 1 and 64 characters. A mask specification can include the following wildcard characters: Percent sign (%) indicates that zero or more characters can occupy that position and all remaining positions to the end of the name, or to the next character. The percent sign can be used anywhere in the name. However, the source and target characters must match exactly. Hyphen or dash (-) indicates that any character can occupy that position, but a character must exist at that position, and the source and target character must match exactly. The hyphen can be repeated in several places in the name. Asterisk (*) indicates matching values. An asterisk cannot be used with other characters. Use a semicolon to separate mask specifications. Multiple mask specifications for the same object type are supported. Example: The following example demonstrates different ways of matching the table MYNAME.MYTABLE to the table YOURNAME.YOURTABLE: TABLE MY%.%TABLE YOUR%.%TABLE; TABLE MYN-M-.MYT% YOURN-M-.YOURT%; TABLE MYNAME.MYTABLE YOURNAME.YOURTABLE; TABLE *.MYTABLE *.YOURTABLE; For a list of mask specifications, see the RC/Migrator documentation. Note: - If `--match-set` and `--match-set-file` are both specified, specifications in match-set-file take precedence. - The matchSetValues options-profile option has the same behavior as the match-set-file command option.	
modification	Specifies a named set of server-managed default parameter values that control the execution behavior of the zowe dbm-db2 commands. For example, you can use a modification to identify a set of default values that differ from the current set of default values.	string

Property	Description	Allowed
	For more information about using the modification option, see the DBM Data Service documentation.	
overwriteOutputFiles	Specifies whether to overwrite output files if they exist.	**boolean**: `true` `false`
ruleSet	Specifies the creator and name of an existing RC/Migrator rule set that overrides Db2 object attributes in the target Db2 subsystem with the corresponding values from the input DDL file. The changes only apply to existing objects, as determined by match-set processing. Format: <rule-set-creator.rule-set-name> For more information about rule database services, see the RC/Migrator documentation.	string
sqlid	Specifies the authorization ID that is used in generated SET CURRENT SQLID statements.	string
sourceDb2	Specifies the source Db2 subsystem or data sharing group where the objects that you want to use in a command are located. Note: If you specify the data sharing group, the first active Db2 subsystem in the group is used.	string
targetDb2	Specifies the target Db2 subsystem or data sharing group where you want to use a command. Note: If you specify the data sharing group, the first active Db2 subsystem in the group is used.	string
terminationCharacter	Specifies the SQL termination character to use in DDL generation when the default termination character conflicts with the SQL statements that are used in triggers, XML indexes, and routines (external SQL functions and native SQL stored procedures). The default termination character is a semi-colon (;). You cannot specify a comma, double quote, single quote, left or right parentheses, or an underscore.	string
type	Specifies the type of DDL statements that you want to generate. You can generate CREATE or DROP statements.	**string**: `drop` `create`

Property	Description	Allowed

verify	Specifies whether to verify that the objects to be created do not exist on the Db2 subsystem and that the related objects that are required for successful creation of the objects exist on the Db2 subsystem or in the input DDL.
	
	Default: `no`
		string:
		`yes`
		`no`

workDatasetPrefix	Specifies the prefix (high-level qualifier) in z/OS work data set names.	string

endevor

Property	Description	Allowed
host	The hostname of the endevor session	string
port	The port number of the endevor session	number
user	The username of the endevor session	string
password	The password of the user	string

protocol	The protocol used for connecting to Endevor Rest API
	
	Default: `https`
		string:
		`http`
		`https`

basePath	The base path used for connecting to Endevor Rest API **Default**: `EndevorService/api/v2`	string

rejectUnauthorized	If set, the server certificate is verified against the list of supplied CAs	**boolean**:
		`true`
		`false`

reportDir	The default path where any reports will be written to, either absolute or relative to current directory **Default**: `.`	string

endevor-location

Property	Description	Allowed
instance	The STC/datasource of the session **Default**: `ENDEVOR`	string

Property	Description	Allowed
environment	The Endevor environment where your project resides **Default**: `DEV`	string
system	The Endevor system where the element resides	string
subsystem	The Endevor subsystem where your element resides	string
type	Name of the Endevor element's type	string

stageNumber	The Endevor stage where your project resides	**string**:
		`1`
		`2`

comment	The Endevor comment you want to use when performing an action	string
ccid	The Endevor CCID you want to use when performing an action	string
maxrc	The return code of Endevor that defines a failed action **Default**: `8`	number

override-signout	Always override element signout, without having to specify the override signout option on each command
	
	Default: `false`
		boolean:
		`true`
		`false`

file-extension	The strategy for deciding what file extension to use during a bulk retrieve or workspace synchronization. Must be one of the following:
	
	none:
	File name is equal to element name, no extension is added.
	
	file-ext:
	The file extension defined in the Type definition is used; If not defined, no extension is added.
	
	type-name:
	The type name is used as the file extension.
	
	mixed:
	The file extension defined in Type definition is used; If not defined, the type name is used instead.
	
	Default: `mixed`
		string:
		`none`
		`type-name`
		`file-ext`
		`mixed`

ims

Property	Description	Allowed
host	The IMS Operations API server host name.	string
port	The IMS Operations API server port.	number
imsConnectHost	The hostname of your instance of IMS Connect. This is typically the hostname of the mainframe LPAR where IMS Connect is running.	string
imsConnectPort	The port of your instance of IMS Connect. This port can be found in your IMS Connect configuration file on the mainframe.	number
plex	The name of the IMS plex.	string
user	The web server user name where the IMS Operations API resides.	string
password	The web server user password where the IMS Operations API resides.	string
basePath	The base path for your API Mediation Layer instance. Specify this option to prepend the base path to all z/OSMF resources when making REST requests. Do not specify this option if you are not using an API Mediation Layer.	string

protocol	Specifies protocol.
	
	Default: `https`
		string:
		`http`
		`https`

rejectUnauthorized	Reject self-signed certificates.
	
	Default: `true`
		boolean:
		`true`
		`false`

jclcheck

Property	Description	Allowed
host	Host name of the JCLCheck API service that is running on the mainframe system.	string
port	Port for the JCLCheck API service that is running on the mainframe system. **Default**: `12697`	number
user	User name for authenticating connections to the JCLCheck API service that is running on the mainframe system.	string
password	Password for authenticating connections to the JCLCheck API service that is running on the mainframe system.	string

Property	Description	Allowed
basePath	The base path for your API Mediation Layer instance. Specify this option to prepend the base path to all resources when making REST requests. Do not specify this option if you are not using an API Mediation Layer. **Default**: `cajclcheck/api/v1`	string

rejectUnauthorized	Reject self-signed certificates.
	
	Default: `true`
		boolean:
		`true`
		`false`

protocol	Specifies protocol to use for JCLCheck connection.
	
	Default: `https`
		string:
		`http`
		`https`

jclcheckOptions	The desired set of JCLCheck runtime options. Specify the options exactly as you would on the PARM= or OPTIONS DD on a batch run of JCLCheck. See the JCLCheck runtime options documentation for details on available runtime options. If you specify options that change the format of the JCLCheck reports, you should request `--raw-output`. Changing the format of the report will affect the ability to produce a structured API response.	string

mat

Property	Description	Allowed

protocol	Specifies the protocol defined for the MAT REST API server.
	
	Default: `https`
		string:
		`http`
		`https`

hostname	Specifies the hostname or IP address defined for the MAT REST API server (e.g. 127.0.0.0 or localhost).	string
port	Specifies the server port (e.g. 8080).	number
user	Your mainframe username.	string
password	Your mainframe password.	string
basePath	The base path for your API Mediation Layer instance. Specify this option to prepend the base path to all resources when making REST requests. Do not specify this option if you are not using an API Mediation Layer.	string

rejectUnauthorized	Reject self-signed certificates.
	
	Default: `true`
		boolean:
		`true`
		`false`

Property	Description	Allowed
listingDir	Specifies the directory where you want to store the registered program listings (e.g. `c:\listings`) for your immediate source code inspection. You can use the advantage of automated listing registration with MAT and listing retrieval through Endevor® footprints for Cobol, C/C++, and Assembler programs. When a source program listing is registered with MAT, you can enhance the histogram analysis data with the program listing details that pertain to the specific CSECT and program statement. The listing is transfered to the specified directory, which enables you to navigate directly to the line of the source code in you VS Code IDE and inspect the program statement. To use the listing retrieval option through Endevor® footprints, you need to have the Endevor® Web Services installed and configured and specify the Endevor® web server details in the MAT database configuration.	string

mq

Property	Description	Allowed
host	The host name used to access the IBM MQ REST API. This might be the host name of the IBM MQ mqweb server, or the Zowe API Mediation Layer..	string
port	The port number used to access the IBM MQ REST API. This might be the port number of the IBM MQ mqweb server, or the Zowe API Mediation Layer.	number
user	The mainframe (MQ) user name, which can be the same as your TSO login.	string
password	The mainframe (MQ) password, which can be the same as your TSO password.	string

rejectUnauthorized	Reject self-signed certificates.
	
	Default: `false`
		boolean:
		`true`
		`false`

protocol	Specifies the MQ protocol.
	
	Default: `https`
		string:
		`http`
		`https`

omspool

Property	Description	Allowed
account	z/OS TSO/E accounting information.	string
spoolhlq	High level qualifier of OM Spool installation.	string

Property	Description	Allowed
subsys	OM Spool subsystem name. **Default**: `ESF`	string
outds	The SYSTSPRT data set allocated by CAI.CBQ4JCL(BQ4JZOWE). It must be unique for each Zowe CLI user interacting with OM Spool.	string
clist	The data set containing ESFZOWE REXX exec.	string

omview

Property	Description	Allowed

protocol	Protocol of the target OM Web Viewer instance.
	
	Default: `https`
		string:
		`http`
		`https`

host	Hostname or ip address of the target OM Web Viewer instance.	string
port	Port of the target OM Web Viewer instance. **Default**: `443`	number
basePath	Context name of the target OM Web Viewer instance. **Default**: `web-viewer`	string
user	User name used to authenticate against the target OM Web Viewer instance.	string
password	Password used to authenticate against the target OM Web Viewer instance.	string

ops

Property	Description	Allowed
host	The hostname of the server where OPS/MVS Web Services / REST API is running.	string
port	The port number for OPS/MVS Web Services / REST API.	number
user	Your z/OS user name that is used to authenticate to OPS/MVS Web Services / REST API.	string
password	Your z/OS password that is used to authenticate to OPS/MVS Web Services / REST API.	string

Property	Description	Allowed

protocol	The protocol that is used for connecting to OPS/MVS Web Services / REST API.
	
	Default: `https`
		string:
		`http`
		`https`

rejectUnauthorized	If set to true, the server certificate is verified against the list of supplied CAs. If set to false, certificate verification is not performed.
	
	Default: `true`
		boolean:
		`true`
		`false`

subsystem	Specifies the subsystem ID of the OPS/MVS instance to which commands will be directed. This parameter is ignored by the `show status` and `show subsystem` commands. **Default**: `OPSS`	string

restApi	If set to true, the plug-in executes the command against the OPS/MVS REST API. If set to false, the plug-in executes against the OPS/MVS Web Services.
	
	Default: `false`
		boolean:
		`true`
		`false`

basePath	If set to true, the plug-in executes the command against the OPS/MVS REST API. If set to false, the plug-in executes against the OPS/MVS Web Services. **Default**: `false`	string

pma

Property	Description	Allowed
job_acct	Specifies z/OS TSO/E accounting information. Values: numeric characters (0-9)	string
job_class	Your z/OS class information. Values: alphanumeric characters (A-Z, 0-9)	string
job_mclass	Specifies the MSGCLASS parameter value and assigns the job log to the specified output class. The specified MSGCLASS value is used in all JCLs that PMA runs while you execute the commands. If you do not provide the job_mclass parameter, the default MSGCLASS value is used. Values: alphanumeric characters (A-Z, 0-9) **Default**: `A`	string
job_load	Specifies the PMA loadlib data set name that you defined during the PMA customization (&HLQ.CEETLOAD)	string
job_pmahlq	Specifies your PMA HLQ to access the KSDSALT, KSDSJOB, and KSDSEXC VSAM files that ensure the collection of the necessary data	string

rse

Property	Description	Allowed
host	The z/OS host name running the Zowe REST API.	string
port	The server port used by the REST API. **Default**: `6800`	number
user	The user name for the Zowe REST API operations.	string
password	The password of the user for the Zowe REST API operations.	string
rejectUnauthorized	Reject self-signed certificates. **Default**: `true`	**boolean**: `true` `false`
basePath	The base path of the API for the REST API operations. **Default**: `rseapi`	string
protocol	Only HTTPS supported for a TLS handshake to access REST API. **Default**: `https`	**string**: `https`
encoding	The encoding for download and upload of z/OS data set and USS files. The encoding should be specified in the form of "IBM-1047".	string
tokenType	JWT type assigned to profile when "zowe rse auth login" is used for authentication.	string
tokenValue	JWT value assigned to profile when "zowe rse auth login" is used for authentication.	string
tokenExpiration	JWT expiration assigned to profile when "zowe rse auth login" is used for authentication.	string

ssh

Property	Description	Allowed
host	The z/OS SSH server host name.	string
port	The z/OS SSH server port. **Default**: `22`	number

Property	Description	Allowed
user	Mainframe user name, which can be the same as your TSO login.	string
password	Mainframe password, which can be the same as your TSO password.	string
privateKey	Path to a file containing your private key, that must match a public key stored in the server for authentication	string
keyPassphrase	Private key passphrase, which unlocks the private key.	string
handshakeTimeout	How long in milliseconds to wait for the SSH handshake to complete.	number

sysview

Property	Description	Allowed
host	The hostname of the SYSVIEW REST API	string
port	The port number of the SYSVIEW REST API	number
user	Your z/OS username used to authenticate to the SYSVIEW REST API	string
password	Your z/OS password used to authenticate to the SYSVIEW REST API	string
rejectUnauthorized	If set, the server certificate is verified against the list of supplied CAs	**boolean**: `true` `false`
ssid	SSID of the SYSVIEW instance. **Default**: `GSVX`	string
basePath	The base path for your API Mediation Layer instance. Do not specify this option if you are not using an API Mediation Layer. **Default**: `/api/v1`	string

sysview-format

Property	Description	Allowed
contextFields	Context fields to display. Defaults to hiding all context	array
overview	Display the overview section	**boolean**: `true`

Property	Description	Allowed
		`false`
info	Display the information area, if any	**boolean**: `true` `false`
pretty	Display formatted data	**boolean**: `true` `false`
blankIfZero	Show a blank space instead of `0` values	**boolean**: `true` `false`
truncate	Truncate displays that are too wide for the console **Default**: `false`	**boolean**: `true` `false`

tso

Property	Description	Allowed
account	Your z/OS TSO/E accounting information.	string
characterSet	Character set for address space to convert messages and responses from UTF-8 to EBCDIC. **Default**: `697`	string
codePage	Codepage value for TSO/E address space to convert messages and responses from UTF-8 to EBCDIC. **Default**: `1047`	string
columns	The number of columns on a screen. **Default**: `80`	number
logonProcedure	The logon procedure to use when creating TSO procedures on your behalf. **Default**: `IZUFPROC`	string
regionSize	Region size for the TSO/E address space. **Default**: `4096`	number

Property	Description	Allowed
rows	The number of rows on a screen. **Default**: `24`	number

zftp

Property	Description	Allowed
host	The hostname or IP address of the z/OS server to connect to.	string
port	The port of the z/OS FTP server. **Default**: `21`	number
user	Username for authentication on z/OS	string
password	Password to authenticate to FTP.	string
secureFtp	Set to `true` for both control and data connection encryption, `control` for control connection encryption only, or `implicit` for implicitly encrypted control connection (this mode is deprecated in modern times, but usually uses port 990). Note: Unfortunately, this plug-in's functionality only works with FTP and FTPS, not `SFTP` which is FTP over SSH. **Default**: `true`	boolean,null
rejectUnauthorized	Reject self-signed certificates. Only specify this if you are connecting to a secure FTP instance.	boolean,null
servername	Server name for the SNI (Server Name Indication) TLS extension. Only specify if you are connecting securely	string,null
connectionTimeout	How long (in milliseconds) to wait for the control connection to be established. **Default**: `10000`	number
encoding	The encoding for download and upload of z/OS data set.	string

zosmf

Property	Description	Allowed
host	The z/OSMF server host name.	string
port	The z/OSMF server port. **Default**: `443`	number
user	Mainframe (z/OSMF) user name, which can be the same as your TSO login.	string
password	Mainframe (z/OSMF) password, which can be the same as your TSO password.	string

rejectUnauthorized	Reject self-signed certificates.
	
	Default: `true`
		boolean:
		`true`
		`false`

certFile	The file path to a certificate file to use for authentication	string
certKeyFile	The file path to a certificate key file to use for authentication	string
basePath	The base path for your API Mediation Layer instance. Specify this option to prepend the base path to all z/OSMF resources when making REST requests. Do not specify this option if you are not using an API Mediation Layer.	string

protocol	The protocol used
	
	Default: `https`
		string:
		`http`
		`https`

encoding	The encoding for download and upload of z/OS data set and USS files. The default encoding if not specified is IBM-1047.	string
responseTimeout	The maximum amount of time in seconds the z/OSMF Files TSO servlet should run before returning a response. Any request exceeding this amount of time will be terminated and return an error. Allowed values: 5 - 600	number

Creating profiles

Configuration profiles are used to connect to different mainframe services, and you can structure each profile based on how that connection is made.

For example, profiles can be nested to share the same connection information, or keep different information separate. Services can be accessed directly by Zowe CLI, or they can be accessed through the API Mediation Layer.

Review the following scenarios to help determine the profile types best suited for your environment.

As a team leader, you can share the configuration you create with your team members so they can easily access mainframe services.

Accessing LPARs that contain services that share the same credentials

In the following configuration, nested profiles (highlighted in the example) use the credentials from the same base profile to access services directly on multiple LPARs:

Accessing LPARs that contain services that do not share the same credentials

In the following configuration, profiles are highlighted to show they are nested to use the credentials from parent profiles for different LPARs to access services directly on multiple LPARs.

Accessing LPARs that access services through one API Mediation Layer

In the following configuration, services are accessed through API ML (where multi-factor authentication (MFA) or single sign-on (SSO) is achievable) using token-based authorization stored in a base profile (highlighted in the example).

Accessing LPARs that access services through one API Mediation Layer using certificate authentication

In the following configuration, services are accessed through API ML using certificate authentication stored in a base profile (highlighted in the example).

Accessing services through multiple API ML gateways

There are different ways to access mainframe services through multiple API ML gateways, depending on how you organize the profiles in your configuration. Determine the method to use by the requirements of your client component.

In Zowe CLI, profiles do not need to be nested in order to use multiple API ML gateways. Nested profiles are required for Zowe Explorer for VS Code.

Select one of the following tabs to see the configuration possible for the client components.

Zowe CLI, Zowe Explorer for VS Code | **Zowe CLI alternative**

In the following configuration, profiles are highlighted to show they are nested so their connection information can be used with multiple API ML gateways.

To authenticate to a specific API ML gateway from this configuration, issue the `zowe auth login apiml --base-profile lpar1` or `zowe auth login apiml --base-profile lpar2` commands.

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Sharing team configuration

As a team leader, or DevOps advocate, you might want to share a team configuration globally in the following scenarios:

- You want to share profiles with application developers so that they can work with a defined set of mainframe services. The recipient of the file places it in their local `~/.zowe` folder manually before issuing CLI commands.
- You want to add the profiles to your project directory in a software change management (SCM) tool, such as GitHub. When you store the profiles in an SCM tool, application developers can pull the project to their local computer and use the defined configuration. Zowe CLI commands that you issue from within the project directory use the configuration scheme for the project automatically.
- You want to enable test automation in a CI/CD pipeline, which lets your pipelines make use of the project configuration.

Team leaders can share team configuration files using several methods:

- Shared network drive
- Project repository (for example, GitHub)
- Web server

Network drive

To use a network drive to share a team configuration file:

1. Store the configuration files on a shared network drive.
2. Open a command line prompt and issue the following command:
    - `<DriveLetter>`

      Specifies the drive letter of the shared network drive
    - `<FolderPath>`

      Specifies the directory path on the drive

> **NOTE**
>
> You can specify any path that file management applications, such as Windows Explorer and Finder, can access. For example, a UNC network path (`\\<HostName>\SharedZoweConfig\zowe.config.json`) or local file path (`C:\Users\<UserName>\Downloads\zowe.config.json`).

Project repository and web server

To import the team configuration file from a GitHub repository and a web server:

1. Store the configuration files in a project repository or on a web server.

2. Issue the following command:

- **Project repository** (such as GitHub)
  - `<user>`

    Specifies the user ID
  - `<password>`

    Specifies the password for the user ID
  - `<githubUrl>`

    Specifies the URL to the GitHub repository
  - `<repoName>`

    Specifies the name of the repository
  - `<branch>`

    Specifies the name of the branch that contains the configuration file
  - `<folderPath>`

    Specifies the path to the configuration file
- **Web server**

  > **NOTE**
  >
  > You can host team configuration files on **private** and **public** web servers. The user name and password are required for only private URLs. However, to maintain the highest level of security, you should **not** store team configuration files on public URLs.

  - `<user>`

    Specifies the user ID
  - `<password>`

    Specifies the password for the user ID
  - `<hostname>`

    Specifies the host name of the system
  - `<folderPath>`

    Specifies the path to the team configuration file

  > **TIP**

To import the schema automatically from shared drives and from web servers, store the schema in the same directory as the `zowe.config.json` file. In the configuration file, reference the schema as a relative path at the top of the configuration file.

Example:

Initializing user configuration

As an application developer or Zowe CLI user, you can manage your connection details efficiently and in one location.

Typically, that means the use of a team configuration file. An important convenience of team configuration is that it is easier to share connection information. Another advantage (whether you work in a team or are the sole developer in your organization) is that team configuration is optimized to leverage the broadest capabilities of Zowe CLI.

However, there might come a time when applying your own *user* configuration file could make sense.

The necessity of user configuration is rare, and setting up a user configuration file should not be a priority unless there is a specific need for one. For example, user configuration can be helpful when only one user needs access to a highly restricted project.

If you do want to use user configuration, it is advised that you create your `zowe.config.user.json` file after you have a global team configuration `zowe.config.json` file in place.

To learn more about how profiles and different configuration files work, see How Zowe CLI uses configurations.

Creating user profiles

Generate a *user* configuration file that overrides the values defined in the global `zowe.config.json` file:

1. If you do not already have a global team configuration file, open a command line prompt and issue the following command to generate one:

   The configuration file `zowe.config.json` is created in the `ZOWE_CLI_HOME` directory.

2. Respond to subsequent prompts to create connection profiles for mainframe services.

3. Generate the global user configuration file:

   The configuration file `zowe.config.user.json` is created in the `ZOWE_CLI_HOME` directory.

   When created, the user configuration file contains profiles with no properties and the `defaults` object is empty. Refer to the following example.

4. Use a text editor or IDE (such as Visual Studio Code) to add your connection details as properties in the `zowe.config.user.json` file to either override the same properties in `zowe.config.json`, or to add new connection details.

How Zowe CLI uses configurations

When you run a command, Zowe CLI needs specific information, or *properties*, in order to perform the command action.

There are two common ways that properties and their values can be provided to Zowe CLI. One method is to manually include this information with each command when it is issued, as in the example command below:

Including properties with every command can be tedious, because a lot of information can be required. This can lead to typos and mistakes.

Another way of specifying these properties — using configuration files — can make things easier. A configuration file contains profiles with properties that Zowe CLI can use when you run a command.

If configuration files were used in the example above, the user would have needed to issue only the command:

```
zowe zos-files list data-set "SYS1.PARMLIB*"
```

Learning the terminology

As of Zowe V2, Zowe CLI relies on the profiles stored in configuration files to obtain connection information.

Both *user* and *team* profiles are stored in configuration files, and these configuration files can either be *project* configuration files or *global* configuration files. It is helpful to understand how these differ.

- A **user configuration file** stores *user profiles* and is used for one person who needs their own unique properties to run commands.
- A **team configuration file** stores *team profiles* and is used by a group of people who need the same properties to run commands.
- A **global configuration file** resides in the `ZOWE_CLI_HOME` directory (YourUserHomeDirectory/.zowe, by default). It contains global *user profiles* and global *team profiles*.
- A **project configuration file** resides in a directory of your choice. It contains project *user profiles* and project *team profiles*.

All configuration files are saved in `.json` format.

How configuration files and profiles work together

There may be instances where a user has all four types of files in their system, and all four configurations are referred to simultaneously by Zowe CLI for a particular command.

This can mean working with files that have conflicting configurations. One file can specify that a certain profile property has a value of `ABC`, while another file uses `XYZ` as a value.

When the same properties have different values across multiple configuration files, Zowe CLI follows a two-step check to determine which configurations apply:

1. Does the configuration file have a *more narrow* or a *more broad* scope?
2. Is the configuration file *more specific* or *less specific*?

Zowe CLI considers a user configuration file to have a more specific use than a team configuration file, and a project configuration file have a narrower scope than a global configuration file, which has a broader scope.

When checking all possible configuration file types, Zowe CLI categorizes files in the manner below:

	more specific	less specific
narrow scope	project user config file	project team config file
broad scope	global user config file	global team config file

This order is applied no matter the directory in which you issue a Zowe CLI command. As a user, it can be easy to trace this logic when configuration files are all either in your ZOWE_CLI_HOME directory (broad scope) or your project directory (narrow scope).

But when there are configuration files across directories (meaning, in a project directory *and* a home directory), tracking how these files work together can seem more complicated.

Read on to go over some examples.

Using a profile found in multiple configuration files

Consider a user that has all configuration file types, as in the following scenario:

specificity type	file type	profile	property	value
narrow scope/more specific	project user config file	One	ABC	red
narrow scope/less specific	project team config file	Two	XYZ	yellow
broad scope/more specific	global user config file	Three	MNO	green
broad scope/less specific	global team config file	Two	XYZ	blue

In the case above, if Zowe CLI needs the `MNO` property to carry out a command, it refers to the global user configuration file to apply the `green` value because it is the only configuration file that has this particular property. No need to compare the specificity of files here.

On the other hand, if a Zowe CLI command needs the information in the `Two` profile, it can seem like there are two possible values, `yellow` and `blue`. In this case Zowe CLI knows to use `yellow` by following the rules of specificity: The project team file has a narrower scope than the global team file.

Zowe CLI takes the following steps:

1. Finds the `XYZ` property in both `Two` profiles.
2. Ignores the `blue` value for the `XYZ` property because the global configuration file has a broad scope.
3. Uses the `yellow` value for the `XYZ` property because the project configuration file has a narrow scope.

Using multiple properties found in multiple profiles

Consider a more layered scenario. Again, assume you have all four configuration file types, but the following conditions apply:

- There are multiple profiles across all four configuration file types.
- Some profiles appear in multiple configurations. Other profiles show up in only one file.
- There are multiple properties shared across several profiles.
- Some properties are found in only one profile.

In this scenario, the following profiles, properties, and values exist, displayed in the format **profile:** *property:* value:

Project User Configuration File	**Project Team Configuration File**	**Global User Configuration File**	**Global Team Configuration File**
abc: *direction:* north	**abc:** *direction:* east	**abc:** *direction:* south	**abc:** *direction:* west **abc:** *numbers*: 123
def: *shape:* triangle	**def:** *shape:* square	**def:** *shape:* circle	
			ghi: *texture:* bumpy
jkl: *temperature:* cold			
	mno: *fruit:* banana		
		pqr: *distance:* near	

The table below shows how Zowe CLI determines which profiles, properties, and values to use in a command.

Configuration files in use	**Specificity rules**	**Profiles, properties and values used**
• global user profile • global team profile	• When the same property exists within the same profile in both config files, the property value from the global user config is used.	**abc:** *direction:* south **abc:** *numbers:* 123 **def:** *shape:* circle

Configuration files in use	Specificity rules	Profiles, properties and values used
	• When the same profile exists in both config files, but a property of that profile exists in only one file, that property is used. • If a profile exists in only one config file, that profile is used in its entirety.	**ghi:** *texture:* bumpy **pqr:** *distance:* near
• project team profile • global user profile • global team profile	• When a profile exists in all three config files, the project team profile is used.* • If a profile exists in only one config file, that profile is used in its entirety.	**abc:** *direction:* east **def:** *shape:* square **ghi:** *texture:* bumpy **mno:** *fruit:* banana **pqr:** *distance:* near
• project user profile • project team profile • global user profile • global team profile	• When the same profile with the same properties exists in all four config files, the property values from the project user config is used. • When the same profile exists in all four config files, the project files override the global files. If a property of the profile exists in only one of the two project configurations, that property is used.* • If a profile exists in only one config file, that profile is used in its entirety.	**abc:** *direction:* north **def:** *shape:* triangle **ghi:** *texture:* bumpy **jkl:** *temperature:* cold **mno:** *fruit:* banana **pqr:** *distance:* near

***** If the same profile exists in both a global configuration file and a project configuration file, the project configuration profile completely replaces the global profile. This is true even when the project profile has fewer properties in the same profile found in the global file.

The preceding rules apply when profiles have the same name. To maintain the same set of properties in two different profiles, give each profile a different name so that Zowe CLI uses a specific profile, if needed.

For more information on how configuration files work together, see How Zowe CLI team configuration files are merged together.

Version: v3.2.x LTS

Managing credential security

Secure credential storage

The Zowe CLI **Secure Credential Store (SCS) Plug-in** was deprecated in Zowe V2, rendering the `zowe scs` command group obsolete.

Secure credential encryption is included with the Zowe CLI core application. When a command using a profile with missing `user` and `password` information is issued, Zowe CLI prompts you to enter the username and password. Both are then stored securely by default.

For other ways to store credentials securely, use the `zowe config` command group. See the following instructions.

Configuring secure properties

Create a configuration file and set its secure properties (such as usernames and passwords):

1. Open the Zowe CLI command prompt.
2. To initialize a **project team** configuration file in the current working directory:

   To initialize a **project user** configuration file in the current working directory:

   To initialize a **global team** configuration file in the `ZOWE_CLI_HOME` directory:

   To initialize a **global user** configuration file in the `ZOWE_CLI_HOME` directory:

   A configuration file is created, if one does not already exist.

   Additionally, the `user` and `password` fields are added to the generated base profile's `secure` array for that configuration file. Zowe CLI stores the username and password in the secure credential store.
3. If needed, add other fields to the secure array.

   - Use a text editor or an IDE (such as Visual Studio Code) to edit the configuration file.
   - Issue the `zowe config set --secure <property-path>` command to secure a specific property in a specific profile.

     For example, in a global configuration file, `zowe config set profiles.global_base.properties.password pw123 --secure` adds the `password` property to the `global_base` profile's `secure` array and saves the password `pw123` in the secure credential store.

     If you issue the command for a property that is already secured, the CLI prompts you to enter a new property value.

   The values for these properties are saved in the secure credential store.

Updating secure properties

Update secure credentials in an existing config profile:

1. Open the Zowe CLI command prompt.
2. To update values for secure fields in a **project team** configuration file:

   To update values for secure fields in a **project user** configuration file:

   To update values for secure fields in a **global team** configuration file:

   To update values for secure fields in a **global user** configuration file:

   Prompts request new values for all secure fields defined in the configuration file. In most cases, these properties include a username or password, but some users may include other fields, such as a token value or connection properties.
3. Respond to prompts as needed. Press `Enter` to leave the value unchanged.

   New values are saved in the secure credential store. After the last secure value is submitted, the user returns to the system command prompt.

Setting secure properties programmatically

When configuring secure properties with scripts or workflow pipelines, use the `zowe config set` command. See Step 3 in Configuring secure properties for instructions on how to use the command.

Storing properties automatically

When you issue a command that is missing a required option value for a property (for example, host or password) the CLI prompts you to enter the option value.

The `autoStore` property in the `zowe.config.json` file lets you store the option values for properties automatically. When you specify the `autoStore` property in `zowe.config.json` to `true`, the value that you enter when prompted is stored for future commands to use. The values for secure fields are stored securely in the credential vault (if configured accordingly), and the other values are written to `zowe.config.json` on disk.

The default value of the `autoStore` property is `true`. However, if you do not want to store properties automatically, set the value of `autoStore` to `false`.

A value of `false` prompts for missing values on all commands that you issue.

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Integrating API ML with Zowe CLI

The Zowe API Mediation Layer (API ML) provides a secure single point of access to a defined set of mainframe services. API ML provides API management features such as high-availability, consistent security, and a single sign-on (SSO) and multi-factor authentication (MFA) experience.

The recommended way to interact with API ML is through the use of tokens.

Tokens allow you to access services through API ML without reauthenticating every time you issue a command. Tokens provide secure interaction between the client and server. When you issue commands to API ML, the mediation layer routes requests to an appropriate API instance based on system load and available API instances.

Tokens can be obtained by logging into API ML with a username and password, or a client certificate.

How token management works

When you log in with Zowe CLI, an API ML token is supplied and stored on your computer to be used in place of a username and password. The token provides a secure handshake with API ML when you issue commands so that you do not need to reauthenticate until the token expires.

> **NOTE**
>
> Zowe CLI also supports standard token implementations such as Java Web Tokens (JWT) and Lightweight Third-Party Authentication (LTPA).

Logging in with username and password

Provide your username and password to generate a token and log in to API ML:

1. Log in to API ML:

   For users who do not have a base profile that has been used to log into API ML, this creates a new base profile that is set as the default base profile in your configuration file.

   For users who have a default base profile already used to log into API ML, this updates the existing default base profile with a new token.

2. When prompted, enter the following information:

   - Username
   - Password (can be a PIN concatenated with a second factor for MFA)
   - Host
   - Port for the API ML instance

   A base profile is created or updated with your token, which is stored on your computer in place of a username and password. When you issue commands, you can omit your username, password, host, and port.

If you do not want to store the token on your PC, append the `--show-token` option to the `login` command in Step 1. This returns the token value in your terminal for you to use on subsequent commands.

If you already created a base profile, you might not be prompted for the host and port.

3. If you do not have a profile for the service, respond to Zowe CLI prompts for connection information to create a profile for the service.

   > **TIP**
   > - To establish a base path, see instructions for Zowe V2 profiles or Zowe V1 profiles.

   If you already have a profile in your configuration for the service you want to connect to, use a text editor to open the applicable configuration file and replace the `port` property with a `basePath` property to enable the use of API ML.

   A profile with a port number:

   A profile with a base path:

   If you use the `--show-token` option with the `login` command, you must manually supply the token on each command using the `--token-value` option. For example:

   - `<searchPattern>`

     Specifies the data set search criteria (for example, `<IBMUSER.*>`)

   - `<123>`

     Specifies the token value supplied in Step 2.

> **NOTES**
> - Tokens expire after a period of time defined by your security administrator. When a token expires, you must log in to API ML again to get a new token.
> - If you omit connection details from a service profile, such as `zosmf` profile, the CLI uses the information from your base profile.
> - You can choose to specify all connection details on a service profile and connect directly to the service. Routing through API ML is not required.

Logging in with a client certificate

Use a client certificate to generate a token and log in to API ML:

- `<APIML Host>`

  Specifies the API ML host.

- `<APIML Port>`

  Specifies the API ML port.

- `<PEM Public Certificate Path>`

  Specifies the path for the PEM public certificate.

- `<PEM Private Certificate Path>`

  Specifies the path to the PEM private certificate.

Zowe CLI procures a security token from API ML and adds that token to the base profile in the applicable configuration file.

> **NOTE**
>
> If you have multiple types of configuration files and base profiles, see How configuration files and profiles work together to learn which configuration and profile would be used to store the API ML token.

Logging out

Log out to prompt the API ML token to expire and remove it from your base profile:

This causes the token to expire. Log in again to obtain a new token.

If you used the `--show token` option and never stored your token in profile, add the `--token-value` option to this command to invalidate the token.

Specifying a base profile

Base profiles contain mainframe connection information that is used by the service profiles in your configuration. There can be multiple base profiles in the same configuration file, including a default base profile. This could be the case, for example, if you run different systems for development and testing and use a different base profiles for each.

The `zowe auth login apiml` and `zowe auth logout apiml` commands use your configuration's default base profile when issued without additional options.

However, you might need to use a different base profile. To do so, add the `--base-profile` option to specify the base profile that you want to use when logging in or out of API ML.

- Use `--base-profile` to log in to API ML and save your token in a specific base profile that is not the default base profile:

  Logging in with a username and password:

  Logging in with a client certificate:

- Use `--base-profile` when issuing commands with API ML:

- Use `--base-profile` to log out of API ML and invalidate your token:

Accessing a service through API ML

To access mainframe services through API ML using the token in your base profile, use the `basePath` property in your service profile to indicate the base path of the API on the API ML instance that you want to access.

To establish a base path, see instructions for Zowe V2 profiles.

> **NOTE**
>
> Ensure that you *do not* provide username, password, host, or port directly on the service commands or profiles. Supplying those options causes the CLI to ignore the API ML token in your base profile and access the service directly.

Specifying a base path with Zowe team configuration

Use the following steps to specify a base path with Zowe team configuration:

1. Note the complete path for a z/OSMF instance registered to API ML.

   For example:

   The format of base paths can vary based on how API ML is configured at your site.

2. Using the example in Step 1, access the API ML instance by creating or updating a service profile, or issuing a command, with the base path value of `ibmzosmf/api/v1`. Your service profile uses the token and credentials stored in your default base profile.

   To create or update a service profile with the preceding base path in a **project** team configuration file:

   If you are using a **global** team configuration file (located in your home directory), add `--global-config` to the end of the command.

   Commands issued with this profile are routed through API ML to access an appropriate z/OSMF instance.

Specifying a base path with Zowe V1 profiles

See the Integrating with API Mediation Layer Zowe V1 documentation.

Accessing multiple services with SSO

If multiple services are registered to the API Mediation Layer at your site, Zowe CLI lets you access the services with Single Sign-on (SSO). Log in once to conveniently access all available services.

Edit your configuration file so that each service profile includes the `basePath` property and the corresponding value. Ensure that you do not provide username, password, host, or port in the service profiles. Supplying those options causes the CLI to ignore the token in your base profile and directly access the service.

For information about registering an API service at your site, see Developing for API Mediation Layer.

Accessing services through SSO and a service not through API ML

A scenario might exist where you log in to API ML with SSO, but you also want to access a different service *directly*.

In this case, your `zowe.config.json` file might look like the following client configuration:

zowe.config.json

In the preceding configuration, the base profile `my_one_base_profile` (Lines 10-16) includes connection information to be used by the two z/OSMF service profiles, `zosmf_thru_apiml` (Lines 17-23) and `zosmf_direct` (Lines 24-33). Use `zosmf_thru_apiml` to connect to z/OSMF with API ML and `zosmf_direct` to connect to z/OSMF directly.

Use the configuration example to connect with z/OSMF using API ML's SSO feature:

1. Add a base profile that includes the information that API ML needs to connect to z/OSMF, like the host and port.
    - Include the `port` property and value to avoid entering the port number manually when logging into API ML.
2. Add a service profile for z/OSMF that includes the `basePath` property.
    - The base path indicates the starting point for the z/OSMF REST API.
    - Omit the host and port because these are supplied by the base profile.
3. Log in to API ML.
    - This creates an authentication token that is stored on your computer. The `tokenType` property is also added to your base profile.
4. Issue commands.
    - If you have multiple base profiles in your configuration, use the `--base-profile` option to specify which base profile to use with API ML.

Use the configuration example to connect to z/OSMF directly:

1. Ensure that the base profile includes the information to connect directly to z/OSMF, like the host.
    - Leave the port information as it was set for API ML.
2. Add a service profile for z/OSMF that includes the `port` property and value.
    - This port number should match the port on the mainframe through which applications can access the z/OSMF REST services. This port number overrides the port in the base profile.
3. Issue commands.
    - If you have multiple base profiles in your configuration, use the `--base-profile` option to specify which base profile to use for the host.

Accessing services through SSO and a service through API ML but not SSO

You might want to access multiple services with SSO, but also access a service through API ML that is not SSO-enabled.

To perform SSO for the first set of services, edit your configuration file so that these service profiles include the `basePath` property and the corresponding value. Ensure that you do not provide username, password, host, or port in the service profiles. Supplying those options causes the CLI to ignore the token in your base profile and directly access the service.

To access the service that is *not* SSO-enabled, add the `basePath` property and value to that service profile and also include a secure array containing `user` and `password`. (The credentials are stored in your computer's secure vault.)

This ensures that the request is routed to API ML, but `user` and `password` that you provide in the non-SSO service profile overrides the credentials in your base profile. This lets you sign in to the individual service.

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Working with certificates

Certificates authorize communication between a server and client, such as z/OSMF and Zowe CLI. The client CLI must "trust" the server to successfully issue commands. Use one of the following methods to let the CLI communicate with the server.

Configure certificates signed by a Certificate Authority (CA)

System administrators can configure the server with a certificate signed by a Certificate Authority (CA) trusted by Mozilla. When a CA trusted by Mozilla exists in the certificate chain, the CLI automatically recognizes the server and authorizes the connection.

FIND OUT MORE

- Using certificates with z/OS client/server applications in the IBM Documentation.
- Configuring the z/OSMF key ring and certificate in the IBM Documentation.
- Certificate management in Zowe API Mediation Layer
- Mozilla Included CA Certificate List

Extend trusted certificates on client

If your organization uses self-signed certificates in the certificate chain (rather than a CA trusted by Mozilla), you can download the certificate to your computer and add it to the local list of trusted certificates. Provide the certificate locally using the `NODE_EXTRA_CA_CERTS` environment variable.

Organizations might want to configure all client computers to trust the self-signed certificate.

FIND OUT MORE

The blog post Zowe CLI: Providing NODE_EXTRA_CA_CERTS outlines the process for using environment variables to trust a self-signed certificate.

Bypass certificate requirement

If you do not have server certificates configured at your site, or you want to trust a known self-signed certificate, you can append the `--reject-unauthorized false` flag to your CLI commands. Setting the `--reject-unauthorized` flag to `false` rejects self-signed certificates and essentially bypasses the certificate requirement.

IMPORTANT

Understand the security implications of accepting self-signed certificates at your site before you use this command.

To bypass the certificate requirement, open a command line window and issue the following command with your information:

- `<host>`

  Specifies the host name.

- `<port>`

  Specifies the port number.

- `<username>`

  Specifies the user name.

- `<password>`

  Specifies the user password.

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Using environment variables

> **NOTE**
>
> For information on how to modify Zowe CLI default environment variables, see Configuring Zowe CLI environment variables.

You can define environment variables to execute commands more efficiently. Store a value such as your password in an environment variable, then issue commands without specifying your password every time.

The term *environment* can refer to your operating system, container environment, or automation server such as Jenkins.

Consider assigning a variable in the scenarios outlined in the following table. See Formatting environment variables for instructions.

Use case	Example	Benefit
Store a commonly used value.	Specify your mainframe username as an environment variable.	Issue commands without the `--user` option, and Zowe CLI automatically uses the value defined in the environment variable.
Override a value in existing profiles.	Override a value previously defined in multiple profiles. Specify the new value as a variable to override the value in profiles.	Avoid recreating each profile.
Secure credentials in an automation server or container	Set environment variables for use in scripts that run in your CI/CD pipeline. You can also define sensitive information in the Jenkins secure credential store.	Hide passwords and other sensitive information from plaintext in logs.

Store credentials securely in CI/CD pipelines

You can use environment variables when running CI/CD pipelines to load credentials that are securely stored.

To do so, use the `ZOWE_OPT_` prefix to turn a Zowe CLI command option into the proper format for a Zowe CLI environment variable. For instructions, see Formatting environment variables.

The environment variables to use environment variables for a username and password are `ZOWE_OPT_USER` and `ZOWE_OPT_PASSWORD`.

Include the username and password environment variables in CI/CD pipelines that run Zowe CLI, as in the following example Jenkinsfile that uses the Jenkins credential store:

For more information on Jenkins credential storage, see Using credentials and Using a Jenkinsfile.

Formatting environment variables

Transform an option into the proper format for a Zowe CLI environment variable, then define a value to the variable. Transform option names according to the following rules:

- Prefix environment variables with `ZOWE_OPT_`.
- Convert lowercase letters in arguments/options to uppercase letters.
- Convert hyphens in arguments/options to underscores.

> **TIP**
>
> Refer to your operating system documentation for information about how to set and get environment variables. The procedure varies between Windows, Mac, and various versions of Linux.

Examples of transformed CLI options

The following table provides examples of CLI options and the corresponding environment variable to which you can define a value:

Command Option	Environment Variable	Use Case
`--user`	`ZOWE_OPT_USER`	Define your mainframe username to an environment variable to avoid specifying it on all commands or profiles.
`--reject-unauthorized`	`ZOWE_OPT_REJECT_UNAUTHORIZED`	Define a value of `true` to the `--reject-unauthorized` flag when you always require the flag and do not want to specify it on all commands or profiles.
`--editor`	`ZOWE_OPT_EDITOR`	Define an editor that Zowe CLI uses to open files. The value can be either the editor's executable file location or the name of a program (for example, *notepad* on Windows or *nano* on Linux).

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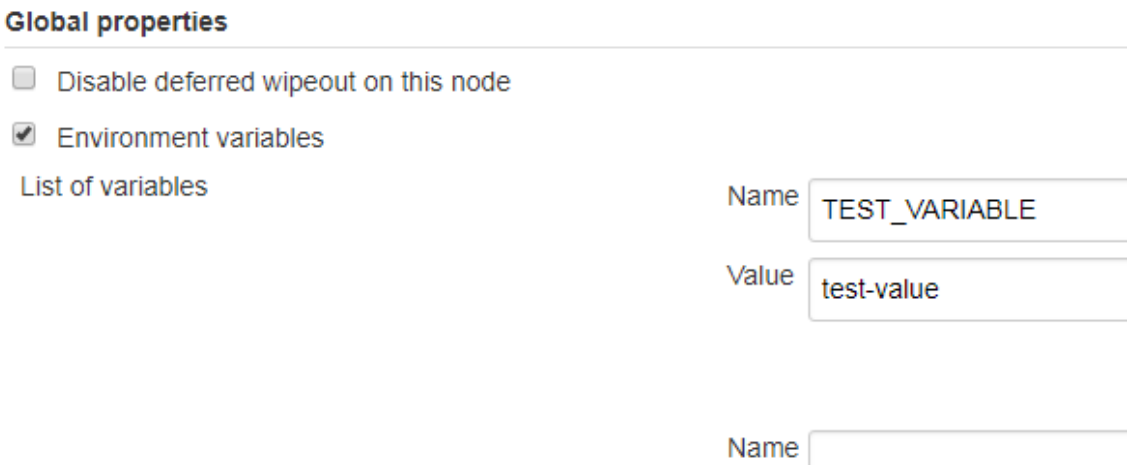
Setting environment variables in an automation server

You can use environment variables in an automation server, such as Jenkins, to write more efficient scripts and make use of secure credential storage. Automation tools such as Jenkins automation server usually provide a mechanism for securely storing configuration (for example, credentials). In Jenkins, you can use `withCredentials` to expose credentials as an environment variable (ENV) or Groovy variable.

You can set environment variables by using one of the following options:

- The `SET` command within your scripts
- The Jenkins web interface to navigate to **Manage Jenkins > Configure System > Global Properties** and define an environment variable in the Jenkins GUI.

For an example of using the web interface, see the following image:



Using the prompt feature

Zowe CLI uses a command-line "prompt" feature to request you to provide required option values. The CLI always prompts for host, port, username, and password information if not supplied in commands or profile configuration.

You can also manually enable the prompt for any option. This is helpful to mask sensitive information on the screen while you type. You can enable a one-time prompt, or you can choose to always prompt for a particular option.

Enabling a one-time prompt

To enable a one-time prompt:

1. Open the Zowe CLI command prompt.
2. Specify an option or positional argument as `prompt*`:

   Zowe CLI responds with a prompt for the information.
3. Enter the correct value at the prompt.

   The prompt hides the user's input as it is entered into the command line.

Always prompting for a particular option

Always prompting can be a good practice when your environment's security protocols prevent storing credentials on a personal computer, or expire passwords frequently (as with multi-factor authentication).

To always prompt for a particular option:

1. Use a text editor to open the configuration file that contains the profile to be modified.
2. In the profile, save `prompt*` as the plain-text value for the profile properties for which you want to be prompted:
3. Test the prompt by running a command using the modified profile.

   Zowe CLI prompts for the configured properties, such as the user ID and password in the following example:

   The prompt hides the user's input as it is entered into the command line.

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Writing scripts

You can combine multiple Zowe CLI commands in bash or shell scripts to automate actions on z/OS. Implement scripts to enhance your development workflow, automate repetitive test or build tasks, and orchestrate mainframe actions from continuous integration/continuous deployment (CI/CD) tools such as Jenkins or TravisCI.

> **NOTE**
>
> The type of script that you write depends on the programming languages that you use and the environment where the script is executed. The following is a general guide to Zowe CLI scripts. Refer to third-party documentation to learn more about scripting in general.

To write a script:

1. Create a new file on your computer with the extension .sh. For example, `testScript.sh`.

   > **NOTE**
   >
   > On Mac and Linux, an extension is not required. To make the file executable, issue the command `chmod u+x testScript`.

2. For Mac and Linux only: At the top of the file, specify the interpreter that your script requires. For example, type `#!/bin/sh` or `#!/bin/bash`.

   > **NOTE**
   >
   > The command terminal that you use to execute the script depends on what you specify at the top of your script. Bash scripts require a bash interpreter (bash terminal), while shell scripts can be run from any terminal.

3. Write a script using a series of Zowe CLI commands.

   > **TIP**
   >
   > You can incorporate commands from other command-line tools in the same script. You might choose to "pipe" the output of one command into another command.

4. From the appropriate command terminal, issue a command to execute the script. The command you use to execute script varies by operating system.

The script runs and prints the output in your terminal. You can run scripts manually, or include them in your automated testing and delivery pipelines.

Sample script library

Refer to the Zowe CLI Sample Scripts repository for examples that cover a wide range of scripting languages and use cases.

Example: Clean up Temporary Data Sets

The script in this example lists specified data sets, then loops through the list of data sets and deletes each file. You can use a similar script to clean up temporary data sets after use.

> **NOTE**
>
> Run this script from a bash terminal.

Example: Submit Jobs and Save Spool Output

The script in this example submits a job, waits for the job to enter output status, and saves the spool files to local files on your computer.

> **NOTE**
>
> Run this script from a bash terminal.

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Using a z/OS attributes file

Use a `.zosattributes` file to control how files are converted and tagged when you upload a local directory to a USS directory on the mainframe.

What is a `.zosattributes` file

A `.zosattributes` file saved in your source directory provides uploading and downloading instructions to the mainframe. A line in the file can specify a code comment or instructions.

An example `.zosattributes` file:

- `#`
  - Denotes a comment when used at the start of a line. In the preceding example, comments are highlighted.
- Each line can specify up to three positional attributes, or instructions:
  - A pattern to match a set of files.
    - Pattern-matching syntax follows the same rules as those that apply in `.gitignore` files. Negated patterns that begin with `!` are not supported.
    - For syntax, see Pattern Format.
  - A local-encoding to identify a file's encoding on the local workstation.
    - When `-` is specified for local-encoding, files that match the pattern are not transferred.
  - A remote-encoding to specify the file's desired character set on USS.
    - This attribute must either match the local encoding or be set to `EBCDIC`. If set to `EBCDIC`, files are transferred in text mode and converted, otherwise they are transferred in binary mode.
    - Remote files are tagged either with the remote encoding or as binary.

Using a `.zosattributes` file with Zowe CLI

Use a `.zosattributes` file with Zowe CLI to issue commands to control how the mainframe uploads your local files.

`.zosattributes` file location

A `.zosattributes` file can be saved in the top-level directory you want to upload.

Or specify its location by using the `--attributes` option with the `zowe zos-files upload dir-to-uss` command:

`.zosattributes` files that are placed in nested directories are ignored.

Using a `.zosattributes` file with Zowe Explorer for VS Code

In Zowe Explorer for Visual Studio Code, first upload a `.zosattributes` file to a USS directory on the mainframe and then upload files to that directory.

Creating a `.zosattributes` file

Use a text editor to create a `.zosattributes` file to instruct Zowe what local files to upload and how to convert and tag them.

For pattern-matching syntax, follow the Pattern Format. For how to write the local encoding and remote encoding instructions, see What is a `.zosattributes` file.

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Zowe CLI plug-ins

You can install plug-ins to extend the capabilities of Zowe™ CLI. CLI Plug-ins for third-party applications are also available.

Plug-ins add functionality to the product in the form of new command groups, actions, objects, and options.

> **IMPORTANT**
>
> Plug-ins can gain control of Zowe CLI legitimately during the execution of every command. Install third-party plug-ins at your own risk.

You can install the following Zowe plug-ins:

- IBM® CICS® Plug-in for Zowe CLI
- IBM® Db2® Plug-in for Zowe CLI
- IBM z/OS FTP Plug-in for Zowe CLI
- IBM MQ Plug-in for Zowe CLI
- Third-party Zowe Conformant Plug-ins

Use either of the following methods to install plug-ins:

- Install from an online NPM registry. Use this method when your computer can access the Internet.

  For more information, see Installing plug-ins from an online registry.

- Install from a local package. With this method, you download and install the plug-ins from a bundled set of `.tgz` files. Use this method when your computer cannot access the Internet.

  For more information, see Installing plug-ins from a local package.

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Installing Zowe CLI plug-ins

Use commands in the `plugins` command group to install and manage Zowe™ CLI plug-ins.

> **IMPORTANT**
>
> Plug-ins can gain control of Zowe CLI legitimately during the execution of every command. Install third-party plug-ins at your own risk.

Installing plug-ins from an online registry

The following procedure assumes that you previously installed Zowe CLI core.

To install Zowe CLI plug-ins on Windows, Mac, and Linux:

1. Meet the software requirements for each plug-in to be installed.
2. Install a plug-in from public npm:
   - `<my-plugin>`

     Specifies the command syntax for the plug-in to be installed. Use the following table to determine the syntax for your plug-in.

Plug-in	Syntax
IBM CICS Plug-in for Zowe CLI	`@zowe/cics-for-zowe-cli@zowe-v3-lts`
IBM Db2 Plug-in for Zowe CLI	`@zowe/db2-for-zowe-cli@zowe-v3-lts`
IBM z/OS FTP Plug-in for Zowe CLI	`@zowe/zos-ftp-for-zowe-cli@zowe-v3-lts`
IBM MQ Plug-in for Zowe CLI	`@zowe/mq-for-zowe-cli@zowe-v3-lts`
3. (Optional) Issue the following command to install two or more plug-ins using one command. Separate the `<my-plugin>` names with a single space.

   > **NOTE**
   >
   > The IBM Db2 Plug-in for Zowe CLI requires additional licensing and ODBC driver configurations. If you installed the DB2 plug-in, see IBM Db2 Plug-in for Zowe CLI.

   You have successfully installed the specified Zowe CLI plug-in(s).

Installing plug-ins from a local package

The following procedure assumes that you previously installed Zowe CLI core.

To install plug-ins from a local package on any computer that has limited or no access to the Internet:

1. Meet the software requirements for each plug-in that you want to install.

2. Obtain the installation files.

   From the Zowe Download website, click **Download Zowe CLI** to download the Zowe CLI installation package named `zowe-cli-package-<X.Y.Z>.zip` to your computer.

   - `v`

     Specifies the version number

   - `r`

     Specifies the release number

   - `m`

     Specifies the modification number.

3. Open a command-line window, such as Windows Command Prompt. Browse to the directory where you downloaded the Zowe CLI installation package (.zip file). Issue the following command, or use your preferred method to unzip the files:

   Example:

   By default, the unzip command extracts the contents of the zip file to the directory where you downloaded the .zip file. You can extract the contents of the zip file to your preferred location.

4. Issue the following command against the extracted directory to install each available plug-in:

   Replace `<my-plugin>` with the .tgz file name listed in the following table:

Plug-in	**`.tgz` File Name**
IBM CICS Plug-in for Zowe CLI	`cics-for-zowe-cli.tgz`
IBM Db2 Plug-in for Zowe CLI	`db2-for-zowe-cli.tgz`
IBM z/OS FTP Plug-in for Zowe CLI	`zos-ftp-for-zowe-cli.tgz`
IBM MQ Plug-in for Zowe CLI	`mq-for-zowe-cli.tgz`

   You have successfully installed the Zowe CLI plug-ins.

Validating plug-ins

Issue the plug-in validation command to run tests against all plug-ins (or against a plug-in that you specify) to verify that the plug-ins integrate properly with Zowe CLI. The tests confirm that the plug-in does not conflict with existing command groups in the base application. The command response provides you with details or error messages about how the plug-ins integrate with Zowe CLI.

The `validate` command has the following syntax:

- **`[plugin]`**

  Specifies the name of the plug-in that you want to validate. If you do not specify a plug-in name, the command validates all installed plug-ins. The name of the plug-in is not always the same as the name of the NPM package.

Plug-in	Syntax
IBM CICS Plug-in for Zowe CLI	`@zowe/cics-for-zowe-cli`
IBM Db2 Plug-in for Zowe CLI	`@zowe/db2-for-zowe-cli`
IBM z/OS FTP Plug-in for Zowe CLI	`@zowe/zos-ftp-for-zowe-cli`
IBM MQ Plug-in for Zowe CLI	`@zowe/mq-for-zowe-cli`

Examples: Validate plug-ins

- The following example illustrates the syntax to use to validate the IBM CICS Plug-in for Zowe CLI:
- The following example illustrates the syntax to use to validate all installed plug-ins:

Updating plug-ins

You can update Zowe CLI plug-ins from an online registry or from a local package.

Update plug-ins from an online registry

Issue the `update` command to install the latest stable version or a specific version of a plug-in that you installed previously. The `update` command has the following syntax:

- [plugin...]

  Specifies the name of an installed plug-in that you want to update. The name of the plug-in is not always the same as the name of the NPM package. You can use npm semantic versioning to specify a plug-in version to which to update. For more information, see npm semver.

- `[--registry \<registry>\]`

  (Optional) Specifies a registry URL that is different from the registry URL of the original installation.

Examples: Update plug-ins

The following example illustrates the syntax to use to update an installed plug-in to the latest version:

The following example illustrates the syntax to use to update a plug-in to a specific version:

Update plug-ins from a local package

You can update plug-ins from a local package. You acquire the media from the Zowe Download website and update the plug-ins using the `zowe plugins install` command.

To update plug-ins from a local package, follow the steps described in Installing plug-ins from a local package.

Uninstall Plug-ins

Issue the `uninstall` command to uninstall plug-ins from Zowe CLI. After the uninstall process completes successfully, the product no longer contains the plug-in configuration.

The uninstall command contains the following syntax:

- `[plugin]`

  Specifies the name of the plug-in that you want to uninstall.

The following table describes the uninstallation command syntax for each plug-in:

Plug-in	Syntax
IBM CICS Plug-in for Zowe CLI	`@zowe/cics-for-zowe-cli`
IBM Db2 Plug-in for Zowe CLI	`@zowe/db2-for-zowe-cli`
IBM z/OS FTP Plug-in for Zowe CLI	`@zowe/zos-ftp-for-zowe-cli`
IBM MQ Plug-in for Zowe CLI	`@zowe/mq-for-zowe-cli`

Example:

The following example illustrates the command to uninstall the CICS plug-in:

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IBM® CICS® Plug-in for Zowe CLI

The IBM® CICS® Plug-in for Zowe™ CLI lets you extend Zowe CLI to interact with CICS programs and transactions. The plug-in uses the IBM CICS® Management Client Interface (CMCI) API to achieve the interaction with CICS. For more information, see CICS management client interface on the IBM Knowledge Center.

Use cases

As an application developer, you can use the plug-in to perform the following tasks:

- Deploy code changes to CICS applications that were developed with COBOL.
- Deploy changes to CICS regions for testing or delivery. See the define command for an example of how you can define programs to CICS to assist with testing and delivery.
- Automate CICS interaction steps in your CI/CD pipeline with Jenkins Automation Server or TravisCI.
- Deploy build artifacts to CICS regions.
- Alter, copy, define, delete, discard, and install CICS resources and resource definitions.

Commands

For detailed documentation on commands, actions, and options available in this plug-in, see our web help.

There are several methods to view Zowe CLI web help:

- Use a web browser
- Extract from a ZIP file
- Download a PDF file

Software requirements

Before you install the plug-in, meet the software requirements in Software requirements for Zowe CLI plug-ins.

Installing

Use one of the following methods to install or update the plug-in:

- Installing plug-ins from an online registry
- Installing plug-ins from a local package

Creating a user profile

After you install the plug-in, create a CICS profile to avoid entering your connection details each time that you issue a command. You can create multiple profiles and switch between them as needed.

Specify your plug-in profile and connection details in the `zowe.config.json` configuration file.

Creating plug-in profiles using a configuration file

If you have the CICS plug-in installed and issue the `zowe config init`, `zowe config auto-init`, or `zowe config convert-profiles` command, the command creates an entry for a CICS profile in your `zowe.config.json file`.

Alternatively, you can create a CICS profile manually by adding a section that contains the configuration details to your `zowe.config.json` configuration file.

Creating a CICS profile with a command

1. Install the CICS Plug-in for Zowe CLI.
2. Create a CICS profile:
3. Set the port number to the port configured for a CICS connection on your mainframe.
   - `<port number>`

     Specifies the port number for the instance.

   You can now use your profile when you issue commands in the cics command group.

Creating a CICS profile manually

1. Install the CICS Plug-in for Zowe CLI.
2. Browse to the directory `C:\Users\<username>\.zowe`.
3. Open the `zowe.config.json` configuration file using a text editor or IDE, such as Visual Studio Code or IntelliJ IDEA.

   > **NOTE**
   >
   > If the file does not exist, issue the following command to create the configuration file:

4. Add code to the "profiles" section as shown in the following example:
5. Save the file.

   You can now use your profile when you issue commands in the zftp command group.

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IBM® Db2® Database Plug-in for Zowe CLI

The IBM® Db2® Database Plug-in for Zowe™ CLI lets you interact with Db2 for z/OS to perform tasks through Zowe CLI and integrate with modern development tools. The plug-in also lets you interact with Db2 to advance continuous integration and to validate product quality and stability.

Zowe CLI Plug-in for IBM Db2 Database lets you execute SQL statements against a Db2 region, export a Db2 table, and call a stored procedure. The plug-in also exposes its API so that the plug-in can be used directly in other products.

Use cases

As an application developer, you can use Zowe CLI Plug-in for IBM Db2 Database to perform the following tasks:

- Execute SQL and interact with databases.
- Execute a file with SQL statements.
- Export tables to a local file on your computer in SQL format.
- Call a stored procedure and pass parameters.

Using commands

For detailed documentation on commands, actions, and options available in this plug-in, see our web help.

There are several methods to view Zowe CLI web help:

- Use a web browser
- Extract from a ZIP file
- Download a PDF file

Software requirements

Before you install the plug-in, meet the software requirements in Software requirements for Zowe CLI plug-ins.

Installing

Use one of the following methods to install the the Zowe CLI Plug-in for IBM Db2 Database:

- Install from an online registry
- Install from a local package

Installing from an online registry

If you installed Zowe CLI from **online registry**:

1. Open a command line window and issue the following command:

2. Address the license requirements to begin using the plug-in.

Installing from a local package

Follow these procedures if you downloaded the Zowe installation package:

Downloading the ODBC driver

Download the ODBC driver before you install the Db2 plug-in:

1. Download the ODBC CLI Driver. Use the table within the download URL to select the correct CLI Driver for your platform and architecture.

2. Create a new directory named `odbc_cli` on your computer. Remember the path to the new directory. You need to provide the full path to this directory immediately before you install the Db2 plug-in.

3. Place the ODBC driver in the `odbc_cli` folder. **Do not extract the ODBC driver**.

   You downloaded and prepared to use the ODBC driver successfully. Proceed to install the plug-in to Zowe CLI.

Installing Xcode on MacOS

To install the Db2 CLI plug-in on MacOS, you need the command line tools, which can be obtained by installing Xcode from the App Store.

> **NOTE**
>
> On some versions of MacOS, you may receive the error `xcrun: error: invalid active developer path` as shown below:
>
> If this occurs, a manual refresh of the command line tools is required by running the following commands:

Installing the plug-in

With the Db2 ODBC CLI driver downloaded, set the `IBM_DB_INSTALLER_URL` environment variable and install the Db2 plug-in to Zowe CLI:

1. Open a command line window and change the directory to the location where you extracted the `zowe-cli-plugins-<X.Y.Z>.zip` file. If you do not have the `zowe-cli-bundle.zip` file, see Installing Zowe CLI and Zowe CLI plug-ins from a local package for information about how to obtain and extract it.

2. From a command line window, set the `IBM_DB_INSTALLER_URL` environment variable:

   - Windows operating systems:

   - Linux and Mac operating systems:

     For example, if you downloaded the Windows x64 driver (`ntx64_odbc_cli.zip`) to `C:\odbc_cli`:

3. To install the IBM Db2 Database Plug-in:

4. See Addressing the license requirement to begin using the plug-in.

You have installed the IBM Db2 Database Plug-in successfully.

Addressing the license requirement

To successfully connect the Db2 CLI plug-in to a database on z/OS, a license needs to be present either on the client where the Zowe CLI is executed from, or on z/OS. If you do not have a license configured when you execute Db2 CLI commands, you receive the following error `SQL1598N`:

Server-side license

You can execute the utility `db2connectactivate` on z/OS to enable a Db2 database to accept client requests. For more information, see db2connectactivate - Server license activation utility. This avoids having to apply the Db2 Connect license on each database client that connects directly to the server. It is also the preferred approach to enabling users of the Zowe Db2 CLI because it avoids individual client license distribution and configuration.

Client-side license

If the utility `db2connectactivate` has not been executed against the Db2 database that your profile is connecting to, then it is possible to obtain the license file `db2consv_zs.lic` from a copy of Db2 Connect and use this for client configuration. This will need to be done separately for each client PC.

1. Locate your client copy of the Db2 license file `db2consv_zs.lic`.

   > **NOTE**
   >
   > The license must be of version 11.5 if the Db2 server is not `db2connectactivated`. You can buy a db2connect license from IBM. The connectivity can be enabled either on server using db2connectactivate utility or on client using client side license file. For more information about Db2 license and purchasing cost, please contact IBM Customer Support.

2. Copy your Db2 license file `db2consv_za.lic` and place it in the following directory.

   > **TIP**
   >
   > By default, `<zowe_home>` is set to `~/.zowe` on \UNIX and Mac systems, and `C:\Users\<Your_User>\.zowe` on Windows systems.

   After the license is copied, you can use the Db2 plug-in functionality.

Creating a user profile

After you install the plug-in, create a Db2 profile to avoid entering your connection details each time that you issue a command. You can create multiple profiles and switch between them as needed.

Add your plug-in profile and connection details to the `zowe.config.json` configuration file. In the profile, enter the IP address and port number of the Db2 database, as well as the eight-character database schema name.

> **TIP**

You can get your connection information by either:

- Issuing the `-DISPLAY DDF` command
- Searching for the message ID `DSNL004I` in the JES spool for the Db2 MSTR address space

  Example of how to read the `DSNL004I` message with example values:

  - `DOMAIN`
    Specifies the value for the CLI host.
  - `TCPPORT`
    Specifies the port number.
  - `SECPORT`
    If a TLS certificate is being used, specifies the secure port.
  - `LOCATION`
    Specifies the property to use in the `database` value.

Creating plug-in profiles using a configuration file

You can issue commands to create a Db2 profile, or you can manually edit your configuration file to add a profile.

Creating a Db2 profile with a command

When you issue various `zowe config` commands, such as `init`, `auto-init`, and `convert-profiles`, they create a `zowe.config.json` configuration file. When you install the Db2 plug-in and then issue a command, the command creates an entry for a `db2 profile` in your `zowe.config.json` file.

To create a Db2 profile with a command:

1. Install the IBM Db2 Database Plug-in for Zowe CLI.
2. Create a Db2 profile:
3. Set the port number to the port configured for a Db2 connection on your mainframe.
   - `<port number>`
     Specifies the port number for the instance.
4. If an SSL file is available, set the `sslFile` value to SSL file path:

   You can now use your profile when you issue commands in the Db2 command group.

Creating a Db2 profile manually

To create a Db2 profile manually by adding a section that contains the configuration details in your `zowe.config.json` configuration file:

1. Install the Db2 Plug-in for Zowe CLI.
2. Browse to the directory `C:\Users\<username>\.zowe`.
3. Open the `zowe.config.json` configuration file using a text editor or IDE, such as Visual Studio Code or IntelliJ IDEA.

> **NOTE**
>
> If the file does not exist, issue the following command to create the configuration file:

4. Add code to the "profiles" section as shown in the following example:

5. Save the file.

   You can now use your profile when you issue commands in the Db2 command group.

Version: v3.2.x LTS

IBM® z/OS FTP Plug-in for Zowe CLI

The IBM® z/OS FTP Plug-in for Zowe™ CLI lets you extend Zowe CLI to access z/OS data sets, USS files, and submit JCL. The plug-in uses the z/OS FTP service to achieve the interaction with z/OS.

Use cases

As a z/OS user, you can use the plug-in to perform the following tasks:

- List, view, rename, and download z/OS data sets or USS files.
- Upload local files or `stdin` to z/OS data sets or USS files.
- List, view, and download job status or job spool files.
- Delete a z/OS data set, USS file, or job.

Using commands

> **IMPORTANT**
>
> When transferring files, data sets, or data set members, use only ASCII characters. If a file contains non-ASCII characters (such as glyphs or mathematical symbols), a translation error can happen when the file is downloaded from, or uploaded to, the mainframe. This error can result in data loss.

For detailed documentation on commands, actions, and options available in this plug-in, see our web help.

There are several methods to view Zowe CLI web help:

- Use a web browser
- Extract from a ZIP file
- Download a PDF file

Software requirements

Before you install the plug-in, meet the Software requirements for Zowe CLI plug-ins.

Installing

Use one of the following methods to install or update the plug-in:

- Installing plug-ins from an online registry
- Installing plug-ins from a local package

Creating a user profile

After you install the plug-in, create an FTP profile. An FTP profile is recommended to issue commands via FTP. FTP profiles contain your host, port, user name, and password to connect to z/OS using FTP. You can create multiple profiles and switch between them as needed.

Creating plug-in profiles using a configuration file

If you have the IBM® z/OS FTP plug-in installed and issue the `zowe config init`, `zowe config auto-init`, or `zowe config convert-profiles` command, the command creates an entry for a FTP profile in your `zowe.config.json file`.

Alternatively, you can create an FTP profile manually by adding a section that contains the configuration details to your `zowe.config.json` configuration file.

Creating an FTP profile with a command

1. Install the z/OS FTP Plug-in for Zowe CLI.
2. Create an FTP profile:
3. If using a non-standard port, set the port number to your FTP connection:
   - `<port number>`

     Specifies the port number for the instance.
4. If using an insecure connection, set the `secureFtp` value to `false`:

   You can now use your profile when you issue commands in the zftp command group.

Creating an FTP profile manually

1. Install the z/OS FTP Plug-in for Zowe CLI.
2. Browse to the directory `C:\Users\<username>\.zowe`.
3. Open the `zowe.config.json` configuration file using a text editor or IDE, such as Visual Studio Code or IntelliJ IDEA.

   > **NOTE**
   >
   > If the file does not exist, issue the following command to create the configuration file:

4. Add code to the "profiles" section as shown in the following example:
5. Save the file.

   You can now use your profile when you issue commands in the zftp command group.

Issuing test commands

After installing the plug-in successfully, you can issue commands to test basic Zowe CLI functionality.

For example, you can use one of the following methods to download a data set:

- Download a data set using a default profile:
- Download a data set without using a default profile:
  - `<hostname>`

    Specifies the host name for the instance.
  - `<User_ID>`

    Specifies your user name to log in to the instance.
  - `<password>`

    Specifies your password to log in to the instance.

Version: v3.2.x LTS

IBM® MQ Plug-in for Zowe CLI

The IBM MQ Plug-in for Zowe CLI lets you issue MQSC commands to a queue manager. MQSC commands let you perform administration tasks. For example, you can define, alter, or delete a local queue object.

> **NOTE**
>
> For more information about MQSC commands and the corresponding syntax, see MQSC commands on the IBM Knowledge Center.

Use cases

You can use the plug-in to execute MQSC Commands. With MQSC commands you can manage queue manager objects (including the queue manager itself), queues, process definitions, channels, client connection channels, listeners, services, namelists, clusters, and authentication information objects.

Using IBM MQ plug-in commands

For detailed documentation on commands, actions, and options available in this plug-in, see our web help.

There are several methods to view Zowe CLI web help:

- Use a web browser
- Extract from a ZIP file
- Download a PDF file

Software requirements

Before you install the plug-in, meet the software requirements in Software requirements for Zowe CLI plug-ins.

Installing

Use one of the following methods to install or update the plug-in:

- Installing plug-ins from an online registry
- Installing plug-ins from a local package

Creating a user profile

After you install the plug-in, create an MQ profile. An MQ profile is recommended to issue commands to the MQ resource. MQ profiles contain your host, port, user name, and password for the IBM MQ REST API server of your choice. You can create multiple profiles and switch between them as needed.

Specify your plug-in profile and connection details in the `zowe.config.json` configuration file.

Creating plug-in profiles using a configuration file

If you have the MQ plug-in installed and issue the `zowe config init`, `zowe config auto-init`, or `zowe config convert-profiles` command, the command creates an entry for a MQ profile in your `zowe.config.json file`.

Alternatively, you can create an MQ profile manually by adding a section that contains the configuration details to your `zowe.config.json` configuration file.

Creating an MQ profile with a command

1. Install the IBM MQ Database Plug-in for Zowe CLI.
2. Create an MQ profile:
3. Set the port number to the port configured for an MQ connection on your mainframe.
   - `<port number>`

     Specifies the port number for the instance.

   You can now use your profile when you issue commands in the MQ command group.

Creating an MQ profile manually

1. Install the IBM MQ Database Plug-in for Zowe CLI.
2. Browse to the directory `C:\Users\<username>\.zowe`.
3. Open the `zowe.config.json` configuration file using a text editor or IDE, such as Visual Studio Code or IntelliJ IDEA.

   > **NOTE**
   > If the file does not exist, issue the following command to create the configuration file:

4. Add code to the "profiles" section as shown in the following example:
5. Save the file.

   You can now use your profile when you issue commands in the MQ command group.

Version: v3.2.x LTS

IDF Plug-in for Zowe CLI

The IDF Plug-in for Zowe CLI lets you extend Zowe CLI to make it easier to map mainframe users with an identity provided by an external identity provider.

The plug-in is designed to work with the ESMs: IBM RACF, ACF/2, and Top Secret.

Use case

For a system administrator for the Zowe API Mediation Layer, the IDF Plug-in for Zowe CLI can help facilitate the mapping of an external identity from a distributed identity provider to mainframe users administered by the system ESM.

Commands

The plug-in provides the `map` command. For details about the map command, see Using.

> **NOTE**
>
> The plug-in `help` command includes specific parameters of Zowe-profiles which are not used.

Software requirements

Before you install the plug-in, ensure that you meet the software requirements in Software requirements for Zowe CLI plug-ins.

Installing

Use one of the following methods to install or update the plug-in:

- Installing plug-ins from an online registry
- Installing plug-ins from a local package

Use the following Plug-in ID with either of these installation methods:

Plug-in	Syntax
IDF Plugin for Zowe CLI	`@zowe/id-federation-for-zowe-cli`

Using

Currently, the plug-in does not interface with the mainframe system, so no Zowe CLI profile configuration is required.

For the most up-to-date details of required parameters, use the `help` command:

`zowe idf map --help`.

Use the following command to enable Zowe to generate a JCL. A security administrator can then submit this JCL to create a mapping.

`zowe idf map <csv-file> --esm <esm> --registry <registry> --system <system>`

- **csv-file**
  The path to the input CSV-formatted file, see below for the details of the format.

- **esm**
  The identifier of the target external security manager, one of ACF2, RACF, or TSS.

- **registry**
  The registry to identify the distributed identity provider, for example LDAP `ldap://12.34.56.78:389`

- **system**
  This is an optional parameter, system identifier for JCL purposes. Ensure that this value matches the system name defined in JES.

CSV Format

For proper functionality of the plug-in, ensure that the CSV input file has the following format without a header:

- **name**
  The descriptive name of the user.

- **dist_id**
  The distributed identity of the user.

- **mf_id**
  The mainframe id of the user.

Output

The `map` command generates an output file with a valid JCL. The output file name has the following pattern:

`idf_$ESM$SYSTEM.jcl`

- **$SYSTEM**
  This parameter is omitted if it is not provided.

Version: v3.2.x LTS

Using Zowe Explorer

Familiarize yourself with Zowe Explorer and make the best use of its available options and features.

Using Zowe Explorer in remote environments

As of Zowe Version 2.11, Zowe Explorer and the Zowe Explorer API no longer use `node-keytar`, which was used to manage mainframe credentials. This change might cause issues for some users when trying to interact with remote environments.

See Usage in Remote Environments to learn more about how to resolve credential errors.

Credentials in Zowe Explorer

When working in remote or virtualized environments — such as Eclipse Che, GitHub Codespaces, CodeReady Workspaces — administrators may find the configuration process for storing credentials securely too cumbersome. Instead, they might prefer to rely on the security tools integrated with these environments, such as file access permissions. To do so, administrators need to disable Zowe Explorer's credential management functionality.

> **NOTE**
>
> Consider other options. Use the Kubernetes Secrets plug-in for Zowe CLI and Zowe Explorer as an option for storing credentials in a Kubernetes containerized environment, or create your own Custom Credential Managers in Zowe Explorer and Zowe CLI.

Preventing Zowe Explorer from storing credentials

1. Open the `zowe.config.json` file in Visual Studio Code.
2. Find the `autoStore` property.
3. Set the `autoStore` property to `false`.

   Credentials are stored on a per profile/per panel basis until one of the following takes place:

   - **Data Sets**/**USS**/**Jobs** tree refresh caused by an update to the `zowe.config.json` file
   - Zowe Explorer refresh in the **Command Palette**
   - Reload of the Visual Studio Code window
   - Closing and reopening the VS Code window

Disabling Secure Credential Storage of credentials

Zowe Explorer V2 and V3

1. Navigate to **Settings** in VS Code.
2. In Zowe Explorer Settings, uncheck the **Zowe Security: Secure Credentials Enabled** checkbox.

When disabled and `autoStore` is set to True in `zowe.config.json`, z/OS credentials are stored as plain text in the configuration file.

Managing and using profiles

Use profiles and configuration files to apply specific settings when you work with the mainframe.

Profiles

Managing a profile

Manage existing profiles listed in the **Side Bar**. Right-click the profile and select **Manage Profile** in the context menu to see a list of options in the **Quick Pick**. Choose the option desired for managing the profile.

Deleting a profile

Delete a profile displayed in the **Side Bar**. Right-click the profile and select **Manage Profile** in the context menu to see a list of options in the **Quick Pick**. Select **Edit Profile** to open the associated configuration file and manually delete the profile.

Hiding a profile

Hide a profile from the **Side Bar**. Right-click the profile, select the **Manage Profile** option in the context menu, and then click **Hide Profile** in the **Quick Pick**. If necessary, add the profile back by clicking the **+** icon on the **DATA SETS**, **UNIX SYSTEM SERVICES (USS)**, or **JOBS** bar.

Configuration files

Using configurations across VS Code multi-root workspaces

You can take advantage of Visual Studio Code multi-root workspaces to work on multiple projects. Multi-root workspaces are convenient when projects do not share the same parent folder, or when you want to work on different use cases for the same project.

In scenarios like these, you can apply a project configuration to a VS Code multi-root workspace.

Using a single project configuration

To apply a specific project configuration across a multi-root workspace:

1. In VS Code, open a directory with a project configuration file to create a single-folder workspace.
2. Select the option **Add Folder to Workspace...** in the **File** menu and select a different directory.

   The selected folder displays as a root in the File Explorer and a new multi-root workspace is created.
3. Modify a data set or USS file and save the changes to the mainframe.

   Zowe Explorer uses the profile information stored in the configuration file from Step 1 to communicate with the mainframe.

Using multiple project configurations

To use a project configuration other than the one associated with the first workspace folder, you can either open multiple instances of VS Code, or create a new multi-root workspace.

Opening another instance of VS Code

1. In VS Code, create or open a multi-root workspace.

   The configuration file from the first folder applies across the workspace.

2. To use the configuration from a different folder, open a separate VS Code window to open the folder.

   The new instance of VS Code uses the configuration from that directory.

Creating a new multi-root workspace

1. In VS Code, create or open a multi-root workspace that lists the folder associated with the desired project configuration as the first root.

   The configuration file from the first folder applies across the workspace.

2. Create or open as many multi-root workspaces as necessary to apply different project configurations.

Version: v3.2.x LTS

Zowe Explorer authentication methods

Zowe Explorer for VS Code supports multiple authentication methods including basic authentication, tokens for single sign-on, client certificates, and multi-factor authentication.

Using basic authentication

To use basic authentication with Zowe Explorer, see Using basic authentication in the Zowe CLI documentation.

Using tokens

Tokens provide more security because they have limited lifespans and can be immediately revoked when needed.

Using a token to log in with Single Sign-On (SSO)

SSO lets you use a single token to access all your mainframe services through API Mediation Layer. SSO is configured with Zowe API ML, which generates an authentication token to access the mainframe.

To log into the API ML authentication service with an existing base profile:

1. Right-click on the profile you want to connect to using SSO.
2. Select the **Manage Profile** option from the context menu.
3. In the **Quick Pick**, select **Log in to Authentication Service**.
4. In the following **Quick Pick** menu, select the appropriate option for authenticating to the API ML.
5. Answer the proceeding prompts for information.

   If the request is successful, the token is used for authentication until the logout action is taken or the token expires.

For more information, see Using API Mediation Layer.

> **NOTE**
>
> For services not registered to your API ML instance, please consult the product or extender documentation for SSO support.

Using a token to log in to a specific service

To use a mainframe service that supports to direct connections with tokens:

1. Right-click on the profile you want to connect to.
2. Select the **Manage Profile** option from the context menu.
3. In the **Quick Pick**, select **Log in to Authentication Service**.

4. Answer the proceeding prompts for information.

   If the request is successful, the token is used for authentication until the logout action is taken or the token expires.

Logging out to invalidate your token

If you are done working with Zowe Explorer and want to prevent further use of a token, you can request the server to invalidate your session token.

Use the **Log out from Authentication Service** feature to invalidate a token:

1. Open Zowe Explorer.
2. Right-click the profile you want to disconnect.
3. Select the **Manage Profile** option.
4. In the **Quick Pick**, select the **Log out from Authentication Service** option.

   The token has been successfully invalidated.

Using client certificates

Zowe Explorer supports client certificates used with Zowe API ML as well as directly for connection types that offer these capabilities. z/OSMF connection types are supported by default with Zowe Explorer's dependency on the Zowe SDKs.

To learn how to use Zowe CLI to set up your client certificates in Zowe Explorer, see Using client certificates in the Zowe CLI documentation.

Multi-factor authentication (MFA) support

Zowe Explorer supports multi-factor authentication used with basic authentication (using a username and password) and single-sign on when logging in with a username and password.

To learn how use MFA with Zowe Explorer, see Using multi-factor authentication in the Zowe CLI documentation.

Version: v3.2.x LTS

Usage tips

Make the best use of Zowe Explorer with the following tips.

Data sets, USS, and jobs persistence settings

You can store any data sets, USS files, or jobs permanently in the **Favorites** tab. Right-click on a data set, USS file, or job and click **Add Favorite**.

Identify syntax errors with a syntax highlighter

Zowe Explorer supports a syntax highlighter for data sets. To enhance the experience of using the extension, you can download an extension that highlights syntax.

Configure the detected language of a file or data set

Configure the `file.associations` setting in Visual Studio Code to use a specific language for a particular file extension type. This prevents the language for a file or data set opened in Zowe Explorer from being detected incorrectly.

To set file associations that work for sequential data sets as well as partitioned data set members, use wildcards with the language identifier in the format `**/*LANGUAGE*{,/*}`:

In the example above, Zowe Explorer uses wild cards to find matches of the configured language (`COBOL`) in the file paths of sequential data sets (for example, `/lpar.zosmf/TEST.COBOL.PS`) and PDS members (for example, `/lpar.zosmf/TEST.COBOL.PDS/MEMBER`).

Multi-select functionality

Zowe Explorer lets you open a list of members you have previously worked on. You can access the list by pressing `Ctrl`+`Alt`+`R` or `Command`+`Option`+`R`.

Access resources with virtual workspaces

Use your virtual workspaces to access multiple resources from the **Explorer** view, such as local files or resources from other file systems.

In the **Data Sets** or **Unix System Services (USS)** tree, click on a profile **Search** icon. In the **Search** prompt, enter a data set search pattern or a USS file path. Right click on a resource to select the **Add to Workspace** context menu option. The status bar message displays and the selected folder is listed in the **Explorer** view with any other files/resources.

Version: v3.2.x LTS

Working with data sets

Viewing and accessing multiple profiles simultaneously

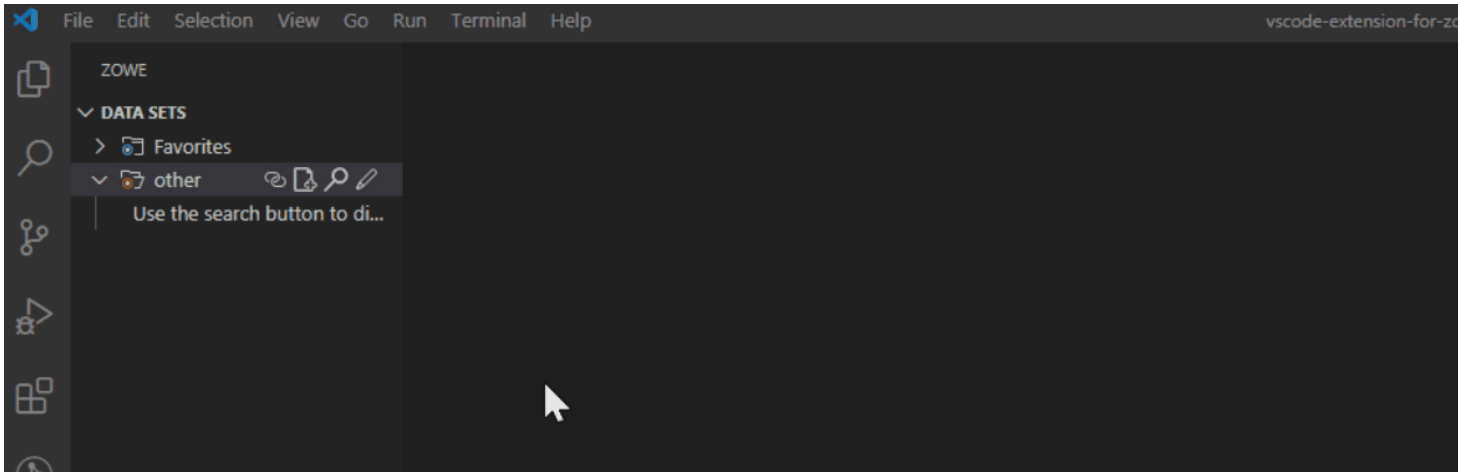
1. Expand the **DATA SETS** tree in the **Side Bar**, and click the **+** icon.
2. Select the profiles from the **Quick Pick** menu to add them to the **Side Bar**.
3. Click the **Search** icon for each profile to search and select associated data sets.

Viewing data sets and using multiple filters

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the data set that you want to view.

   Search results display under the profile in the **Side Bar**.

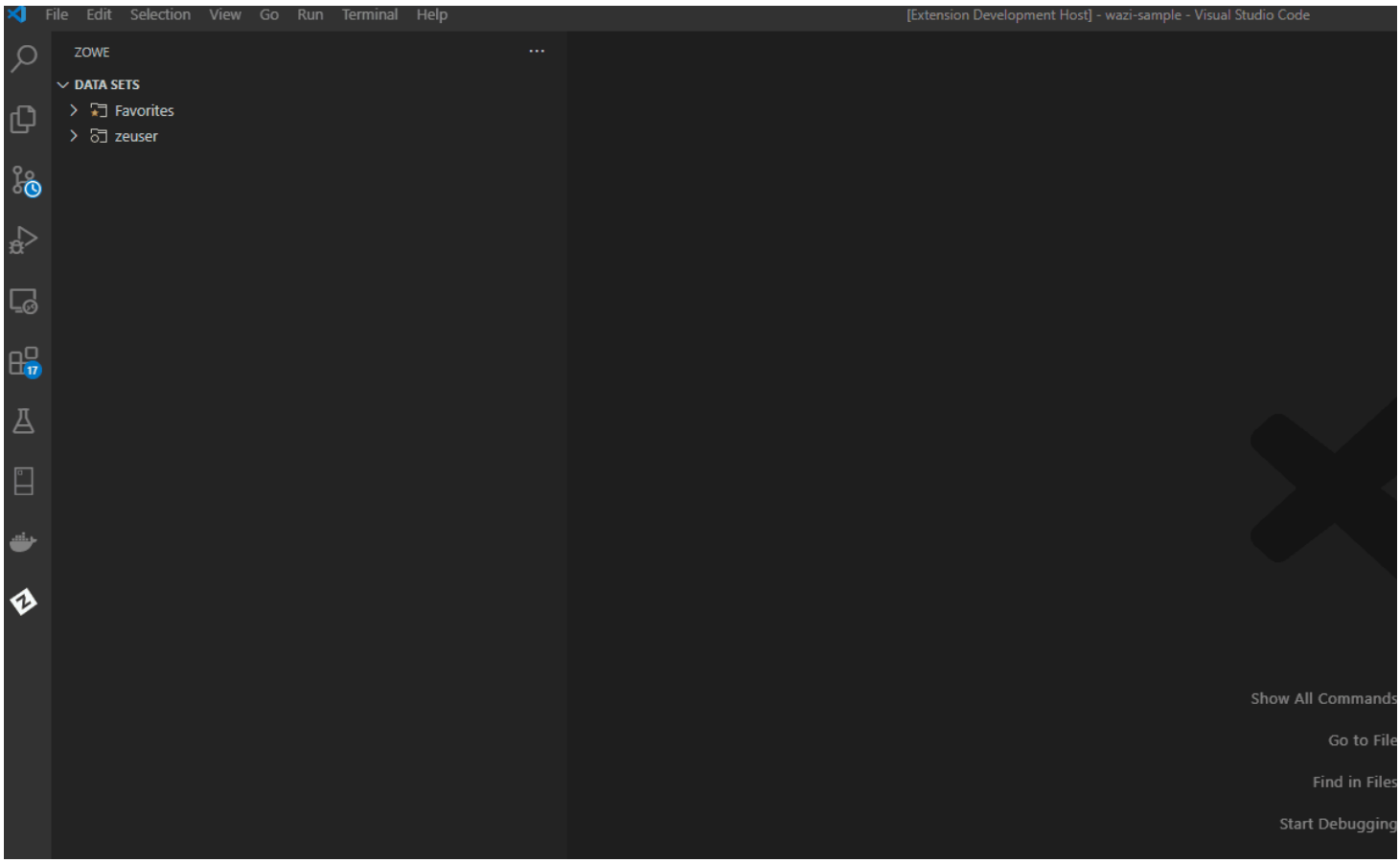
> **TIP**
>
> To use multiple filters, separate individual entries with a comma. You can append or postpend any filter with an `*` to indicate a wildcard search. You cannot enter an `*` as the entire pattern.



Viewing data sets with member filters

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile.
3. In the **Quick Pick**, enter or select a search pattern in the `HLQ.ZZZ.SSS(MEMBERNAME)` format to filter search results.

   The specified member displays under the profile in the **Side Bar**.



Refreshing the list of data sets

1. Hover over **DATA SETS** in the **Side Bar**.
2. Click the **Refresh All** icon.

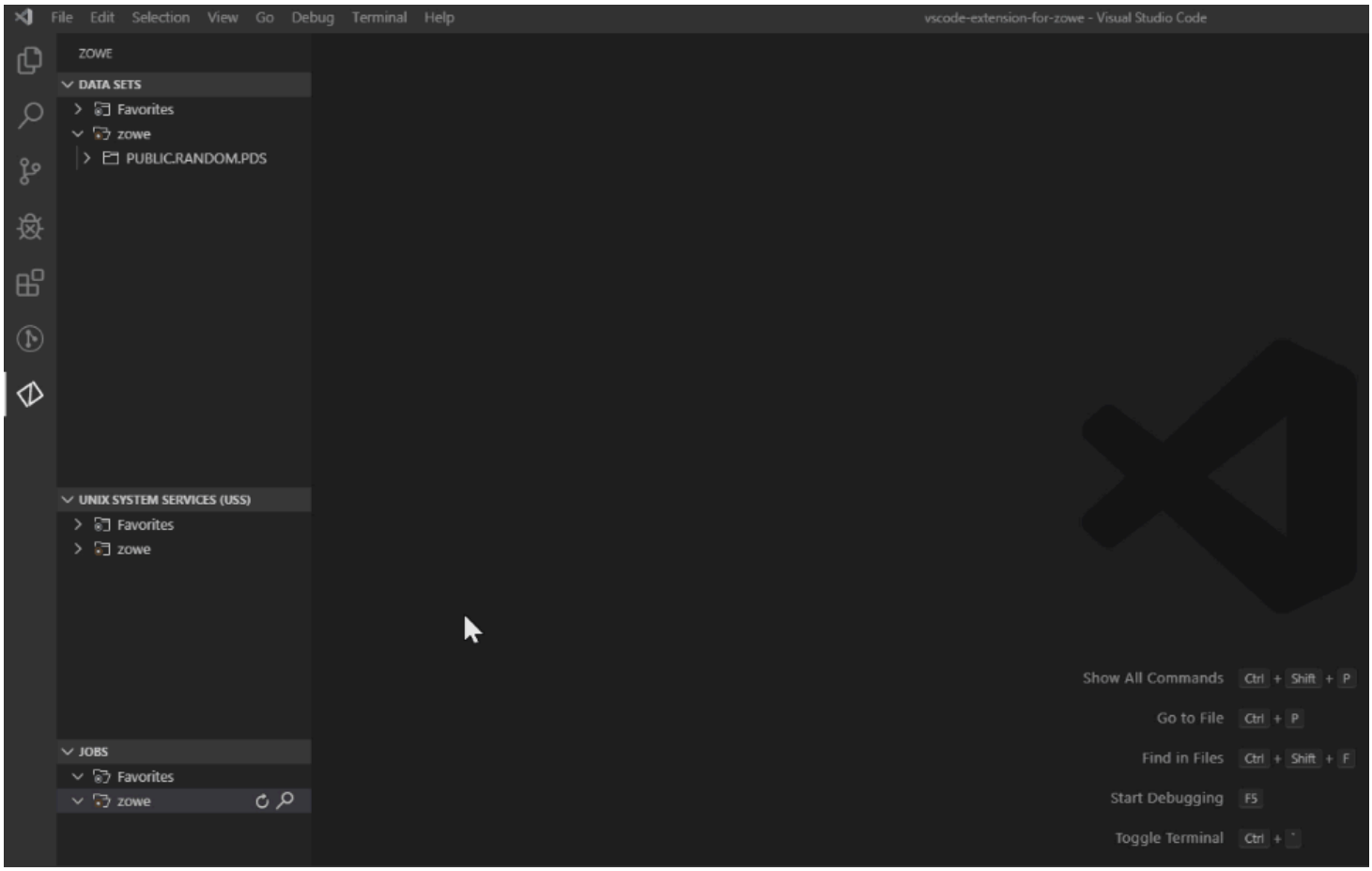
   The list of data sets is updated to reflect the latest changes.

Renaming data sets

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the data set that you want to view.

   Search results display under the profile in the **Side Bar**.
3. Right-click the desired data set and select the **Rename Data Set** option.
4. Enter the new name of the data set in the **input box**.

   The data set is renamed and displays the new name in the **Side Bar**.

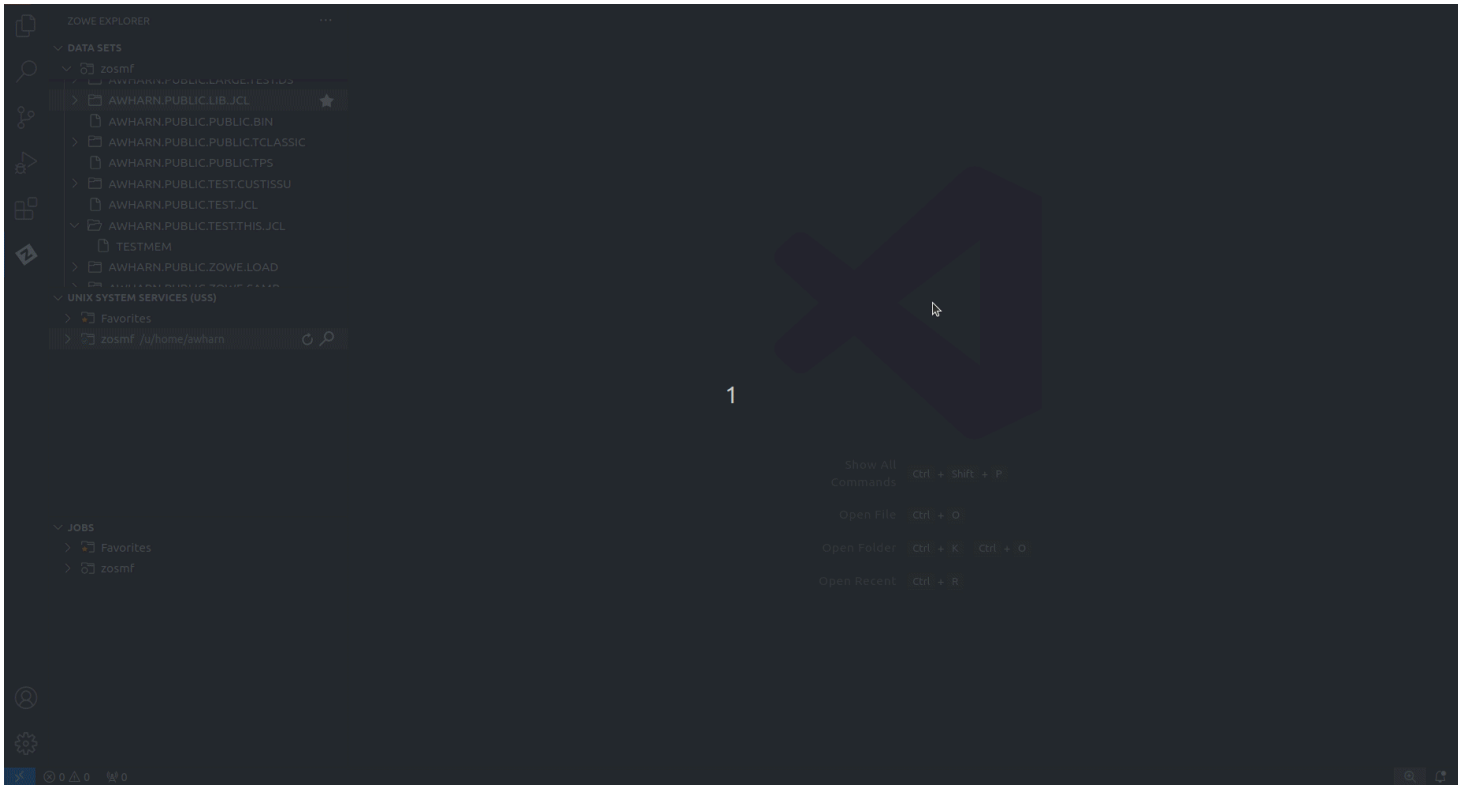


Copying data set members

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the data set that you want to view.

Search results display under the profile in the **Side Bar**.

3. Right-click the desired member and select the **Copy** option.
4. Right-click the data set where the member is to be contained and select the **Paste** option.
5. In the **Quick Pick**, enter the name of the copied member.



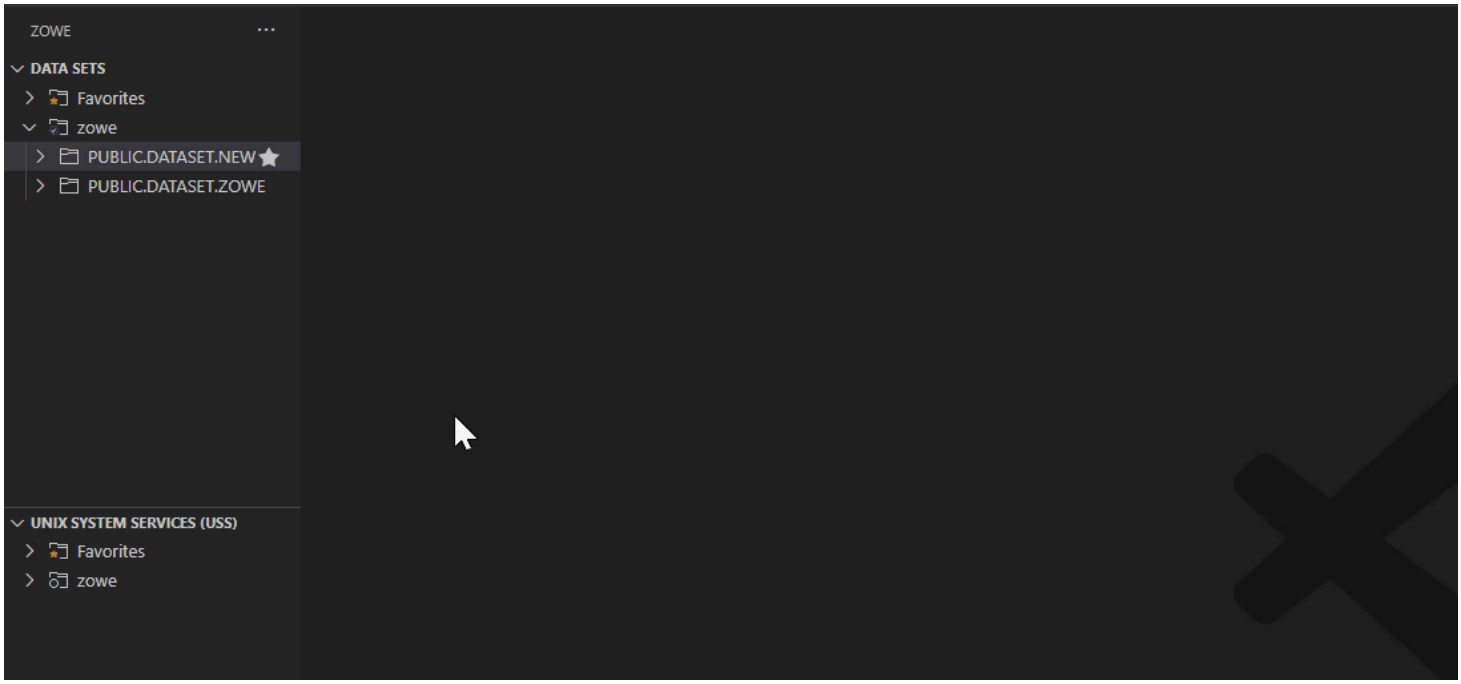
Editing and uploading a data set member

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the data set that you want to view.

   Search results display under the profile in the **Side Bar**.
3. Open the data set with the member you want to edit.
4. Click on the member name to display it in an **Editor**.
5. Edit the document in the **Editor**.
6. Press the `Ctrl`+`S` or `Command`+`S` keys to save the changes.

   The changes are saved and the edited data set is uploaded to the mainframe.

> **NOTE**
>
> If someone else has made changes to the data set member while you were editing, you can merge your changes before uploading to the mainframe. See Preventing merge conflicts for more information.



Uploading a local file to a data set

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the desired data set.

   Search results display under the profile in the **Side Bar**.
3. Right-click on the desired PDS and select the **Upload Member...** option to upload a local file as a member of that data set.

   A file explorer window opens.
4. In the file explorer, select the desired file and click **Upload File**.

   The selected file is uploaded as a member of the data set and appears as a new member in the **DATA SETS** tree after the upload is complete.

Comparing data set members

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the desired data set.

   Search results display under the profile in the **Side Bar**.
3. Right-click on the desired member and select the **Select for Compare** option.
4. Right-click a second member and select the **Compare with Selected** option.

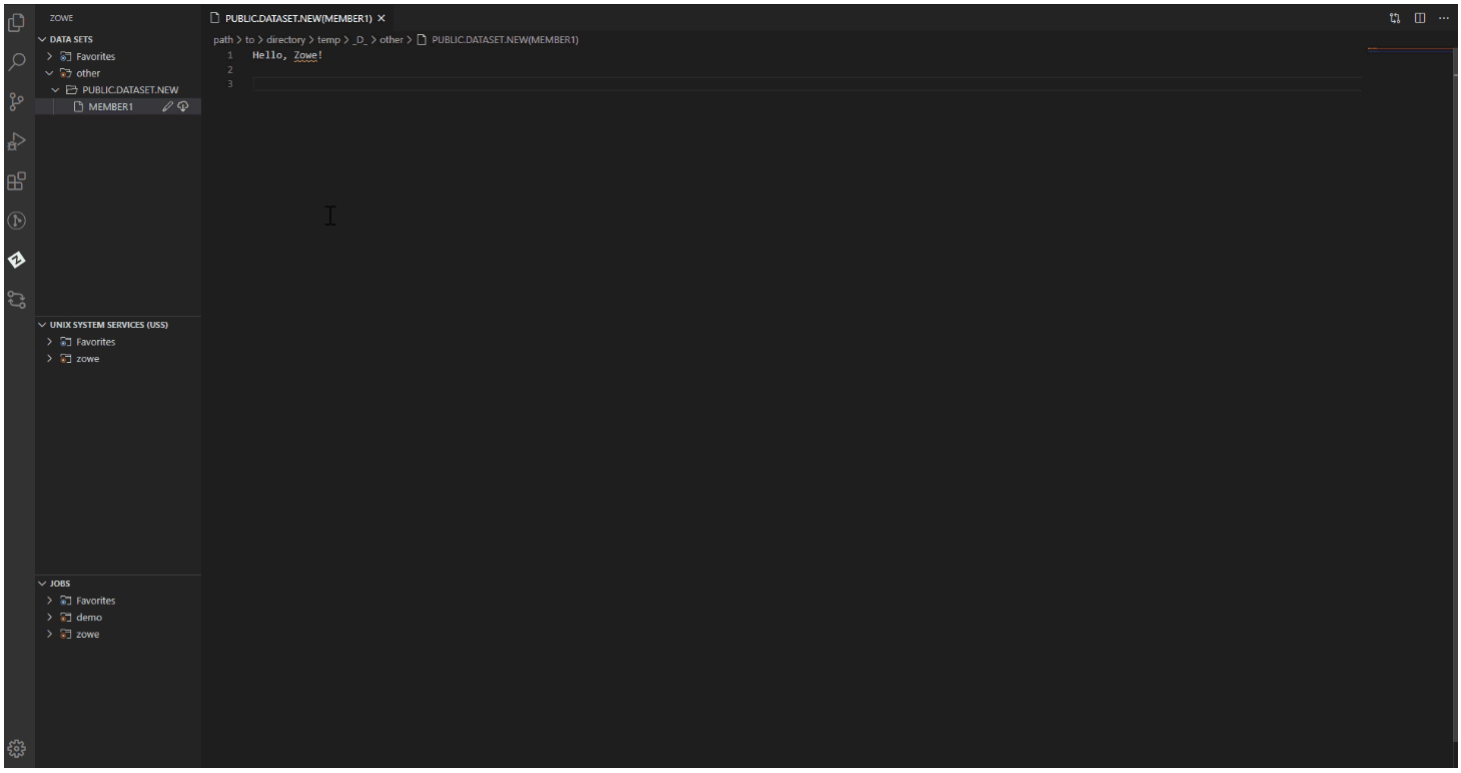
   The first selected member displays in an **Editor** on the left; the second member displays on the right.

Preventing merge conflicts

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the desired data set.

   Search results display under the profile in the **Side Bar**.
3. Select the member to open the file in an **Editor**.
4. Edit the document in the **Editor**.
5. Press the `Ctrl`+`S` or `Command`+`S` keys to save the changes.

   If the original content in your local version no longer matches the same file in the mainframe, a warning message displays advising the user to compare both versions.
6. If necessary, use the editor tool bar to resolve merge conflicts.



Creating data sets and specifying parameters

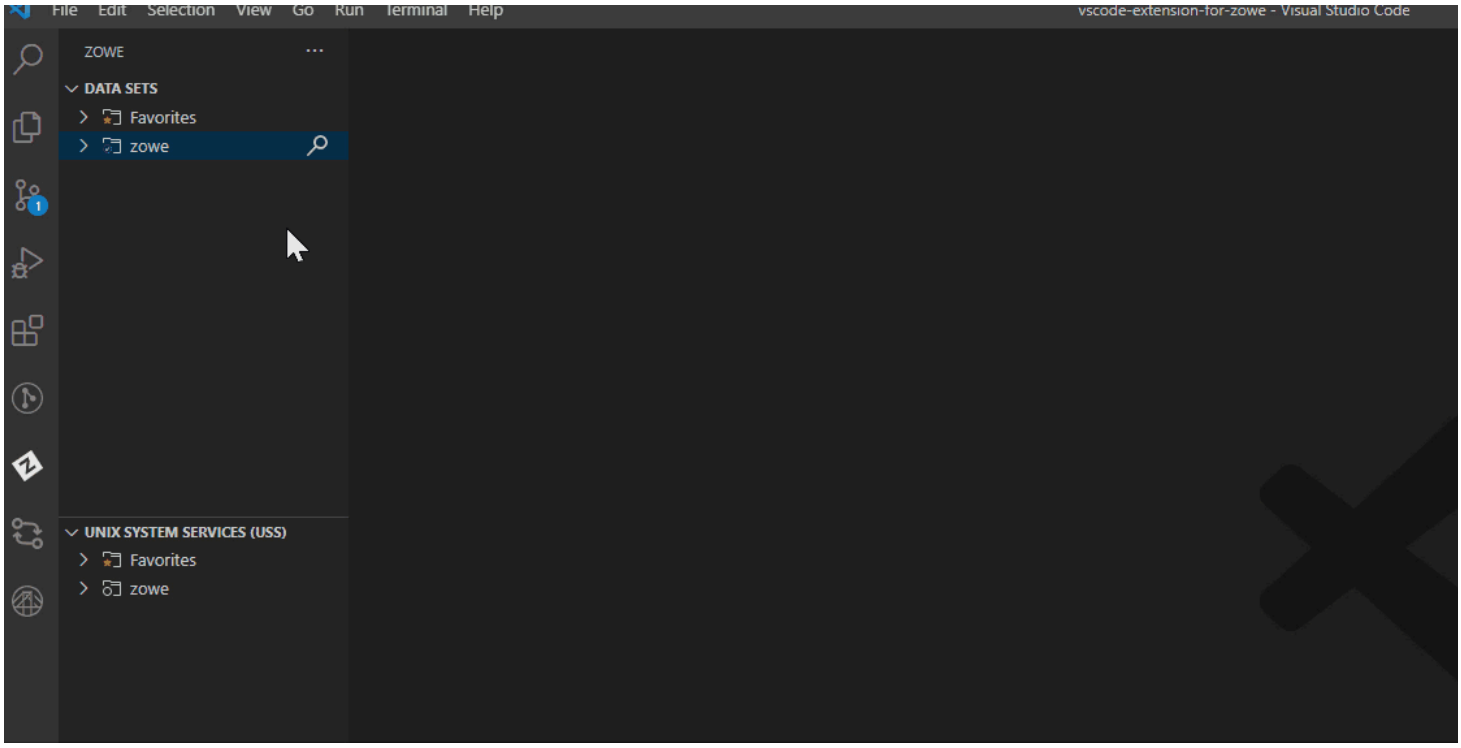
1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Right-click on the profile you want to create a data set with and select **Create New Data Set**.
3. Enter a name for your data set in the **input box** and press the `Enter` key.
4. From the **Quick Pick** menu, select the data set type that you want to create and press the `Enter` key.
5. Select **Edit Attributes** in the **Quick Pick** menu and press the `Enter` key.

The attributes list for the data set displays. You can edit the following attributes:

- Allocation Unit
- Average Block Length
- Block Size
- Data Class
- Device Type
- Directory Block
- Data Set Type
- Management Class
- Data Set Name
- Data Set Organization
- Primary Space
- Record Format
- Record Length
- Secondary Space
- Size
- Storage Class
- Volume Serial

6. Select the attribute you want to edit, provide the value in the **input box**, and press the `Enter` key.
7. (Optional) Edit the parameters of your data set.
8. Select the **+ Allocate Data Set** option.

   The data set is created and listed under the profile in the **Side Bar**.



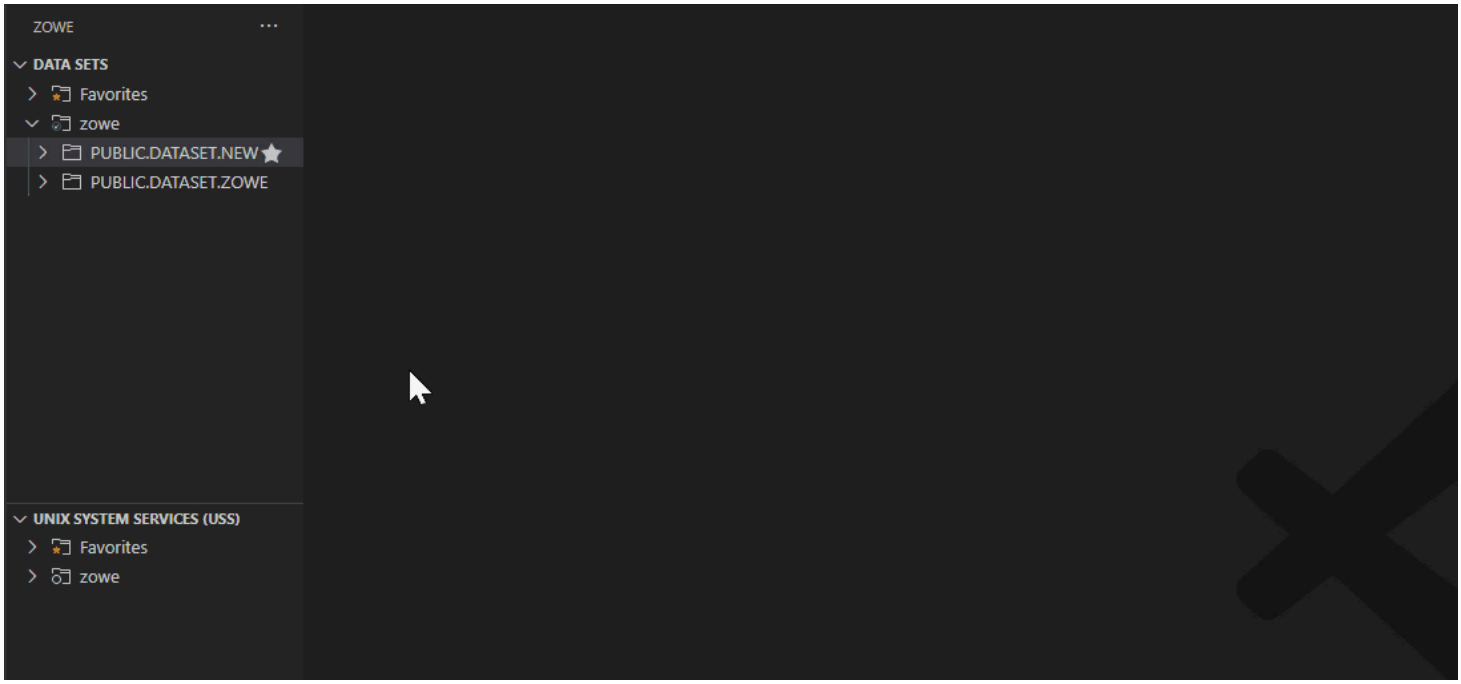
Creating data sets and data set members

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. In the **Side Bar**, right-click on a partitioned data set and select **Create New Member**.
3. Enter a name for your new data set member in the **input box** and press the `Enter` key.

   The member is created and opened in an **Editor**.

Deleting a data set member and a data set

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Open the profile and data set containing the member you want to delete.
3. Right-click the member and select **Delete Member**.
4. Confirm the deletion by selecting **Delete** on the **Quick Pick** menu.
5. To delete a data set, right-click the data set and select **Delete Data Set**, then confirm the deletion.

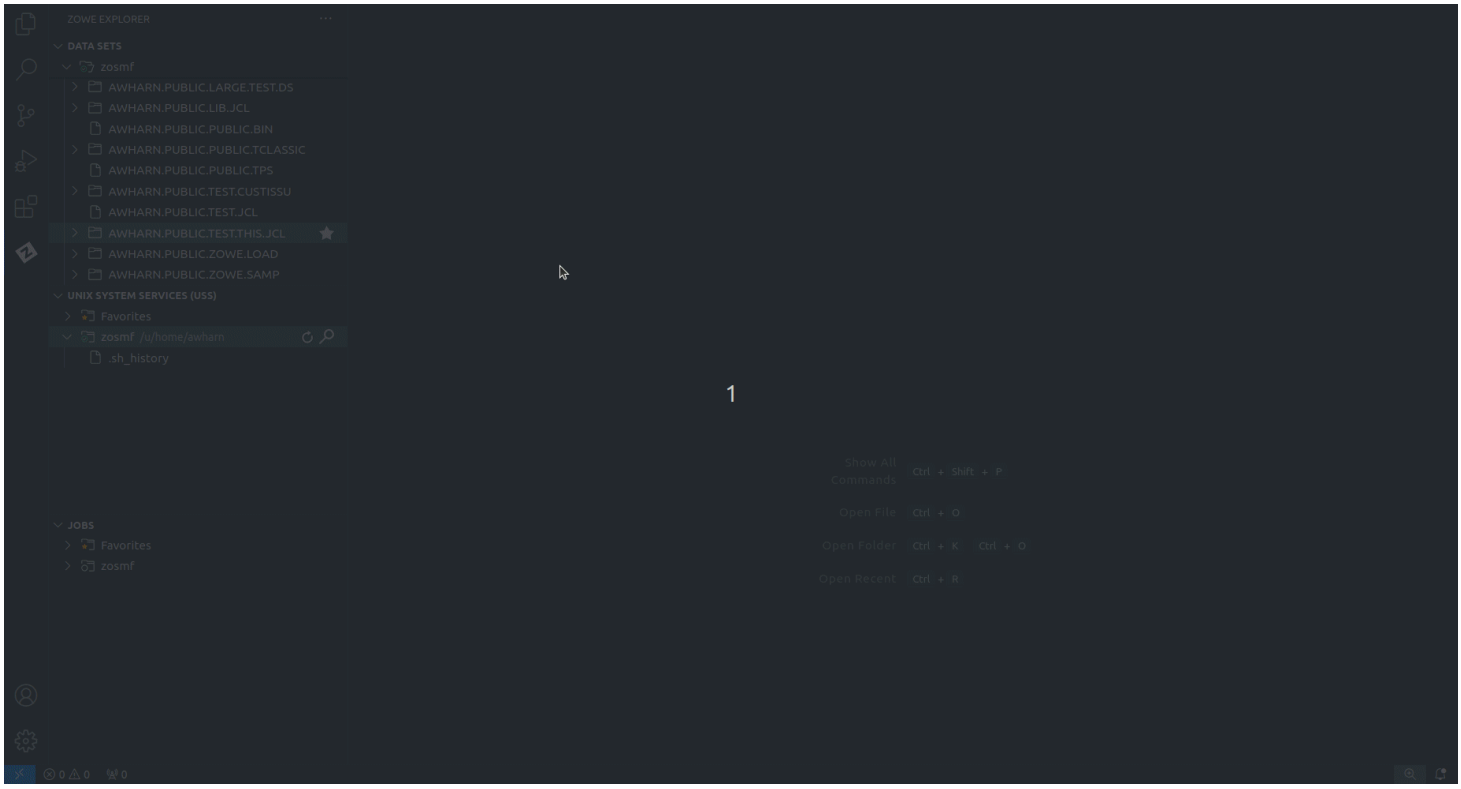


Viewing data set, member attributes

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the data set that you want to upload to.

   Search results display under the profile in the **Side Bar**.
3. Right-click a data set or member and select the **Show Attributes** option.

   The attributes display in an **Editor**.



Filtering partitioned data set members

Filter partitioned data set members in the **DATA SETS** tree view by **Date Modified** or **User ID**.

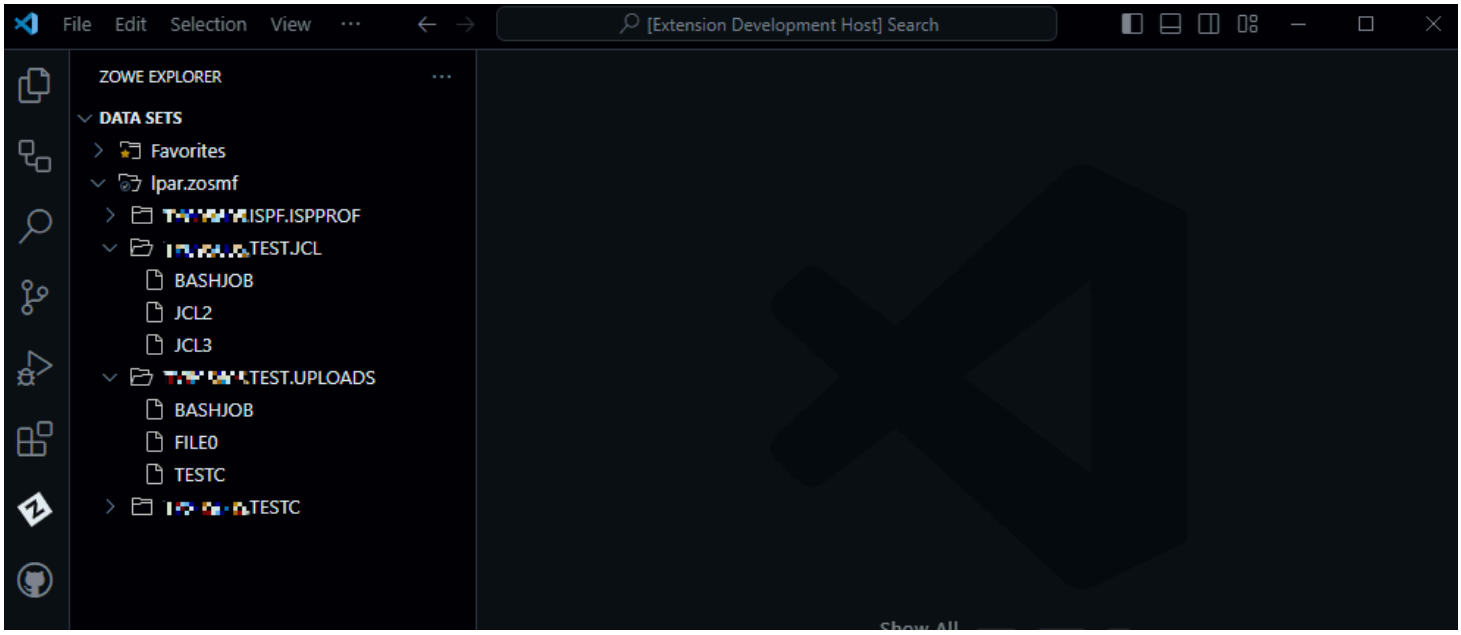
Filtering all partitioned data set members under a specific profile

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Navigate to a profile and click on the **Filter** icon to the right of the profile.

   The filter selection menu appears in the **Quick Pick**.
3. Select a filter type from the list of available options:

   - **Date Modified**
   - **User ID**
4. In the **Quick Pick**, enter a valid value for the selected filter.
5. Press the `Enter` key to confirm the filter.

   Expanded data sets display a filtered list of members under the selected profile in the **DATA SETS** tree.



Filtering members for a single partitioned data set

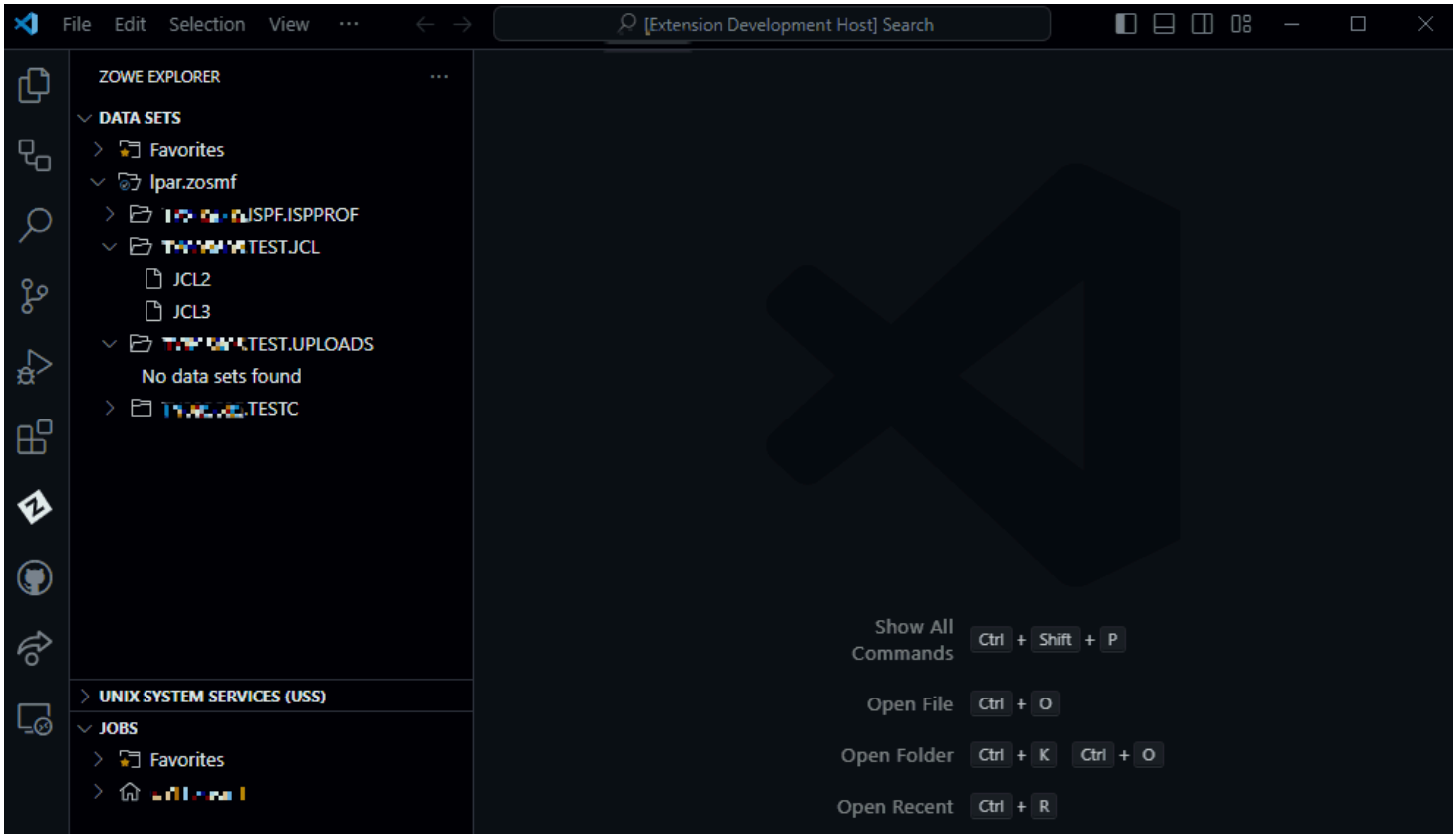
1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the data set that you want to filter.

   Search results display under the profile in the **Side Bar**.
3. In the **DATA SETS** tree, right-click on a data set and select the **Filter PDS members...** option.

   The filter selection menu appears in the **Quick Pick**.
4. Select a filter type from the list of available options:

   - **Date Modified**
   - **User ID**
5. In the **Quick Pick**, enter a valid value for the selected filter.
6. Press the `Enter` key to confirm the filter. This overrides any *profile* filter preferences that might be in effect for the single data set.

   The selected data set displays a filtered list of members in the **DATA SETS** tree.



Sorting partitioned data set members

Sort partitioned data set members in the **DATA SETS** tree view by member **Name**, **Date Modified**, or **User ID**.

> **NOTE**
>
> To change the default sort order for data sets, see Modifying the default sort order for data sets and jobs.

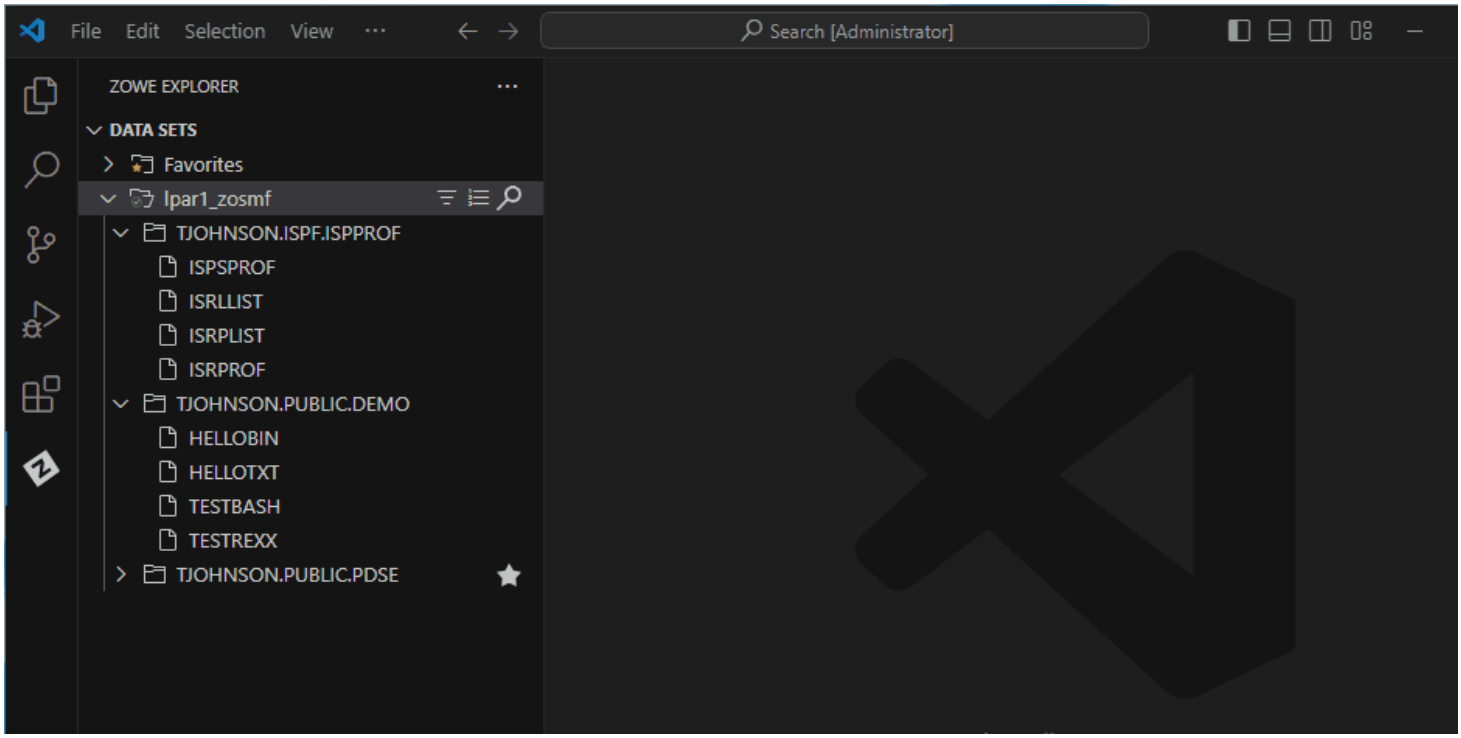
Sorting all partitioned data set members under a specific profile

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Sort** icon to the right of a profile.

   The sorting selection menu appears in the **Quick Pick**.
3. To change the sorting direction, select the **Sort Direction** option and select a direction type from the **Quick Pick** menu.
4. Select a sort type from the list of available options:

   - **Name**
   - **Date Created**
   - **Date Modified**
   - **User ID**

   Expanded data sets display a sorted list of members under the selected profile in the **DATA SETS** tree.



Sorting members for a single partitioned data set

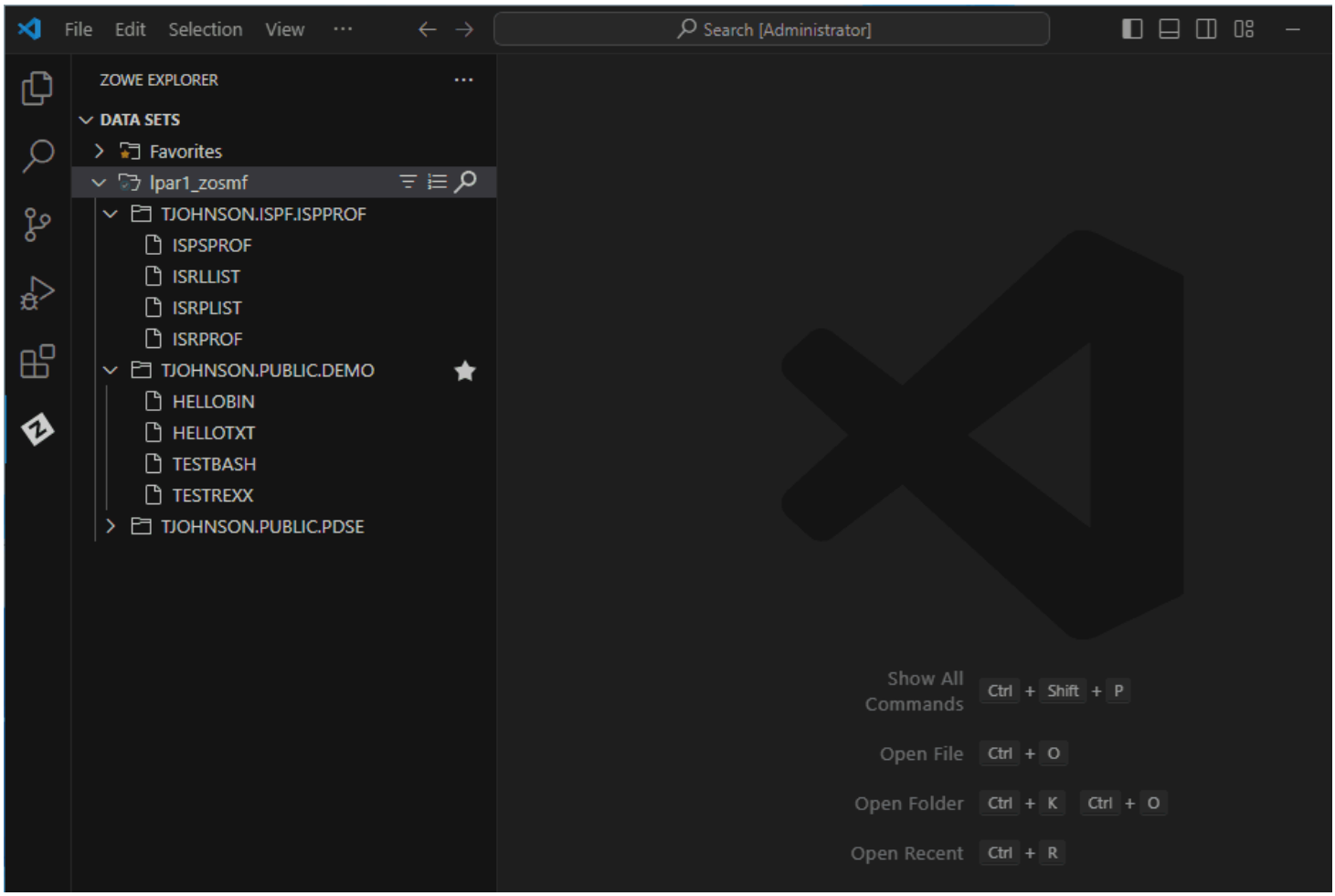
1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the data set that you want to sort.

   Search results display under the profile in the **Side Bar**.
3. Right-click on a data set and select the **Sort PDS members...** option.

   The sort selection menu appears in the **Quick Pick**.
4. To change the sorting direction, select the **Sort Direction** option and select a direction type from the **Quick Pick** menu.
5. Select a sort type from the list of available options:

   - **Name**
   - **Date Created**
   - **Date Modified**
   - **User ID**

   This overrides any *profile* sort preferences that might be in effect for the single PDS. The selected data set displays a sorted list of members in the **DATA SETS** tree.



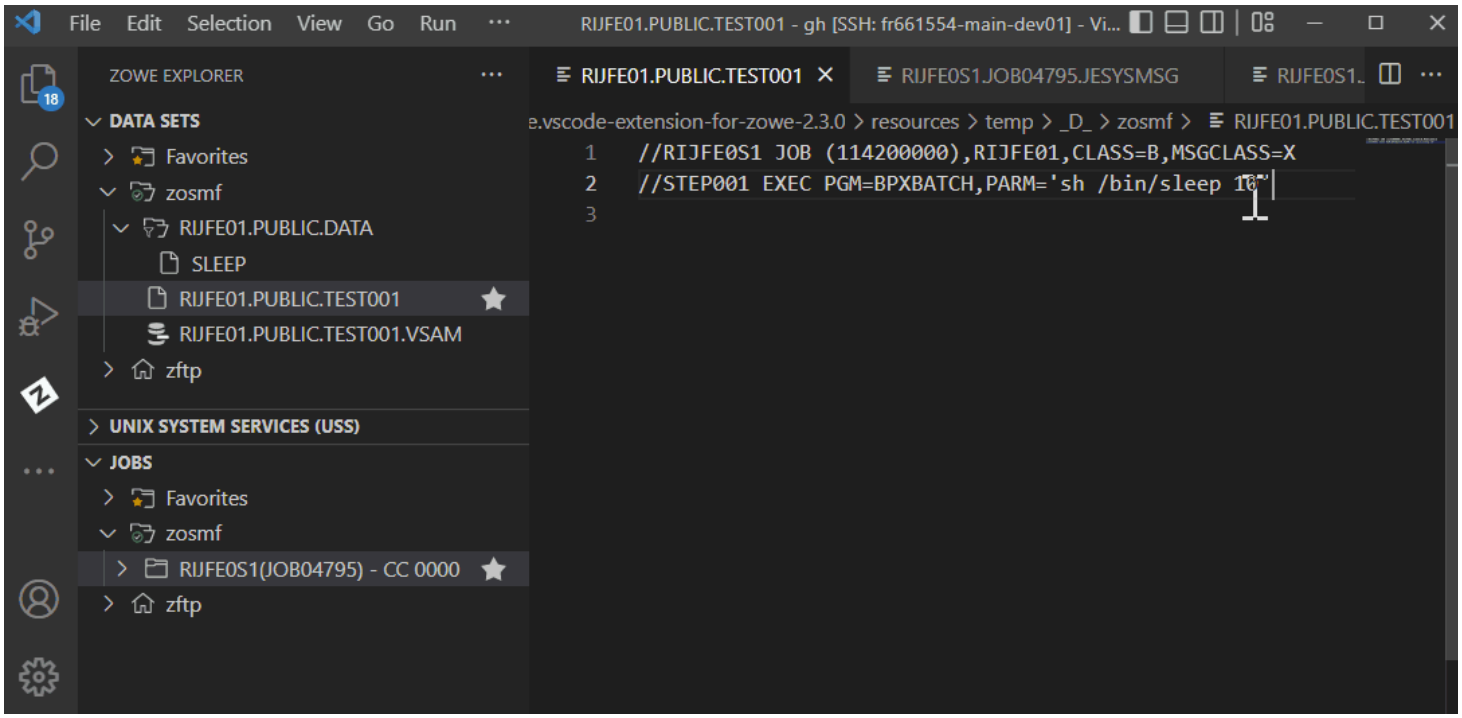
Submitting a JCL

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the desired data set.

   Search results display under the profile in the **Side Bar**.
3. Right-click the desired data set or data set member and select the **Submit Job** option.

   The job is submitted and runs on the mainframe.

> **NOTE**
>
> To view the status of the job, click on the hyperlink on the notification pop-up message.



Submitting a local file as JCL

1. Go to the **File** menu and select the **Open File...** option.
2. Select the desired file on your personal computer.

   The file opens as an **Editor** in VS Code.
3. Right-click on the file's **Editor** and select the option **Submit as JCL**.

   A dialog window opens to ask confirmation, then the **Quick Pick** displays a list of profiles to use for the submit action. Respond to the prompt(s) as necessary.

   The job is submitted and runs on the mainframe.

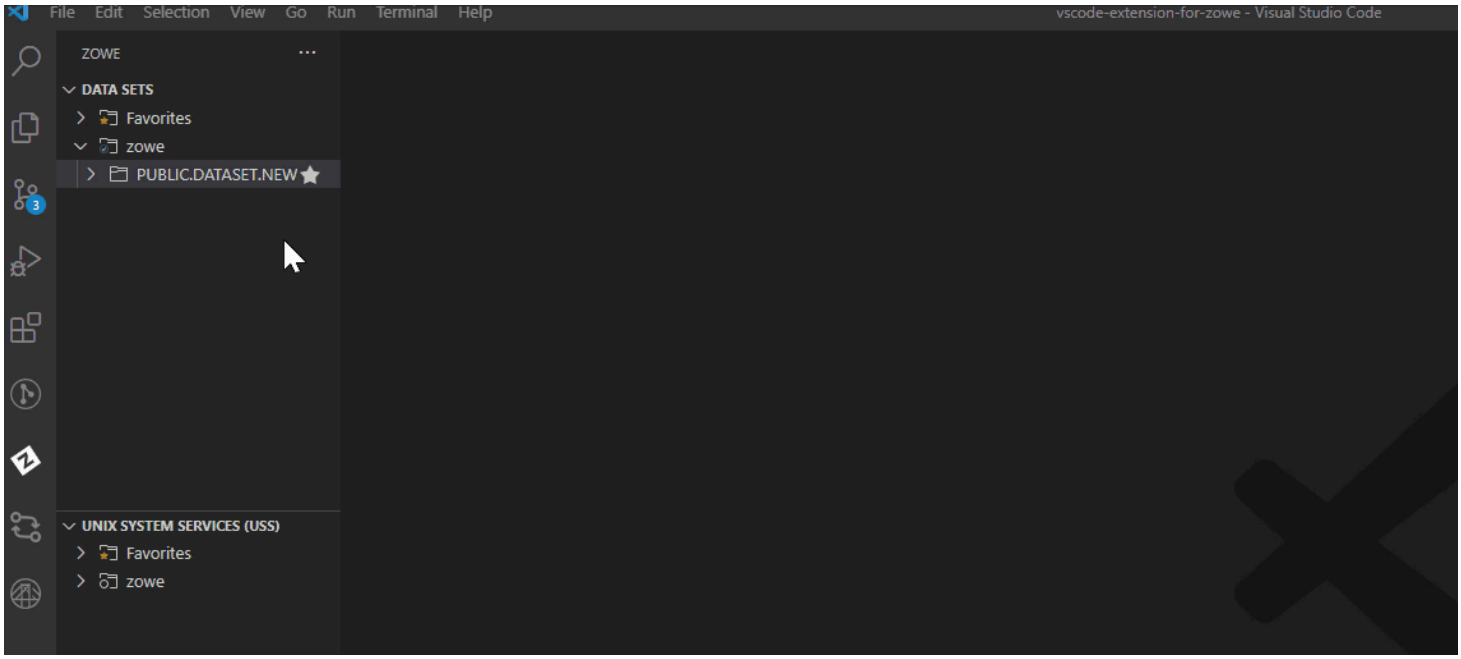
> **NOTE**
>
> To view the status of the job, click on the hyperlink on the notification pop-up message.

Allocate like

1. Expand the **DATA SETS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile to search for a pattern that matches the desired data set.

   Search results display under the profile in the **Side Bar**.
3. Right-click a data set and select the **Allocate Like (New File with Same Attributes)** option.
4. Enter the new data set name in the **input box** and press the `Enter` key.

The new data set displays under the selected profile.



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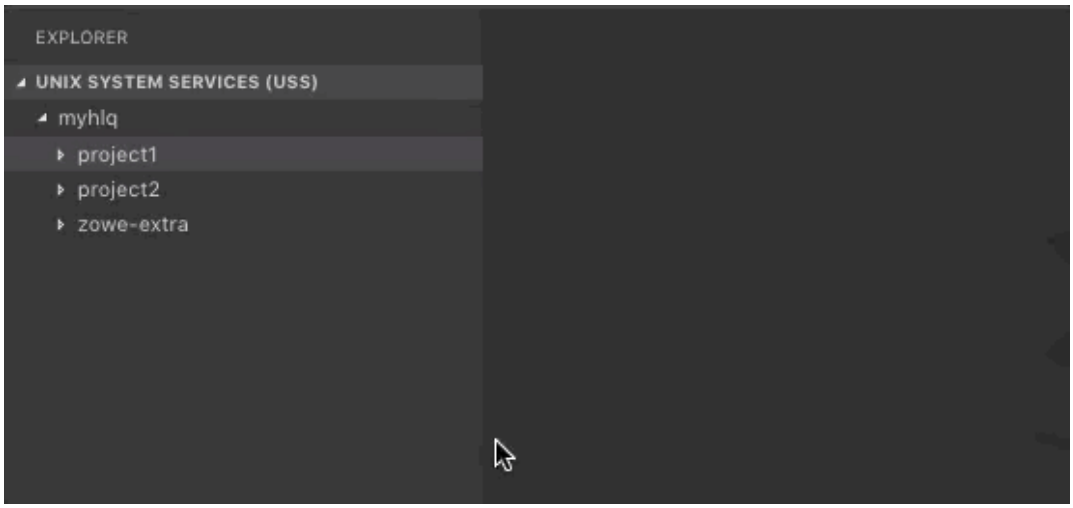
Working with USS files

Viewing and accessing multiple USS profiles simultaneously

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**, and click the **+** icon.
2. Select or enter a profile in the **Quick Pick** menu to add it to the **Side Bar**.

   The profile displays in the **Side Bar**.



Viewing Unix System Services (USS) files

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.

   All child files and directories of that path display under the profile in the **Side Bar**.

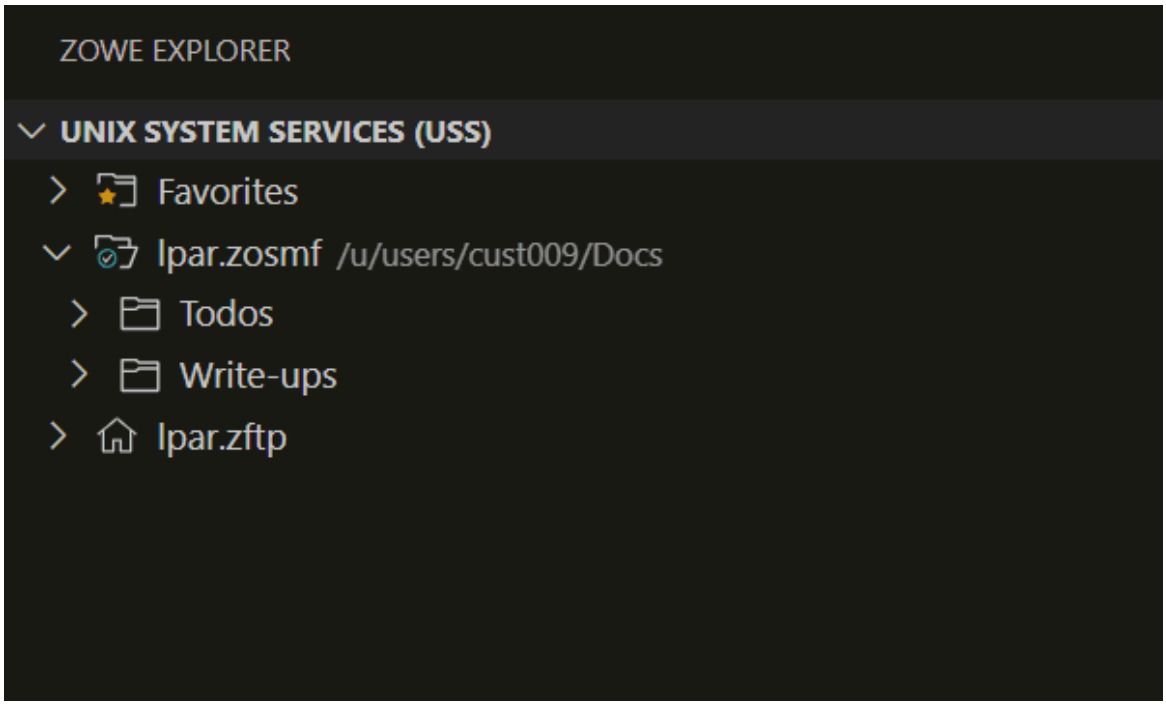
> **NOTE**
>
> You cannot expand directories or files to which you are not authorized.

Dragging and dropping USS files

To select one or more files or folders in the tree and drag them to a folder or session to relocate them:

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.

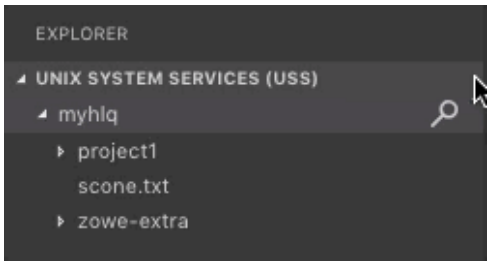
   All child files and directories of that path display under the profile in the **Side Bar**.
3. Select the files or folders you want to move.
   - Select multiple items by pressing the `Ctrl` key as you select each item.
   - Select a continuous range of items by selecting the first item in the range. Then hold down the `Shift` key until selecting the last item in the range.
4. Click and hold the region containing the selected items to start the drag process.
5. As the items are selected, move your cursor to the desired folder or session. Release the mouse button to start the move operation.
   - If the move operation might overwrite one or more files, an “overwrite confirmation" message displays. Select **Confirm** to relocate these items. Select **Cancel** to stop the move operation.
   - Items can be moved across different profiles or LPARs, which may cause a brief delay due to the transfer process.
6. When items are moved, the tree view refreshes and the moved items appear in the destination folder.



Refreshing the list of files

1. Hover over **UNIX SYSTEM SERVICES (USS)** in the **Side Bar**.
2. Click the **Refresh All** button.

The list of directories and child files is updated to reflect the latest changes.



Renaming USS files

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.

   All child files and directories of that path display under the profile in the **Side Bar**.
3. Select a USS file you want to rename.
4. Right-click the USS file and select the **Rename USS file** option.
5. In the **input box**, enter the new name of the USS file and press the `Enter` key.

   The file is renamed and the new name displays in the **Side Bar**.

Copying and pasting USS folders and files

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.

   All child files and directories of that path display under the profile in the **Side Bar**.
3. Select the files or folders you want to move.
   - Select multiple items by pressing the `Ctrl` key as you select each item.
   - Select a continuous range of items by selecting the first item in the range, then hold down the `Shift` key until selecting the last item in the range.
4. Right-click the selected items and select the **Copy** option from the menu
5. Navigate in the USS tree to the folder where you want to paste the files.

   Files can be moved across different profiles or LPARs, which may cause a brief delay due to the transfer process.
6. Right-click on the folder and select the **Paste** option from the menu.

   The copied items display in the new location.

Downloading, editing, and uploading existing USS files

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.

   All child files and directories of that path display under the profile in the **Side Bar**.
3. Click on the file name of the file you want to download.

   The file contents display in an **Editor**.

   > **NOTE**
   >
   > If you define file associations with syntax coloring, the suffix of your file is marked up.
4. Edit the document in the **Editor**.
5. Press the `Ctrl`+`S` or `Command`+`S` keys to save the changes.

   The changes are saved and the USS file is uploaded to the mainframe.

Uploading a local file to a USS directory

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.

   All child files and directories of that path display under the profile in the **Side Bar**.
3. Right-click on the desired directory and select the **Upload Files...** option to upload one or more local files to the directory.

   A file explorer window opens.

4. In the file explorer, select the desired file(s) and click **Upload Files**.

   The selected file(s) is uploaded to the USS directory and appears as new file name in the **UNIX SYSTEM SERVICES (USS)** tree.

Comparing USS files

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.

   All child files and directories of that path display under the profile in the **Side Bar**.
3. Right-click on the desired file and select the **Select for Compare** option.
4. Right-click a second file and select the **Compare with Selected** option.

   The first selected file displays in an **Editor** on the left; the second file displays on the right.

Creating and deleting USS files and directories

Creating a directory

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.

   All child files and directories of that path display under the profile in the **Side Bar**.
3. Right-click the desired directory and select the **Create Directory** option.
4. Enter the directory name in the **input box**.
5. Press the `Enter` key to create the directory.

   A new directory is created and displays in the selected directory.

Creating a file

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.

   All child files and directories of that path display under the profile in the **Side Bar**.
3. Right-click the desired directory and select the **Create File** option.
4. Enter the file name in the **input box**.
5. Press the `Enter` key to create the directory.

   A new file is created and displays in the selected directory.

Deleting a file

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.

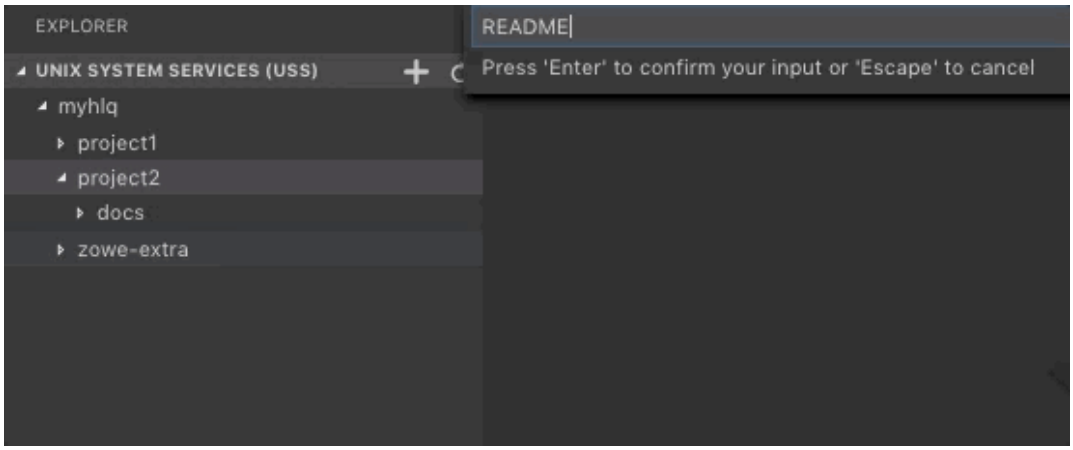
   All child files and directories of that path display under the profile in the **Side Bar**.
3. Right-click on the file you want to remove.
4. Select the **Delete** option and click **Delete** again to confirm and delete the file.

   The file is deleted and no longer displays in the selected directory.

Deleting a directory

1. Expand the **UNIX SYSTEM SERVICES (USS)** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter the path of the desired directory.
3. Right-click the directory you want to remove.
4. Select the **Delete** button and click **Delete** again to confirm and delete the directory and all its child files and directories.

   The directory is deleted and no longer displays in the **Side Bar**.



Version: v3.2.x LTS

Working with jobs

Viewing job spool output

1. Expand the **JOBS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter search criteria.

   Search results display under the profile in the **Side Bar**.
3. Expand a job to view its spool files.

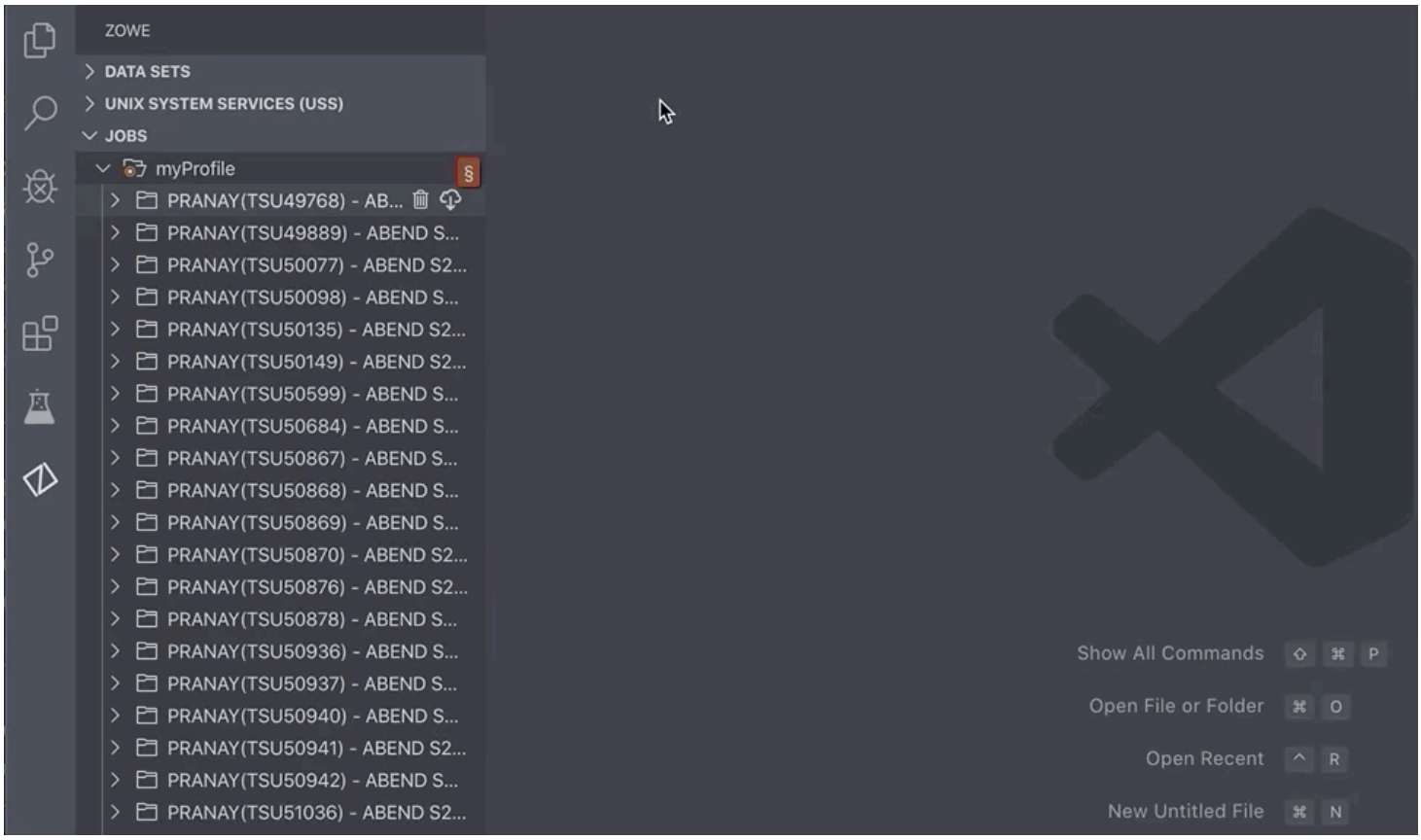
Viewing job contents

1. Expand the **JOBS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter search criteria.

   Search results display under the profile in the **Side Bar**.
3. Right-click on the job you want to view, and select the **Get JCL** option.

   Job contents display in an **Editor**.

> **NOTE**
>
> To edit the job and run it again, make the changes in the **Editor**, right click the **Editor**, and select the **Submit as JCL** option. For instructions, see Step 3 in Submitting a local file as JCL.



Creating a job search filter

1. Expand the **JOBS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter search criteria.
3. In the **Quick Pick**, select the **Create job search filter** option.
4. Select a **Quick Pick** option to submit its respective value.

   The entered value displays next to the **Quick Pick** option.
5. Select the **Submit this query** option in the **Quick Pick** to create the filter.

   The filter is saved as a **Quick Pick** option that displays when the **Search** icon is clicked. Remove the filter with Zowe Explorer's Edit History feature.

Downloading spool content

Downloading spool files from a job

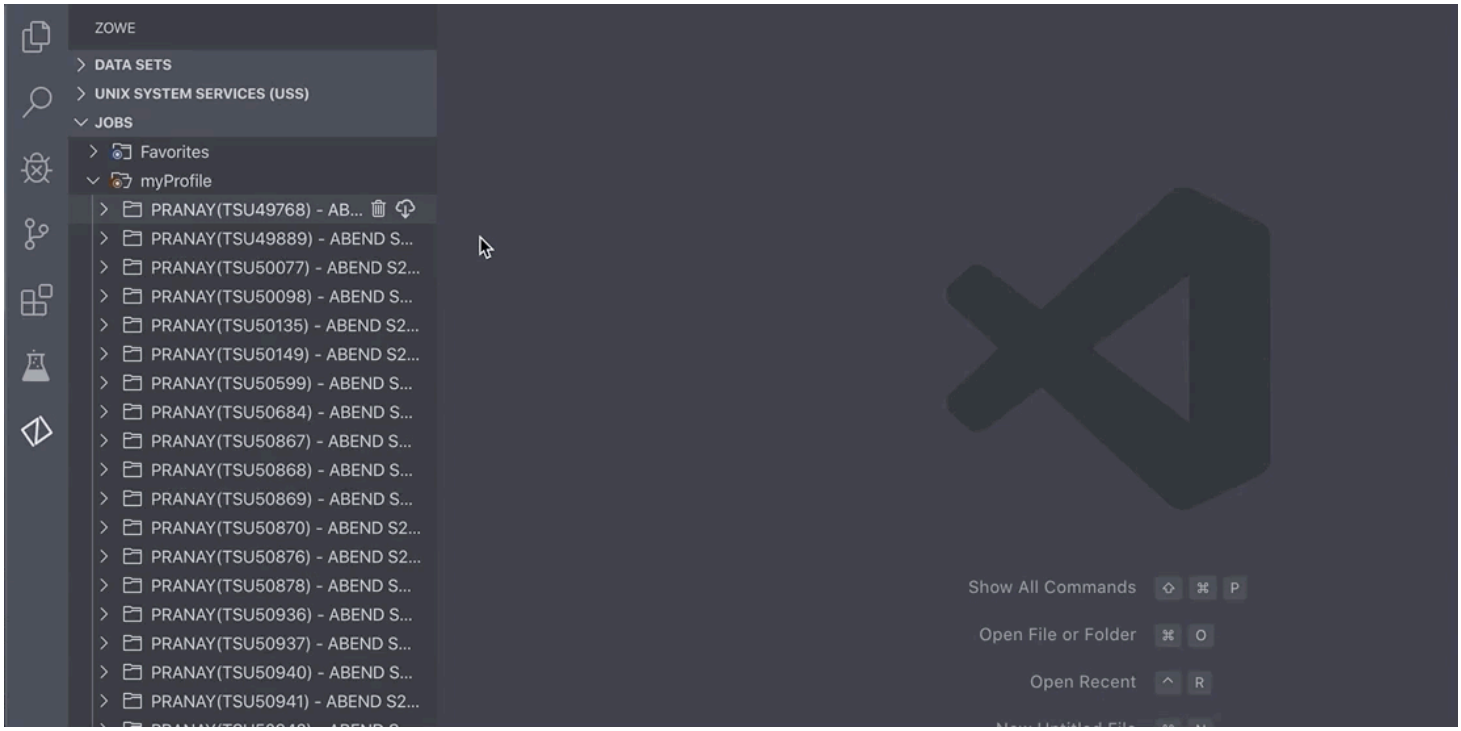
1. Expand the **JOBS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter search criteria.

   Search results display under the profile in the **Side Bar**.

3. Right-click on the desired job and select either:

   - **Download All** to download all the spool files to a folder on your local disk.
   - **Download All (Binary)** to download all the spool files in binary format on your local disk.

   The selected files are saved in a folder that is the job name in the specified location.



Downloading a single spool file

1. Expand the **JOBS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter search criteria.

   Search results display under the profile in the **Side Bar**.
3. Expand the job containing the desired spool file.
4. Right-click on the spool file and select either:

   - **Download All** to download all the spool file contents to a folder on your local disk.
   - **Download All (Binary)** to download all the spool file contents in binary format on your local disk.

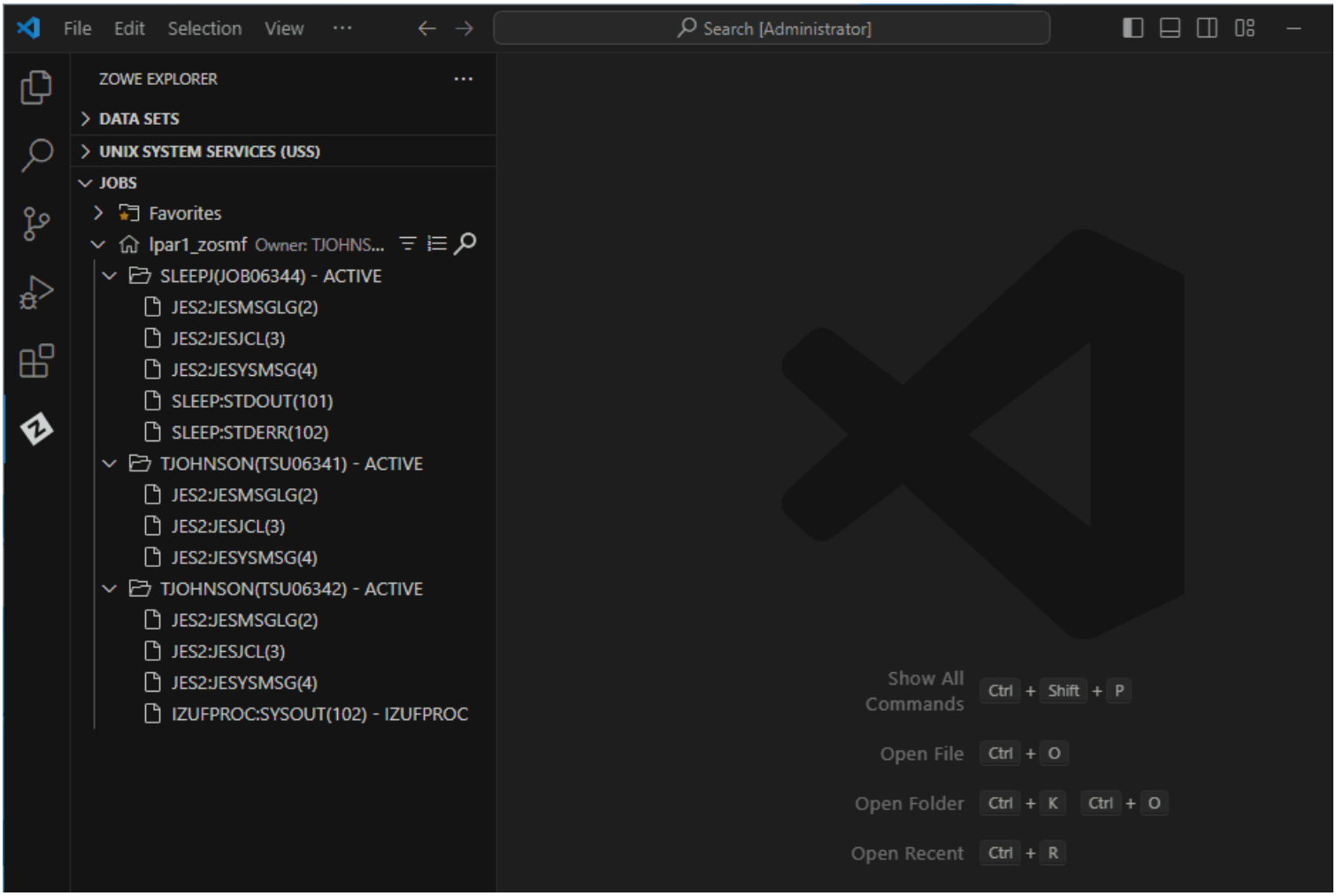
   The selected file is saved in the specified location.

Sorting jobs

1. Expand **JOBS** in the **Side Bar**.
2. Click on the **Sort** icon to the right of a profile.
3. In the **Quick Pick**, select the **Sort Direction** option and select either **Ascending** or **Descending**.
4. Select a sort type from the list of available options:
   - **Job ID (default)**

- **Date Submitted**
- **Date Completed**
- **Job Name**
- **Return Code**

> **NOTE**
>
> To change the default sort order for jobs, see Modifying the default sort order for data sets and jobs.



Polling a spool file

Users can periodically refresh a spool file during long-running jobs to get the latest job outputs. This avoids having to close and reopen a spool file to get the latest job outputs.

There are two ways to poll a spool file: automatically at set intervals or manually on demand.

Defining a default interval for polling spool files

1. Click on the **Manage** icon on the **Activity Bar** and select **Settings**.
2. In either the **User** or **Workspace** tab, click on the **Extensions** option to open the menu.
3. Select **Zowe Explorer**.

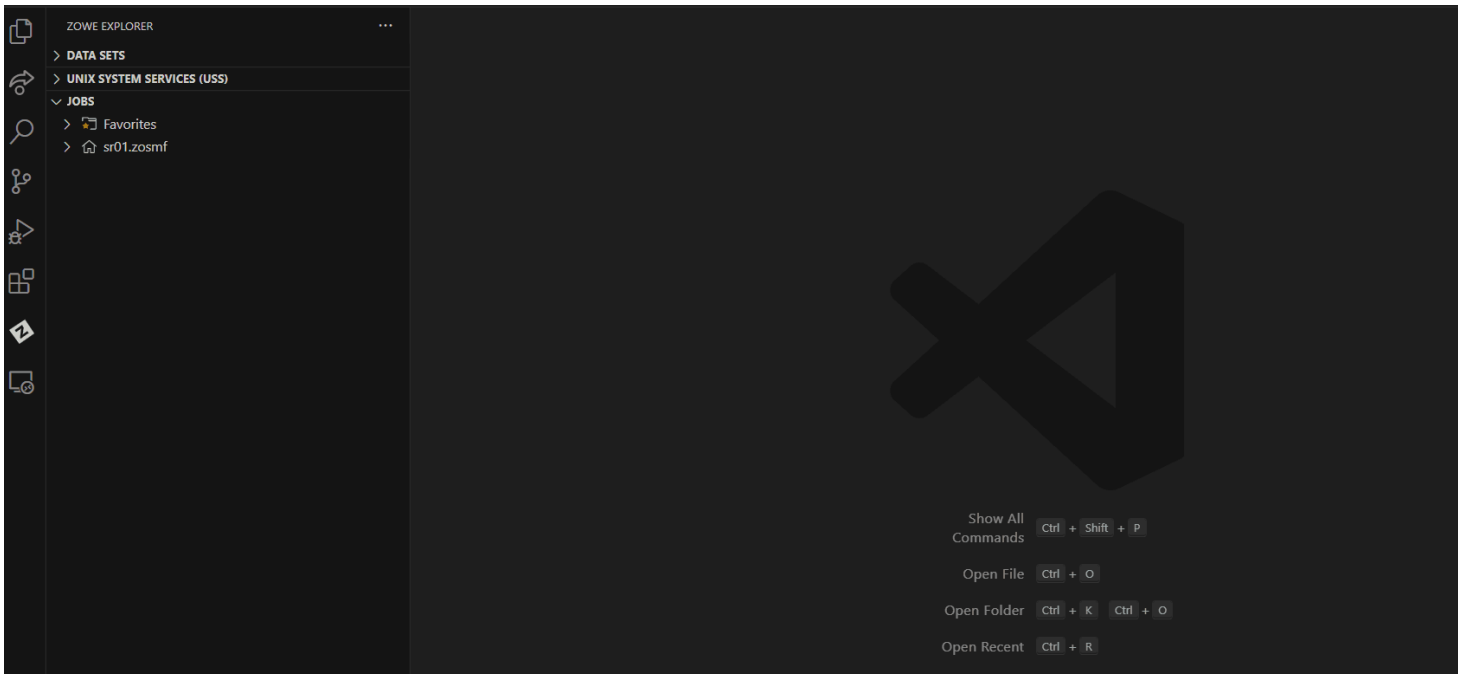
4. In the **Jobs: Poll Interval** field, enter a valid time interval, in milliseconds.
    - Value must be greater than or equal to 1000 ms (or 1 second).
5. Press the `Enter` key to start the polling action.

Polling a spool file at set intervals

1. Expand the **JOBS** tree in the **Side Bar**.
2. Click on the **Search** icon next to a profile and enter search criteria.

   Search results display under the profile in the **Side Bar**.
3. Right click on the desired spool file and select the **Start Polling** option.
    - Repeat this step with additional spool files to poll multiple files simultaneously.
4. The **Poll interval (in ms) for: <spoolfilename>** field displays the current interval value.
    - The default value is set to 5000 ms.
    - Change the value by entering a different number (must be greater than or equal to 1000 ms).
5. Press the `Enter` key to confirm the interval time and start the polling action.

   The poll request is added to the poller, and the selected spool file is marked with a "**P**" in the **Side Bar** and any corresponding **Editor** tabs.



Stopping spool file polling

1. In the **Side Bar**, select a spool file that is being polled.

   Spool files being polled are marked with a "**P**" in the **Side Bar**.

2. Right click the spool file and select the **Stop Polling** option.

   The poll request is removed from the poller, and the selected spool file is no longer marked with a "**P**" in the **Side Bar** and any corresponding **Editor** tabs.

Polling a spool file manually

A spool file can be polled on demand by using a designated keyboard shortcut.

To manually poll a spool file:

1. In the **Side Bar**, double click a spool file to open it in an **Editor**.
2. With the spool file in an active tab, press the keyboard shortcut.
   - See Configuring the keyboard shortcut for manual polling to set the keyboard shortcut.

   The spool file is updated and "**Polling...**" displays in the bottom status bar.

Configuring the keyboard shortcut for manual polling

1. Click on the **Settings** icon on the **Activity Bar** and select **Keyboard Shortcuts**.
2. Navigate to **Zowe Explorer: Poll Content in Active Editor**.
3. Select the **Edit** icon to designate a different keyboard shortcut.
   - The default shortcut is the `F5` key.

   The entered key(s) can be used to activate polling.

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Working with commands

You can issue the same commands used in ISPF with Zowe Explorer.

MVS commands can be used to obtain information from the zOS console, while SSH commands can be used to issue shell commands to Unix System Services (USS). TSO commands can be used to invoke mainframe scripts in a zOS terminal session.

Issuing MVS commands

1. Expand **DATA SETS**, **UNIX SYSTEM SERVICES (USS)**, or **JOBS** in the **Side Bar**.
2. Right-click on your profile and select the **Issue MVS Command** option.

   Alternatively, press the `F1` key to open the **Command Palette**, and then select the **Zowe Expolorer: Issue MVS Command** option.
3. In the **Quick Pick**, enter a new command or select a saved command.
4. Press the `Enter` key to execute the command.

   The output displays in the **Output** panel.

> Example command: Issue `D T` to get the system time.

Issuing SSH commands

1. Expand **DATA SETS**, **UNIX SYSTEM SERVICES (USS)**, or **JOBS** in the **Side Bar**.
2. Right-click on your profile and select the **Issue Unix Command** option.

   Alternatively, press the `F1` key to open the **Command Palette**, then select the **Zowe Explorer: Issue Unix Command** option.
3. In the **Quick Pick**, enter a new command or select a saved command.
4. Press the `Enter` key to execute the command.

   The output displays in the **Output** panel.

> Example command: Issue `ls` to list the contents of the current directory.

Issuing TSO commands

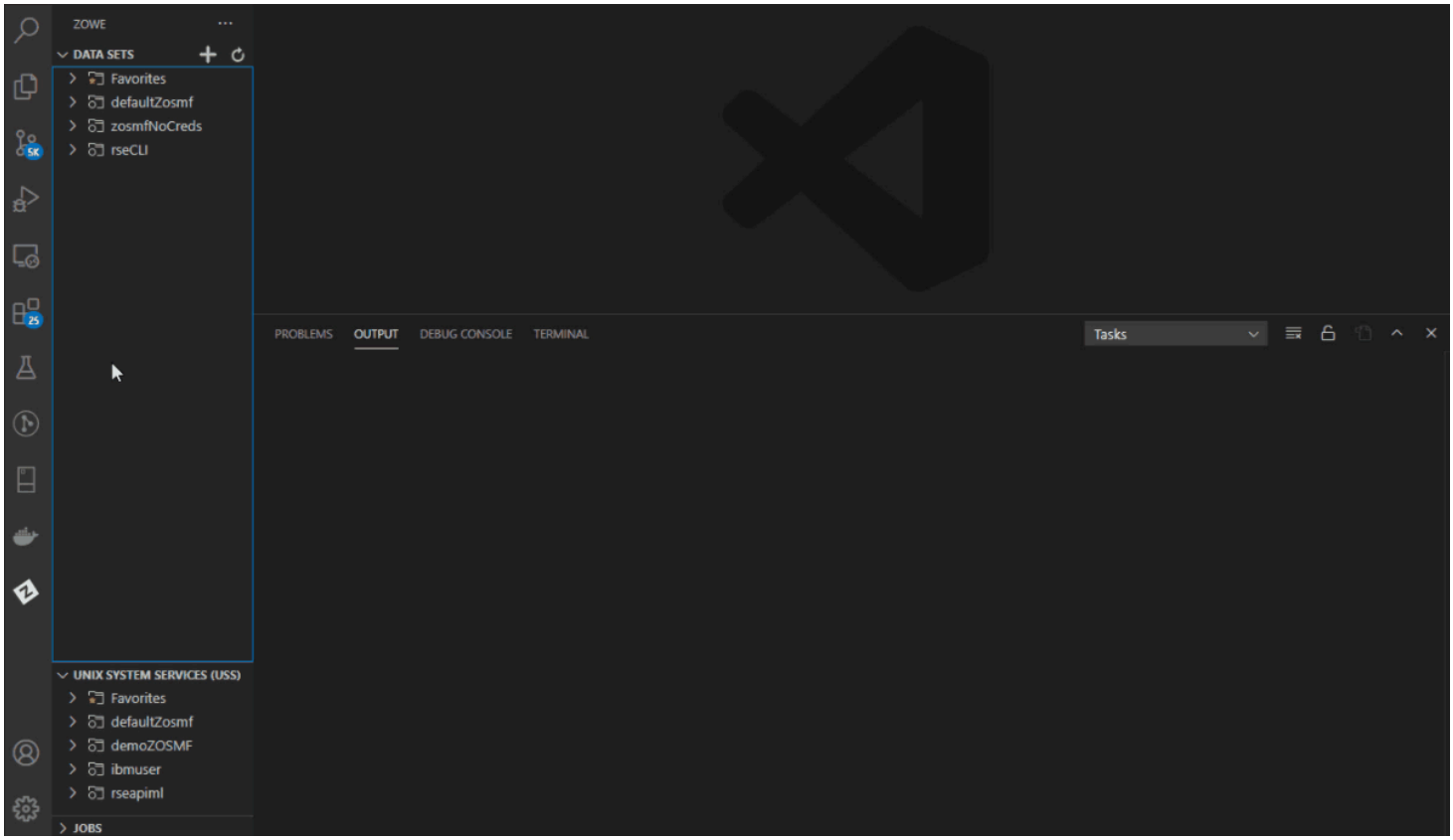
1. Expand **DATA SETS**, **UNIX SYSTEM SERVICES (USS)**, or **JOBS** in the **Side Bar**.
2. Right-click on your profile and select the **Issue TSO Command** option.

Alternatively, press the `F1` key to open the **Command Palette**, then select the **Zowe Explorer: Issue TSO Command** option.

3. In the **Quick Pick**, enter a new command or select a saved command.

4. Press the `Enter` key to execute the command.

   The output displays in the **Output** panel.



> Example command: Issue `profile` to get information on your zOS system user profile.

Version: v3.2.x LTS

Using Zowe Explorer CICS Extension

The CICS Extension for Zowe Explorer adds additional functionality to the popular Visual Studio Code extension Zowe Explorer. This extension allows you to interact with CICS regions and programs, and run commands against them.

Features

- Create new Zowe CICS profiles and connect to them.
- **Work with multiple regions** that contain programs, local transactions, and local files within a plex in a comprehensible tree-like format.
- Perform actions such as **Enable**, **Disable**, **New Copy**, and **Phase In** directly from the UI.
- Perform additional actions on local files including **Open** and **Close** directly from the UI.
- View and search attributes of resources and regions by right-clicking and using the dynamic filtering feature.
- **Apply multiple filters** to regions, programs, local transactions, and local files.
- View and interact with various resources (regions, transactions, programs, libraries, local files, and more) under a plex.

Usage tips

Make the best use of the Zowe Explorer CICS Extension with the following tips.

Multi-select functionality

Apply an action to multiple objects at the same time for increased efficiency. All menu action commands available when right-clicking a profile or resource (excluding **Show Attributes**) can be applied to multiple items. To do this, select the multiple nodes of the same type before right-clicking and selecting the command.

To select multiple nodes, hold the `Ctrl` or `Cmd` key while selecting the resources. You can also select multiple consecutive nodes by selecting the first item in a list of nodes and then holding the `Shift` key while selecting the last item in the list.

Refreshing the resources view

Click the **Refresh** icon at the top of the **CICS** tree view to reload the resources in every region.

Managing Zowe Explorer CICS Extension profiles

To use all functions of the Zowe Explorer CICS extension, you need to have a Zowe Explorer profile.

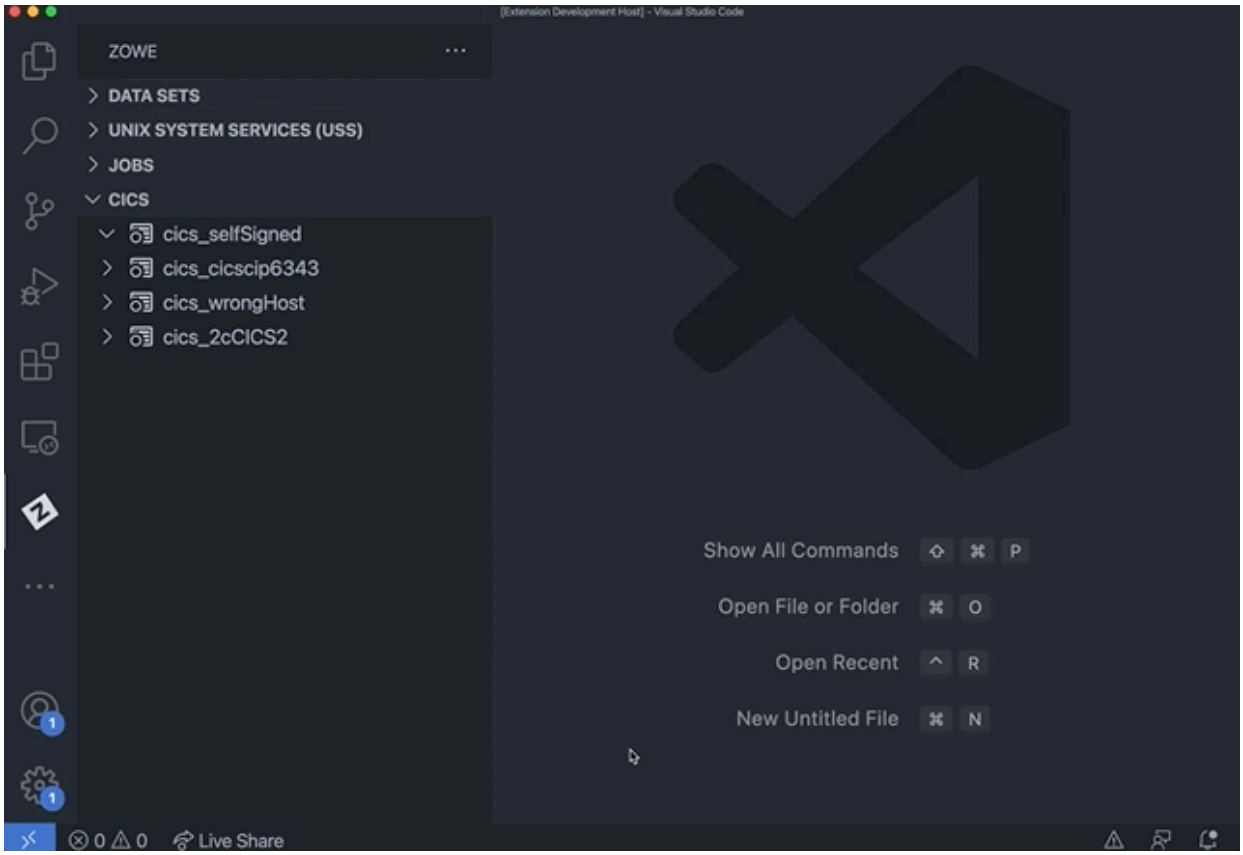
If you already have a Zowe CICS CLI profile, the CICS tree in the VS Code **Side Bar** loads the default profile on startup.

If you do not have an existing Zowe CICS CLI profile, refer to the following instructions.

Using Zowe team configuration

1. Expand the **CICS** tree in the **Side Bar**, and click the **+** icon.
2. In the **Quick Pick** menu, select the **Create New CICS profile** option to open the configuration file. If no configuration file is available, select the **Create a new Team Configuration File** option from the **Quick Pick** menu.

   The active configuration file opens in an **Editor**. If none exists, a new configuration file opens in an **Editor**.
3. Edit the configuration file to add a CICS profile.
4. Save the configuration file.
5. Refresh the Zowe Explorer for IBM CICS extension. Either click the **Refresh** icon at the top of the **CICS** tree in the **Side Bar**, or select the `Zowe Explorer for IBM CICS: Refresh` option in the **Command Palette**.
6. In the **CICS** tree, select the **+** icon and select the newly created profile from the **Quick Pick** menu to display it in the **CICS** tree.



::: Note

The CICS profile must specify a CICS region's CICS Management Client Interface (CMCI) TCP/IP host name and port number. The region can be a WUI server in a CICSPlex or a stand-alone CICS System Management Single Server (SMSS) region.

Configuring a CICS region to have a connection is a system programmer task and more details can be found in Setting up CMCI with CICSPlex SM or Setting up CMCI in a stand-alone CICS region. If your CMCI connection is configured to use a self-signed certificate that your PC's trust store does not recognize, see Overriding untrusted TLS certificates.

:::

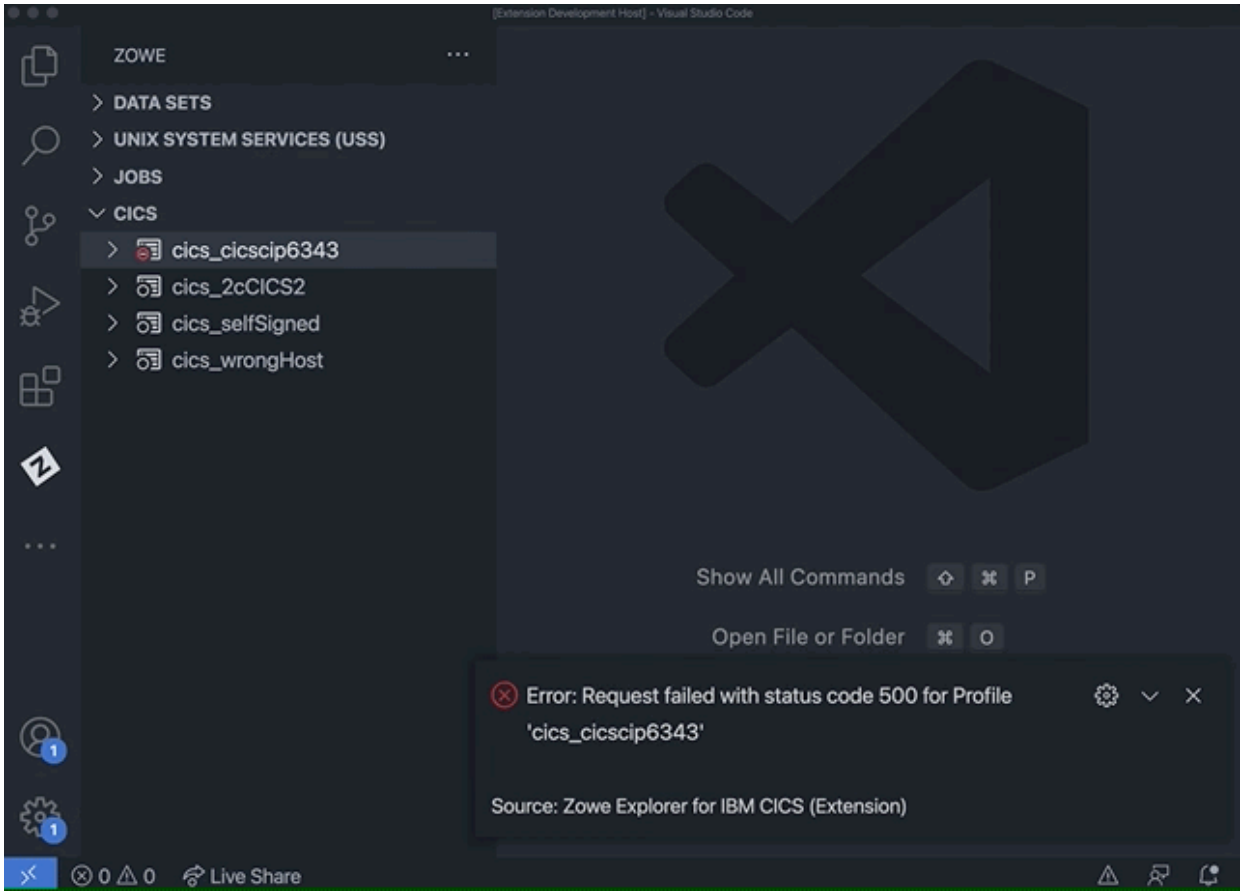
To show more than one CICS profiles in the tree, select the **+** button and choose from the list of profiles. Only profiles that are not already included in the CICS tree are shown.

Updating profiles

1. Expand the **CICS** tree in the **Side Bar**, and right-click a profile to open up the profile menu actions.
2. Select the **Update Profile** option.

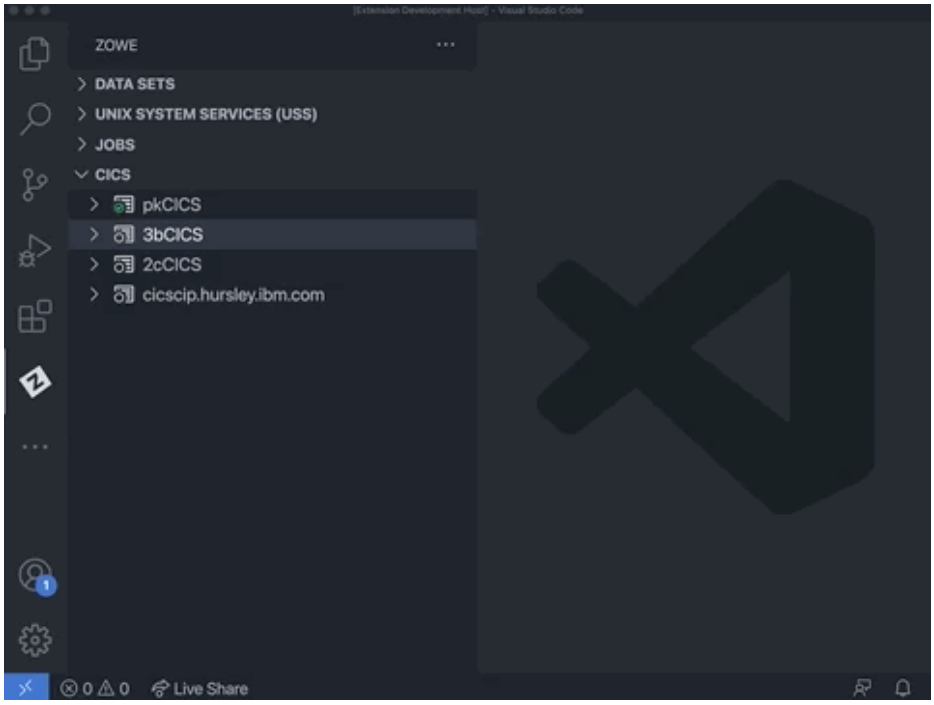
   The associated configuration file opens in an **Editor**.
3. Edit the configuration file to update the profile(s).
4. Save the configuration file.

5. Refresh the Zowe Explorer for IBM CICS extension. Either click the **Refresh** icon at the top of the **CICS** tree in the **Side Bar**, or select the `Zowe Explorer for IBM CICS: Refresh` option in the **Command Palette**.



Hiding and unhiding profiles

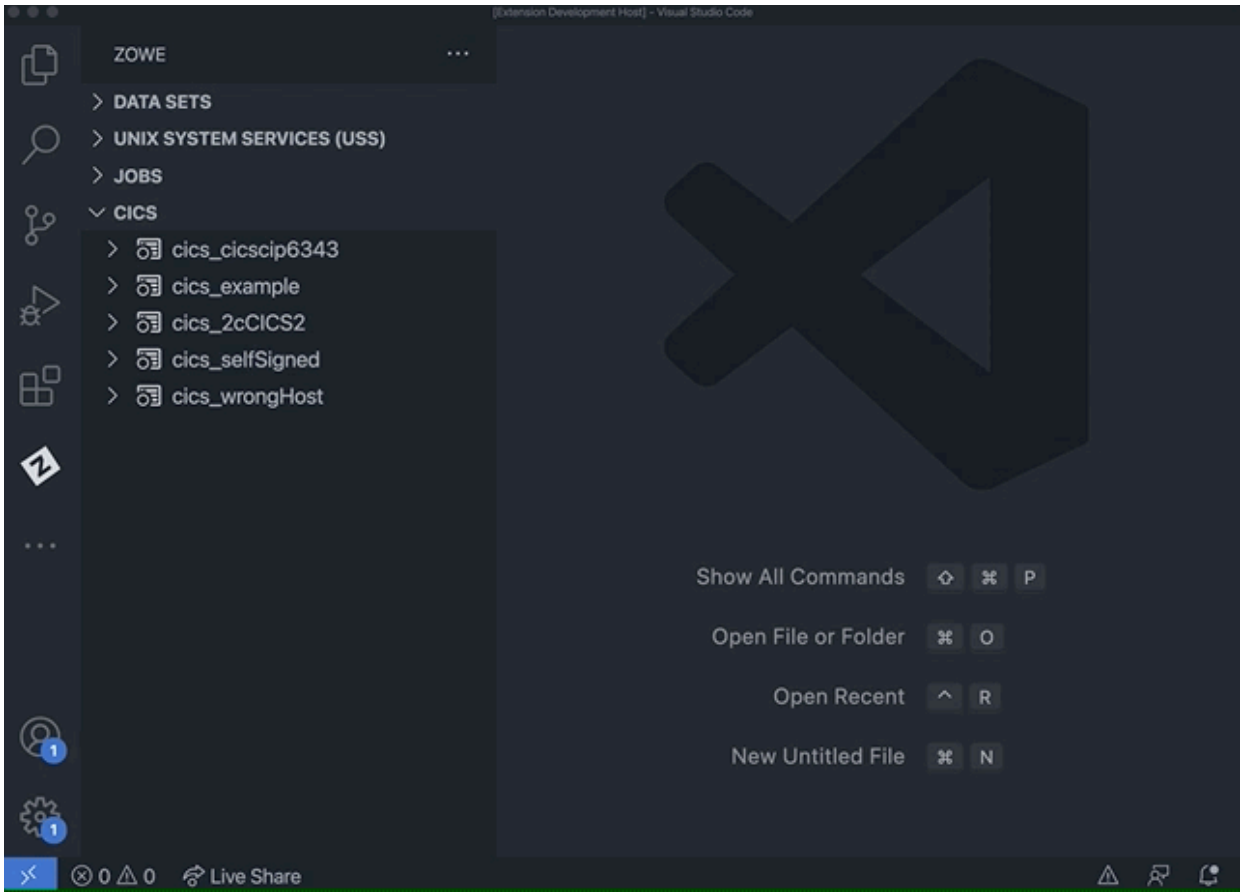
1. Expand the **CICS** tree in the **Side Bar**, and right-click the desired profile.
2. Select the **Hide Profile** option to hide it from the **CICS** tree view.
3. To unhide the profile, click the **+** icon at the top of the **CICS** tree and select the profile from the **Quick Pick** menu.



Deleting profiles

1. Expand the **CICS** tree in the **Side Bar**, and right-click the desired profile.
2. Select the **Delete Profile** option.

   The associated configuration file opens in an **Editor**.
3. Edit the configuration file to remove the profile.
4. Save the configuration file.
5. Refresh the Zowe Explorer for IBM CICS extension. Either click the **Refresh** icon at the top of the **CICS** tree in the **Side Bar**, or select the `Zowe Explorer for IBM CICS: Refresh` option in the **Command Palette**.


[Extension Development Host] - Visual Studio Code
ZOWE
DATA SETS
UNIX SYSTEM SERVICES (USS)
JOBS
CICS
cics_cicscip6343
cics_example
cics_2cCICS2
cics_selfSigned
cics_wrongHost
Show All Commands
Open File or Folder
Open Recent
New Untitled File
Live Share

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Using CICS resources

Expand a CICS profile to see the region name, and expand the region to view its resources.

- If the CICS profile is connected to a CMAS region that is part of a CICSPlex, the tree shows all of the regions managed by the CICSPlex.
- If the CICS profile is for an SMSS region, then only one region displays. Inactive regions in a plex display with an empty icon.

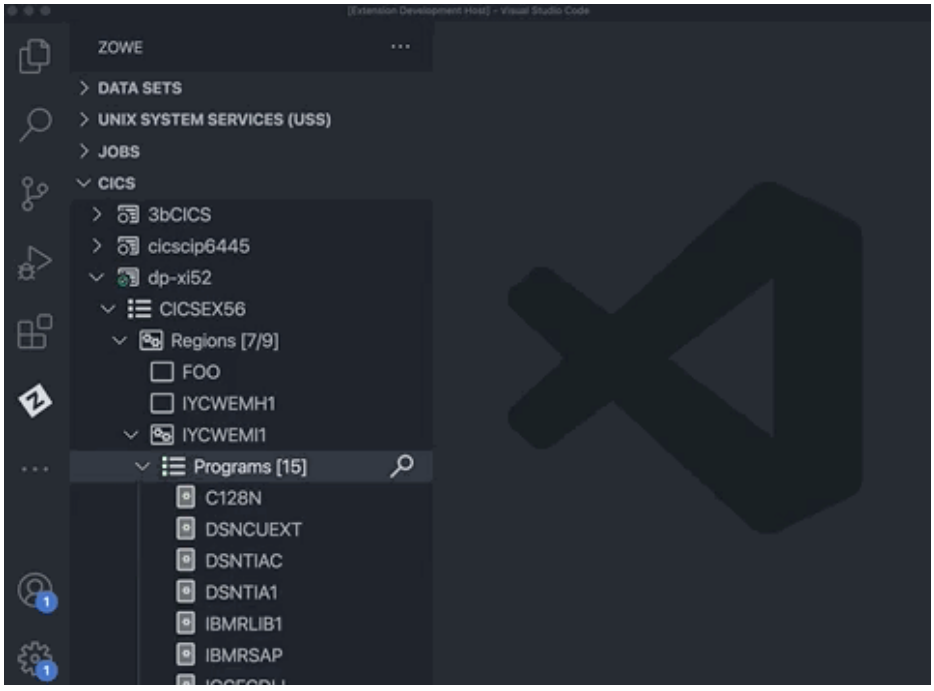
Showing and filtering resources in a region

1. Expand the **CICS** tree in the **Side Bar** and navigate to a CICS region.
2. Expand the CICS region to show folders for the **Programs**, **Transactions**, and **Local Files** resource types.
3. Expand each resource type to view their resources. (The number of resources in a resource tree displays in square brackets next to the tree name.)

   The list of resources is pre-filtered to exclude many of the IBM-supplied resources. This narrows the contents to include only user programs.
4. Use the **Search** icon in a resource type to apply a filter.

   Enter an exact resource name or use wildcards. The search history is saved so you can recall previous searches.

   To reset the filter to its initial criteria, use the **Clear** filter icon in the resource type. To see all resources in a region (including those supplied by IBM), use an `*` as a filter.



::: Tip

To apply multiple filters, separate entries with a comma. Append a filter with an `*` to indicate wildcard searching.

:::

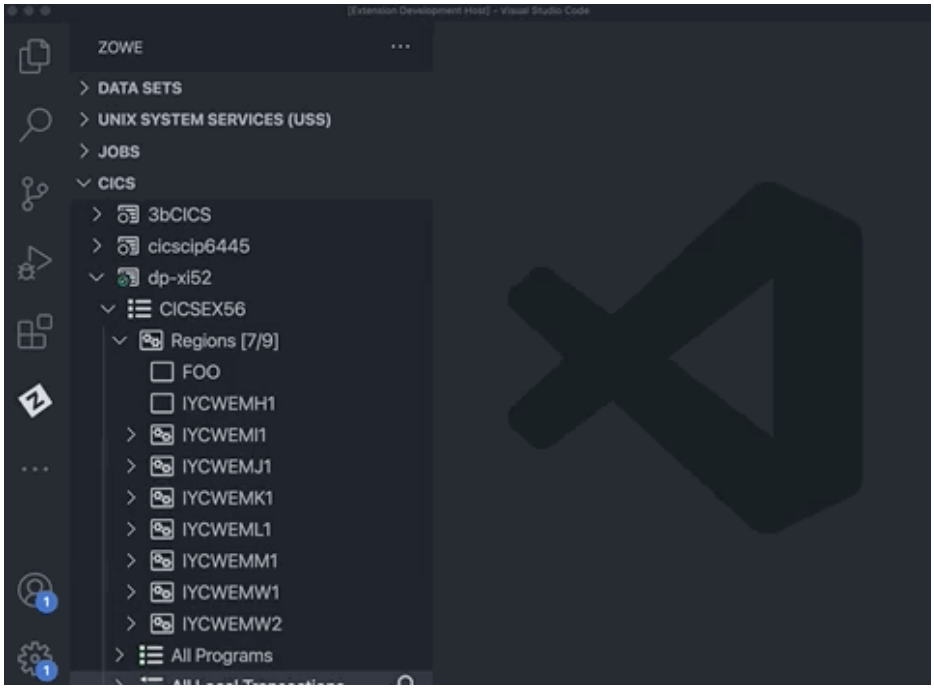
Showing and filtering resources in a plex

Apply a filter on all region resources in a plex.

1. Expand the **CICS** tree in the **Side Bar** and navigate to the **Regions** tree.
2. In the **Quick Pick**, select **Regions**, **Programs**, **Local Transactions**, or **Local Files**.

   This specifies the resource type to apply as the filter for all regions in the plex.
3. To reset the filter to its initial criteria, select the **Clear** filter icon on the **Regions** tree.

   This displays a **Quick Pick** menu that gives the option to clear the filter for all the **Regions**, **Programs**, **Local Transactions** or **Local Files** in the plex, and the option **All** to clear all filters in the plex.



::: Tip

To apply multiple filters, separate entries with a comma. Append a filter with an `*` to indicate wildcard searching.

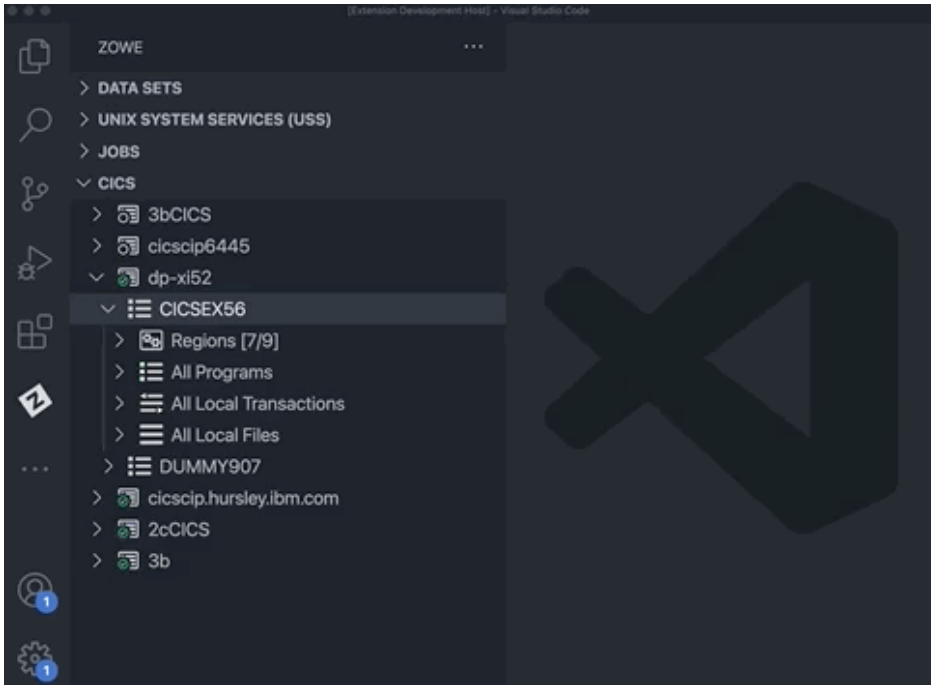
:::

Showing and filtering resources in an 'All' resource tree

Plexes includes **All Programs**, **All Local Transactions** and **All Local Files** trees that contain all the corresponding resources from all regions in the plex.

To view resources under these trees:

1. Expand the **CICS** tree in the **Side Bar** and navigate to the desired tree.
2. Select the **Search** icon in the desired tree and apply a filter from the **Quick Pick**.



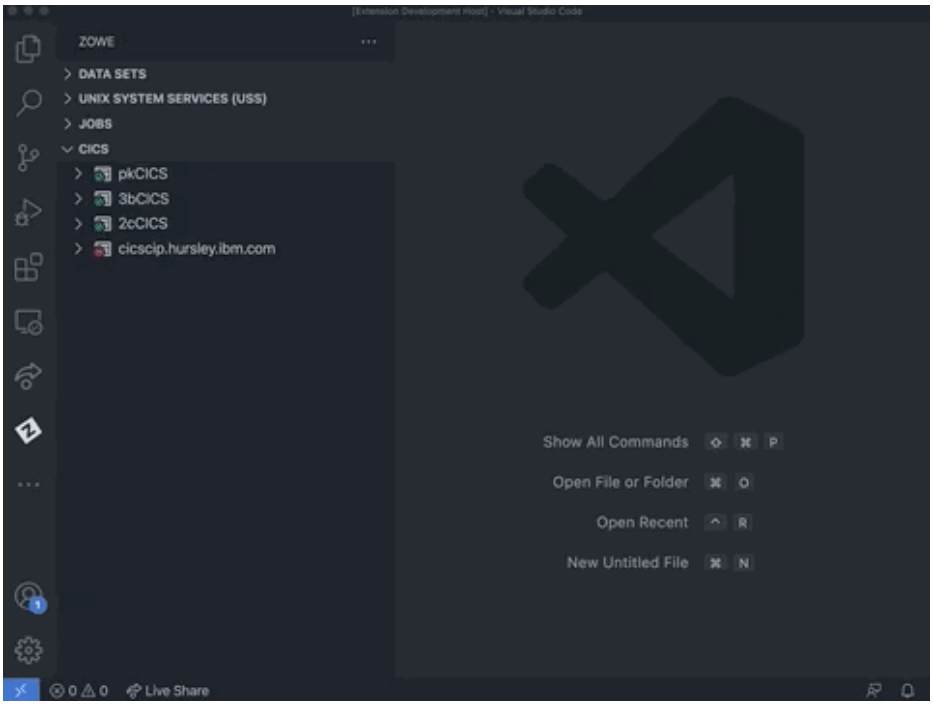
   If the applied filter results in more than 500 records, change the filter to narrow the search, or click the **view X more ...** option to retrieve the specified quantity of resources.

Showing attributes

1. Expand the **CICS** tree in the **Side Bar** and navigate to a program.
2. Right-click the program.

   A context menu lists the available actions that can be performed.
3. Select the **Show Attributes** option.

   All attributes and their values open in an **Editor**. Use the filter box at the top of the **Editor** to search for attributes matching the search criteria.

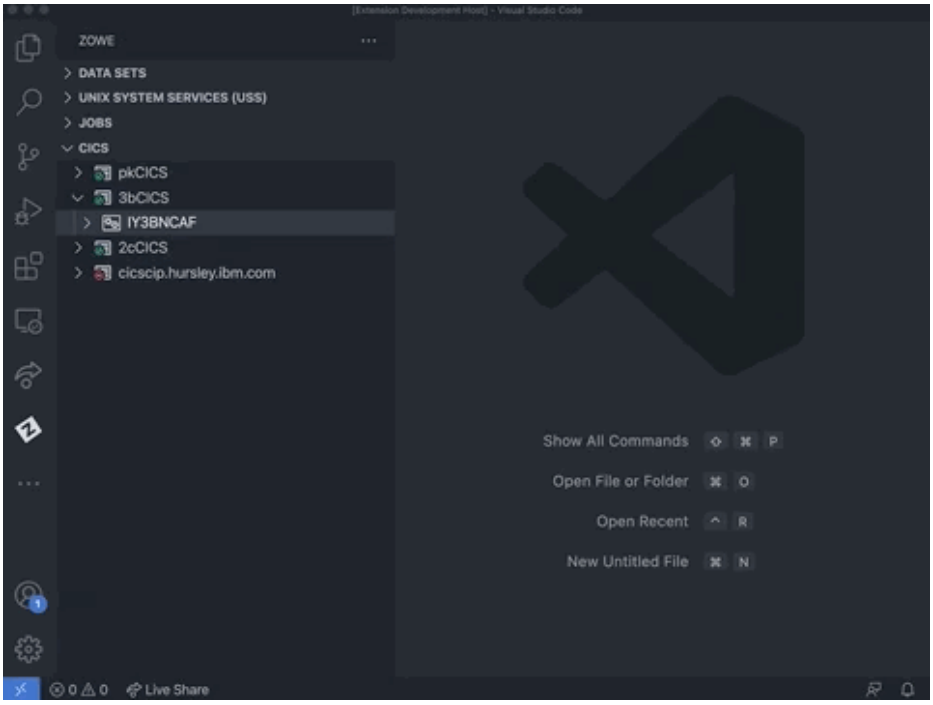


Enabling and disabling

1. Expand the **CICS** tree in the **Side Bar** and navigate to a program, local transaction, or local file.
2. Right-click a program, local transaction, or local file.

   A context menu lists the available actions that can be performed.
3. Select the **Disable [CICS resource]** option.

   The resource is disabled. A disabled resource is identified by a `(Disabled)` indicator next to its name.
4. To enable resource, right-click a disabled program, local transaction, or local file and select the **Enable [CICS resource]** option from the context menu to re-enable it.



New copy and phase in

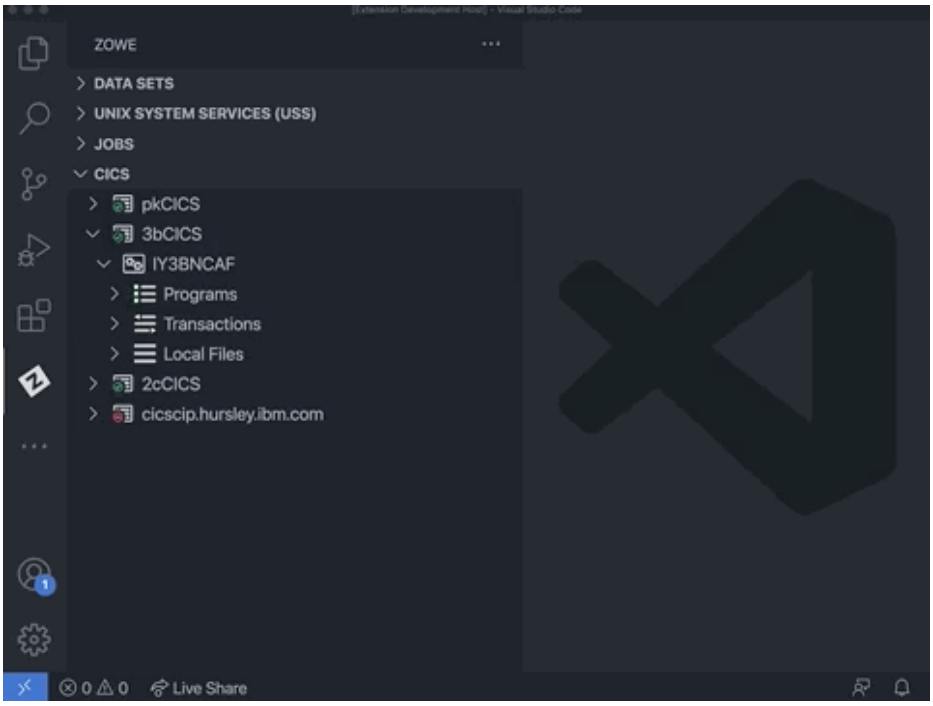
Use the **New Copy** and the **Phase In** actions against a CICS program to get the CICS region to load a fresh copy of the selected program into memory. This could be useful after you edited a COBOL program source and successfully compiled it into a load library and now want to test your change.

1. Expand the **CICS** tree in the **Side Bar** and navigate to a program.
2. Select the program and click on the **New Copy** icon next to it, or right-click a program and select the **New Copy** option from the context menu.

   The program is applied to the CICS region to use it on the associated transaction, and a pop-up message displays the status of the operation.

   The `New copy count` for a program is shown next to the program in the **CICS** tree.
3. Select the program and click on the **Phase In** icon next to it, or right-click a program and select the **Phase In** option from the context menu.

   The program is applied to the CICS region whether or not the program is actively running, and a pop-up message displays the status of the operation.



Opening and closing local files

To open a local file:

1. Right-click a closed local file.
2. Select the **Open Local File** option from the context menu.

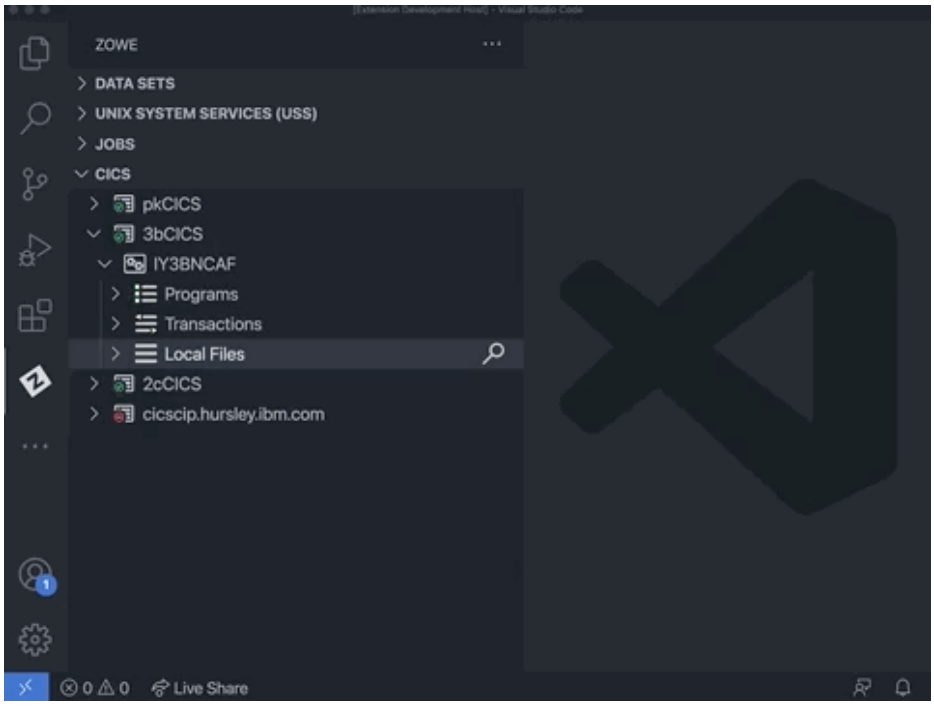
   The `openstatus` attribute for the file is set to `OPEN`.

To close a local file:

1. Right-click an open local file.
2. Select the **Close Local File** option from the context menu.
3. When prompted, choose one of the following options from the pop-up window:

   - **Wait** for the file/resource to not be in use.
   - **No Wait** to close the file/resource without waiting.
   - **Force** to abort any process that was using the file/resource.

   After an option is selected, the local file name is appended with a `(Closed)` label.


ZOWE
DATA SETS
UNIX SYSTEM SERVICES (USS)
JOBS
CICS
pkCICS
3bCICS
IY3BNCAF
Programs
Transactions
Local Files
2cCICS
cicscip.hursley.ibm.com
0 0
Live Share

Version: v3.2.x LTS

Overriding untrusted TLS certificates

There are times when a user might want to override a rejected TLS certificate.

By default, if the CICS Management Client Interface (CMCI) connection uses a TLS certificate that does not exist in your PC's trust store, Zowe Explorer rejects the connection because the certificate could originate from an unsafe site.

You might want to override this behavior if you are using certificates not signed by a recognized certificate-issuing authority. For instance, z/OSMF might only have certificates created on the mainframe, resulting in self-signed certificates. Zowe Explorer rejects these types of certificates by default as a security measure.

There are two ways to override a rejected TLS certificate.

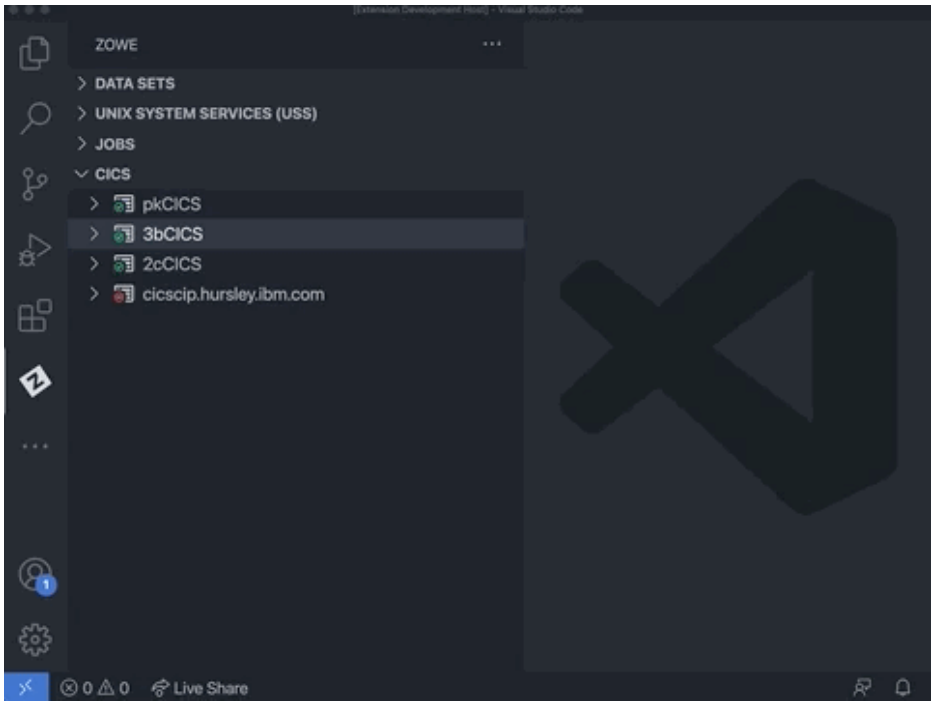
Updating the CICS profile with Zowe Explorer

1. Attempt the CMCI connection.

   Zowe Explorer rejects the TLS certificate and displays a pop-up message warning about the certificate.

2. Select the **Yes** option on the warning.

   Zowe Explorer updates the `rejectUnauthorized` property in the respective CICS profile to `false` and updates the **CICS** tree with the modified profile.



Updating the CICS profile manually

1. Expand the **CICS** tree in the Visual Studio Code **Side Bar**, and right-click a profile to open up the profile menu actions.

2. Select the **Update Profile** option.

   The associated configuration file opens in an **Editor**.

3. Edit the configuration file to set the `rejectUnauthorized` property in the respective CICS profile to `false`.

4. Save the configuration file.

5. Refresh the Zowe Explorer for IBM CICS extension. Either click the **Refresh** icon at the top of the **CICS** tree in the **Side Bar**, or select the `Zowe Explorer for IBM CICS: Refresh` option in the **Command Palette**.

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Using Zowe Explorer FTP Extension

Using

> **CAUTION**
>
> When transferring files, data sets, or data set members, use only ASCII characters. If a file contains non-ASCII characters (such as glyphs or mathematical symbols), a translation error can happen when the file is downloaded from, or uploaded to, the mainframe. This error can result in data loss.

To use the FTP Extension with Zowe Explorer:

1. Select the **Zowe Explorer** icon on the **Activity Bar** in Visual Studio Code.
2. Hover over the **DATA SETS**, **UNIX SYSTEM SERVICES (USS)**, or **JOBS** bar and select the corresponding **+** icon to view the Zowe CLI FTP profiles in the **Quick Pick** menu.

   If you do not have an existing FTP profile, see Creating an FTP profile with Zowe Explorer.
3. Select a profile to display it in the **Side Bar**.
4. Hover over the profile and click the **Search** icon.
5. Enter the applicable values in the **Quick Pick**:
   - For data sets, select or enter the data set name.
   - For USS, select or enter the path.
   - For jobs, select or enter the job owner and job prefix.

Creating an FTP profile with Zowe Explorer

If you do not have an existing Zowe FTP profile, you can create one graphically with Zowe Explorer:

1. Select the **Zowe Explorer** icon on the **Activity Bar** in VS Code.
2. Expand the **UNIX SYSTEM SERVICES (USS)** tree and click the **+** icon.
3. In the **Quick Pick** menu, select the **Create a New Connection to z/OS** option.
4. Enter a profile name and press the `Enter` key.
5. Select the **zftp** connection type from the dropdown list of available connection options.
6. Continue providing values for the remaining prompts, which are specific for FTP-type connections.

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Supported functionality

Review the following list for the functionality available in Zowe Explorer FTP Extension.

Supported data set functionalities

Migrated data set:

- Show Data Set Attribute
- Add to Favorites

Sequential data set:

- Show Data Set Attribute
- Pull from Mainframe
- Edit Data Set
- Rename Data Set
- Delete Data Set

Partitioned data set:

- Show Data Set Attribute
- Create New Member
- Edit Member
- Upload Member
- Rename Data Set
- Delete Data Set

Partitioned data set member:

- Pull from Mainframe
- Edit Member
- Rename Member
- Delete Member

Supported USS functionalities

- List USS files and directories
- View file in text/binary mode
- Edit file
- Save file
- Copy/paste folders and files
- Create a new directory/new file
- Upload file

- Rename file/directory
- Delete file/directory
- Pull from mainframe
- Add to Favorites

Supported jobs functionalities

- List Jobs with prefix and owner
- List job by jobid
- List spool files
- View spool files content
- Download spool files
- Submit job from dataset/member
- Delete job
- Add to favorites

Version: v3.2.x LTS

Using Zowe Explorer plug-in for IntelliJ IDEA

What can I do using the plug-in for IntelliJ IDEA?

The plug-in provides the ability to work with a mainframe through z/OSMF REST API. It has such functionalities as:

- Working with z/OS data sets and USS Files: you can create new entities, copy and move them, delete, edit right in the IDE, check and change properties
- Working with JES jobs: you can submit a job, see an output of any job, edit and run JCL right through the JES Explorer, see and change the status of a job
- Working with TSO: you can submit any TSO command through the plug-in's TSO Command Line Interface in a console way, see the output of TSO commands

Who is the plug-in for IntelliJ IDEA intended for?

The plug-in is suitable for your needs if you meet one or more of the criteria:

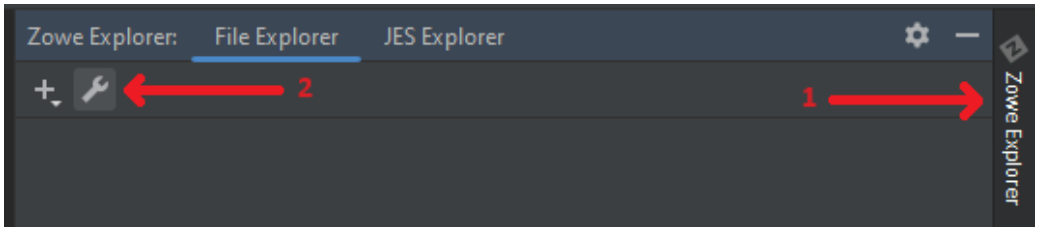
- You are a **System Programmer** and use **COBOL** / **JCL** / **PLI/I**: with the plug-in, you can easily change the source code, situated on a mainframe, right in the IDE's editor, without the risk of exposing your data anywhere, as all the content is stored under and displayed from the secure IntelliJ's storage. With a bunch of available plug-ins, it will provide the most of opportunities to work with your programs, written on mainframe-specific languages
- You are a **System Administrator** / **System Operator**: the plug-in's **TSO CLI** provides the way of interacting with a mainframe the same as the other tools do, extending the User Experience to the highest possible peak
- You are a **QA** / **Test Automation** person: it gives as much possibilities to check the actual content of a mainframe as the most modern technologies do, reducing latencies in any interaction with the components of the system
- You are a **Java** / **Kotlin** / **Scala** developer: IntelliJ IDEA provides native support for **JVM languages**, so it is more suitable for these technologies to develop for a mainframe

Version: v3.2.x LTS

Working with plug-in's settings

Before you start to use the plug-in, there are some settings that will help you to customize the way you are working with it. To open the plug-in's settings:

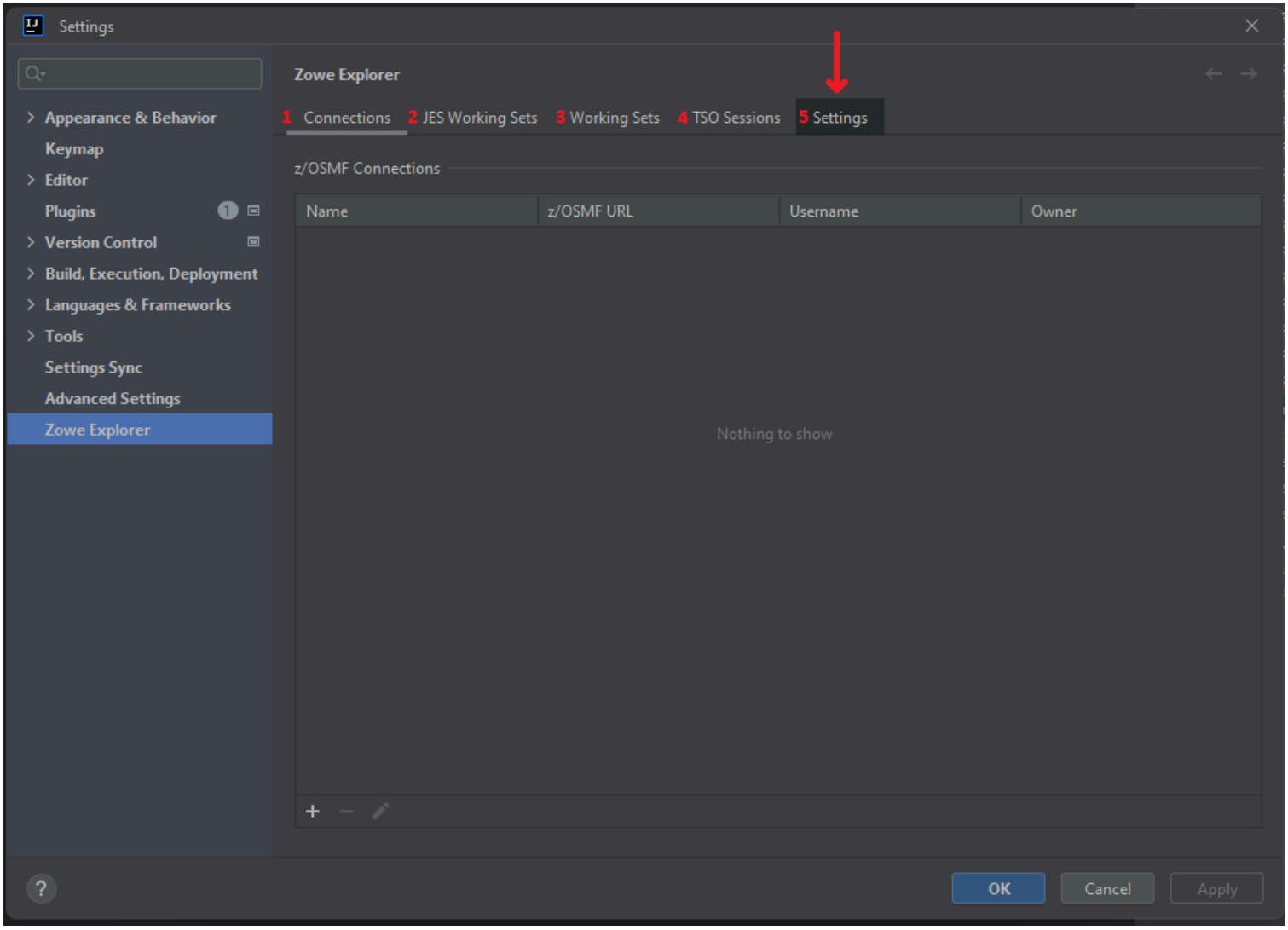
1. Open the **Zowe Explorer** tab **(1)**, click the **Settings** button **(2)**. The action will open all the configurations of the plug-in



2. After the window of the configuration appears, there are some tabs:

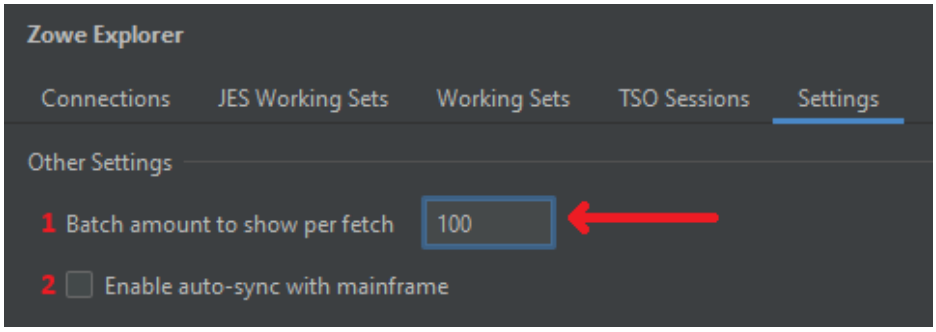
- **Connections (1)** - to manage the connections to z/OS you have. From there, you can add a new connection and delete or edit the old one
- **JES Working Sets (2)** - to manage the JES Working Sets
- **Working Sets (3)** - to manage the Files Working Sets
- **TSO Sessions (4)** - to manage TSO Sessions
- **Settings (5)** - the actual customization options of the plug-in

Click the **Settings** tab to proceed to the customization options



3. At the **Settings** tab, there are two available customization options:

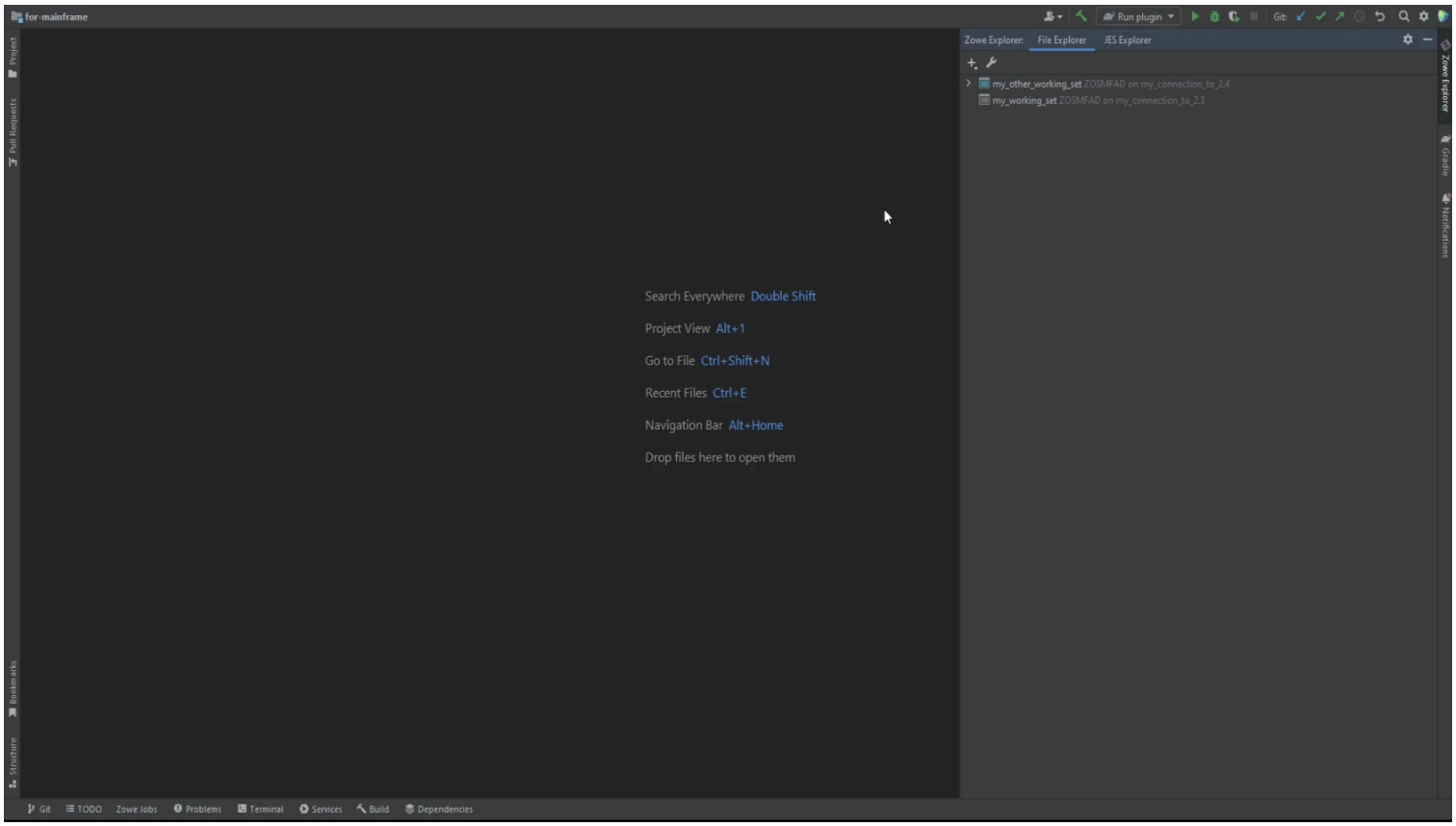
- **Batch amount to show per fetch (1)** - the amount of data sets to show under a mask. The option is editable and accepts integer numbers
- **Enable auto-sync with mainframe (2)** - the option to save content of the edited data sets and USS files automatically if selected



Batch amount to show per fetch

There could be a huge amount of data sets / files under a specified mask. Sometimes the loading of their list could take a lot of time. To eliminate this problem, the plug-in provides the ability to control the amount of items loading at one

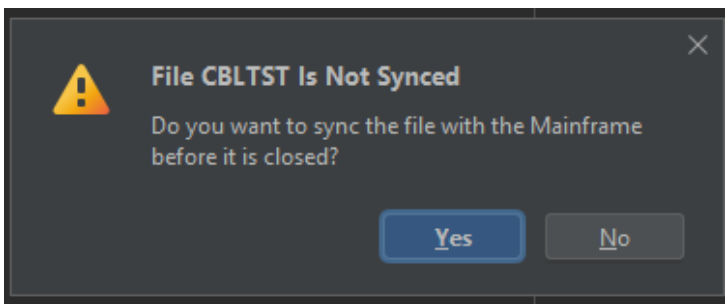
time. The option is called **Batch amount to show per fetch**. By default, it is set to **100** entries. It means that when the request to display entities under a mask contains more than the specified number, it will show the first "x" entities with the button to load more of them. You can load the next amount by double-clicking on the **load more** at the bottom of the list.



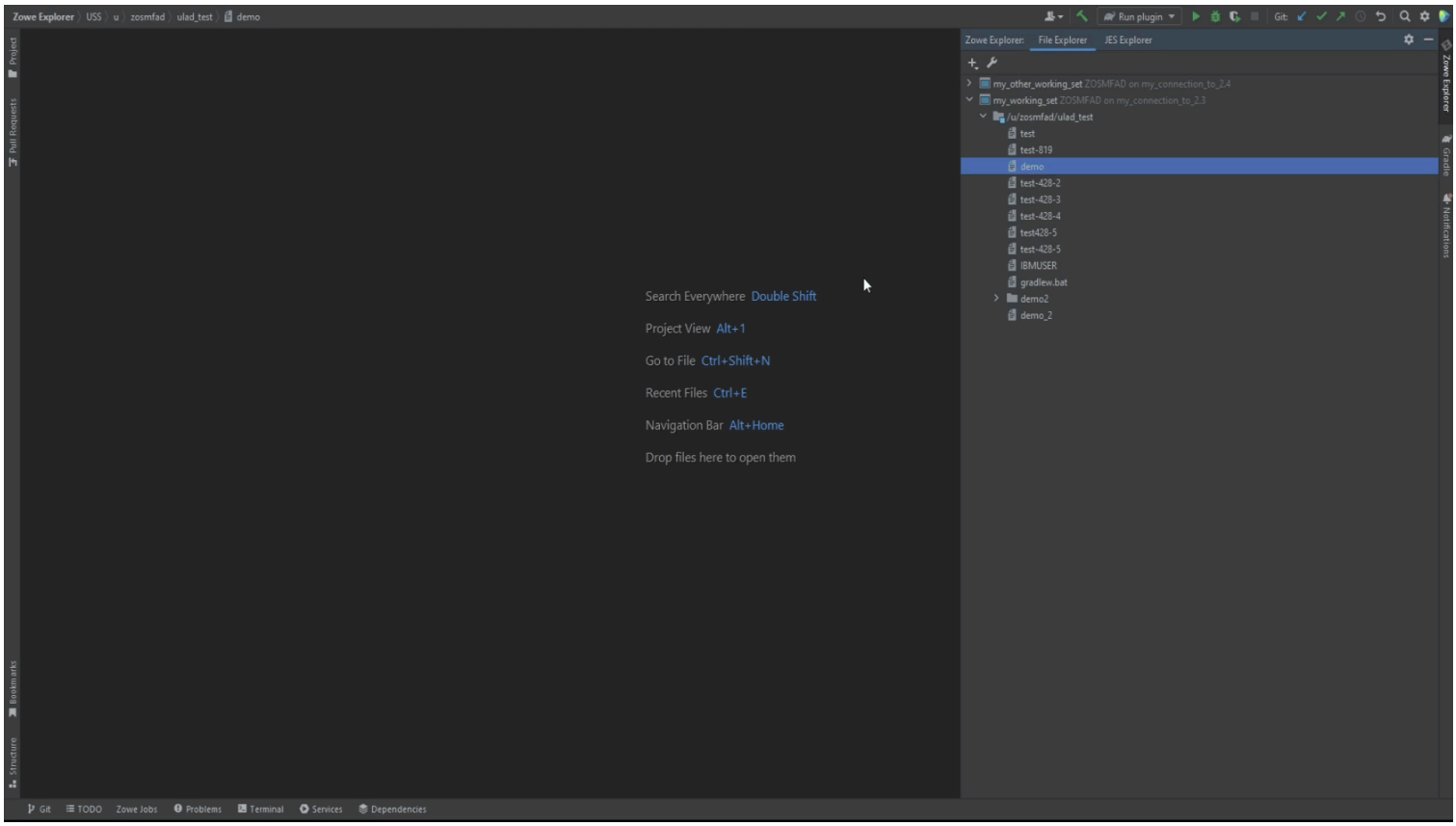
Enable auto-sync with mainframe

It is possible to synchronize the file or data set you are editing either manually or automatically. The method of synchronizing is controlled by the **Enable auto-sync with mainframe** option. When it is marked, you don't need to manually synchronize the file / data set whilst editing it, the plug-in decides by itself, when to synchronize it. In case you want to be sure that you control the process of synchronizing the content with a mainframe, or in case you have some limitations for calls to z/OSMF REST API, or for some other reason, you can disable this option and continue with manual synchronization. The synchronization process starts either by the button in the editor ( ), appearing if there are any changes in the file, or by pressing simultaneously **Ctrl + Shift + S (Cmd + Shift + S for MacOS)**.

If the manual synchronization is turned on, and you try to close the file in the editor, the plug-in will ask what to do with the content. Clicking **Yes** will synchronize the content, **No** will delete the local changes:



Here's how auto-synchronization works:



Working with plug-in's Working Sets

The concept

We use term "Working Sets" to describe the place to store sets of masks and filters. These items are stored separately for each working set. The working set is more like a "profile" *(don't confuse with the "Zowe Profile")* and is used to logically aggregate sets for different separate needs (both for users' convenience and to separate the different items to categories, in case it is needed).

There are two types of working sets:

- **Files Working Sets** - are to store z/OS and USS masks
- **JES Working Sets** - are to store JES Job filters

You can create working sets either through **Settings** or by clicking **+** button and selecting **Working Set** / **JES Working Set** from a dropdown in the plug-in's tab.

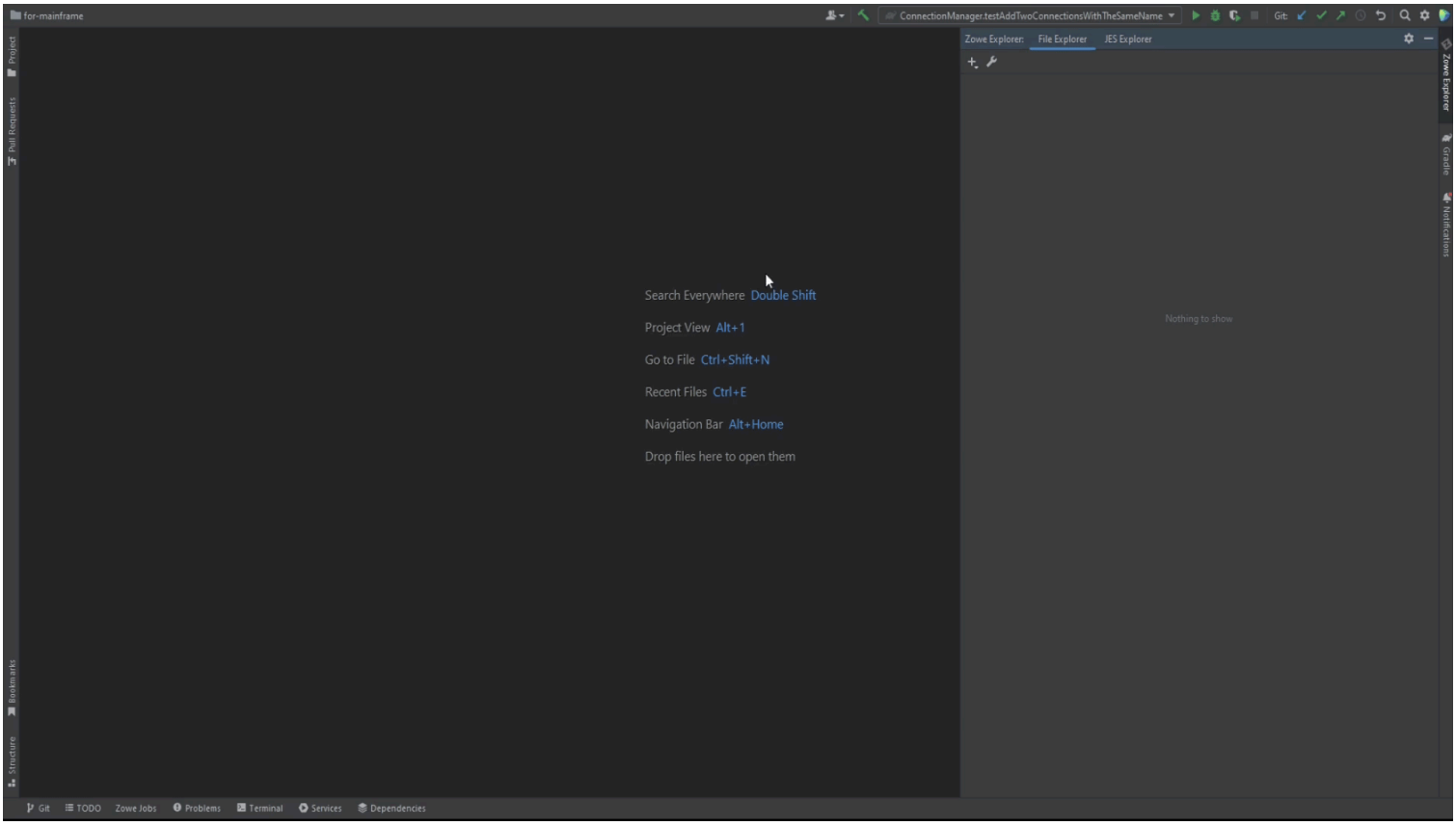
> **NOTE**
>
> You can create a working set only when a connection is set up.

Files Working Set

This type of working sets is used to store z/OS and USS masks. **Masks** are similar to filters, they are used to show z/OS data sets and USS files under a specified path.

To create Files working set:

1. Press **+** button
2. Select **Working Set**
3. Type the Working Set's name in the **Working Set Name** field (it should be unique) and select the connection under which to create the Working Set
4. Add some masks to the newly created Working Set. It can be both z/OS data set masks or USS Files masks
5. Click **OK**

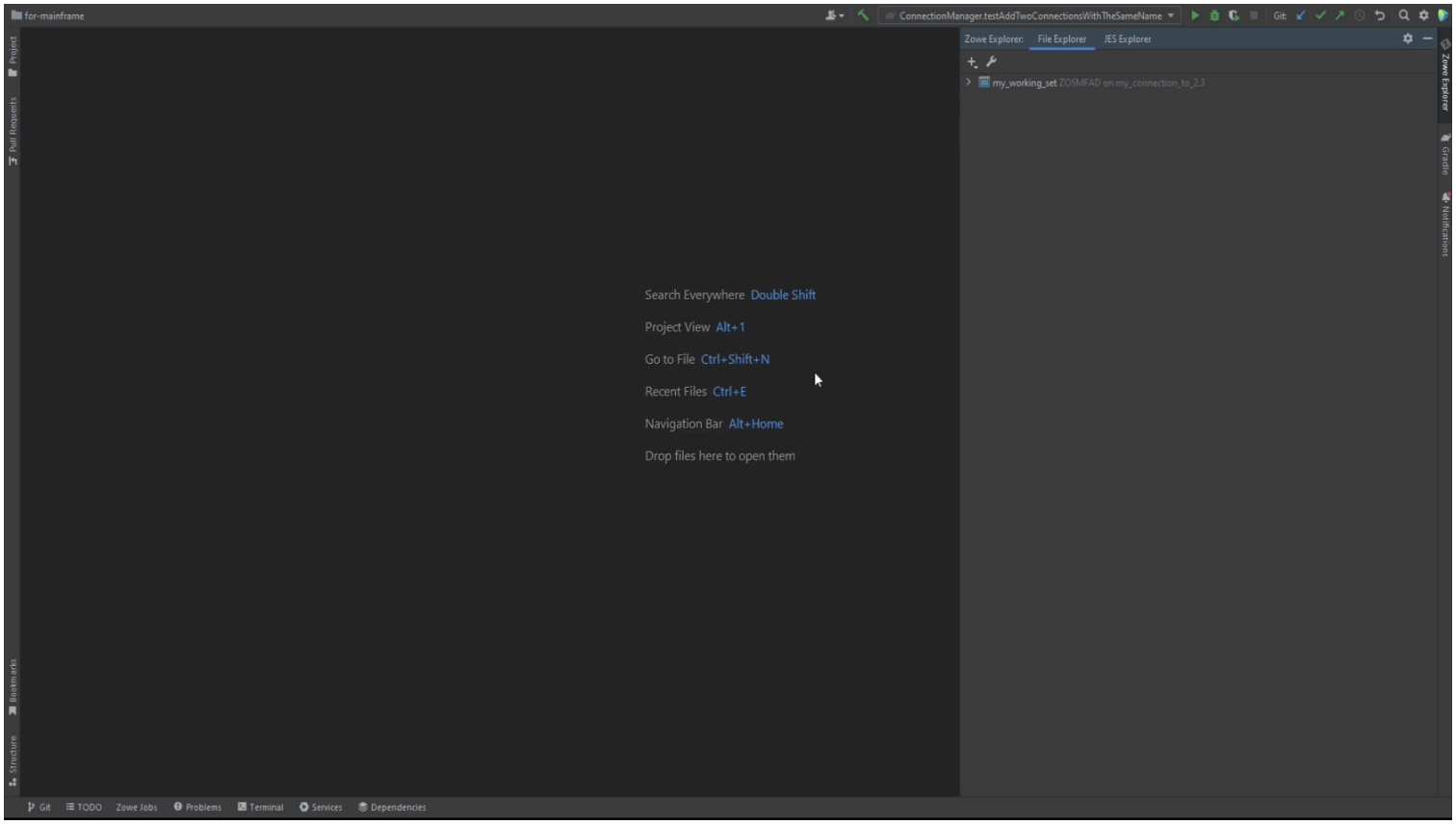


JES Working Set

This type of Working Sets is used to operate with your JES Jobs, see their logs, view and edit JCL and later run it. It holds all the filters for the JES Explorer.

To create JES Working Set:

1. Select the **JES Explorer** tab
2. Press **+** button
3. Select **JES Working Set**
4. Type the Working Set's name in the **Working Set Name** field (it should be unique) and select the connection under which to create the Working Set
5. Add some **JCL filters**
6. Click **OK**


for-mainframe
ConnectionManager.testAddTwoConnectionsWithTheSameName
Git:
Project
Pull Requests
Zowe Explorer: File Explorer JES Explorer
my_working_set ZOSMFAD on my_connection_to_2.3
Zowe Explorer
Gradle
Notifications
Search Everywhere Double Shift
Project View Alt+1
Go to File Ctrl+Shift+N
Recent Files Ctrl+E
Navigation Bar Alt+Home
Drop files here to open them
Bookmarks
Structure
Git
TODO
Zowe Jobs
Problems
Terminal
Services
Dependencies

Version: v3.2.x LTS

Working with z/OS data sets

Using the plug-in, it is possible to:

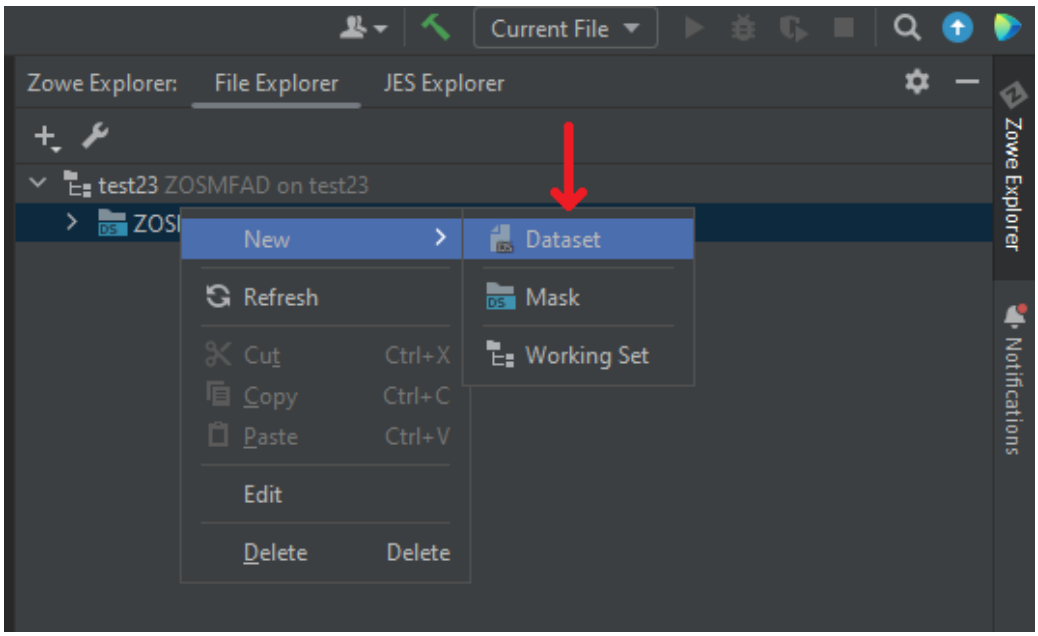
- create, rename, view, edit, delete PS, PDS, PDS/e data sets, as well as PDS and PDS/e members
- use the feature **Allocate Like** to create a data set with parameters of the other data set
- use the feature **Migrate** and **Recall** for archived data sets
- submit JCL jobs with **Submit Job** option
- copy, move z/OS data sets, both inside the filesystem, and between them, as well as between systems with different IP address
- sort data sets

After you set up a Files Working Set and create a mask to display data sets on the z/OS part, it is possible to manipulate PS, PDS and PDS/E data sets

Allocating a data set

To allocate a data set:

1. Right-click on any entity, related to z/OS data sets (it could be **Files Working Set**, **z/OS data sets mask**, any **other data set or member**)
2. Select **New** -> **Dataset**

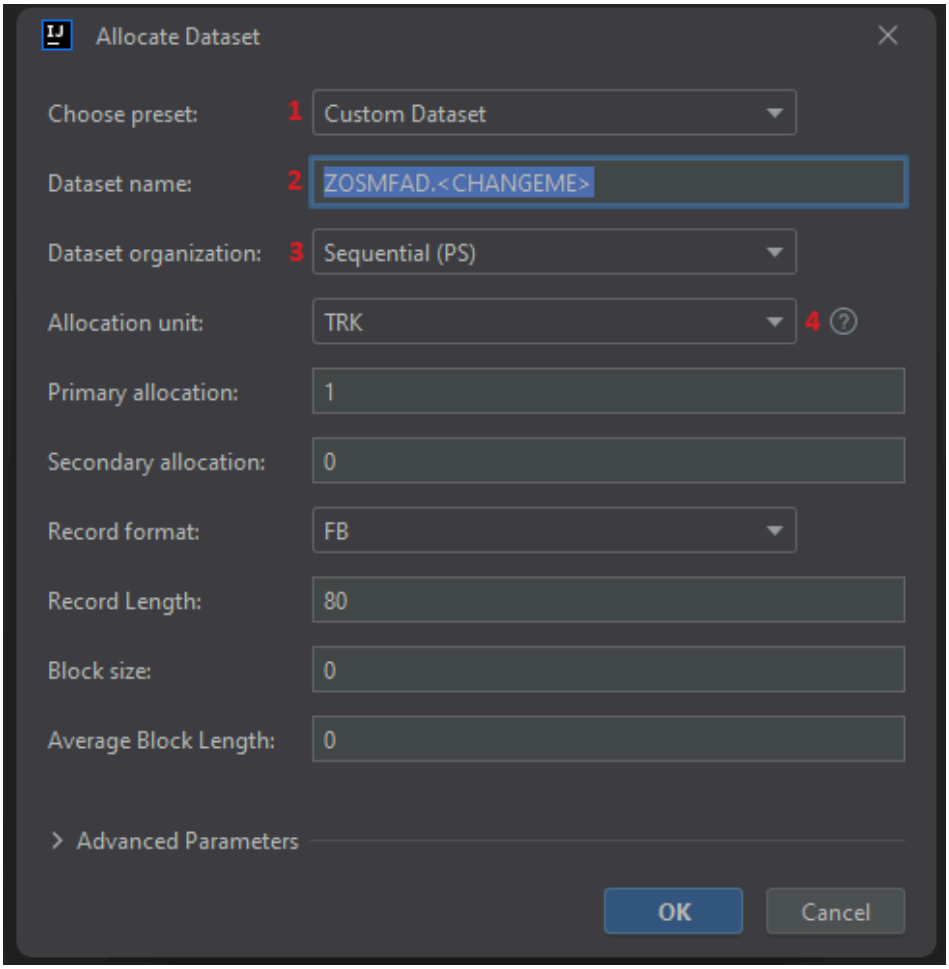


3. Specify the necessary fields. There are some custom options to help with specifying the data set parameters:
   - **Choose preset (1)** - the option provides the most commonly used data set presets both for PS and PDS options. Selecting on of the presets will automatically setup all the necessary fields to create the selected type of a data set (the presets are described more later)
   - **Dataset name (2)** - the name of the data set to be created. It automatically provides the template of the data set name with the user's HLQ as the starting string and **.<CHANGEME>** string that is intended to be changed

by the user

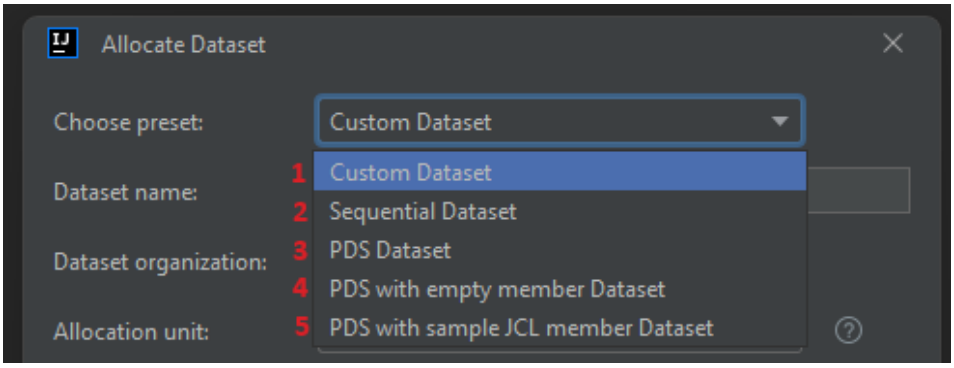
- **Dataset organization (3)** - the data set organization to be used. The options are: **PS (Physical Sequential)**, **PO (Partitioned Organization)** and **PO-E (Partitioned Organization - Extended)**
- **Allocation unit hint (4)** - a small UI improvement hint for better understanding the allocation units and their relative values to each other

All the other parameters are the same as the z/OS provides to allocate a new data set. In the **Advanced Parameters** section, there are some additional fields to setup if your prefer to set yourself such things as **Volume**, **Device Type**, **Storage class**, etc.

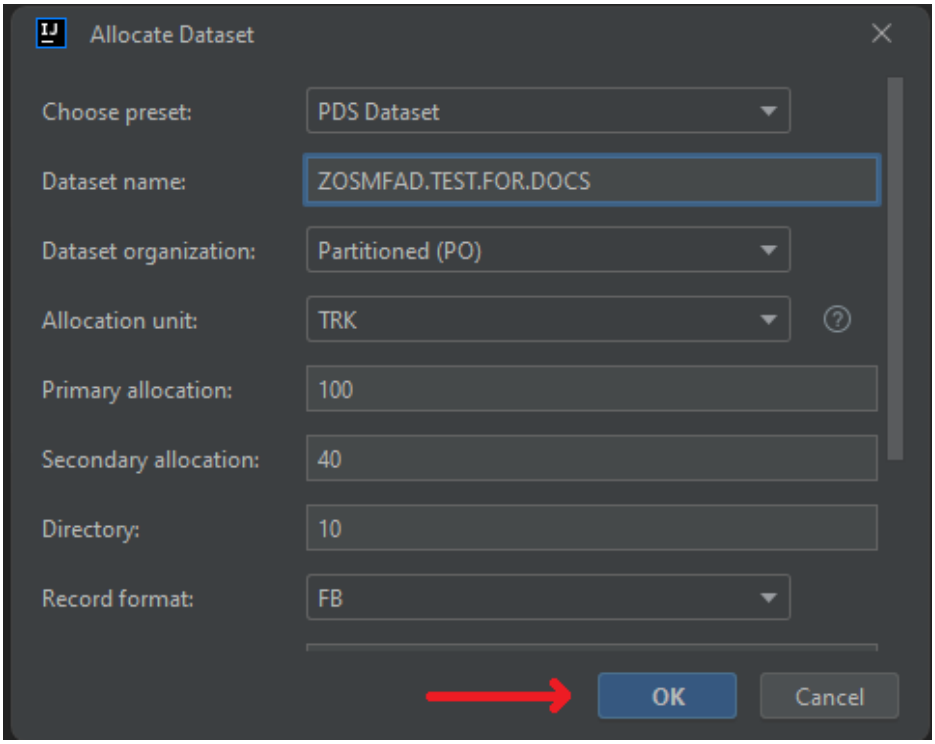


If you want to choose a preset, there are 5 options available for now:

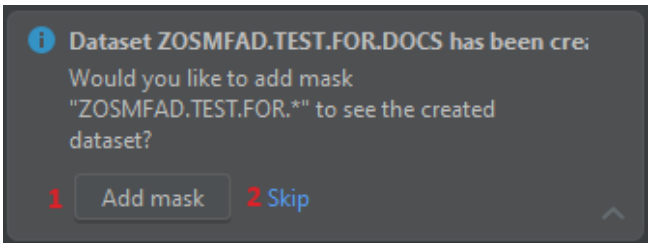
- **Custom Dataset (1)** - all the fields are set by the user
- **Sequential Dataset (2)** - the fields are set to allocate a template PS data set
- **PDS Dataset (3)** - the fields are set to allocate a template PDS data set
- **PDS with empty member Dataset (4)** - the fields are set to allocate a template PDS data set with an empty member inside
- **PDS with sample JCL member Dataset (5)** - the fields are set to allocate a template PDS data set with a member with a template JCL job inside



4. After specifying all the necessary fields, click **OK**

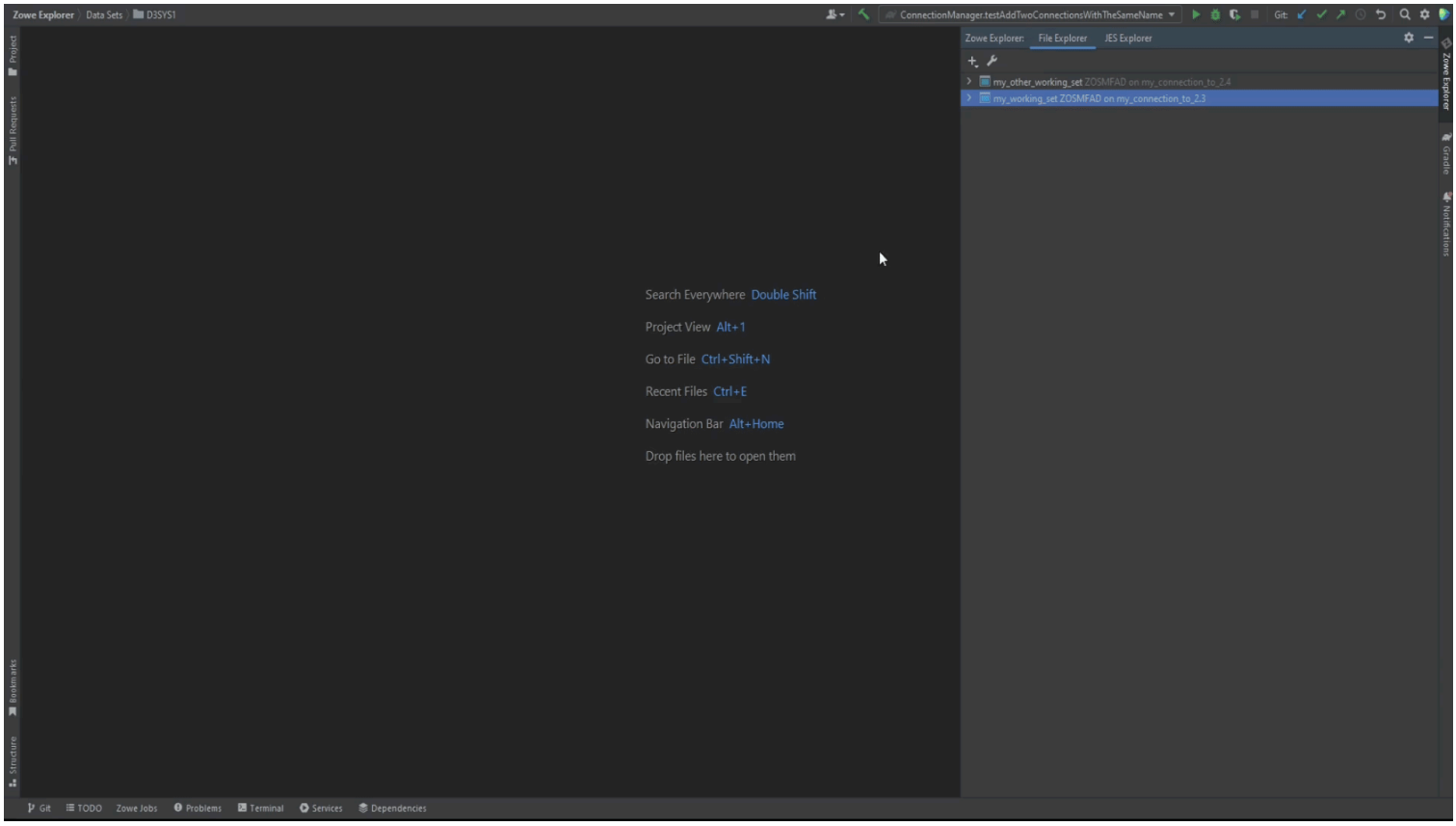


5. When the data set is allocated, the plug-in will suggest creating a mask to display the data set created under. Click **Add mask (1)** to add the mask and **Skip (2)** to skip the mask creation



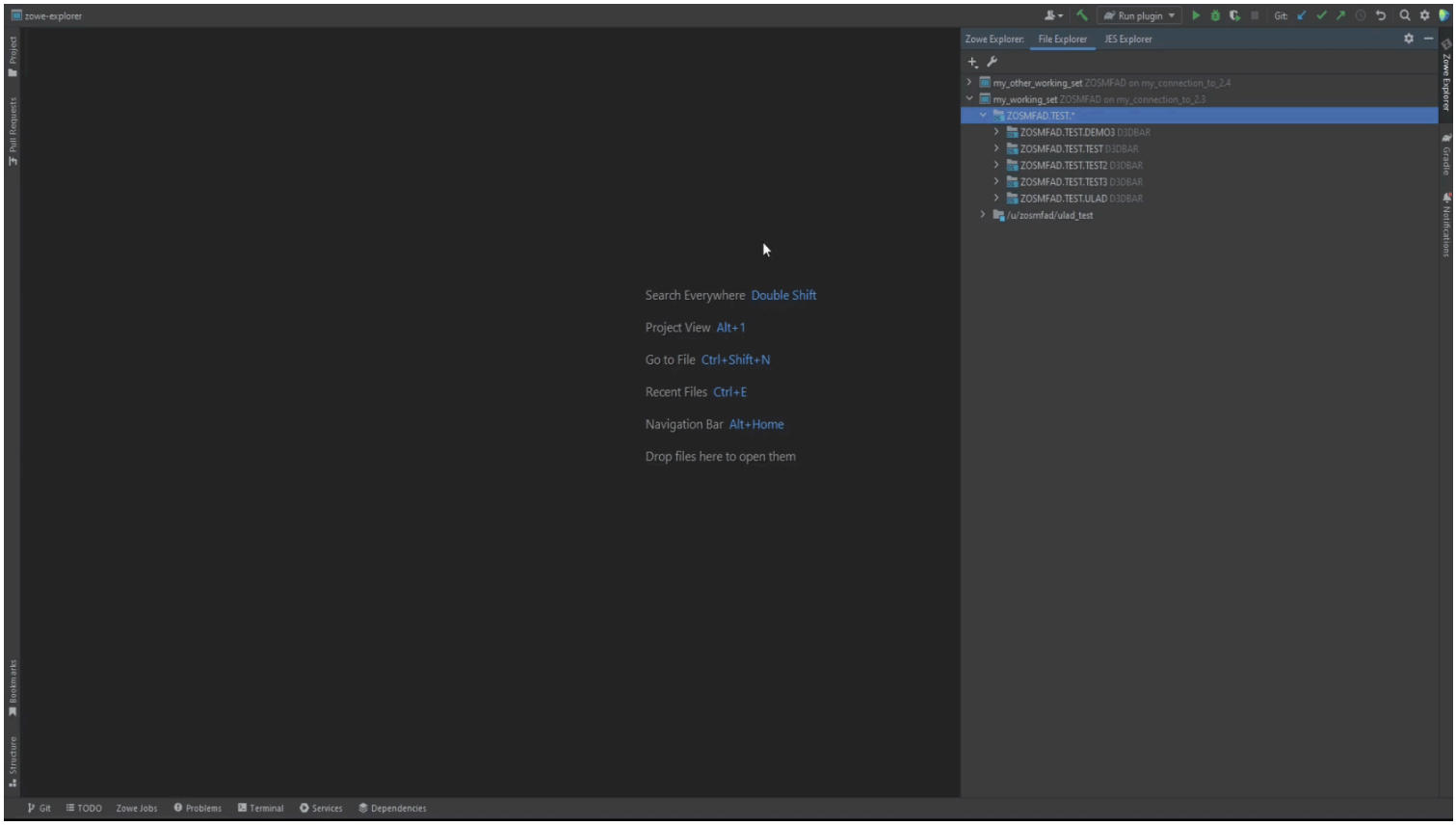
Working with z/OS PS data sets

Here you can see a possible scenario of working with PS data sets



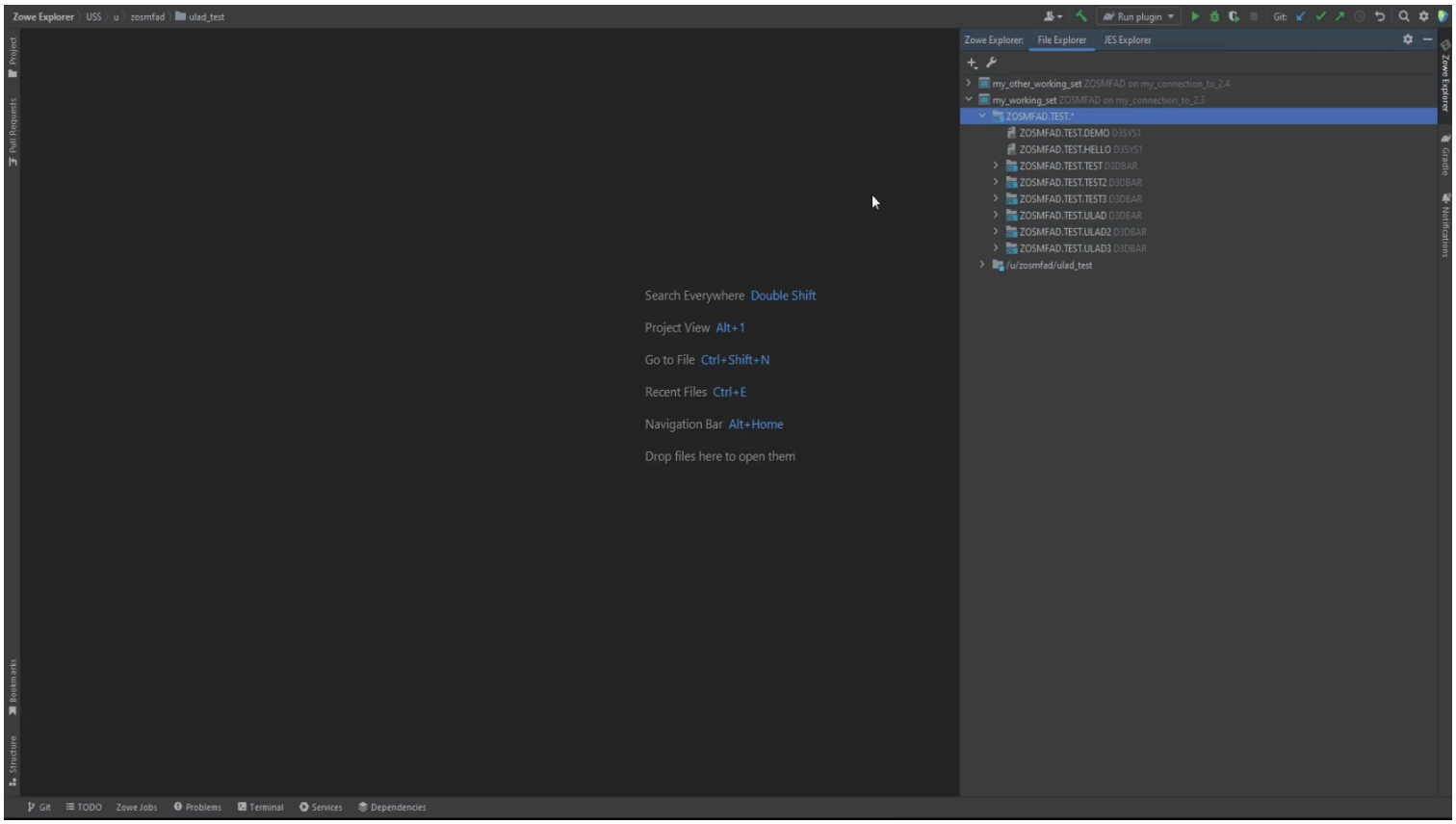
Working with z/OS PDS / PDS/E data sets

Here you can see a possible scenario of working with PDS / PDS/E data sets



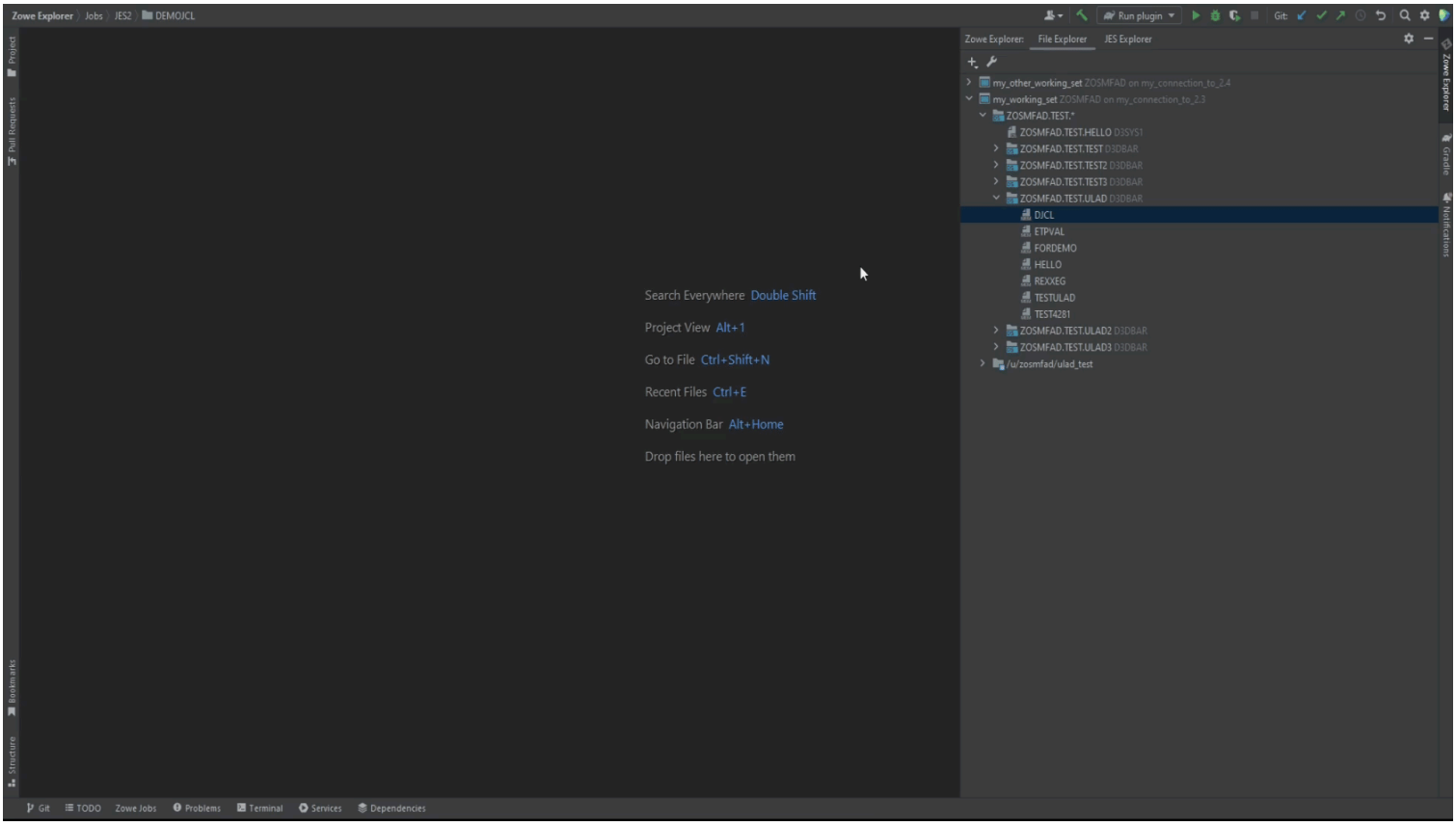
"Allocate Like" feature

To issue the **Allocate Like**, right-click on any of data sets and select **Allocate Like**.



"Submit Job" feature

To issue the **Submit Job**, right-click on any of PS data sets or PDS / PDS/E members and select **Submit Job**.

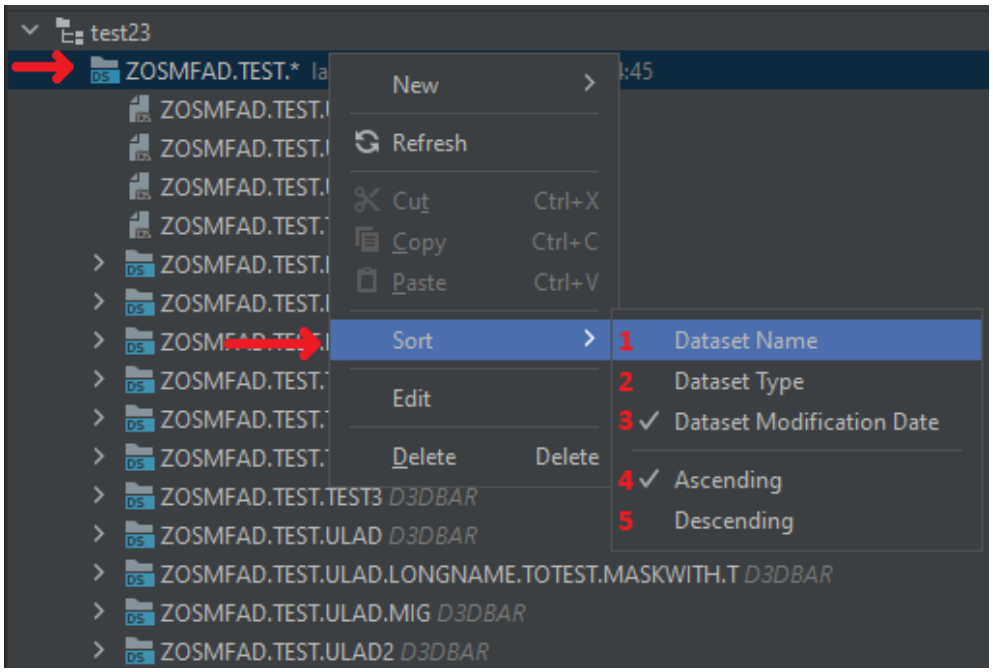


Sort a data sets mask

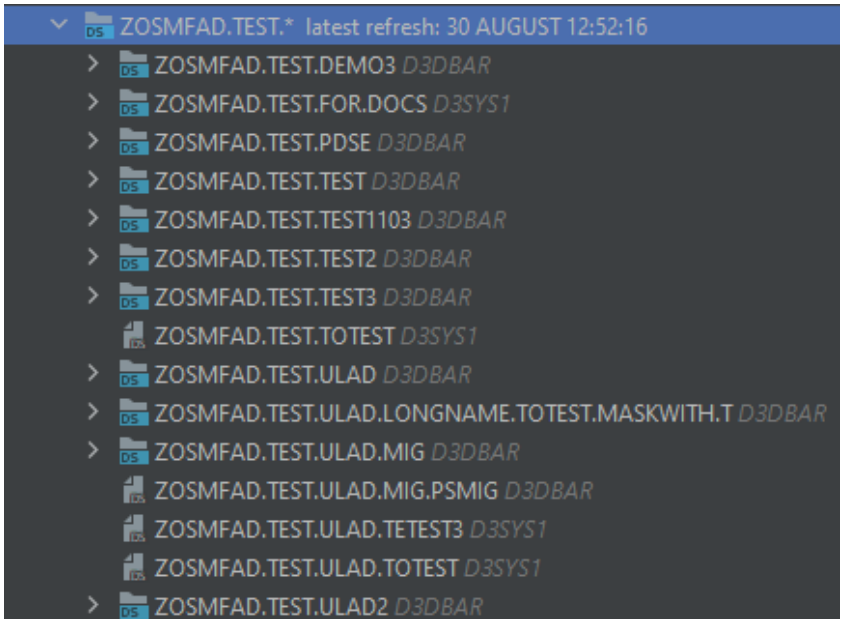
To sort z/OS data sets list:

1. Right click on a data sets mask, select **Sort**. The list of sorting options will appear:
    - **Dataset Name (1)** - to sort by data set names
    - **Dataset Type (2)** - to sort by data set types (PS / PO / PO-E)
    - **Dataset Modification Date (3)** - to sort by data set modification date and time. Data sets list is sorted by this option by default

Also, there is a possibility to change the order for the items to be displayed: **Ascending (4)** (by default) or **Descending (5)**. For the example purposes, select **Dataset Name**



2. The list will be refreshed with the new sort order



Version: v3.2.x LTS

Working with USS Files

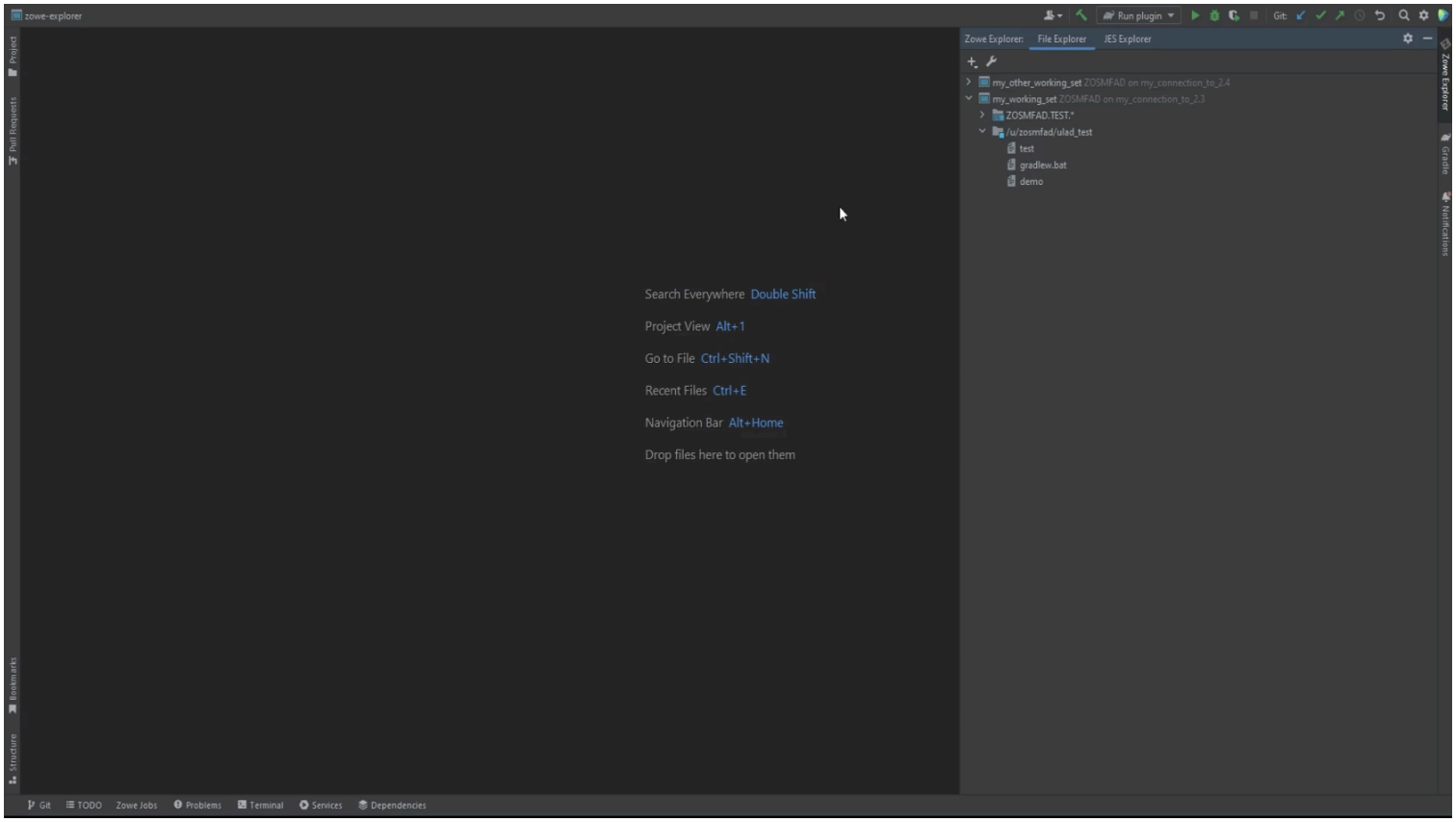
Using the plug-in, you will be able to:

- create, rename, view, edit, delete USS files and folders
- submit JCL jobs with **Submit Job** option
- change the encoding a USS file content is displayed or saved in
- manipulate USS files and folders rights
- copy, move USS files and folders, both inside the filesystem, and between them, as well as between systems with different IP address
- sort USS paths

After you set up a Files Working Set and create a mask to display USS paths, it is possible to manipulate USS files and folders.

Basic operations

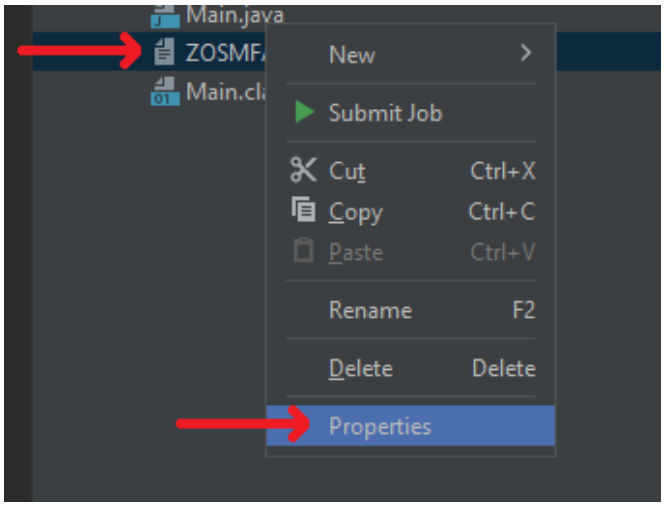
The plug-in allows users to work with USS part of a mainframe. As the basic operations, you can create files with a specific set of permits, edit files, rename and delete them. Also, you can submit a job from a USS file if it is a JCL.



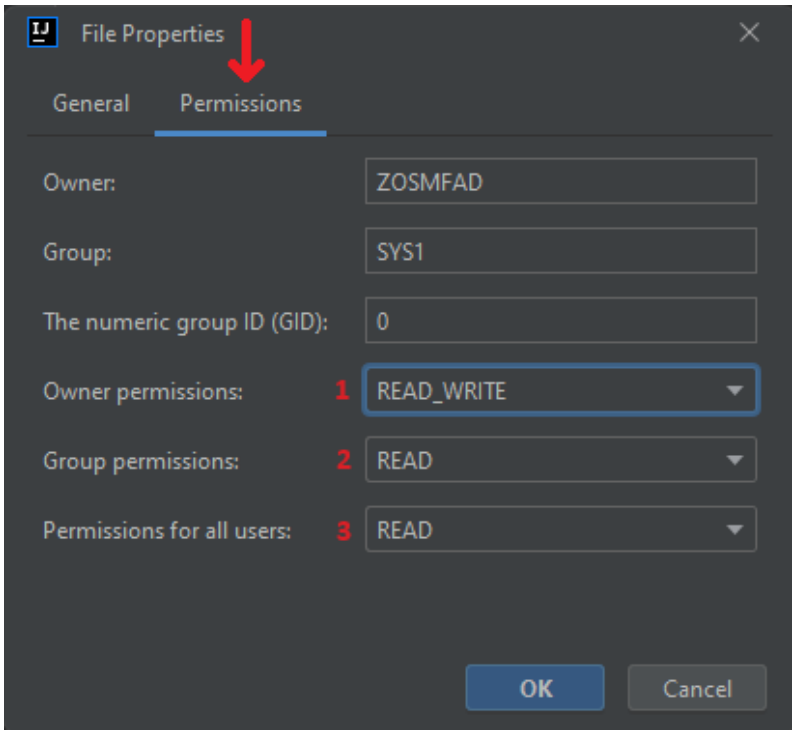
Working with permissions

The plug-in allows users to edit permissions of the USS files and folders:

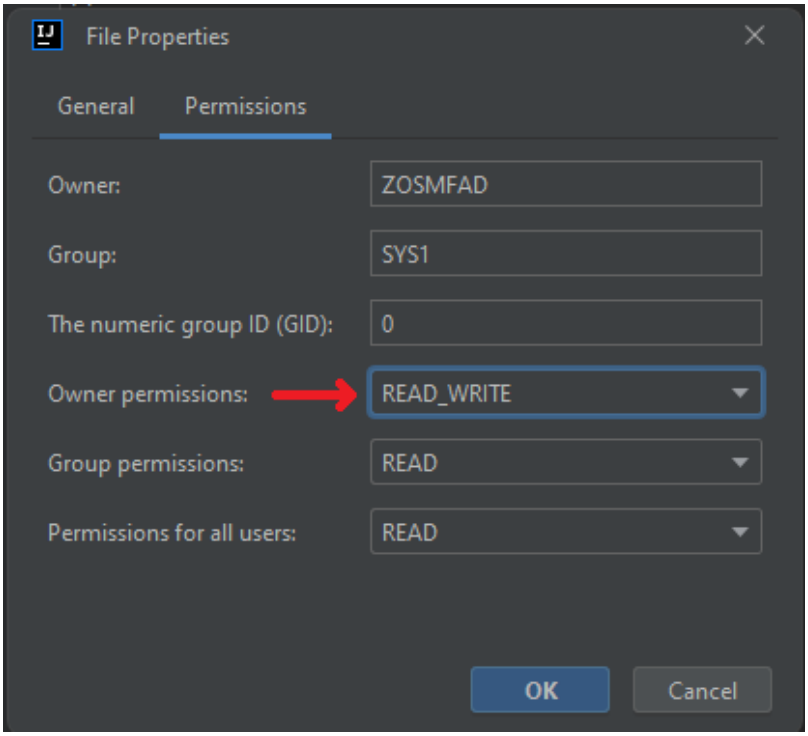
1. Right-click on the file in USS explorer, click **Properties**



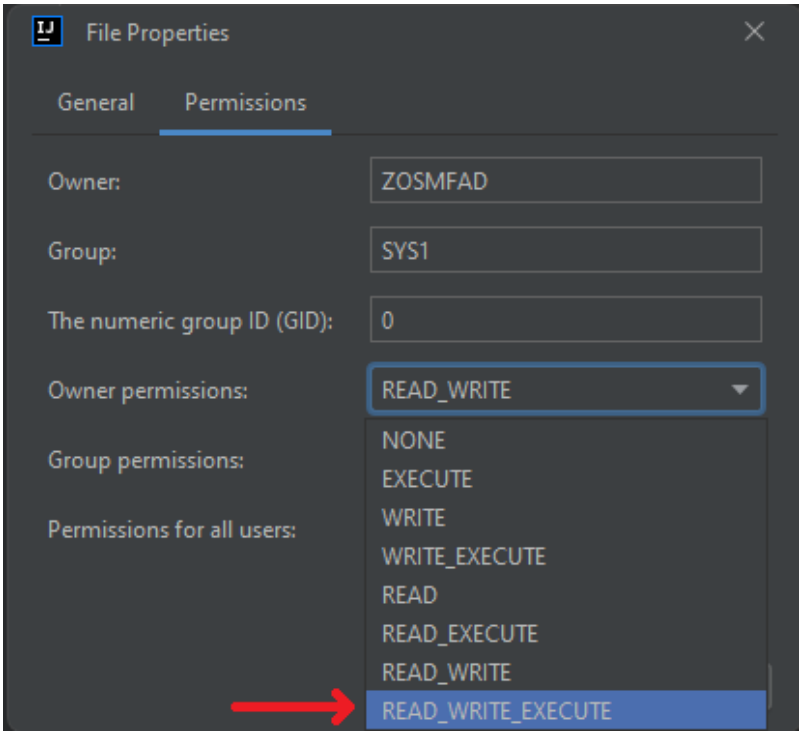
2. In the **File Properties** dialog window, select the **Permissions** tab



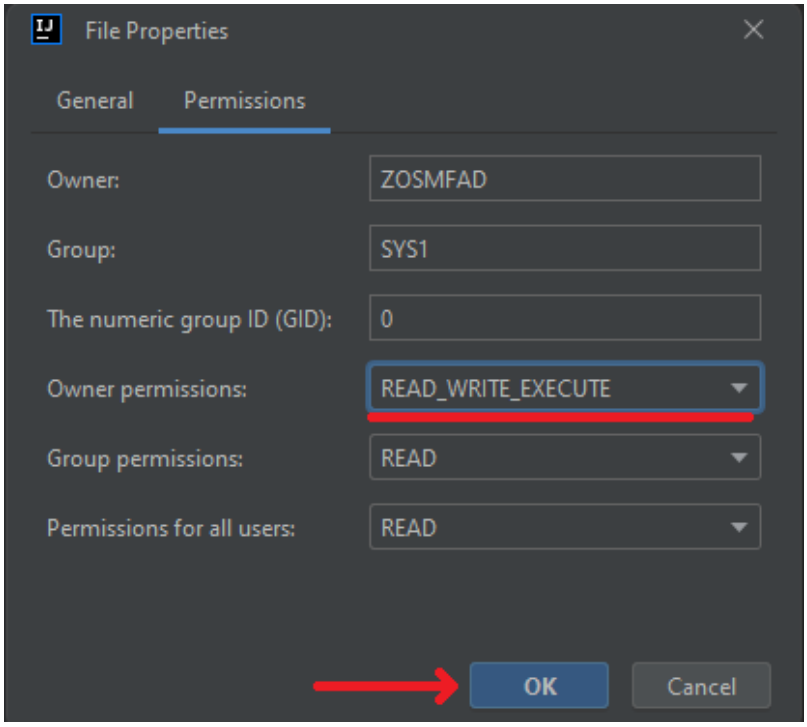
3. In there, you will have three options to change when needed: **Owner permissions (1)**, **Group permissions (2)** and **Permissions for all users (3)**. To change any of the options, click one of them



4. From the drop-down list, select a new value



5. Click the **OK** button for the changes to be applied

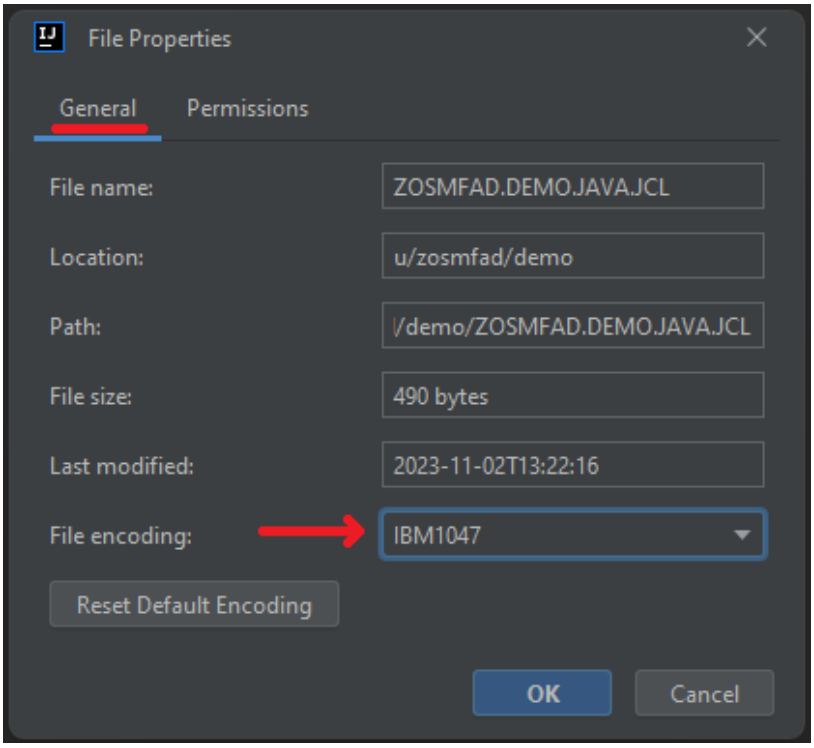


Working with files encoding

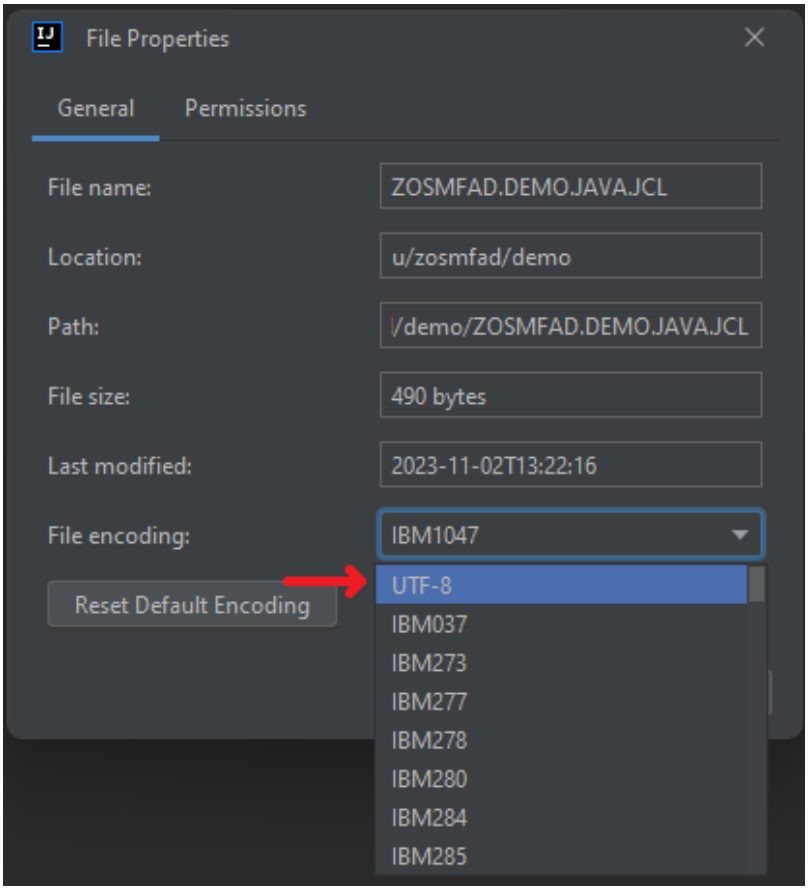
Sometimes it is necessary to display file content in a specific encoding or save it in some different encoding. To do so:

1. Double-click the USS file to open it in the editor

2. In the **File Properties** dialog window, you should be at the **General** tab. Click the **File encoding** button for the drop-down list to appear

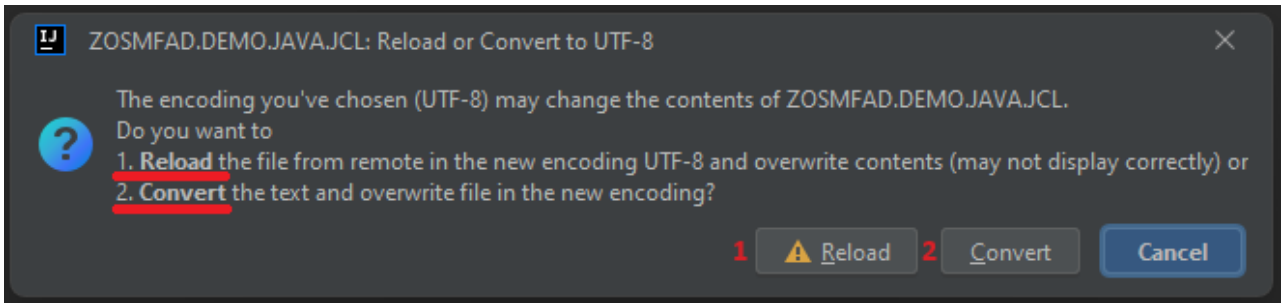


3. Select the encoding you want the file content to be in



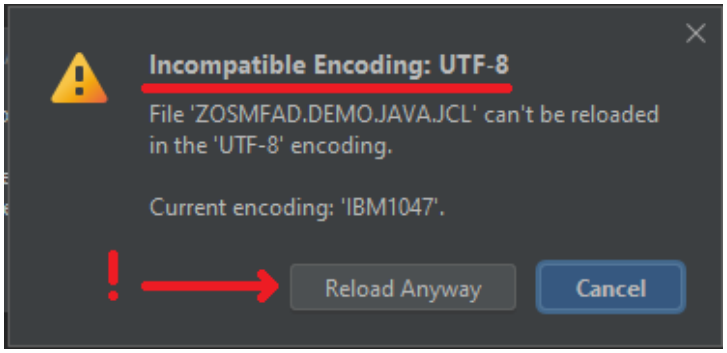
4. After the actions, the encoding change dialog will appear. It will ask you to choose between the 2 options:
   - **Reload (1)** - changes the file tag, specifying the encoding to show the file in. This action does not actually rewrite the contents of the file and just changes the way it is displayed in the editor
   - **Convert (2)** - tries to convert the file to the specified encoding, actually changing the content of the file. This option will also change the file tag, and after that it will try to modify the content, changing the file bytes to the

respective ones to try to display the same content with the actually different bytes



5. Click the option you want to perform on the file. Sometimes it is not possible to correctly reload or convert the file content to the encoding you select. In this case, the *Warning* icon will appear in the button of an action that is not possible to perform correctly. You will be still able to perform the operation, but the additional warning dialog will appear, describing the issue

> **MAKE SURE YOU KNOW WHAT YOU ARE DOING**
>
> The contents after clicking **Reload anyway** or **Convert anyway** could be unpredictable. Do it only in the cases where you are sure nothing will go wrong.



After the operation is finished, the content of the file will be reloaded. If you had some characters that were not visible in the default encoding, and you selected the correct encoding, the content will be displayed regarding the option you've selected.

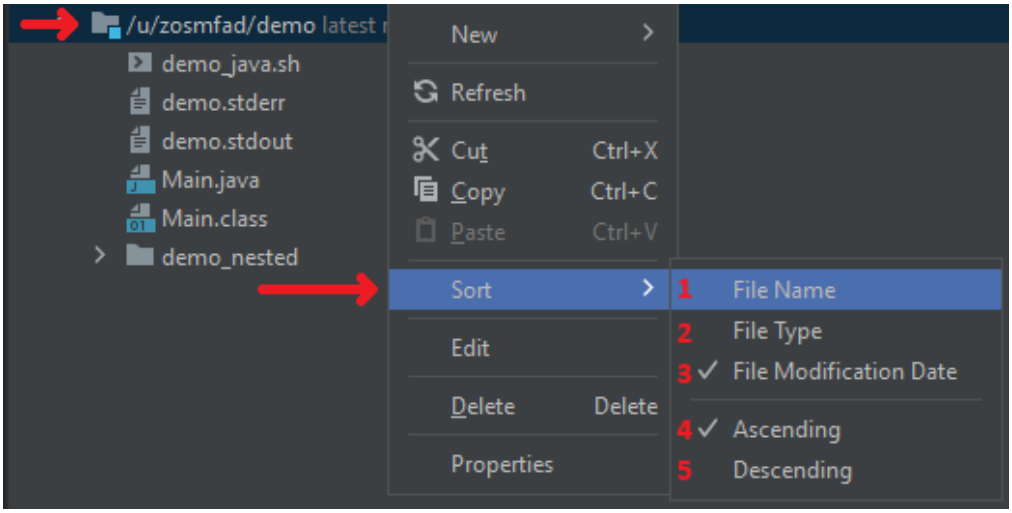
Sort a USS path

There is a functionality of the plug-in to sort USS files and folders. The plug-in allows to sort not only the root path, but any USS path you have in your working tree.

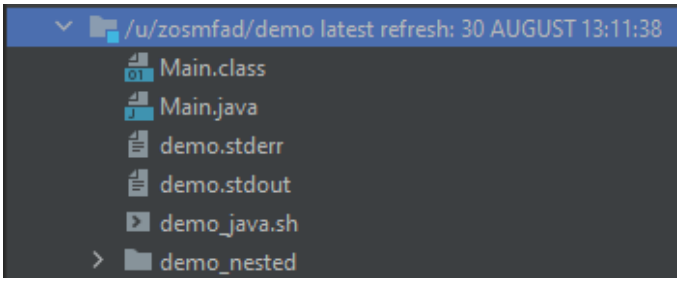
To sort USS files and folders list:

1. Right click on a USS path, select **Sort**. The list of sorting options will appear:
   - **File Name (1)** - to sort USS entities by name
   - **File Type (2)** - to sort USS entities by type
   - **File Modification Date (3)** - to sort USS entities by modification date. USS path is sorted by this option by default

Also, there is a possibility to change the order for the items to be displayed: **Ascending (4)** (by default) or **Descending (5)**. For the example purposes, select **File Name**



2. The list will be refreshed with the new sort order



Version: v3.2.x LTS

Copying and moving data using the plug-in

The essential feature of the plug-in is to provide the ability to copy and move content between different entities and systems. The plug-in provides functionalities to copy and move any kind of information possible (also in terms of security).

Copy and move: the same system

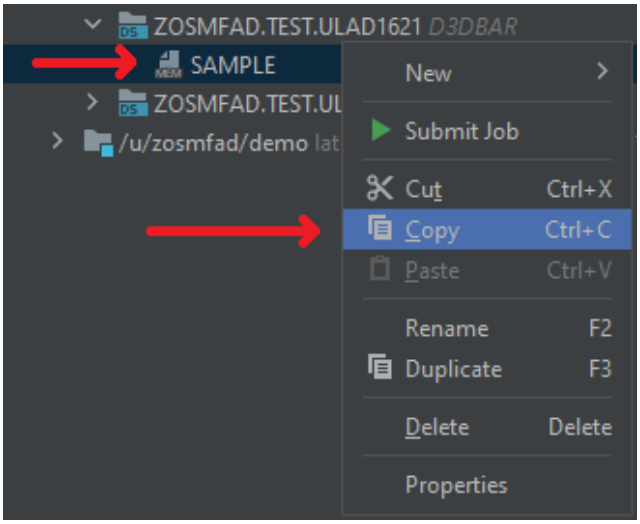
There are different options to copy and move z/OS data sets and members between each other, as well as USS files. It is possible to move and copy files and data sets either through keyboard shortcut buttons and context menu, or using **Drag & Drop**.

Copy and move: a data set member copy and move examples

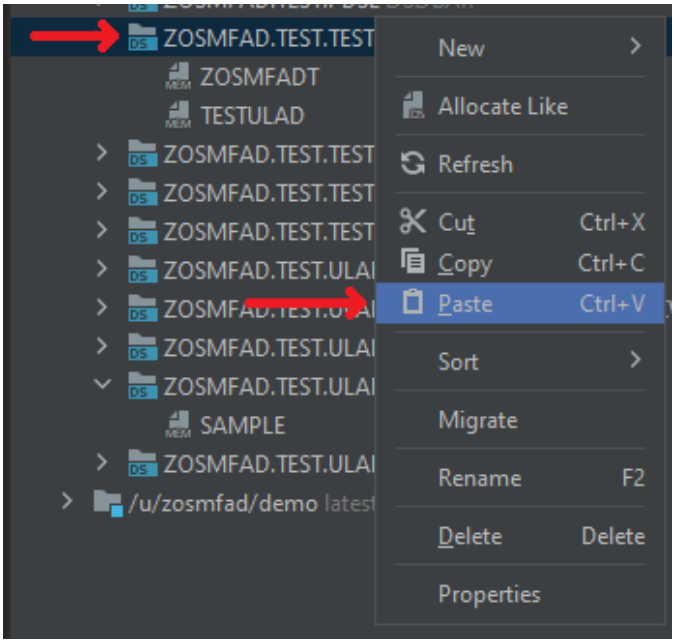
> **NOTE**
>
> Make sure the parameters of the target data set allow you to paste a new member. Sometimes there is an error occures during paste operation to the data set due to the directory blocks value being not enough to fit the member.

To copy member from one data set to another:

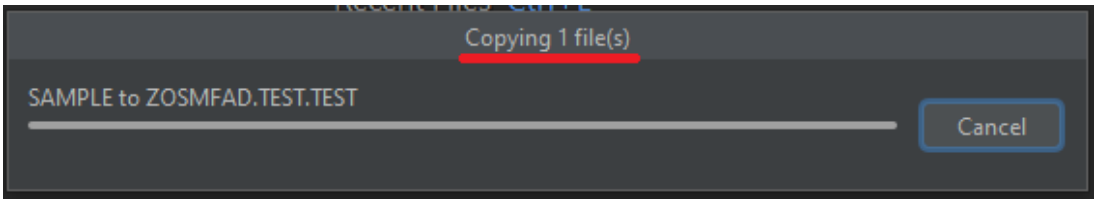
1. Right click on the member to be copied, select **Copy**



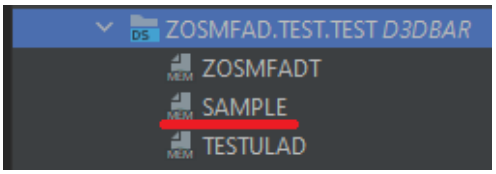
2. Right click on the target PDS / PDS/E data set, select **Paste**



3. A dialog about the copy operation appears. It is also possible to cancel the operation until it is finished

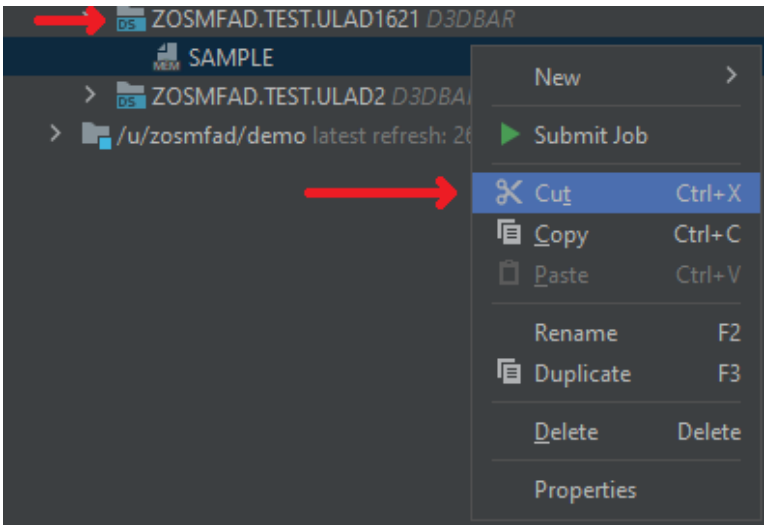


4. After the operation is completed, the data set will be automatically refreshed and the member will appear in the list of the data set members

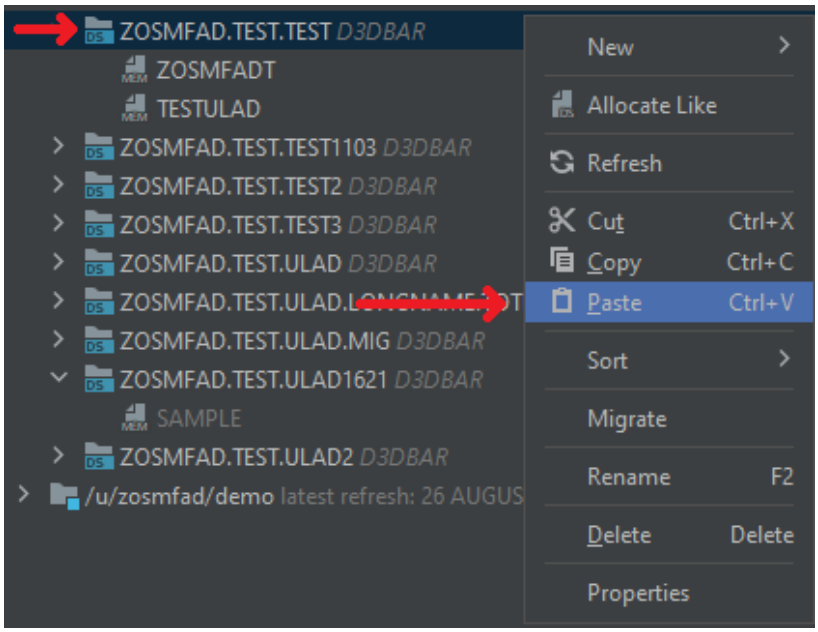


To move a member from one data set to another:

1. Right click on the member to be moved, select **Cut**

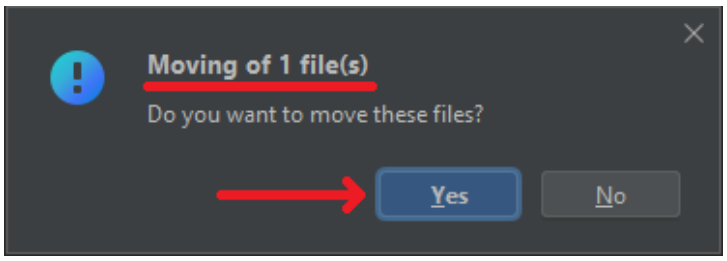


2. Right click on the target PDS / PDS/E data set, select **Paste**

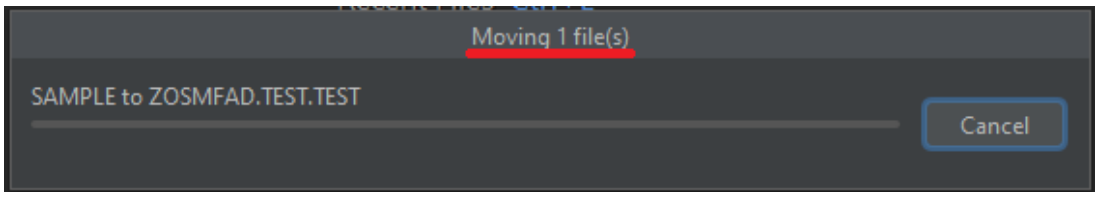


> **NOTE**
>
> You can use a **Drag & Drop** feature to accomplish the same action

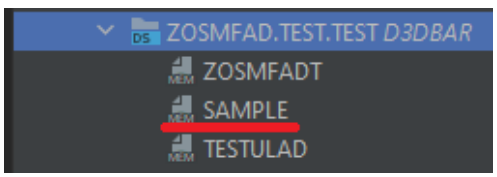
3. A confirmation dialog for the member to be moved will appear, select **Yes**



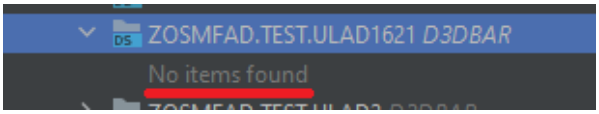
4. A dialog about the move operation appears. It is also possible to cancel the operation until it is finished



5. After the operation is completed, the data set will be automatically refreshed and the member will appear in the list of the data set members



The member will disappear from the source data set.



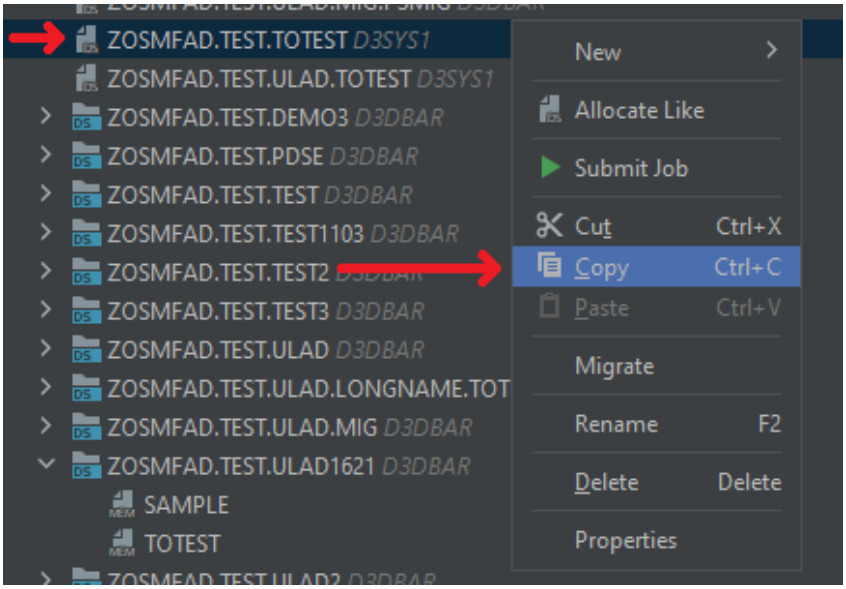
Copy and move: a PS data set to a PDS member copy example

The plug-in allows to copy and move PS data sets to PDS / PDSE data sets. The data set will become a member of the target data set. The name of the member will be trimmed to the last element of the source HLQ. If there are already a member with the same name as the newly pasted one has, the name will be changed to the same data set member's name with the last character(s) replaced with the next available number to form a non-conflicting name of the member.

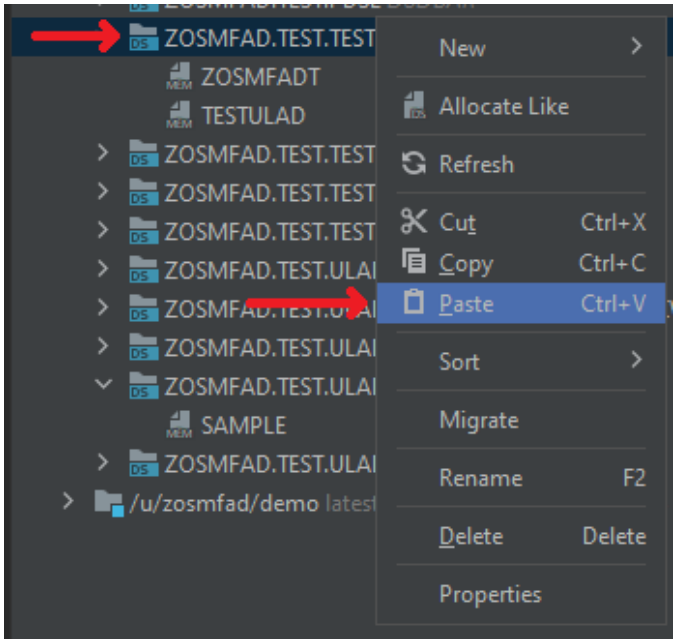
> **NOTE**
>
> Make sure the parameters of the target data set allow you to paste a new member. Sometimes there is an error occures during paste operation to the data set due to the directory blocks value being not enough to fit the member.

To copy a sequential data set to a partitioned data set:

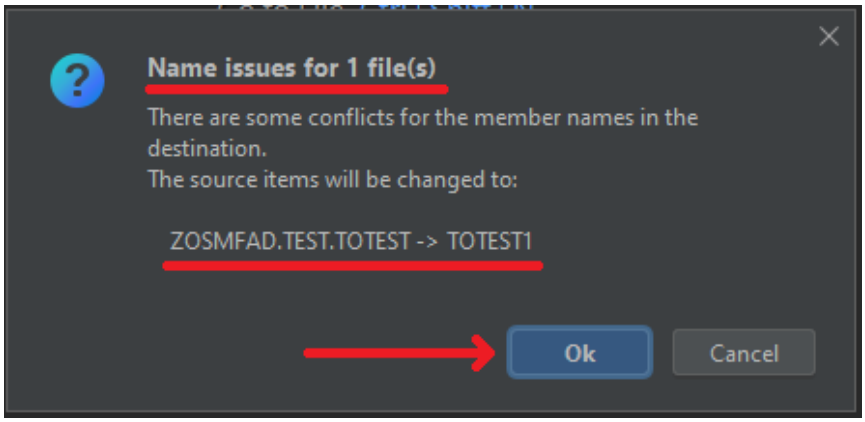
1. Right click on the PS to be copied, select **Copy**



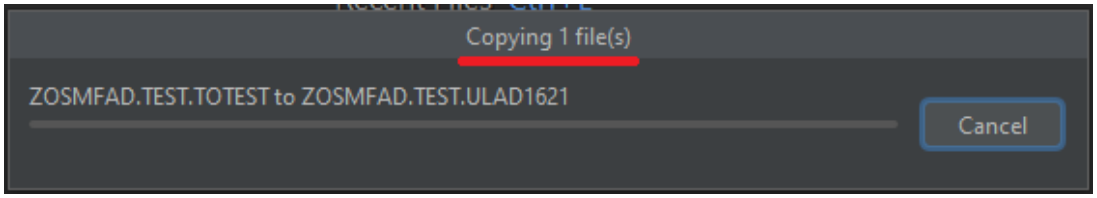
2. Right click on the target PDS / PDS/E data set, select **Paste**



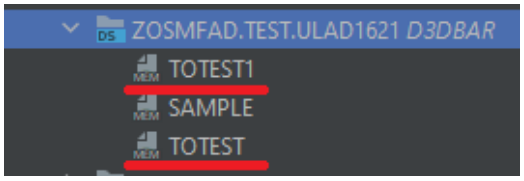
3. If there is a conflicting name member in the data set exists, the plug-in will suggest a new name to apply to the member to appear in the data set members list. Click **Ok** to agree to use the new name



4. A dialog about the copy operation appears. It is also possible to cancel the operation until it is finished



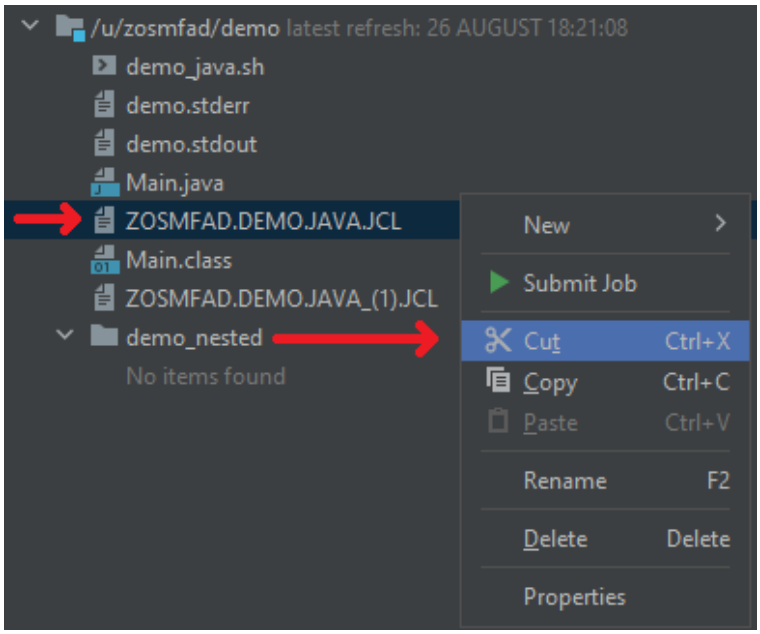
5. After the operation is completed, the data set will be automatically refreshed and the member will appear in the list of the data set members



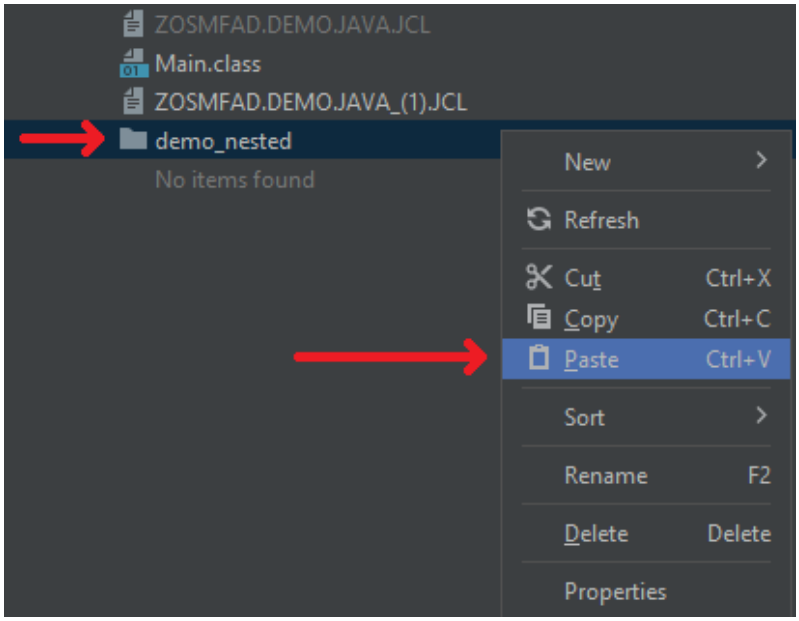
Copy and move: a USS file to a USS folder move example

To move USS file or folder to another USS folder:

1. Right click on the folder or the file to be moved, select **Cut**

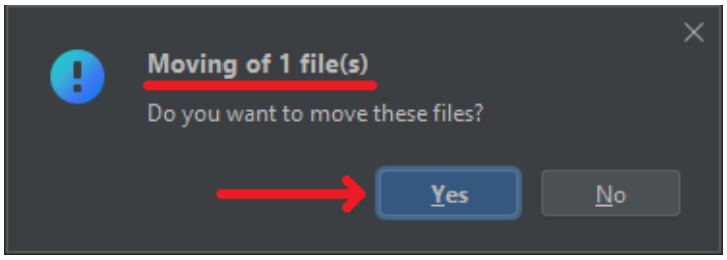


2. Right click on the target USS folder, select **Paste**

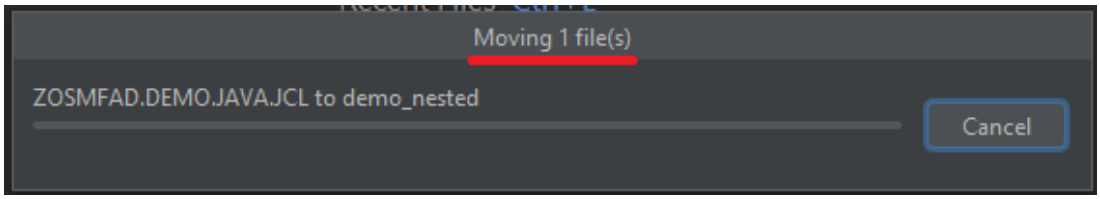


> **NOTE**
>
> You can use a **Drag & Drop** feature to accomplish the same action

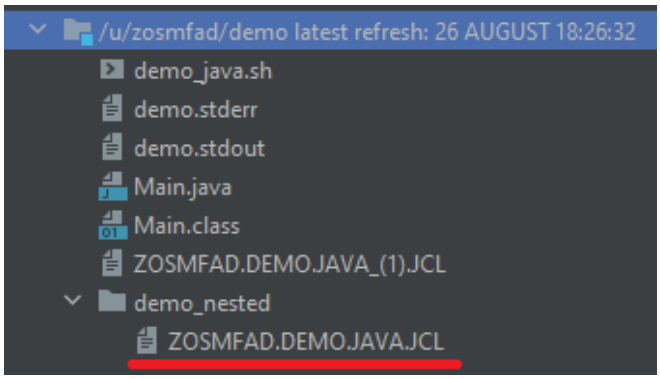
3. A confirmation dialog for the file to be moved will appear, select **Yes**



4. A dialog about the move operation appears. It is also possible to cancel the operation until it is finished



5. After the operation is completed, the path will be automatically refreshed and the file will appear in the refreshed list. Also the file will disappear from the source path

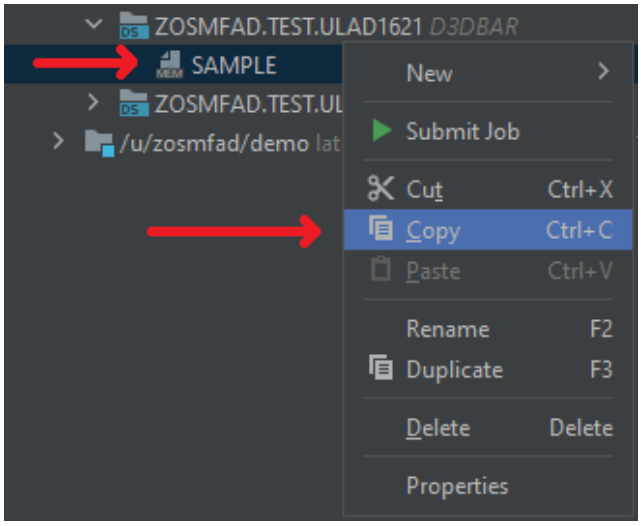


Copy and move: a PDS / PDS/E member to a USS folder copy example

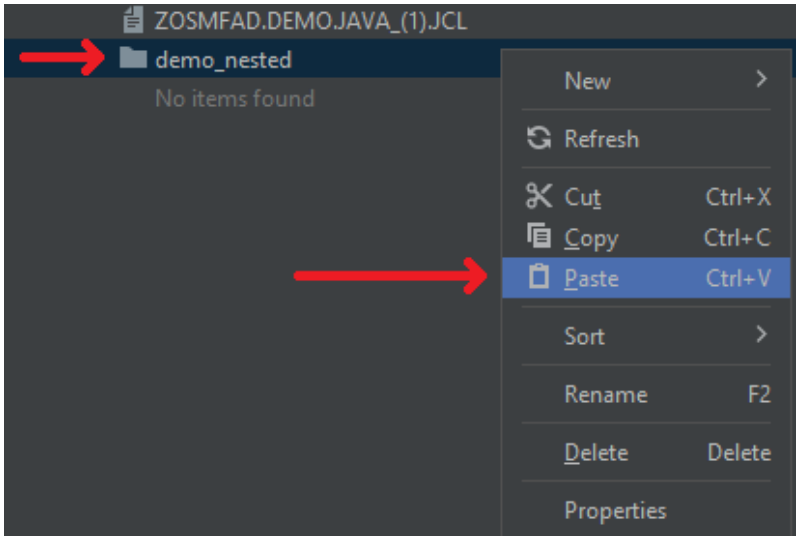
There is also a functionality provided by the plug-in to copy and move PS, PDS / PDS/E data sets and members to a USS path.

To copy a PDS / PDS/E member to a USS folder:

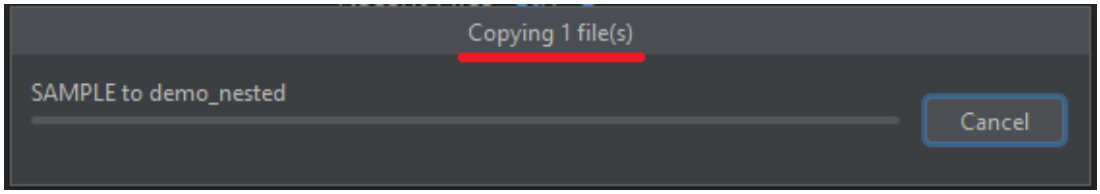
1. Right click on the member to be copied, select **Copy**



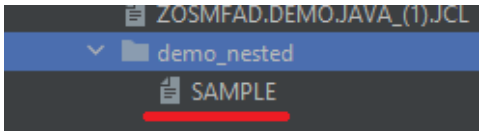
2. Right click on the target USS folder, select **Paste**



3. A dialog about the copy operation appears. It is also possible to cancel the operation until it is finished



4. After the operation is completed, the USS path will be automatically refreshed and the newly pasted USS file will appear

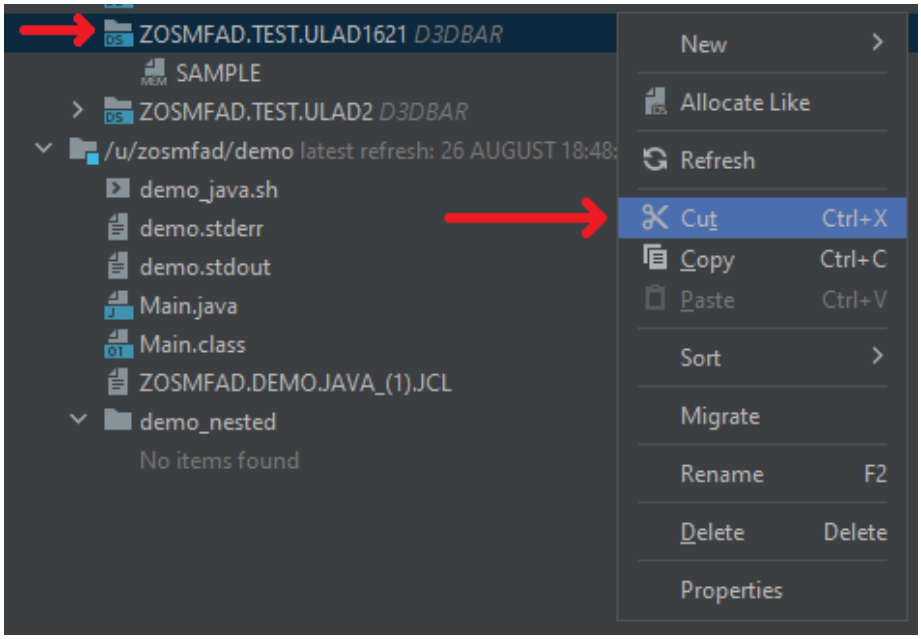


Copy and move: a PDS / PDS/E data set to a USS folder move example

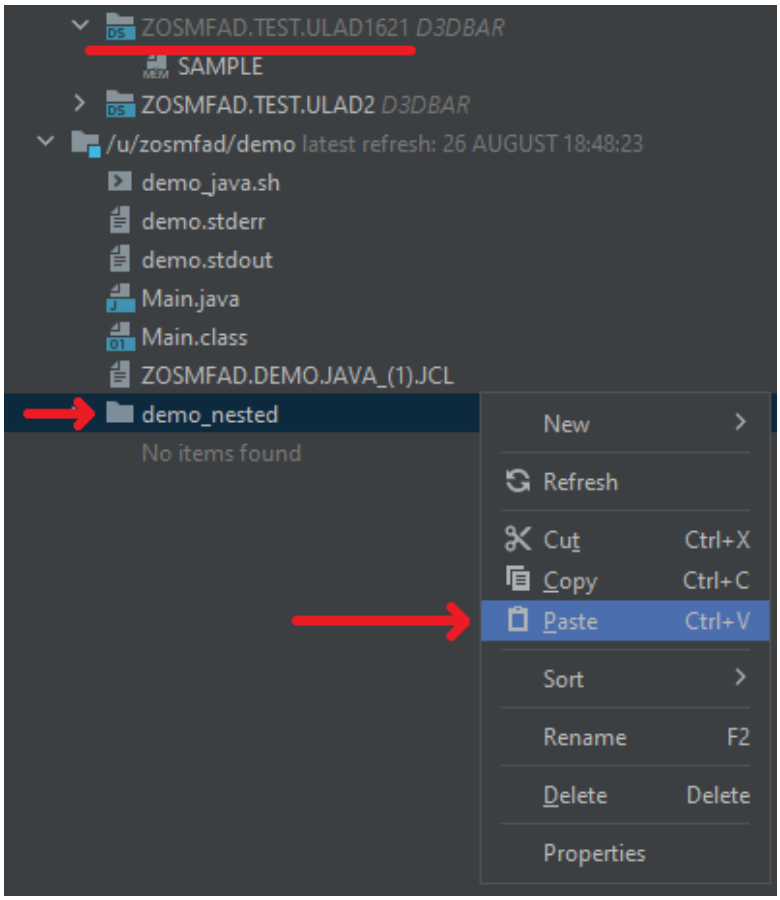
While moving or copying a partitioned data set to the USS path, it will be converted to a USS folder with USS files.

To move a PDS / PDS/E data set to a USS path:

1. Right click on the PDS to be copied, select **Cut**

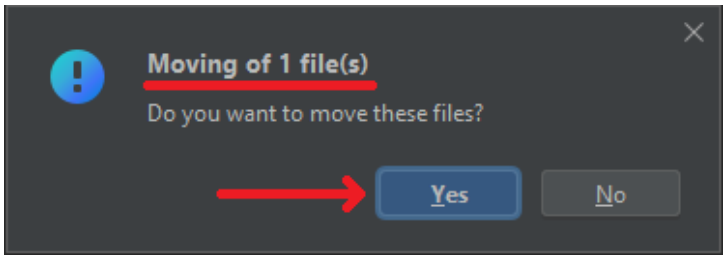


2. Right click on the target USS folder, select **Paste**

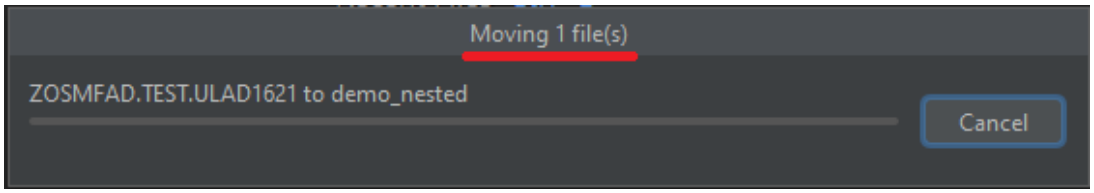


> **NOTE**
>
> You can use a **Drag & Drop** feature to accomplish the same action

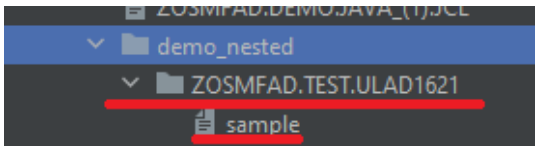
3. A confirmation dialog for the file to be moved will appear, select **Yes**



4. A dialog about the move operation appears. It is also possible to cancel the operation until it is finished



5. After the operation is completed, the path will be automatically refreshed and the folder will appear in the refreshed list. Also the data set will disappear from the z/OS part



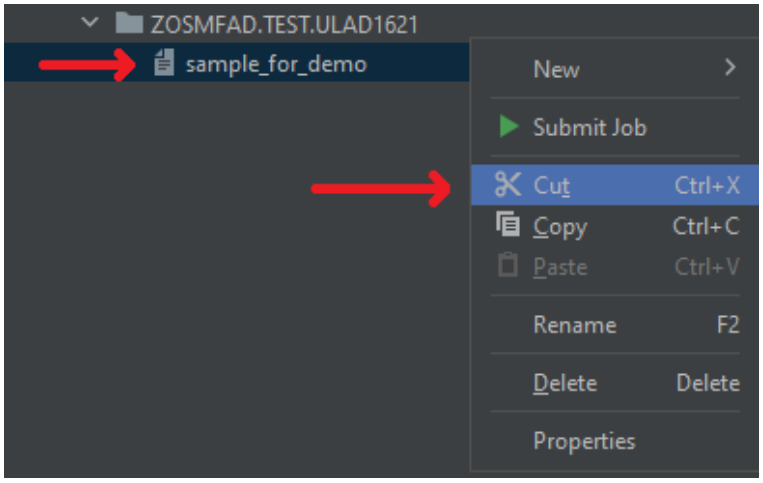
Copy and move: a USS file to a PDS / PDS/E data set move example

Also, it is possible to copy and move a USS file to a PDS / PDS/E data set. The file will become a PDS member.

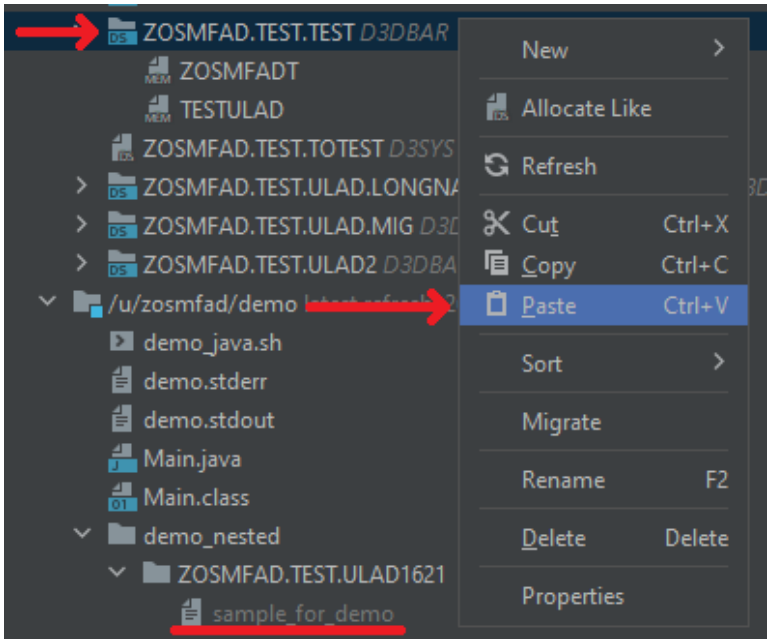
> **NOTE**
>
> The contents of the source files and data sets will stay the same, until you try to copy/move a file from USS to a z/OS partitioned data set. If the file lines are longer than the specified for the PDS / PDS/E logical record length, the plug-in will cut the rest of the line, exceeding the LRECL, for each of the exceeding lines.

To move a USS file to a PDS / PDS/E data set:

1. Right click on the file to be copied, select **Cut**

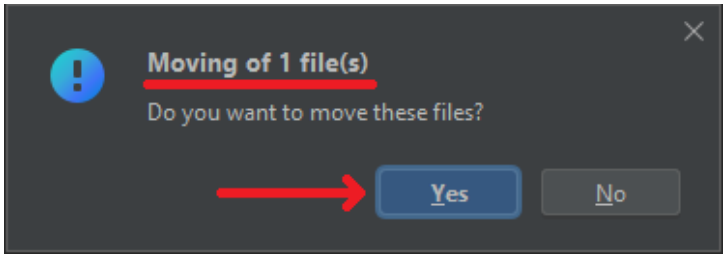


2. Right click on the target PDS / PDS/E data set, select **Paste**

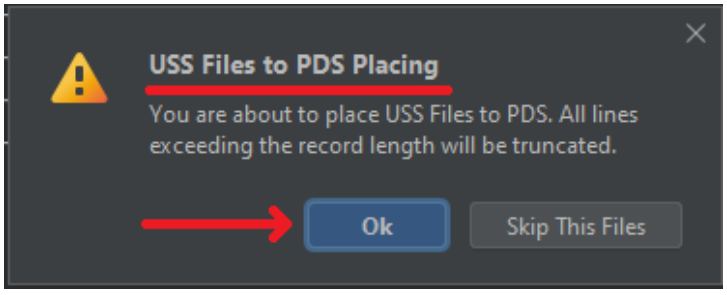


> **NOTE**
>
> You can use a **Drag & Drop** feature to accomplish the same action

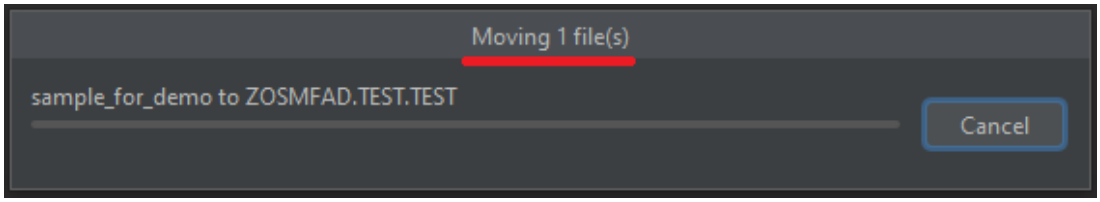
3. A confirmation dialog for the file to be moved will appear, select **Yes**



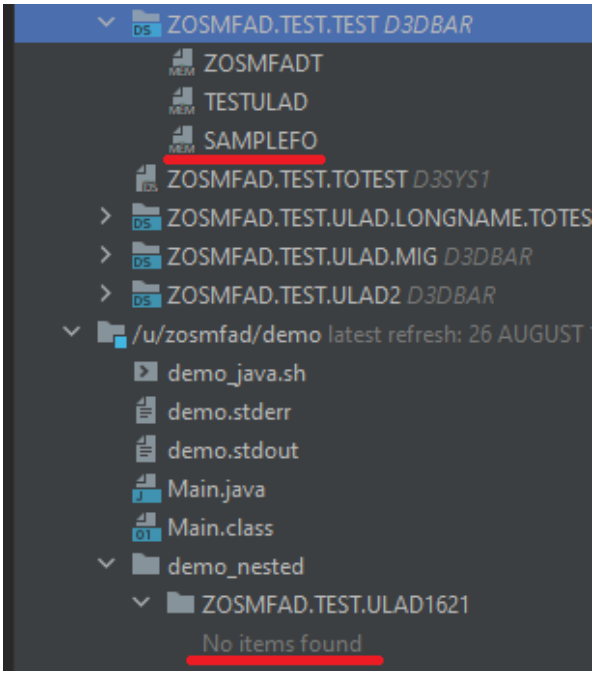
4. Also, the warning dialog about placing a USS file under a PDS / PDS/E data set will appear. It will describe the actual result of this operation. Click **Ok**



5. A dialog about the move operation appears. It is also possible to cancel the operation until it is finished



6. After the operation is completed, the data set will be automatically refreshed and the list of the members will be refreshed with the new member in the list present. Also the file will disappear from the USS path



> **NOTE**
>
> You could notice the new member name. It is formed from the first 8 alphanumeric characters of the source file. Also, when there are member name conflicts, there is a resolution mechanism implemented in the plug-in. The new name will be formed as the change of the conflicting name, adding the next available number to the new name of the new member.

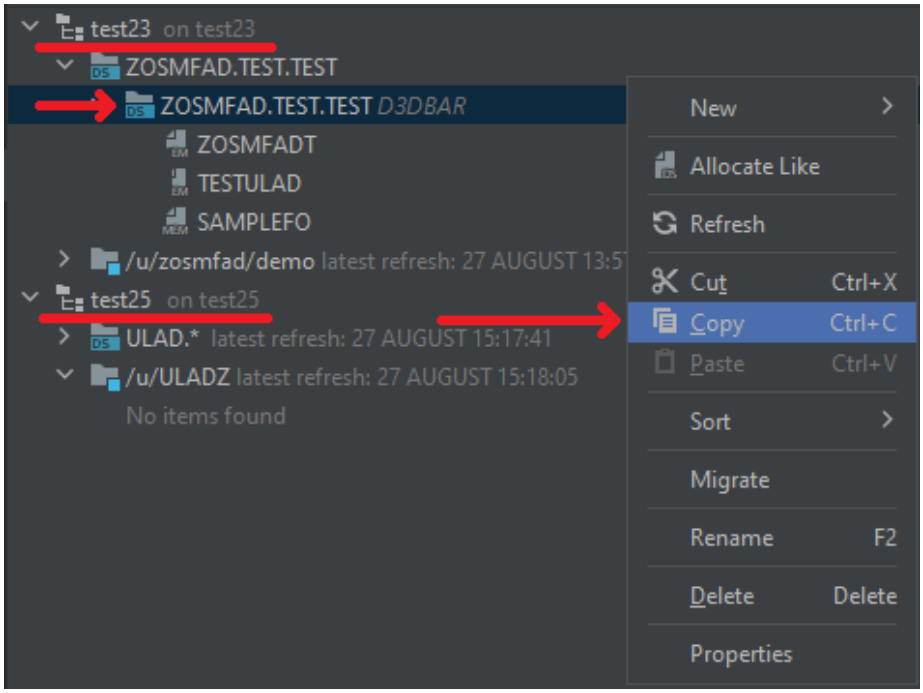
Cross-system copy and move

The plug-in provides a functionality to move and copy z/OS data sets and USS files between different systems. E.g.: a user has two systems with different IPs. So, it is possible to copy or move files and data sets either from the first IP to the second, or vice versa. The rules of copying and moving that are described previously, are the same for this action.

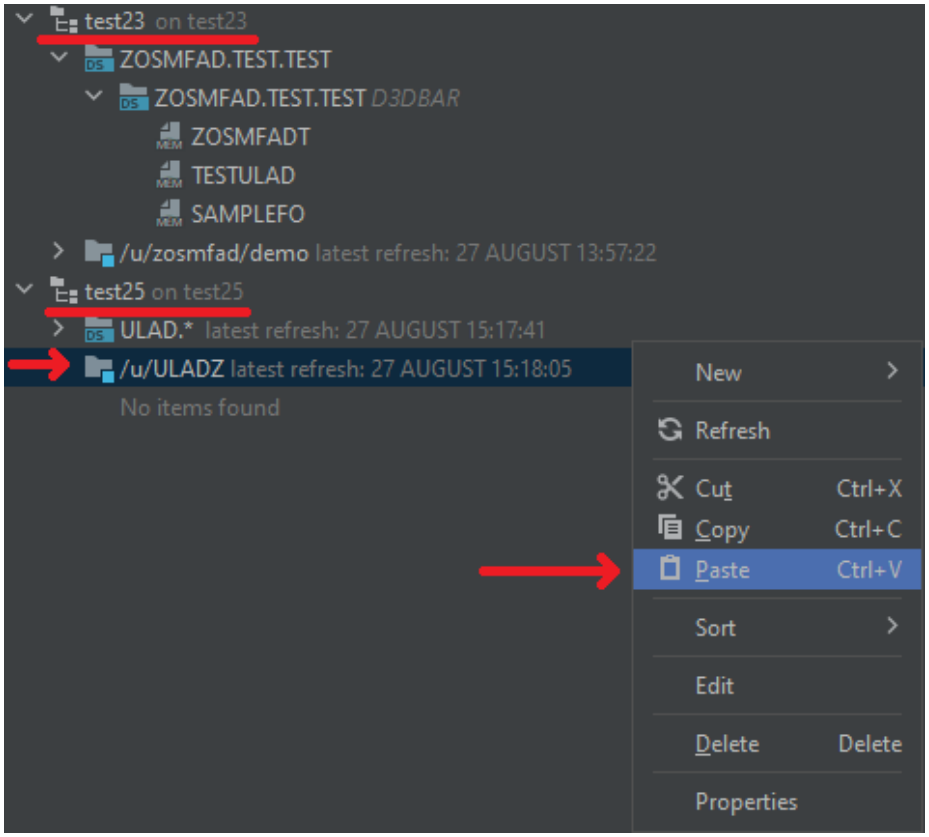
Copy and move: a PDS / PDS/E data set to a USS path cross-system copy example

To copy a PDS / PDS/E data set to a USS path in a different system:

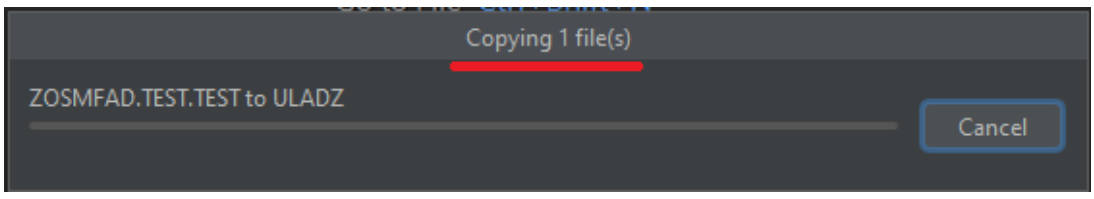
1. Right click on the data set to be copied, select **Copy**



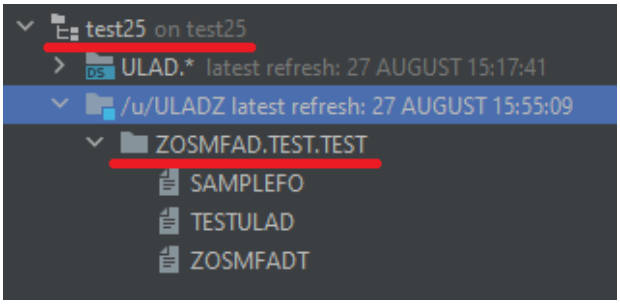
2. Right click on the target system's USS path, select **Paste**



3. A dialog about the copy operation appears. It is also possible to cancel the operation until it is finished



4. After the operation is completed, the USS path will be automatically refreshed and the path will be refreshed with the new USS folder in the list present



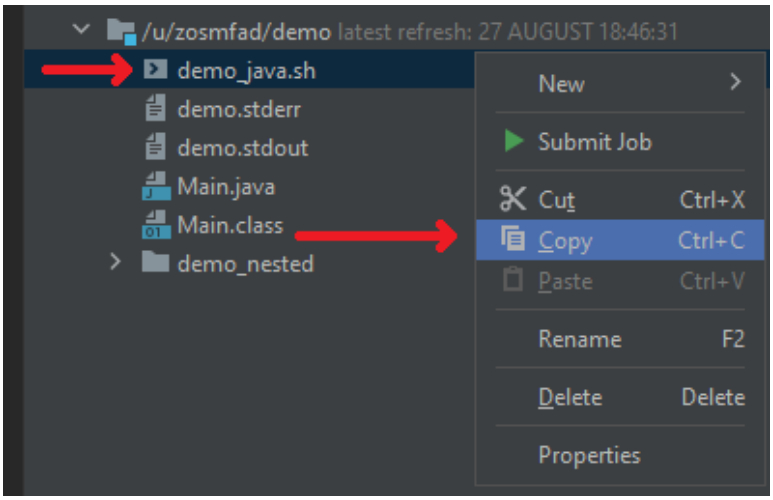
Downloading USS files and folders and z/OS data sets and members

There is a feature to download USS files and folders, as well as z/OS data sets and members. Both **Copy** and **Cut** functionalities are available for the downloading feature.

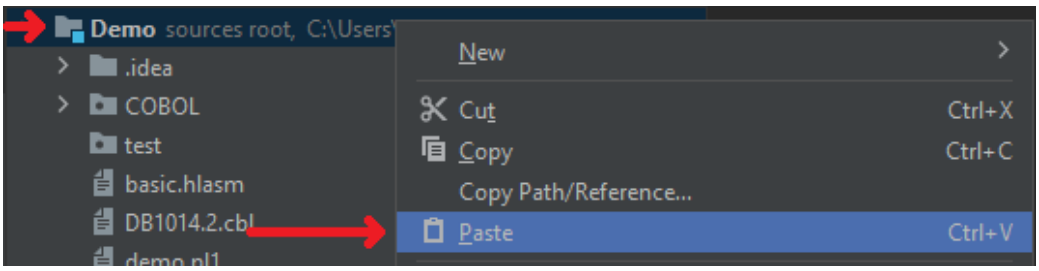
Download feature: a USS file download as a copy operation

To copy a USS file to a local machine:

1. Right click on the z/OS system's USS file, select **Copy**



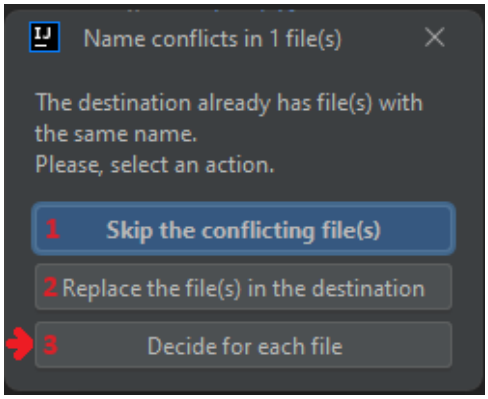
2. Right click in the local project's explorer view, select **Paste**



3. If there are conflicts in the names of the entities being copied, the plug-in will ask for the option to select:
   - **Skip the conflicting file(s) (1)** - will skip the entities copying

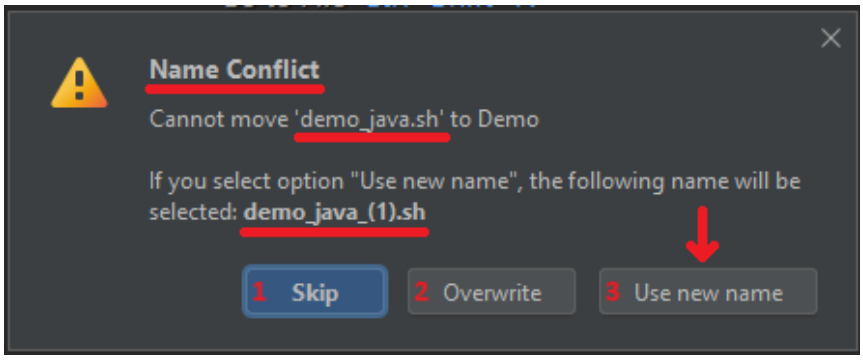
- **Replace the file(s) in the destination (2)** - will replace the entities in the destination with the being copied ones
- **Decide for each file (3)** - will ask separately for each entity being copied

For the example purposes, select **Decide for each file (3)**



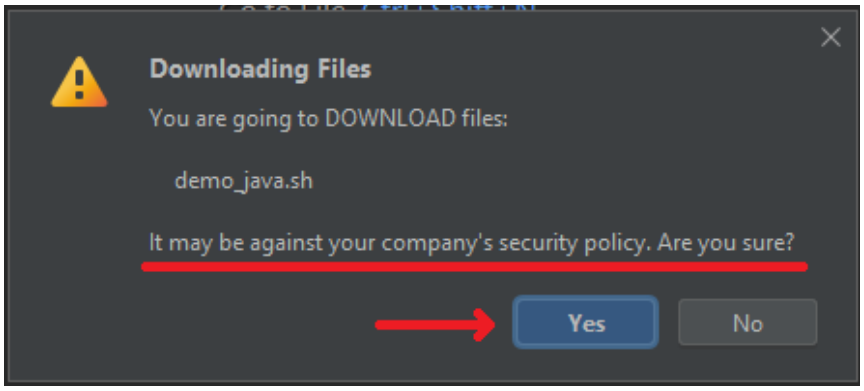
4. The next dialog window will appear, asking what to do with the conflicting file:
   - **Skip (1)** - will skip the entity copying
   - **Overwrite (2)** - will overwrite the entity with the same name in the destination
   - **Use new name (3)** - will create a new entity as a copy of the entity being copied with a new name, provided by the plug-in

For the example purposes, select **Use new name(3)**

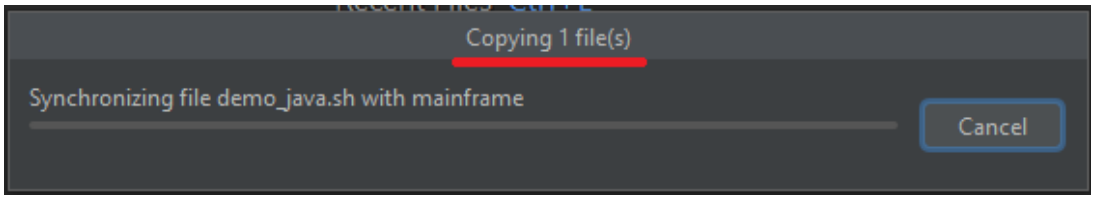


5. The final warning dialog will appear, notifying that the operation may be against the security rules in your company. Select **Yes**

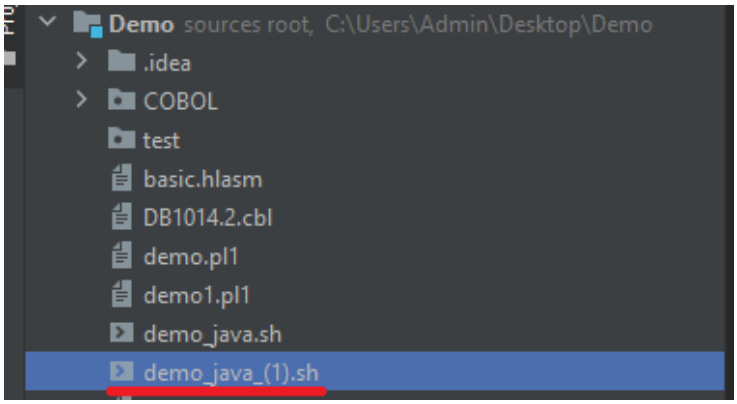
> **⚠ DO IT ON YOUR OWN RISK!**
>
> Do not proceed with the operation if your organization does not allow you to distribute information from your mainframe. It may contain sensitive data that is not meant to be distributed outside a mainframe.



6. A dialog about the copy operation appears. It is also possible to cancel the operation until it is finished



7. After the operation is completed, the file will appear in your local project's tree



Uploading files to a USS subsystem and z/OS data sets

It is also possible with the plug-in to upload files to a USS path and z/OS data set as a member

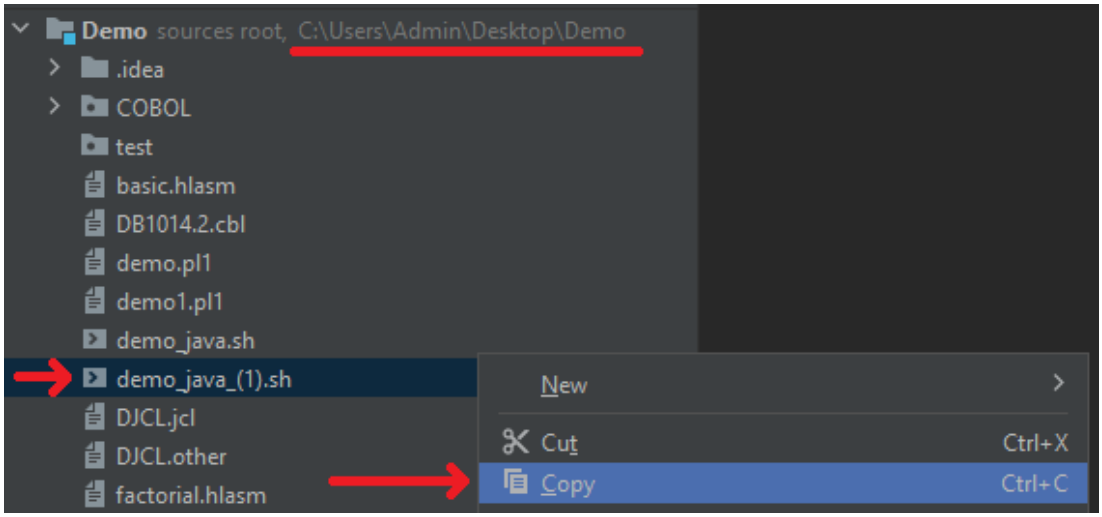
Upload feature: a file to a PDS / PDS/E member upload as a copy operation

> **NOTE**
>
> Make sure the parameters of the target data set allow you to paste a new member. Sometimes there is an error occures during paste operation to the data set due to the directory blocks value being not enough to fit the member.

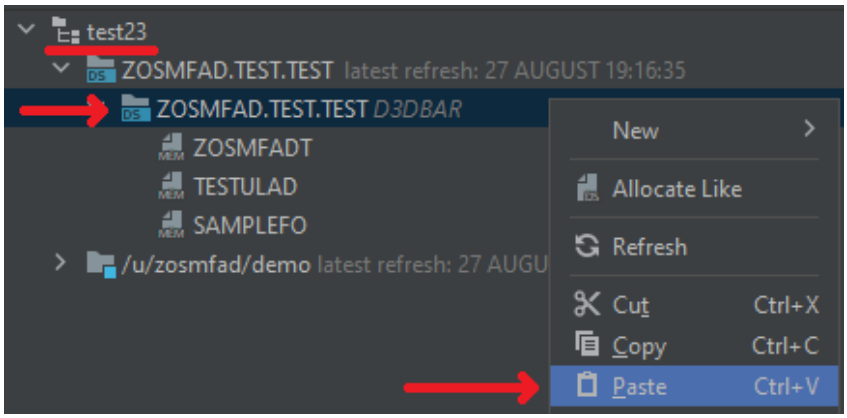
> **NOTE**
>
> The contents of the source files and data sets will stay the same, until you try to copy/move a file from USS to a z/OS partitioned data set. If the file lines are longer than the specified for the PDS / PDS/E logical record length, the plug-in will cut the rest of the line, exceeding the LRECL, for each of the exceeding lines.

To upload a file as a copy operation from a local machine to a PDS / PDS/E data sets as a member:

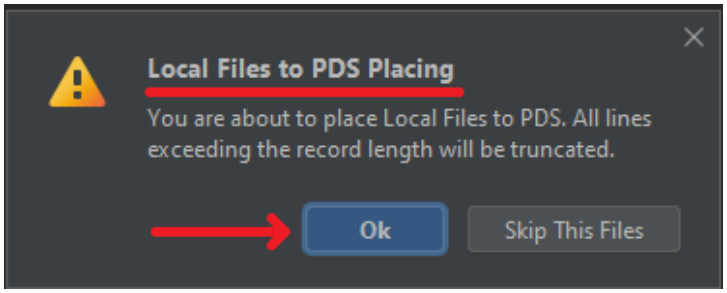
1. Right click on a file on the local project's tree, select **Copy**



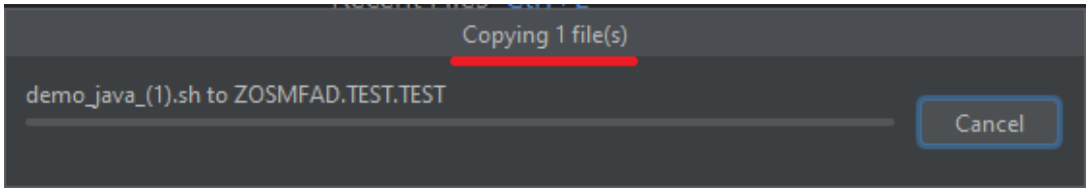
2. Right click on the destination PDS / PDS/E, select **Paste**



3. The truncation warning will appear, click **Ok**

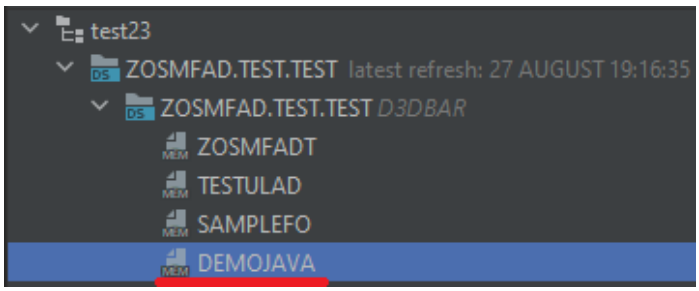


4. A dialog about the copy operation appears. It is also possible to cancel the operation until it is finished



5. After the operation is completed, a new member will appear in the destination PDS / PDS/E

> **NOTE**
>
> Check the content of the member after the operation. It could be truncated due to LRECL of the data set.



Current limitations

There are still some features in development and are not possible to accomplish with the plug-in:

1. **Folder uploading to a USS path**
2. **File uploading to a z/OS mask as a PS data set**
3. **USS folder copy to a z/OS mask as a PDS / PDS/E data set**
4. **Folder uploading to a z/OS mask as a PDS / PDS/E data set**

If you have some ideas regarding these operations or want to make a change in the existing one, please, reach out to us.

Version: v3.2.x LTS

Working with JES Explorer

Using the plug-in, you will be able to:

- view a status of a job, view full log of a job run
- view and edit job's JCL, submit a JCL right after they are edited
- purge a job
- sort jobs

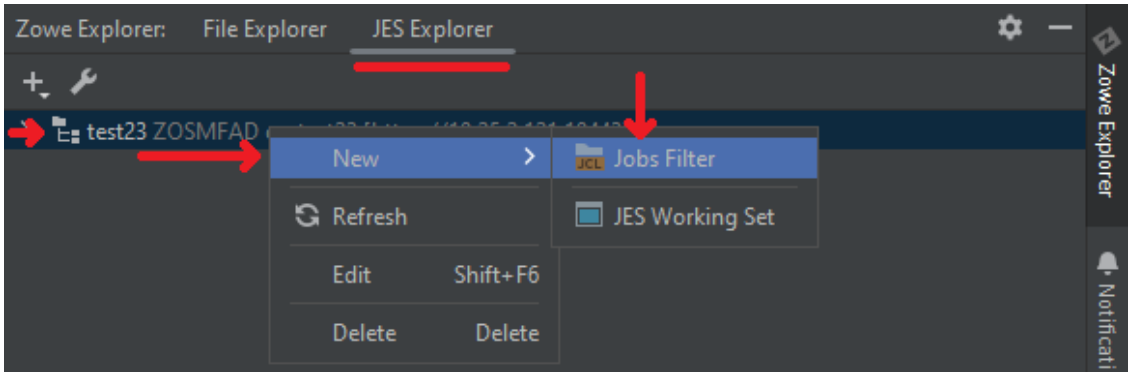
After you set up a JES Working Set and create a job filter to display jobs, you are all set up to work with JES Explorer.

Creating a jobs filter

To see and manipulate JES jobs, you need to specify a jobs filter to search for jobs.

To create a jobs filter:

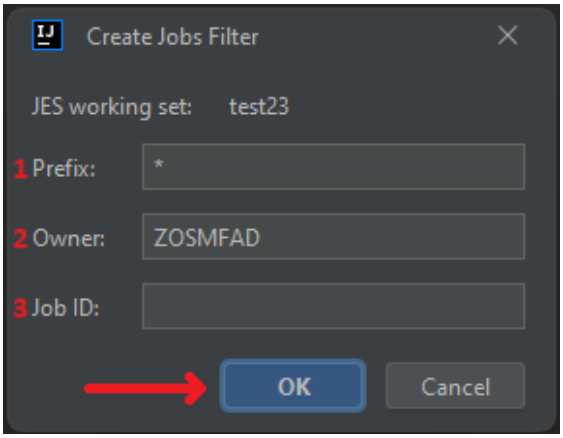
1. Proceed to the **JES Explorer**, right click on a **JES Working Set**, select **New > Jobs Filter**



2. Specify the parameters in the **Create Jobs Filter** dialog:
   - **Prefix (1)** - the prefix for a jobs search. Can be specified as a wildcard
   - **Owner (2)** - the owner for a jobs search. Can be specified as a wildcard
   - **Job ID (3)** - the exact job ID for a job search

> **NOTE**
>
> You can specify either **prefix + owner** or a **job ID** only. A mix of the parameters is not allowed.

After the parameters are specified, click **OK**



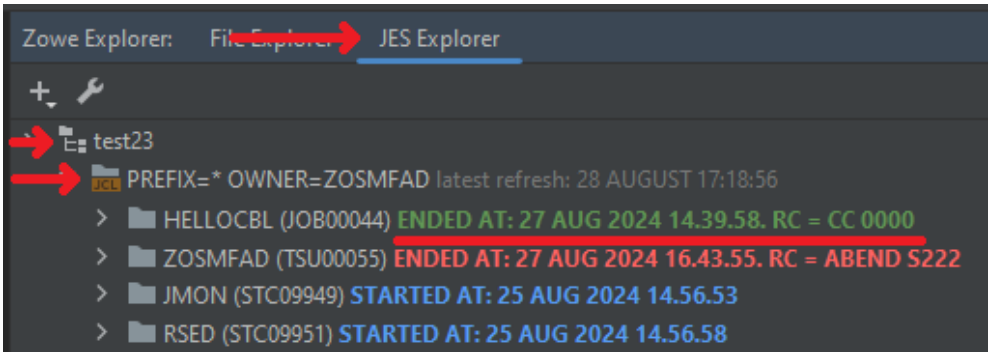
Now, you are ready to proceed to work with JES jobs.

Viewing a job status

The job status is displayed depending on the actual status of the job with the respective colouring.

To view a job status:

1. Proceed to the **JES Explorer**, reveal a **JES Working Set** and a **Jobs Filter**. There are different statuses depending on the state of a job:
   - **ENDED AT: <date and time>. RC = CC 0000** - the job is ended successfully, displaying the actual date and time of the job finish
   - **ENDED AT: <date and time>. RC = <any other>** - the job is ended with an error or a warning, displaying the actual date and time of the job finish
   - **STARTED AT: <date and time>** - the job is started but is in progress and not yet completed, displaying the actual date and time of the job start
   - **PENDING INPUT** / **QUEUED** - the job is not started yet as it is waiting in the queue until the same job already started is finished

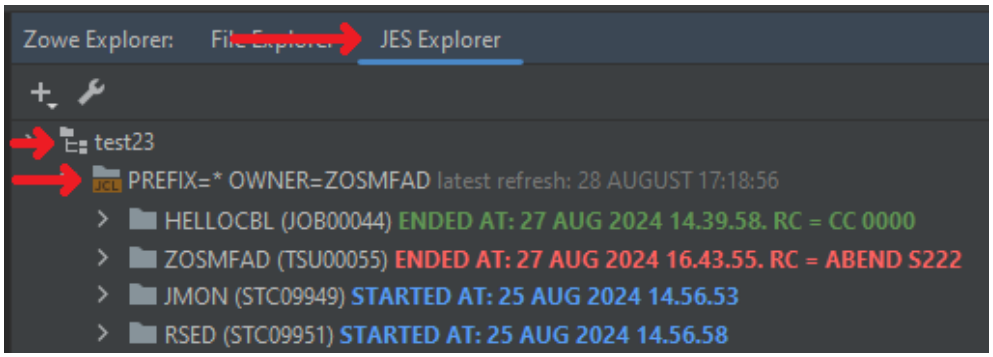


Viewing job spool files and job's run logs

All the spool files available for the jobs could be viewed in the plug-in.

To view the job spool files:

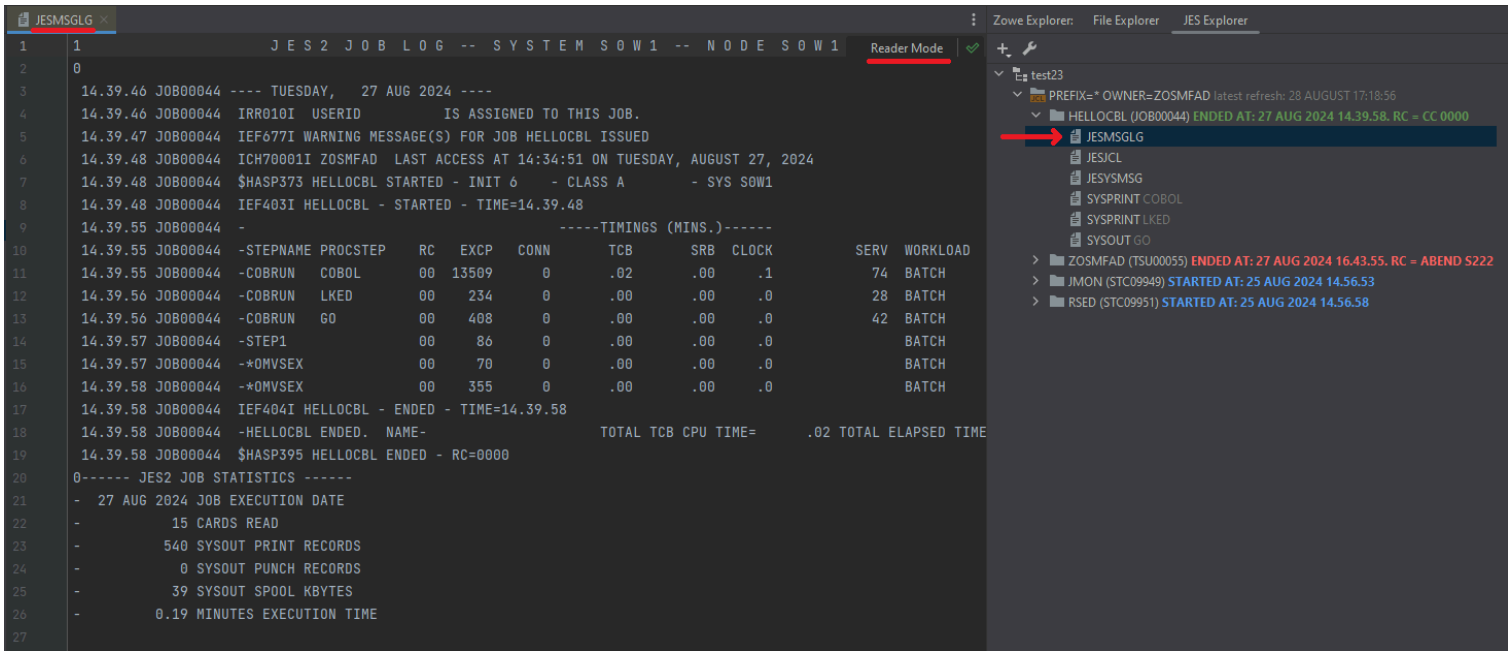
1. At the **JES Explorer** tab, reveal a JES Working Set and a jobs filter



2. Double click on the job or click **>** on the left of it. You will see all the spool files, available for the job

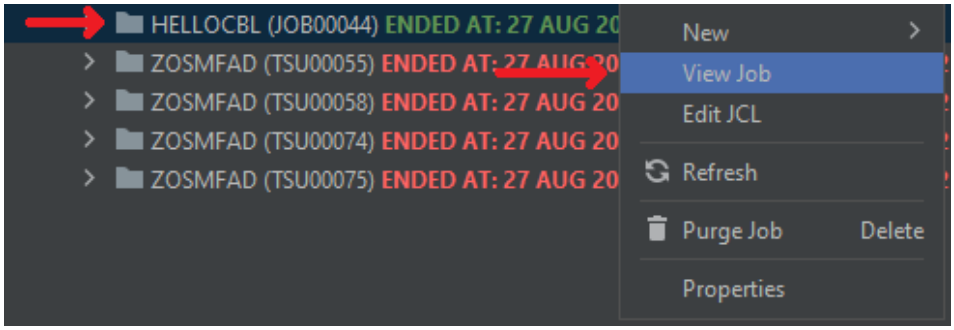
> **NOTE**
>
> If the job is still in progress, it is possible that not all the spool files are available yet. Just wait until the job is finished and refresh the view by right clicking and selecting **Refresh**.

3. Double click on any of the spool files to see the content of it. The lines will be displayed in the editor in a reader mode



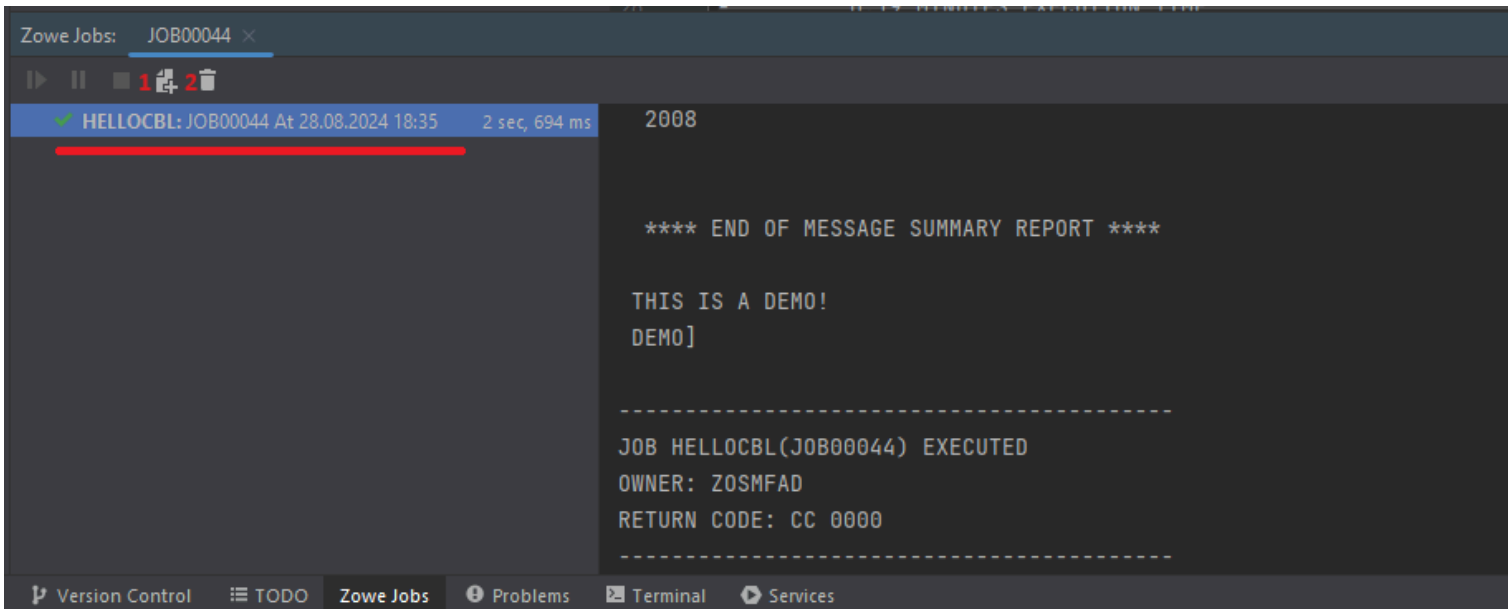
To view all the spool files merged in one log:

1. Right click on the job in **JES Explorer**, select **View Job**



2. The merged spool files log will be displayed in the **Zowe Jobs** console view. There are two buttons to manipulate the job in there:
   - **Go To Job (1)** - reveals the job in **JES Explorer**. If the job is not yet visible in the JES Explorer, the plug-in provides a dialog to create a filter for the exact job to present
   - **Purge Job (2)** - removes the job from JES

> **NOTE**
>
> If the job is completed successfully, the plug-in can hide the successful steps. To show them, right click on the job in the console view and select **Show Successful Steps** and it will show all the spool files of the job as steps.

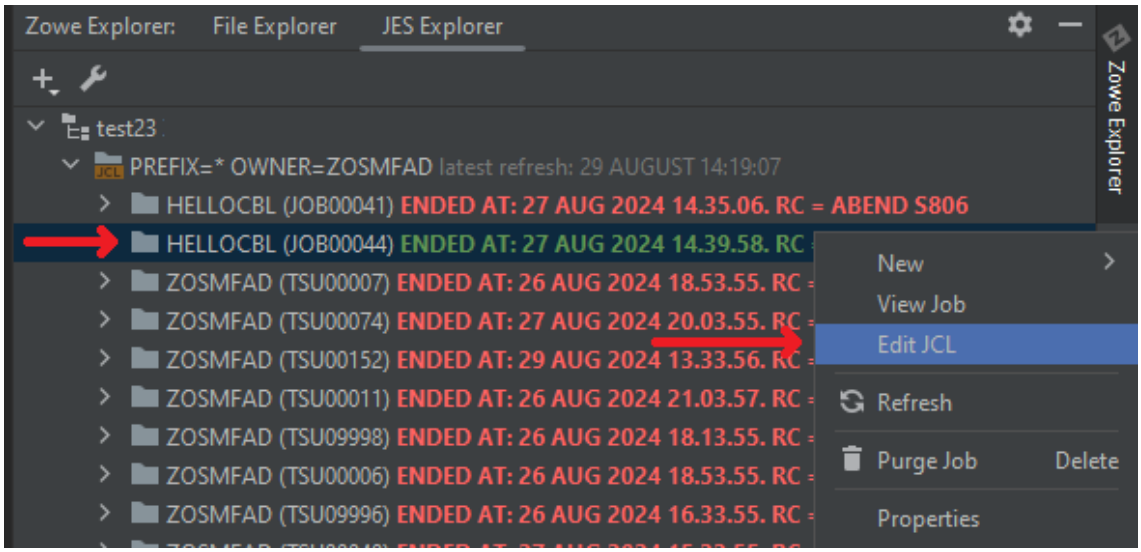


View and edit job's JCL code

The plug-in provides the possibility to view and edit a JCL code of the job in the JES Explorer. The JCL will appear in the IDE's editor. You could change the JCL and submit the job with a new code.

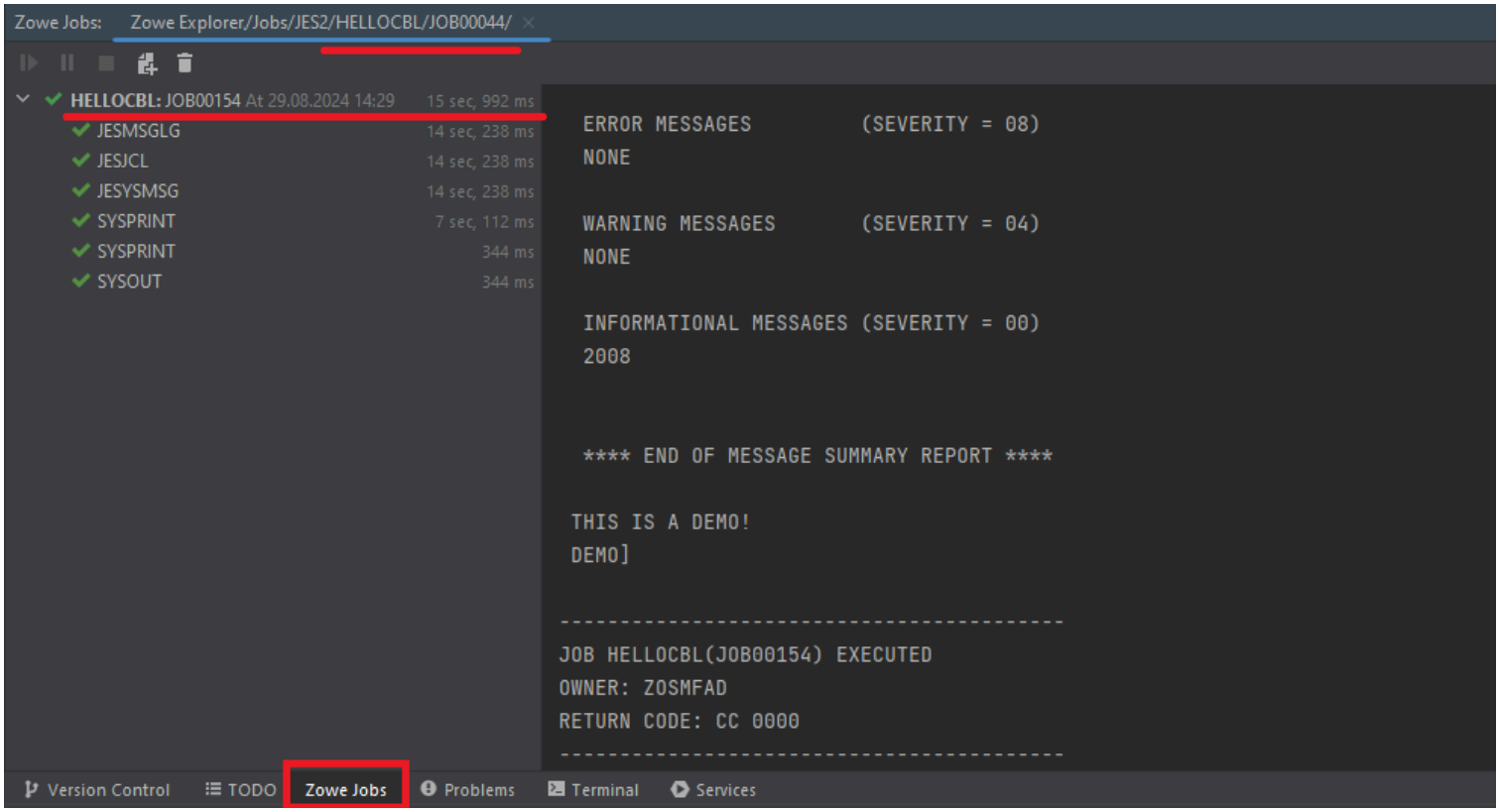
To view and edit the JCL code of a JES job:

1. Right click on the job in **JES Explorer**, select **Edit JCL**

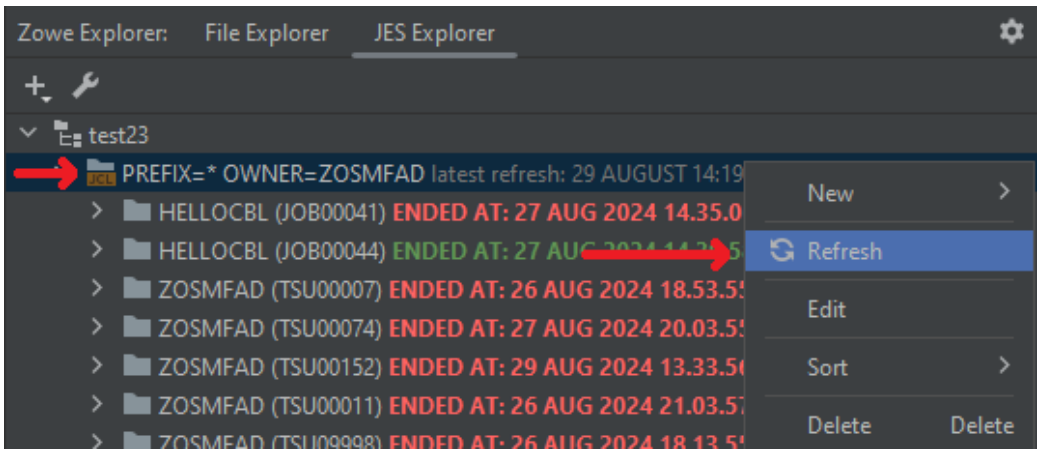


2. After the JCL content is fetched, it will be displayed in the IDE's editor. You can change the JCL as much as you want. Also, the editor allows to submit the JCL again. Click the **Submit Job** button

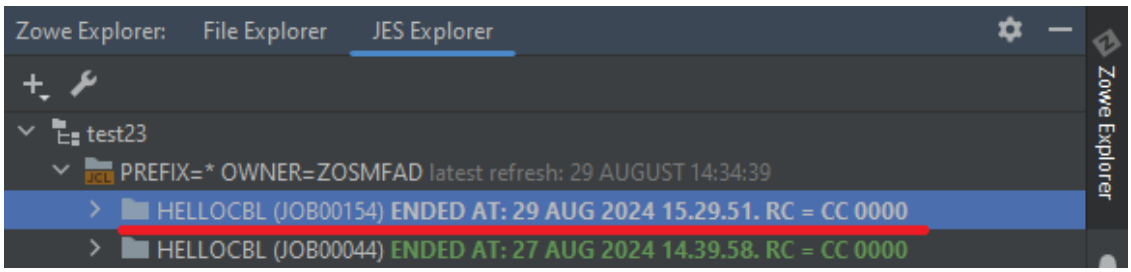
3. When the job is submitted, the console of the job's execution will appear, providing the actual information about the job run



4. Also, it is possible to see the status of the job being run. On the appropriate **Job Filter** in the **JES Explorer**, right click and select **Refresh**



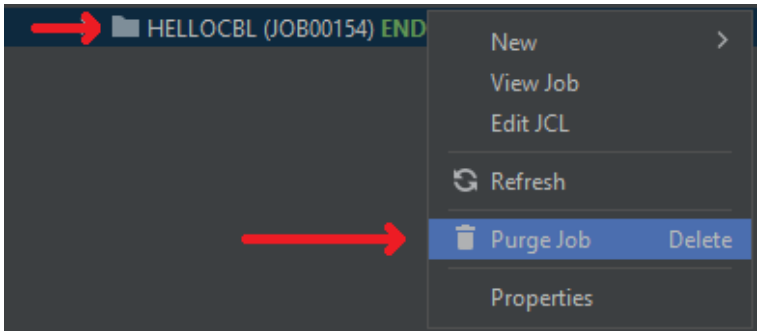
5. After refresh is completed, a new list with jobs will be displayed with the submitted job and its respective status



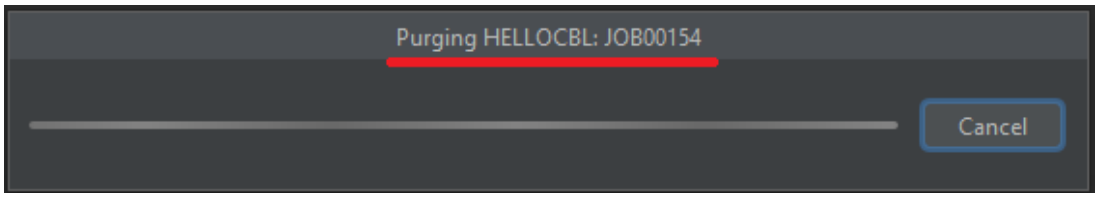
Purge a job

To purge a job from a JES:

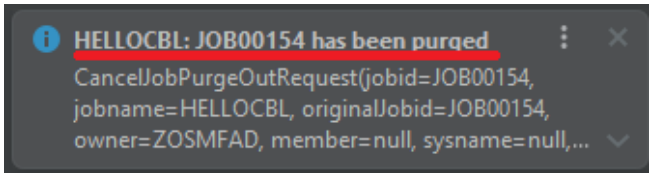
1. Specify a **Jobs Filter**. After the jobs are fetched, right click on a job to purge, select **Purge** (or press **Delete** button when the job is selected)



2. When the job is being purged, a "purge" dialog will appear until the job is purged



3. After the job is purged, a notification about the job is purged will appear and the **Jobs Filter** will be refreshed



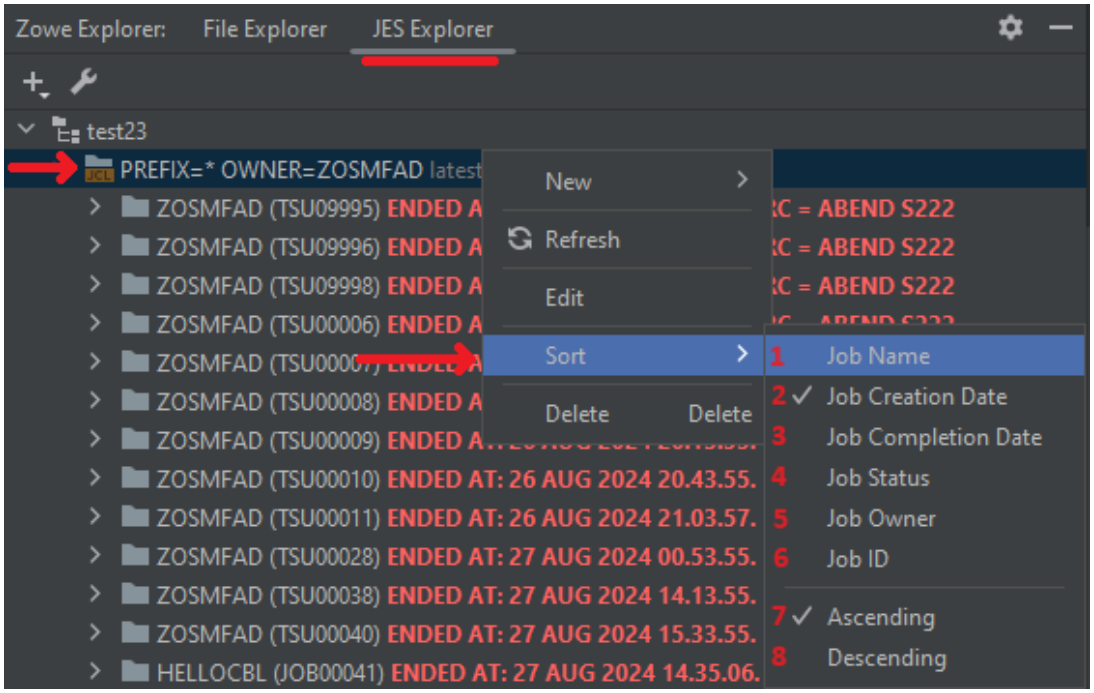
Sort jobs

For the improved user experience, there is a feature of the plug-in to sort jobs for a specified jobs filter.

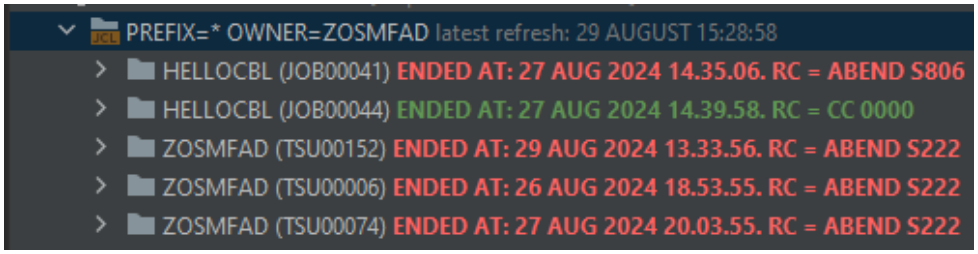
To sort jobs:

1. Proceed to the **JES Explorer**, reveal a **Jobs Filter**, right click on it, select **Sort**. There are will be options:
   - **Job Name (1)** - to sort jobs by their names
   - **Job Creation Date (2)** - to sort jobs by their creation date and time. Jobs are sorted by this option by default
   - **Job Completion Date (3)** - to sort jobs by their completion date and time
   - **Job Status (4)** - to sort jobs by their status. It means that the return code will be analyzed by the status, displayed in the JES Explorer
   - **Job Owner (5)** - to sort jobs by their owners
   - **Job ID (6)** - to sort jobs by their IDs

Also, there is a possibility to change the order for the items to be displayed: **Ascending (7)** (by default) or **Descending (8)**. For the example purposes, select **Job Name**



2. The list will be refreshed with the new sort order



Version: v3.2.x LTS

Working with TSO console

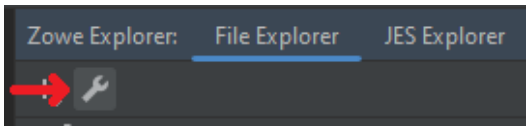
The plug-in provides a functionality to work with TSO in a console way directly from the IntelliJ IDEA. With this feature it is possible to enter commands and see their results, open multiple sessions to different z/OS instances, as well as the same z/OS instance, issue a PA1 command to the console in case the attention functionality is needed to be triggered.

To start working with TSO console, you need to set up a Connection. After that, the **TSO Sessions** functionality will be allowed to work with.

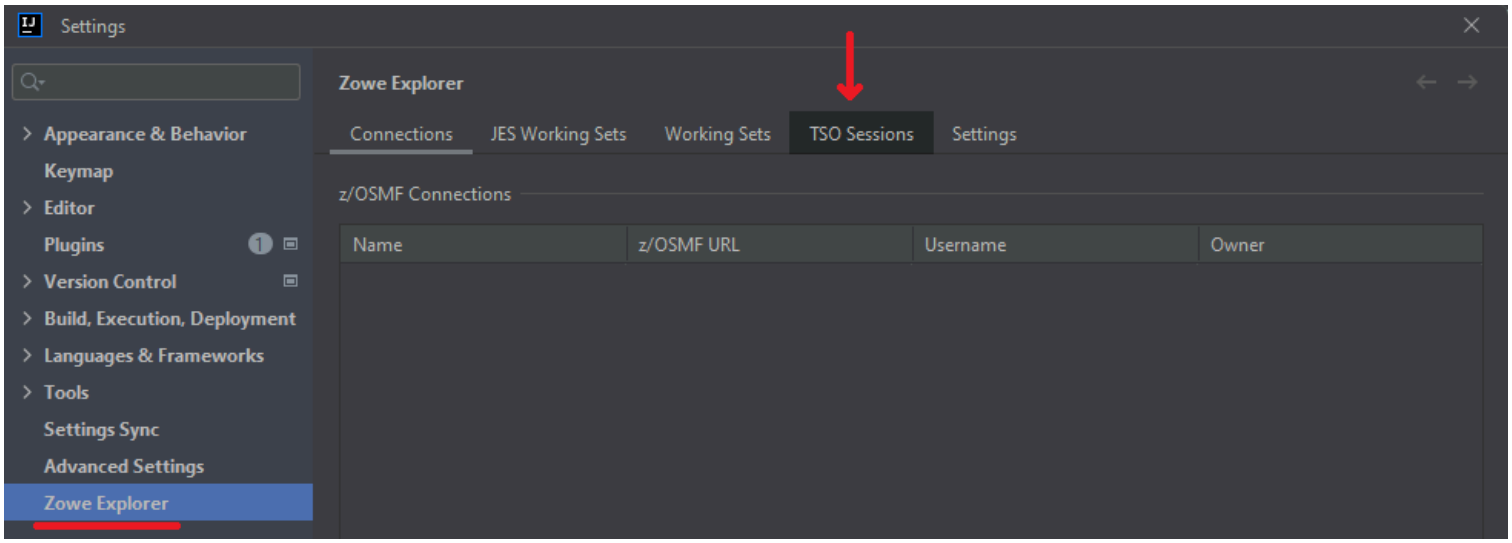
Creating a TSO Session

To create a TSO Session:

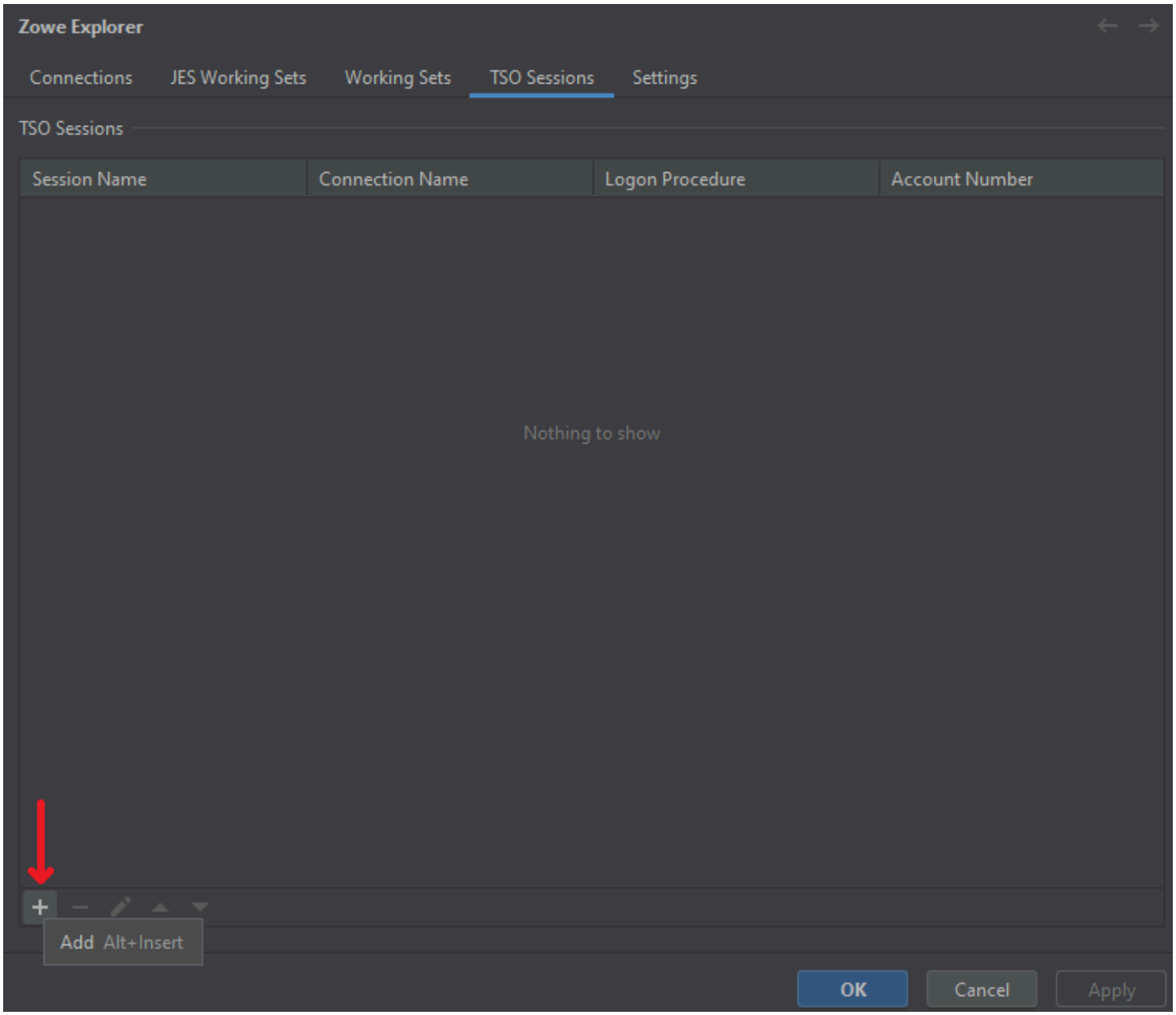
1. Open settings with the wrench button



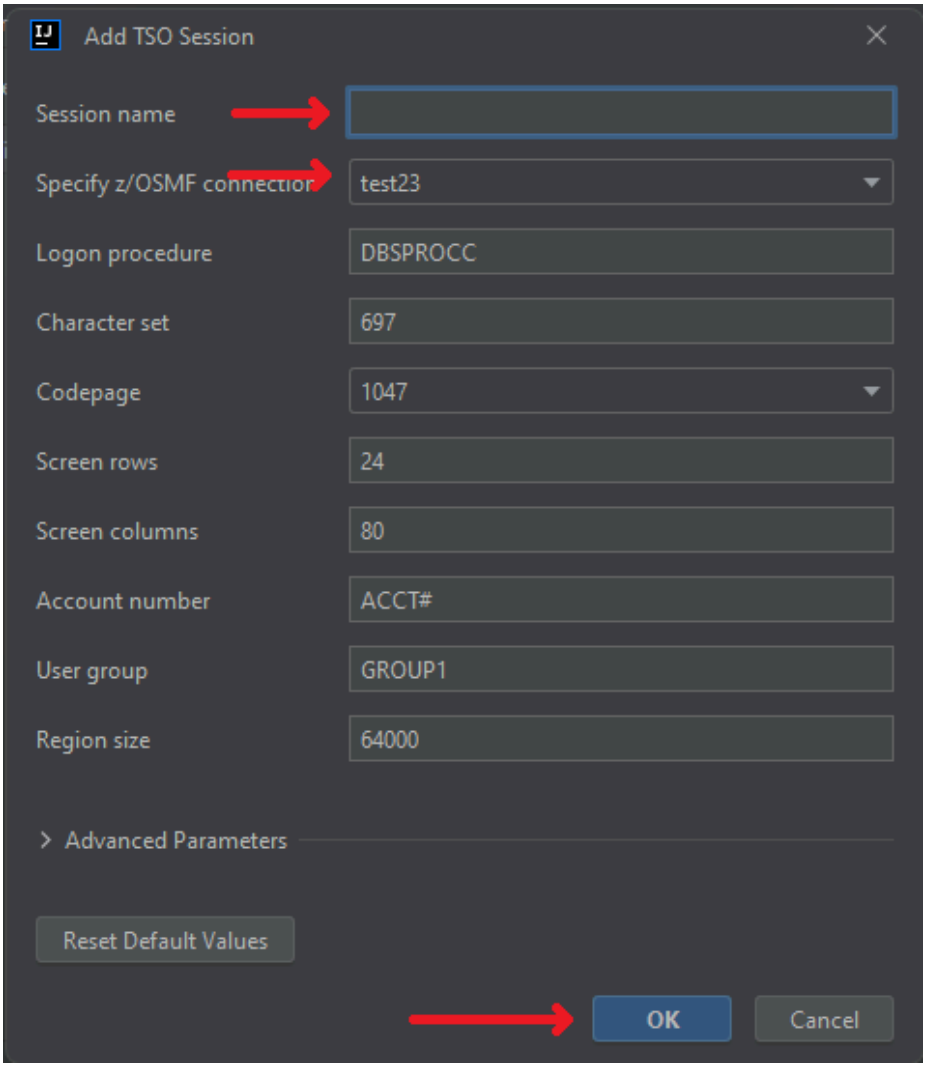
2. Go to **TSO Sessions** tab



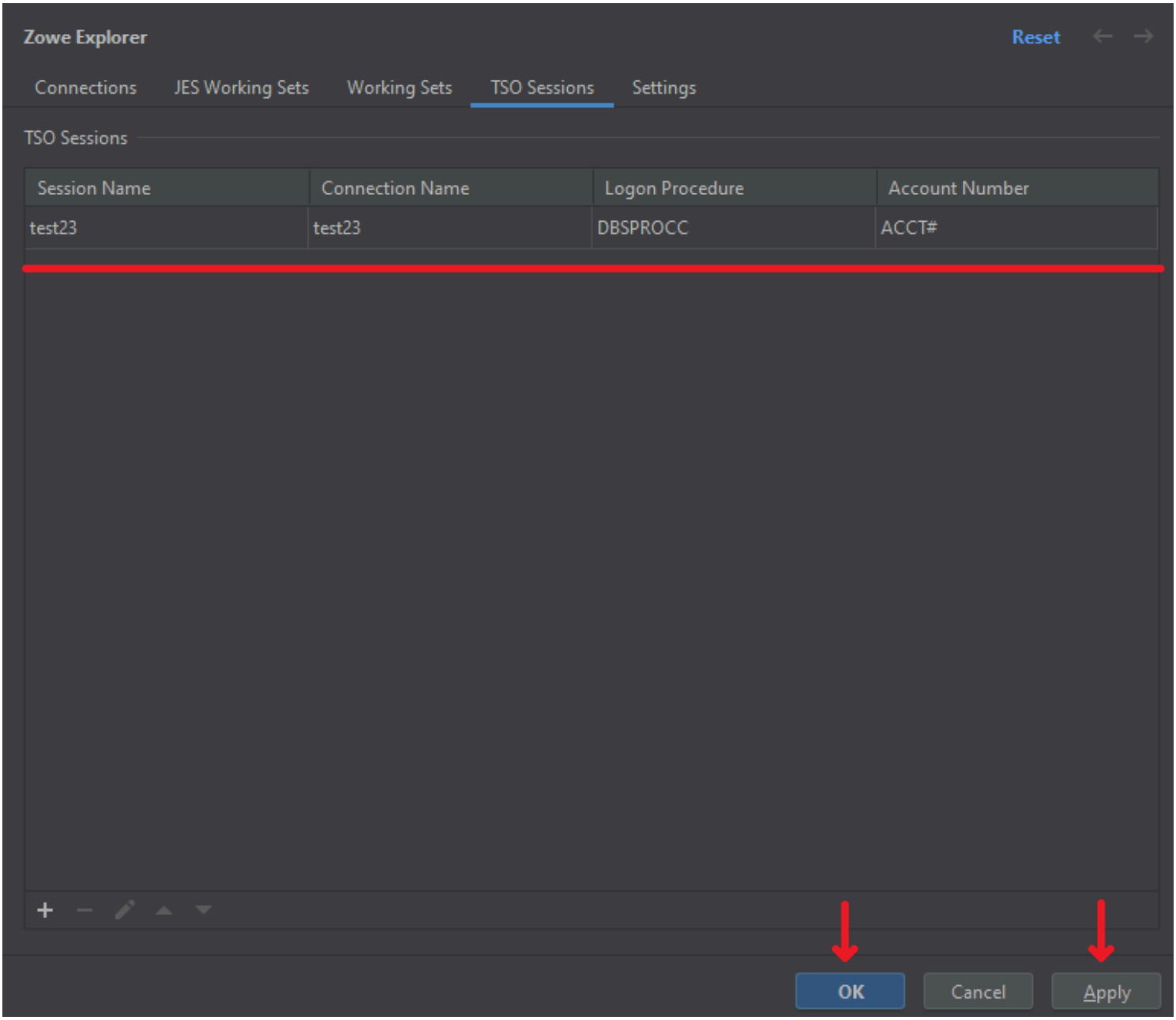
3. At the **TSO Sessions** tab, click on the **+** button



4. The **Add TSO Session** dialog will appear. You need to specify a name of the TSO Session in order to be able to create it. Also, you can select a connection to be used together with the session parameters. To setup such things as reconnection timeout and reconnection attempts count, use the **Advanced Parameters** section. Also, you can reset the defaults of the parameters by clicking **Reset Default Values** button. After all the parameters are set up, click **OK** button



5. After the actions are done, a new **TSO Session** will be added to the list. Click **Apply** and then **OK** buttons to save the new session

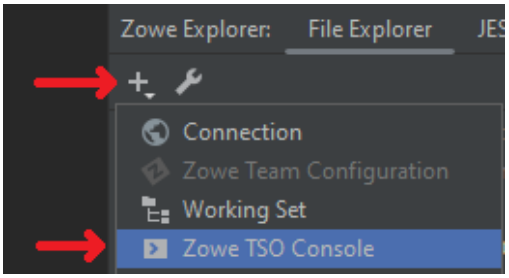


Creating a TSO Console

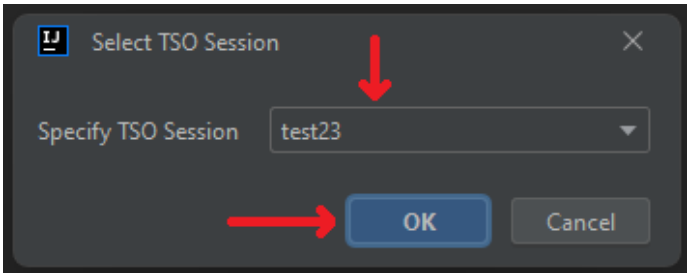
After a **TSO Session** is created, it is possible to create a **TSO Console**.

To create a **TSO Console**:

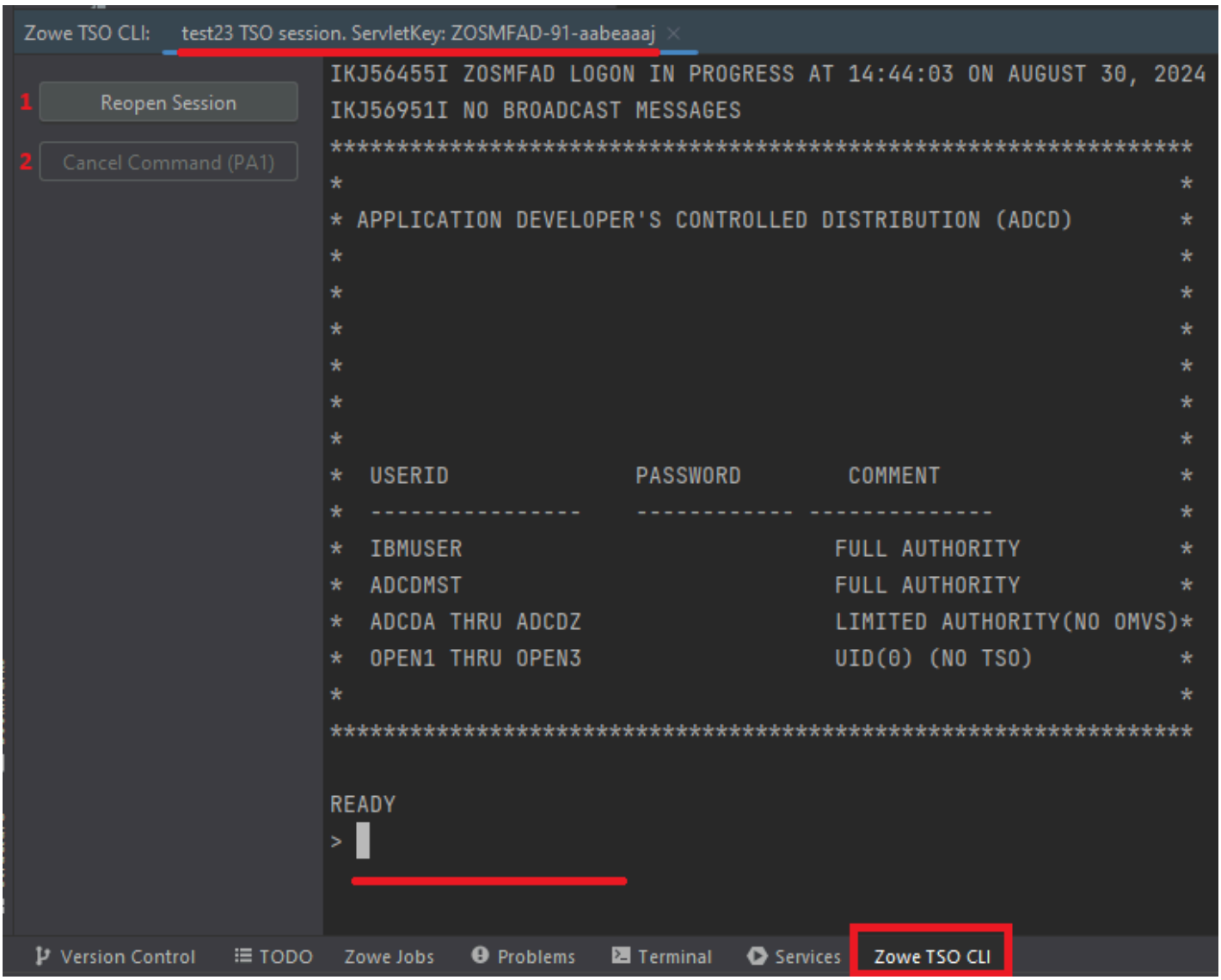
1. Click **+** button, select **Zowe TSO Console**



2. The **Select TSO Session** dialog will appear. Select the appropriate **TSO Session** to use during a TSO console run, click **OK** button



3. When the **TSO Session** is selected, the **TSO Console** will appear. In there you could see the actual information about the session being used, the welcoming message and the prompt, where it is possible to enter TSO commands. Also there are 2 buttons to manipulate the behavior of the console:
   - **Reopen Session (1)** - will reopen the current TSO Console session with the same parameters
   - **Cancel Command (PA1) (2)** - will send the **PA1** command to the TSO console in order to issue a cancellation of the previous command (it is blocked when there is nothing to cancel)



From this point, you are ready to use the **TSO Console**

Version: v3.2.x LTS

Using Zowe SDKs

Leverage the Zowe Client Software Development Kits (SDKs) to build client applications and scripts that interface with the mainframe.

The SDKs include programmatic APIs, each of which performs a particular mainframe task. For example, one API package provides the ability to upload and download z/OS data sets. You can leverage that package to rapidly build a client application that interacts with data sets.

The following SDKs are available.

- Zowe Client Java SDK
- Zowe Client Kotlin SDK
- Zowe Client Node.js SDK
- Zowe Client Python SDK *technical preview*

SDK documentation

For detailed SDK documentation, see the following:

- Zowe Node.js SDK
- Zowe Client Python SDK

Software requirements

Java SDK

Requires Java runtime version 11 and later versions.

Node.js SDK

If you install Node SDK packages from the online registry, the required dependencies are installed automatically.

If you download Node SDK packages from Zowe.org, the folder contains dependencies that you must install manually. Extract the TGZ files from the folder, copy the files to your project, and issue the following commands to install the dependencies:

Python SDK

If you install Python SDK packages from the online registry, the required dependencies are installed automatically.

If you download the Python SDK packages from Zowe.org, the downloaded folder contains dependencies that you must install manually. Extract the WHL files from the folder, copy the files to your project, and issue the following command for each dependency:

Getting started

To get started, import the SDK packages to your project. You can pull the packages from an online registry, or download the packages from Zowe.org to install locally.

Install Java SDK from an online registry

To install this library in your project, use a build tool such as Maven, Gradle or Ant. Use the following link to get the necessary artifact:

https://mvnrepository.com/artifact/org.zowe.client.java.sdk/zowe-client-java-sdk

For a Maven project, add the SDK as a dependency by updating your `pom.xml`:

For a Gradle project, add the SDK as a dependency by updating your `build.gradle`:

The version 2.2.0 can change. Look at the artifact link to select the latest version.

Install Node.js SDK from an online registry

Pull the packages from an online registry such as npm.

1. In the command-line window, navigate to your project directory. Issue the following command to install a package from the registry:

   - To import a Node.js package: `npm install <PackageName>`

     - `<packageName>` The name of the SDK package that you want to install, such as `zos-files-for-zowe-sdk`.

   The packages are installed. Node packages are defined in `package.json` in your project.

2. **(Optional)** You might want to automatically update the SDK version when updates become available, or you might want to prevent automatic updates.

   - To define the versioning scheme for Node packages, use semantic versioning.

Install Python SDK from an online registry

Pull the packages from an online registry such as PyPi.

1. In the command-line window, navigate to your project directory. Issue the following command to install a package from the registry:

   - To import a Python package, use the following syntax: `pip install <PackageName>`

     - `<packageName>` The name of the SDK package that you want to install, such as `zos-files-for-zowe-sdk`.

   Python packages are installed by default to `$PYTHONPATH/Lib/site-packages` (Linux) or to the Python folder in your local `/AppData` folder (Windows).

2. **(Optional)** You might want to automatically update the SDK version when updates become available, or you might want to prevent automatic updates.

   - To define versioning for Python packages, specify versions or version ranges in a `requirements.txt` file checked-in to your project. For more information, see pip install in the pip documentation.

Install Node.js and Python SDKs from a local package

Download and install the packages.

1. Navigate to Zowe.org Downloads. Select your desired programming language in the **Zowe Client SDKs** section.

   The SDK is downloaded to your computer.

2. Unzip the SDK folder, which contains the packages for each set of functionality (such as z/OS Jobs). Copy each file that you want to install and paste them into your project directory.

3. Install required dependencies, which are included in the bundle. See Software requirements above for more information.

4. In a command-line window, navigate to your project directory. Issue *one* of the following commands:

   - To install a Node.js package, use the following syntax: `npm install <packageName>.tgz`
   - To install a Python package, use the following syntax: `pip install <packageName>.whl`
   - `<packageName>` The name of the package that you want to install, such as `zos-files-for-zowe-sdk`.

   Repeat the command for each package that you need. Packages are now installed.

Using

After you install the SDK, you can make API calls to the mainframe from within your project.

Using - Java

For Java SDK usage and syntax examples, refer to the following package READMEs:

- Team Config - Read only team configuration operations.
- z/OS Console - Perform z/OS console operations.
- z/OS Files-dsn - Work with data sets on z/OS.
- z/OS Files-uss - Work with UNIX system services (USS) files on z/OS.
- z/OS Jobs - Work with batch jobs on z/OS.
- z/OS Log - Work with logs on z/OS.
- z/OS Management Facility - Return data about z/OSMF, such as connection status or a list of available systems.
- z/OS TSO - Interact with TSO/E address spaces on z/OS.
- z/OS USS - ssh unix command request operation.

SDK Javadoc:

https://javadoc.io/doc/org.zowe.client.java.sdk/zowe-client-java-sdk/latest/index.html

See the following GitHub organization location Zowe-Java-SDK for demo apps and code examples for most API calls:

https://github.com/Zowe-Java-SDK

Using - Node.js

For Node SDK usage and syntax examples, refer to the following package READMEs:

- Core libraries - Use shared libraries, such as `rest` to access z/OSMF REST APIs, `auth` for connecting to token-based authentication services, and more.
- z/OS Console - Perform z/OS console operations.
- z/OS Files - Work with data sets on z/OS.
- z/OS Jobs - Work with batch jobs on z/OS.
- z/OS Management Facility - Return data about z/OSMF, such as connection status or a list of available systems.
- z/OS Provisioning - Provision middleware and resources such as IBM CICS, IBM Db2, IBM MQ, and more.
- z/OS TSO - Interact with TSO/E address spaces on z/OS.
- z/OS USS - Work with UNIX system services (USS) files on z/OS.
- z/OS Workflows - Create and manage z/OSMF workflows on z/OS.

Using Python

For information about the Python SDK, including usage and syntax examples, see the Python SDK ReadTheDocs.

Using Kotlin

For information about Zowe Client Kotlin SDK, including a setup guide and source code documentation, see the Zowe Client Kotlin SDK docs.

Using Java

For information about how to use Zowe Client Java SDK, see this README.md section.

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Using Zowe Chat

You can interact with Zowe Chat by mouse navigation or issuing commands.

Mouse navigation

Zowe Chat supports users to click buttons, dropdown menu, and other clickable components in chat to query information, drill down content, etc.

Interacting through commands

You can also mention "@" the bot user and issue commands to interact with Zowe Chat. Zowe Chat supports Zowe Chat commands and Zowe CLI commands.

Zowe Chat commands

You can issue Zowe Chat commands in the following format:

For example,

For detailed Zowe Chat commands, see Zowe Chat command reference.

Zowe CLI commands

You can also issue Zowe CLI commands to perform operations, such as help and z/OS resource management including z/OS job, data set, USS file, error code, and console command. Theorytically, most of Zowe CLI commands are supported as long as it is excutable with single-submit.

> **WARNING**
>
> - Zowe CLI must be installed on your Zowe Chat server first before you can issue Zowe CLI commands.
> - Zowe Chat currently does not support the Zowe CLI command-line interactive or "prompt" feature that asks you to provide required option values.

For detailed CLI commands, see Zowe CLI command reference.

Version: v3.2.x LTS

Providing feedback and contributing

To help make Zowe client-side components better, you are welcome to contribute in different ways.

Zowe CLI

Chatting with the Zowe CLI community

Chat with the community on Slack.

Filing an issue for Zowe CLI

Go to the Zowe CLI issue list to file an issue. Include all relevant information.

Zowe Explorer

Chatting with the Zowe Explorer community

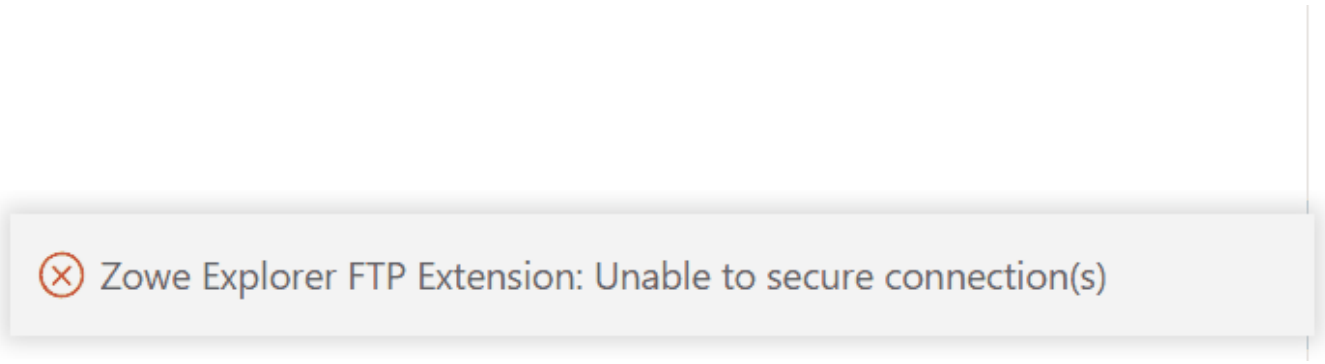
Chat with the community on Slack by indicating whether the message about Zowe Explorer, Zowe Explorer for IBM CICS extension, or the Zowe Explorer FTP Extension.

Filing an issue for Zowe Explorer and Zowe Explorer extensions

Before filing an issue, check if the error stems from either Zowe Explorer, the Zowe Explorer for IBM CICS extension or the Zowe Explorer FTP Extension.

To file an issue:

1. To check the error source, expand the error message that displays in VS Code and review the **Source** description:



   - Errors arising from Zowe Explorer identify the **Source** as *Zowe Explorer (Extension)*.
   - Errors arising from the Zowe Explorer CICS extension identify the **Source** as *Zowe Explorer for IBM CICS (Extension)*.
   - Errors arising from the Zowe Explorer FTP extension identify the **Source** as *Zowe Explorer Extension for FTP (Extension)*.

2. Go to the extension repository to file an issue. Include all relevant information.

    - Zowe Explorer issue list
    - Zowe Explorer for IBM CICS issue list
    - Zowe Explorer FTP Extension issue list
        - Add the label `zFTP` to indicate the extension.

Zowe Explorer plug-in for IntelliJ IDEA

Chatting with the Zowe Explorer plug-in for IntelliJ IDEA community

Chat with the community in Slack.

Filing an issue for Zowe Explorer plug-in for IntelliJ IDEA

Go to the Zowe Explorer plug-in for IntelliJ IDEA issue list to file an issue. Include all relevant information.

Zowe Client SDKs

Chatting with the Zowe Client SDKs community

Chat with the community on Slack by indicating whether the message is about Zowe Client Node.js SDK, Zowe Client Python SDK, Zowe Client Kotlin SDK, or Zowe Client Java SDK.

Filing an issue for Zowe Client Java SDK

Go to the Zowe Client Java SDK issue list to file an issue. Include all relevant information.

Filing an issue for Zowe Client Kotlin SDK

Go to the Zowe Client Kotlin SDK issue list to file an issue. Include all relevant information.

Filing an issue for Zowe Client Node.js SDK

Go to the Zowe Client Node.js SDK issue list to file an issue. Include all relevant information.

Filing an issue for Zowe Client Python SDK *technical preview*

Go to the Zowe Client Python SDK issue list to file an issue. Include all relevant information.

Zowe Chat *technical preview*

Chatting with the Zowe Chat community

Chat with the community on Slack.

Filing an issue for Zowe Chat

Go to the Zowe Chat issue list to file an issue. Include all relevant information.

Version: v3.2.x LTS

Extending Zowe

Zowe is designed as an extensible tools platform. One of the Zowe architecture goals is to provide consistent interoperability between all Zowe components including extensions. The Zowe Conformance Program defines the criteria to help accomplish the aforementioned goal. By satisfying the Zowe Conformance Program criteria, extension providers are assured that their software remains functional throughout the Zowe release cycle. For more information, see the Zowe Conformance Program.

Zowe can be extended in the following ways:

Extending the server side

- Extending Zowe API Mediation Layer
- Developing for Zowe Application Framework

Extending the client side

- Extend Zowe CLI
- Extend Zowe Explorer
- Add a plug-in to the Zowe Desktop

To assist with extension development, see the following Sample extensions:

- Sample Zowe API and API Catalog onboarded service
- Sample Zowe Desktop extension

Extending the server side

Extending Zowe API Mediation Layer

The API Mediation Layer extension primarily focuses on extending via onboarding services running as standalone services. These services are subsequently available in the API Catalog and can be accessed through the API Gateway. For more information about onboarding a service to the API Mediation Layer, see the Onboarding Overview. The API Mediation Layer squad also provides libraries to simplify the integration for multiple programming languages and different frameworks.

Developing for Zowe Application Framework

You can create application plug-ins to extend the capabilities of the Zowe™ Application Framework. An application plug-in is an installable set of files that present resources in a web-based user interface, as a set of RESTful services, or in a web-based user interface and as a set of RESTful services.

For more information about developing for Zowe Application Framework, see Zowe Application Framework overview.

Extending the client side

Extend Zowe CLI

Zowe CLI extenders can build plug-ins that provide new commands. Zowe CLI is built using Node.js and is typically run on a machine other than a mainframe, such as a PC, where the CLI can be driven through a terminal or command prompt, or on an automation machine such as a DevOps pipeline orchestrator.

For more information about extending the Zowe CLI, see Developing a new plug-in. This article includes a sample plug-in that is provided with the tutorial; see Installing the sample plug-in.

Extend Zowe Explorer

Zowe Explorer provides extension APIs that assist third party extenders to create extensions that access Zowe Explorer resource entities to enrich the user experience. There are many ways Zowe Explorer can be extended to support many different use cases.

For the kinds of extensions that are supported and how to get started with extending Zowe Explorer, see Extensions for Zowe Explorer.

Add a plug-in to the Zowe Desktop

The Zowe Desktop allows a user to interact with z/OS applications through a web browser. The Desktop is served by the Zowe Application Framework Server on z/OS, also known as Z Lightweight User Experience (ZLUX). The Zowe desktop comes with a set of default applications. You can extend it to add new applications. For more information, see Developing for Zowe Application Framework.

The Zowe Desktop is an angular application that allows native plug-ins to be built that provide for a high level of interoperability with other desktop components. The React JavaScript toolkit is also supported. Additionally, you can include an existing web application in the Zowe Desktop using an iframe.

Notes: For more information, see the following samples:

- Sample iframe App.
- Sample Angular App.
- Sample React App.

Sample extensions

To help Zowe extenders better understand how extensions are developed and deployed, we provide a set of sample. These sample extensions contain the necessary boilerplate project setup, application code, and installation scripts to jumpstart the extension development and deployment to Zowe.

Note: For more information on the architecture of Zowe, see Zowe Architecture.

Sample Zowe API and API Catalog onboarded service

The service Discoverable Client within API Mediation Layer repository contains a sample Zowe onboarded service with a Spring Boot server providing sample Helo world APIs. For more information, see discoverable-client.

Sample Zowe Desktop extension

The repository https://github.com/zowe/sample-trial-app contains a sample Zowe extension with a node server providing a web page that gives a user interface to the APIs included with the API sample above.

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Zowe Conformance Program

Introduction

Administered by the Open Mainframe Project, the Zowe™ Conformance Program aims to give users the confidence that when they use a product, app, or distribution that leverages Zowe, they can expect a high level of common functionality, interoperability, and user experience.

Conformance provides Independent Software Vendors (ISVs), System Integrators (SIs), and end users greater confidence that their software will behave as expected. Just like Zowe, the Zowe Conformance Program will continue to evolve and is being developed by committers and contributors in the Zowe community.

As vendors, you are invited to submit conformance testing results for review and approval by the Open Mainframe Project. If your company provides software based on Zowe, you are encouraged to get certified today.

> **FIND OUT MORE**
>
> The Zowe Conformance Program Explained blog on Medium.com describes the conformance program in more detail.

How to participate

To participate in the Zowe Conformance Program, follow the process on the Zowe Conformance Program website. You can also find a list of products that have earned Zowe Conformant status.

To learn the criteria of achieving Zowe conformance for an offering, see Zowe Conformance Criteria.

How to suggest updates to the Zowe conformance program

The Zowe conformance criteria is available as a table in a Markdown file in the Open Mainframe Project's GitHub repo. If you find a mistake with the Zowe conformance documents, or you are a Zowe squad lead and want to make an amendment to the criteria, you can update that Markdown file. The same information is also held in another document Zowe Conformance Test Evaluation Guide that has history going back to Zowe 2019 conformance and allows easy change history comparison.

To submit a proposal to update the conformance criteria, fork the OMP's `foundation` repository at https://github.com/openmainframeproject/foundation and make a pull request. Flag the Pull Request to the attention of GitHub user ID `@mertic`, and also reach out to the Zowe onboarding squad in the #zowe-onboarding Slack channel. If you are not already signed up to Zowe Slack community, you can sign up at https://slack.openmainframeproject.org first.

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Packaging z/OS extensions

You can extend Zowe in multiple ways. You may extend Zowe with microservices, which may start a new service within Zowe. You can also create Zowe App Framework plug-ins to provide users with a UI.

Before you start, review the following terms:

- **component**

  Component refers to the most generic way to describe a program which can work within Zowe. It can be a microservice, a Zowe App Framework plug-in, or even just a shared program to be used by other Zowe components. This is also the generic word when referring to both Zowe core components and extensions. In most of the cases described in this topic, this terminology does not include programs running on the client side, like Zowe CLI plug-in or Zowe Explorer (VSCode extension).

- **extension**

  Extension is similar to **component** but excludes Zowe core components. It is recommended that you install all Zowe extensions into a shared extension directory.

Zowe server component package format

You can package Zowe components (extensions) into various formats. You can package them as a stand-alone PAX, ZIP, or TAR file. You can also bundle and ship your Zowe extension(s) within another product.

A typical component package consists of the following files and directories:

- `manifest.yaml`

  Refers to the Zowe component manifest file. You can find detailed definition of manifest in Server Component Manifest File Reference.

  For examples of manifests thoughout Zowe GitHub repositories, see the following links:

  - API Catalog manifest.yaml
  - Sample Node API and API Catalog extension manifest.yaml
  - Sample Zowe App Framework extension manifest.yaml

- `schema.json`

  An example filename of the json schema file specified by the manifest property `schemas.configs` as detailed in Server Component Manifest File Reference. The file details the parameters that are valid for the component's configuration within Zowe server configuration files. See documentation on server component schema files for more information.

- `apiml-static-registration.yaml.template`

  Refers to a supporting file that instructs the Zowe launch script how to register this extension service to the API Mediation Layer Discovery service. In this case, this file is referred in the `manifest.yaml`

`apimlServices.static[0].file` field. This file is optional depending on the function of the component. You can change and customize the file name in the manifest file.

- `bin/(configure|start|validate).sh`

  This file contains the Zowe component lifecycle scripts. You may not need these files depending on the function of the component. You can find detailed definition of lifecycle scripts in Zowe component runtime lifecycle.

It is also suggested that you put the following files into the package:

- `README.md`

  This file is a brief introduction to your extension in Markdown format, including how it should be installed, configured, verified, and so on.

- `LICENSE`

  This is the full license text file.

If you decide to bundle and ship Zowe extensions within another product, you can put the whole directory structure presented previously into your product package as subdirectories. Take the following structure as an example.

Packaging default YAML properties

If you package a YAML file that follows the Zowe YAML file schema, you can have users include them in their configuration list to reduce setup actions. The Zowe STC job "ZWESLSTC" contains instructions on how to add such files to the user's overall configuration list.

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Server component schemas

Each Component in Zowe must contain a json schema describing the configuration parameters that are valid for its component section in Zowe's server configuration. If a component does not have anything that can be configured, this file can just be boilerplate specifying that it fully inherits generic Component parameters and nothing more.

The server infrastructure will utilize each components' schema files to validate a Zowe instance configuration every startup, so this requirement is enforced by code.

Requirements

- Server component json schema files must follow the json schema spec 2019-09.
- Each component must state where its base schema file is located by the manifest parameter "schemas.configs"
- The schema file must use and/or extend the Zowe Component base schema by use of the "allOf" attribute.
- The schema must have an `$id` property which is a URI that has a domain related to the entity that developed the Component.
- The file should be tagged on z/OS but elsewhere must at least be encoded as ASCII-subset of UTF-8

Additional information

- The schema file can reference other schema files within the component if compartmentalization of definitions are desired

Example

Below is an example manifest and schema for a Component named "component1". The manifest file specifies the location of the schema file, and the schema file specifies the configuration parameters that are valid for this Component.

Example manifest

Example schema

Below is an example of the "schema.json" file referenced above. In it, we have 1 special property, "my-custom-prop", which is just a boolean that can be true or false.

Validation

Zowe server infrastructure will validate that a user's server configuration is correct by checking every schema file found in every component. If invalid, the servers will not start until the configuration is corrected. Developers may wish to confirm their schema and there are several tools available such as Microsoft Visual Studio Code for validating schema syntax is correct and jsonschemavalidator.net for testing a configuration against a schema.

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Component package registries

Component package registries are on-premisis or remote storage which contains Zowe components (usually, extensions) and allows Zowe administrators to download an extension and its dependent extensions from that storage. A component package registry makes Zowe component and extension management easier by reducing the need for manually uploading and installing an extension and its dependencies into Zowe.

Zowe server content can manage components and extensions via the `zwe components` commands. These commands have optional parameters for performing operations using a registry instead of only using content local to the Zowe host. Note: Using `zwe` with component package registries requires that `zowe.useConfigmgr=true` is set in your Zowe server configuration. See using the configuration manager for more info

Registries can be any technology that can be used to satisfy the Zowe component registry handler API. For example, npm, conda, artifactory, rpm and more could potentially be used as registries. Currently Zowe server installs ship with a registry "Handler" for using an NPM server as a Zowe component package registry. Support for alternatives can be added, please refer to the making your own handler section.

Registry examples

Consider the following examples where use of a registry is compared to managing extensions without a registry.

Installing an extension

A Zowe server extension can be installed with a local archive such as in `zwe components install -o my-zowe-extension-1.0.0.pax --config zowe.yaml`

This has two shortcomings:

- In order to run that command, the extension must first have been uploaded to the Zowe host.
- Does that extension work after installation, or does it have a dependency that must also be installed? It's not known without reading documentation.

Both issues can be resolved by using a registry, such as in `zwe components install -o my-zowe-extension --config zowe.yaml`

In this example, because `zwe` was not given the name of a file, it takes the parameter "my-zowe-extension" and searches for an extension package with that exact name within the component package registry configured for Zowe. If the package is found in the registry, that extension and all of its dependencies will be downloaded and then installed. **Note: This means you must trust the registry that you use. On-premisis registries are a great way to curate a list of trusted extensions and make it easy to install them. On the other hand, it would not be recommended to use a registry found on a public network, because you do not want to install extensions that you have not vetted.**

The above example omits the registry configuration information, so the values default to what is containted within the zowe.yaml If they were explicitly provided instead, the command may look like `zwe components install -o my-zowe-extension --config zowe.yaml --handler npm --registry https://my-on-prem-registry.company.com/npm`

Upgrading an extension

If a new version of an extension comes out, you can upgrade your extension from a local archive with `zwe components install -o my-zowe-extension-2.0.0.pax --config zowe.yaml`

This will replace the old extension with the new one. This has three shortcomings:

- You must somehow be alerted that there is a new version available.
- In order to run that command, the extension must first have been uploaded to the Zowe host.
- Does that extension work after installation, or does it have a dependency that must also be installed? It's not known without reading documentation.

If you use a registry, you can be alerted that a new version is available by running the command `zwe components upgrade -o all --config zowe.yaml --dry-run`

This command reports on **all** of the components that have upgrades available. The `--dry-run` parameter skips doing the actual upgrade, so you could upgrade every available extension at once by running this without `--dry-run` too.

Once learning that an upgrade is available, you can perform it with `zwe components upgrade -o my-zowe-extension --config zowe.yaml`

This command is similar to `install`, it will upgrade your extension and also any dependencies.

Uninstalling extensions

When running `zwe components uninstall -o my-zowe-extension`, the extension will be removed regardless of if you are using a registry or not. But if you are using a registry, the registry handler will also ensure any information it kept about the extension is cleaned up at that time.

Searching for extensions

`zwe components search` requires a registry to function, because it searches that registry to try to find an extension that includes whatever you searched for. You can search for any pattern, which may include fuzzy matches such as

`zwe components search -o database* --config zowe.yaml` This would return a list of extensions that can be installed that start with the word "database". Note that each registry and handler can have different search capabilities. Not all will support partial matches.

Configuring zwe to use a registry

Each `zwe components` command can take the parameter `--registry` to specify the location (such as HTTPS URL) of a registry, and the parameter `--handler` to specify which handler to use with that registry. `--handler` determines which registry type you are using, such as npm.

When these parameters are not specified, then the default values are found within the zowe YAML configuration. Within a zowe YAML configuration, the section `zowe.extensionRegistry` controls how `zwe` uses a registry. The schema for this section can be found in the zowe YAML schema

An example of configuring zwe for use with Zowe's own npm registry and npm handler would look like:

The above example states that the default registry type will be "npm", and that the npm type is handled by the handler located at the path `${{ zowe.runtimeDirectory }}/bin/commands/components/npm.js`. This handler will by default use the registry located at `https://zowe.jfrog.io/zowe/api/npm/npm-local-release/`.

Using multiple registries

It is anticipated that extensions from different companies will be located on different registries, so it is possible to use multiple registries with Zowe. Please note that registry types or handlers may not be able to resolve dependencies across different registries, so in this case extensions should only declare a dependency on other extensions that can be found within the same registry. To switch between registries for accessing extensions in different registries, you can just use the `--registry` option on a `zwe components` command. For example, instead of searching for "database" extensions within the default registry as in

```
zwe components search -o database* --config zowe.yaml
```

You may instead specify a registry,

```
zwe components search -o database* --config zowe.yaml --registry first-registry.foo
```

And if the extension you want isn't found there, you can try another registry,

```
zwe components search -o database* --config zowe.yaml --registry second-registry.foo
```

Then you'd be able to install the extension from that specific registry such as,

```
zwe components install -o database-product --config zowe.yaml --registry second-registry.foo
```

Note that Zowe does not currently track which registry an extension originated from, so when performing `zwe component upgrade`, you will need to specify the registry if the extension did not come from the default registry.

Setting up a registry

Although you can use a registry set up by an organization you trust, you can also set up your own registry. This can be very useful for curating a list of Zowe extensions that are approved for use in your organization. Many package managers, whether language-specific, z/OS native or otherwise, could be used to manage Zowe extension packages via whichever registry or repository technology they use. Therefore Zowe cannot give guidance on every possible registry, but below are some suggestions that may be useful to you.

npm

npm is the nodejs package manager. Typically npm registries store javascript code intended for use in a web browser or nodejs, but it's also possible to just store Zowe extensions instead. npm registries are webservers that have an API which associates uploaded packages to users which own them, and such user accounts may also determine what you are permitted to download. What webserver you use, and how user credentials are managed isn't standardized by npm, any webserver could be an npm server as long as it fulfills the npm API.

As an example, https://verdaccio.org/ is such a webserver that you can set up to create your own on-premisis npm package registry. You can find out more about verdaccio and how to set up a verdaccio-based npm registry on their website

Another example is jfrog artifactory. Artifactory can store packages to serve through an npm registry, a docker registry, and much more. You can find out more about artifactory and how to set up an artifactory-based npm registry on their website

Making your own handler

Handlers connect `zwe` with a component package registry. For each `zwe components` command, `zwe` will call one hanndler with a set of parameters and expect certain output from the handler in return before completing the `zwe` command processing.

Handlers are at minimum an EECMAScript2020-compatible JavaScript module file that implements the Handler API. This file is **not** nodejs, but rather is run within a quickjs environment. This file can in turn call other commands, but must return output for `zwe` to continue with.

This handler JavaScript file can be located at any unix path on the host where Zowe is, and the location is specified within the zowe YAML

When a `zwe components` command needs to use a handler, the handler is given input in the form of environment variables. If output is expected, the handler API requires each output attribute to be a key=value pair on a new line.

The following table details the input and output expected for each handler action.

Attribute	Type	Input or Output	Actions	Description
`ZWE_CLI_REGISTRY_COMMAND`	string	Input	All	Values of 'install', 'upgrade', 'uninstall', 'search' inform handler which action to take and what additional input & output to expect
`ZWE_CLI_PARAMETER_REGISTRY`	string	Input	Install, Upgrade, Uninstall, Search	Used to inform handler which registry to use. Can be any format the handler understands.
`ZWE_CLI_REGISTRY_DRY_RUN`	boolean	Input	Install, Upgrade, Uninstall	If true, handler should show as much as possible about what would happen during this command, without committing changes that would alter which components are installed.
`ZWE_CLI_PARAMETER_COMPONENT_NAME`	string	Input	Install, Upgrade, Uninstall, Search	Value varies by command. For 'install' and 'uninstall', this value is the exact name of a component. For upgrade, it may also be 'all' to perform an upgrade for all components possible. For 'search', it may be any string to perform

Attribute	Type	Input or Output	Actions	Description
				searching for exact or partial matching component names.
`ZWE_CLI_PARAMETER_COMPONENT_FILE`	string	Output	Install, Upgrade, Uninstall	A comma-separated list of components that have been added or removed. During 'install' or 'upgrade', the list must be full unix paths to component folders or archives that were added. For 'uninstall', the list must instead be just the names of the components that were removed. If the handler failed during its operation or there were no changes, the output should instead just be the string 'null'.

An example of running `zwe components install -o exact-component-name --handler npm --registry "https://zowe.jfrog.io/zowe/api/npm/npm-local-release/"` would have the handler being given the following environment variables:

And after the command completes, the handler can print anything in STDOUT and STDERR as long as STDOUT includes a line specifying the location of the components installed, via `ZWE_CLI_PARAMETER_COMPONENT_FILE`. The output could look like:

Where `archive.pax` is an archive of `exact-component-name`, while 'dependency1' is a folder containing the un-archived contents of `dependency1`.

Handler code

The Handler API interface is located within Zowe's code here

And Zowe delivers a handler written for use with npm, located here

Component Packaging Requirements

Zowe extensions can be written in a variety of languages and may have network-level dependencies. These attributes of extensions may seem like an odd fit for some existing package managers such as those that are language specific. However, all Zowe requires out of a package manager is that the manager can deliver an archive of a extension or folder containing an extension. The Zowe community has found that delivering a Zowe extension as an archive can avoid the complexities of some package managers and make it simple to deliver an extension via one or more package manager with minimal work. Below are some patterns that can work for certain package managers.

npm

The npm handler that is delivered by Zowe expects that each npm package either contains an archive of a Zowe extension or that the entire package folder is itself the Zowe extension. You should become familiar with the attributes of

a package.json file as some are referenced below.

The Zowe component registry handler determines which is true by reading the `package.json` of the npm package and looking for the `main` attribute. If `main` exists, its value must be a path to the archive of the extension, relative to the package root folder. For example, the `angular-sample` extension npm package has this folder structure:

The handler determines that `angular-sample.pax` is the archive of the extension when it sees the `main` property within the package.json below:

If `main` were not defined, then Zowe would instead expect that this folder was an extension, which for example would have a `manifest.yaml` at the root of the folder.

npm requires that each package contain a `package.json` file, and there are certain fields that are required within it. Several fields have overlap in meaning with Zowe's extension manifest files, so Zowe delivers a utility to help you automate the creation of a `package.json` file using a `manifest.yaml` file as input. This Zowe npm module will copy the properties from one file to the other for you

The simplest and most robust way to deliver a Zowe extension via npm is to build your extension, then archive the entire folder of the extension as a `.pax` file, and put that into a folder with a single `package.json` file for npm which has the `main` attribute set to the name of your pax archive, and use the `dependencies` section of the package.json to list if your extension depends on any other Zowe extensions. Once you have your npm package, you can upload it to the registry of your choice using standard npm commands, such as:

Additional resources

While this document is the authoritative source on Zowe's component package regpistry technology, older additional information may be found in the presentation and the recording used during the initial technology prototype.

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Zowe server component runtime lifecycle

Zowe runtime lifecycle

This topic describes the runtime lifecycle of Zowe core components and how an offering that provides a Zowe extension can set up runtime lifecycle for their component.

The Zowe UNIX System Services (USS) components are run as part of the started task `ZWESLSTC`. There are two key USS directories that play different roles when launching Zowe.

- The Zowe runtime directory `<RUNTIME_DIR>` that contains the executable files is an immutable set of directories and files that are replaced each time a new release is applied. The initial release or an upgrade is installed either with UNIX shell scripts (see Installing Zowe runtime from a convenience build), or SMP/E where the runtime directory is laid down initially as FMID AZWE002 and then upgraded through rollup PTF builds (see Installing Zowe SMP/E). The Zowe runtime directory is not altered during operation of Zowe, so no data is written to it and no customization is performed on its contents. **Important**, any customizations to the original Zowe runtime directory are not recommended. This may include installing extensions to this directory, putting your `zowe.yaml` or Zowe workspace into this directory, or changing any of the files in it, etc.

- The Zowe workspace directory `<WORKSPACE_DIR>` contains information that is specific to a launch of Zowe. It contains temporary configuration settings that helps an instance of the Zowe server to be started, such as ports that are used or paths to dependent Java and Node.js runtimes. Zowe runtime user should have write permission to this directory. More than one Zowe workspace directories can be created to allow multiple launches of a Zowe runtime, each one isolated from each other and starting Zowe depending on how Zowe YAML configuration is configured.

- The Zowe logs directory `<LOGS_DIR>` contains USS file logs when running Zowe. Some components like app-server and zss will always write USS log files. Some components like APIML Gateway will write log files to this directory if you enabled debug mode. Zowe runtime user should have write permission to this directory.

To start Zowe, the command `zwe start` is run from a USS shell. This uses a program `ZWELNCH` to launch the started task `ZWESLSTC`, passing an optional `HAINST` parameter to define which Zowe HA instance will be started. It is the equivalent of using the TSO command `/S ZWESLSTC,HAINST='<HA_INSTANCE>',JOBNAME='<JOBNAME>'`. The `ZWELNCH` program understands your Zowe YAML configuration and will start components enabled in the `<HA_INSTANCE>` by executing `zwe internal start component` command. If you execute `zwe internal start` directly, the USS processes will not run as a started task and will run under the user ID of whoever ran the `zwe internal start` command rather than the Zowe user ID of `ZWESVUSR`, likely leading to permission errors accessing the contents of the `<RUNTIME_DIR>` as well as the Zowe certificate. For these reasons, the `zwe start` script launches Zowe's USS process beneath the started task `ZWESLSTC`.

Zowe relies on `zowe.yaml` configuration file to know your customization for the instance. For more information, see Zowe YAML Configuration File Reference.

Note:

The scripts of core Zowe components and some extensions use the helper library `<RUNTIME_DIR>/bin/libs`. You can also use those functions but please keep away from functions marked as `internal` or `experimental`.

Zowe component runtime lifecycle

Each Zowe component will be installed with its own USS directory, which contains its executable files. Within each component's USS directory, a manifest file is required to describe itself and a `bin` directory is recommended to contain scripts that are used for the lifecycle of the component. When Zowe is started, by reading components manifest `commands` definition, it identifies the components that are configured to launch and then execute the scripts of those components in the cycle of validate, configure, and start. All components are validated, then all are configured, and finally all are started. This technique is used as follows:

- Used for the base Zowe components that are included with the core Zowe runtime.
- Applies to extensions to allow vendor offerings to be able to have the lifecycle of their 'microservices' within the Zowe USS shell and be included as address spaces under the `ZWESLSTC` started task.

Note:

All lifecycle scripts are executed from the root directory of the component. This directory is usually where the component manifest is located.

Check Server Component Manifest File Reference to learn how to define lifecycle `commands` in component manifest file.

Validate

Each component can optionally instruct Zowe runtime to validate itself with a USS command defined in manifest `commands.validate`.

If present, the `validate` script performs tasks such as:

- Check that the shell has the correct prerequisites.
- Validate that ports are available.
- Perform other steps to ensure that the component is able to be launched successfully.

During execution of the `validate` script, if an error is detected, then a component should echo a message that contains information to assist a user diagnosing the problem.

Configure

Each component can optionally instruct Zowe runtime to configure itself with a USS command defined in manifest `commands.configure`.

If the component has manifest defined, some configure actions will be performed automatically based on manifest definition:

- `apimlServices.static`: Zowe runtime will automatically parse and add your static definition to API Mediation Layer.
- `appfwPlugins.[].path`: Zowe runtime will automatically parse and install/configure the component to Zowe App Framework.

It's possible to export configuration variables from the `configure` step to the `start` step. Each component runs in separated shell space, which means that the variable of one component does not affect the same variable of another component. For example, when you run `export MY_VAR=val` in `/bin/configure.sh`, then the variable `${MY_VAR}` will be available in your `/bin/start.sh` script. However, `${MY_VAR}` will not be available in other components.

Start

Each component can optionally instruct Zowe runtime to start itself with a USS command defined in manifest `commands.start`. If this is not defined, for backward compatible purpose, a call to its `/bin/start.sh` script will be executed if it exists. If your component is not supposed to be started by itself, for example, the component is a shared library, you can skip this instruction.

It is up to each component to start itself based on how it has been written. We recommend that any variables that someone who configure Zowe may need to vary, such as timeout values, port numbers, or similar, are specified as variables in the `instance.env` file and then referenced as shell variables in the `start.sh` script to be passed into the component runtime.

Version: v3.2.x LTS

Creating and adding Zowe extension containers

Zowe extensions can be used within a Zowe container environment. To do this, you must deliver the extension as a container image that is compatible with Zowe containers. Zowe server extensions such as services or app framework plugins must be packaged as components to work in the container environment. You can follow Zowe's container conformance criteria to understand and achieve compatibility.

Note: Container code may depend on z/OS code, and it is recommended that components state these dependencies in their manifest. Users should verify these dependencies to ensure a correctly configured Zowe container environment.

You can add extension containers to a Zowe container environment the same way as Zowe's core components by completing the following steps.

1. Build and publish an extension image to a registry. For details, see Build and publish an extension image to a registry.
2. Define a deployment or job object. For details, see Define Deployment or Job object.
3. Start the extension from the deployment or job definition. For details, see Start your component.

1. Build and publish an extension image to a registry

An extension must have a container image to run in a Zowe container environment. To create such images, you can use a Dockerfile and refer to the following examples of building images for Zowe core components.

Examples:

The core components define component Dockerfiles and use GitHub Actions to build images. For example,

- `explorer-jes` is a Zowe App Server Framework plug-in but does not have a built-in web service. It follows Zowe's container conformance criteria. It defines a Dockerfile at https://github.com/zowe/explorer-jes/blob/v2.x/master/container/Dockerfile. It also defines a GitHub Actions workflow at https://github.com/zowe/explorer-jes/blob/v2.x/master/.github/workflows/build_test.yml to build the images.

The following GitHub Actions are used by the core components to build conformant images. They might not be completely reusable for you, but are provided as an example.

- zowe-actions/shared-actions/docker-prepare will prepare required environment variables used by following steps.
- zowe-actions/shared-actions/docker-build-local can build the Docker image directory on the GitHub Actions virtual machine. By default, the Docker image directory is `ubuntu-latest`. You can use this action to build images for `amd64` CPU architecture.
- zowe-actions/shared-actions/docker-build-zlinux can build Docker image on a `Linux on Z` virtual machine. This is useful if you want to build images for `s390x` CPU architecture.
- zowe-actions/shared-actions/docker-manifest can collect all related images and define them as Docker manifests. This is useful for users to automatically pull the correct image based on cluster node CPU architecture, and also pull images based on popular tags such as `latest` and `latest-ubuntu`.

After a component image is built, it is recommended that you publish it to a container registry before adding it to the Zowe container environment. Alternatively, you can use `docker save` and `docker load` commands to copy the offline

images to your Kubernetes nodes.

2. Define `Deployment` or `Job` object

To start your component in Kubernetes, you must define a Deployment if your extension has built-in web services, or a Job object if your extension is a Zowe Application Framework plug-in without built-in web services.

To define `Deployment` for your component, you can copy from `samples/sample-deployment.yaml` and modify all occurrences of the following variables:

- `<my-component-name>`: this is your component name. For example, `sample-node-api`.
- `<my-component-image>`: this is your component image described in Build and publish an extension image to a registry. For example, `zowe-docker-release.jfrog.io/ompzowe/sample-node-api:latest-ubuntu`.
- `<my-component-port>`: this is the port of your service. For example, `8080`.

Continue to customize the specification to fit in your component requirements:

- `spec.template.spec.containers[0].resources`: defines the memory and CPU resource required to start the container.
- `metadata.annotations`, `spec.template.spec.volumes` and `spec.template.spec.securityContext` and so on.

To define `Job` for your component, you can also copy from `samples/sample-deployment.yaml`. Then, modify all entries mentioned above and make the following changes:

- Change `kind: Deployment` to `kind: Job`,
- Add `restartPolicy: OnFailure` under `spec.template.spec` like this:

3. Start your component

After you define your component `Deployment` or `Job` object, you can run `kubectl apply -f /path/to/your/component.yaml` to apply it to the Kubernetes cluster that runs Zowe.

- If it's a `Deployment`, you should be able to see that the component pod is started and eventually reached the `Running` status.
- If it's a `Job`, you should be able to see that the plug-in pod is started and eventually reached the `Completed` status.

Now you can follow common Kubernetes practice to manage your component workload.

Version: v3.2.x LTS

Zowe Containerization Conformance Criteria

These conformance criteria are applicable for all Zowe components intending to run in a containerized environment. The containerized environment could be Kubernetes or OpenShift running on Linux or Linux on Z.

Image

In general, the image should follow Best practices for writing Dockerfiles. The below requirements are in addition to the list.

Base Image

You are free to choose a base image based on your requirements.

Here are our recommendations of base images:

- Zowe base images:
  - `ompzowe/base`: `zowe-docker-release.jfrog.io/ompzowe/base:latest-ubuntu` and `zowe-docker-release.jfrog.io/ompzowe/base:latest-ubi`.
  - `ompzowe/base-node`: `zowe-docker-release.jfrog.io/ompzowe/base-node:latest-ubuntu` and `zowe-docker-release.jfrog.io/ompzowe/base-node:latest-ubi` has node.js LTS (v14) version pre-installed.
  - `ompzowe/base-jdk`: `zowe-docker-release.jfrog.io/ompzowe/base-jdk:latest-ubuntu` and `zowe-docker-release.jfrog.io/ompzowe/base-jdk:latest-ubi` has JRE v8 pre-installed.
- Red Hat Universal Base Image 8 Minimal
- Ubuntu

The image should contain as few software packages as possible for security and should be as small as possible such as by reducing package count and layers.

Zowe base images,

- are based on both Ubuntu and Red Hat Universal Base Image,
- provide common dependencies including JDK and/or node.js,
- support both `amd64` and `s390x` CPU architecture.

If you use your own base image other than Zowe base images, please check this list and make sure it is compatible with Zowe runtime:

- The default shell `/bin/sh` must be `bash`. If it's not, you can fix it by installing and overwriting `/bin/sh` with the symbolic link of `/bin/bash`.
- These softwares must exist in the image: `date`, `awk`, `sed`, `xargs`.
- These softwares are optional but good to have: `ping`, `dig`, `netstat`.

Multi-CPU Architecture

- Zowe core components must release images based on both `amd64` and `s390x` CPU architecture.

- Zowe core component images must use multiple manifests to define if the image supports multiple CPU architectures.

Image Label

These descriptive labels are required in the Dockerfile: `name`, `maintainer`, `vendor`, `version`, `release`, `summary`, and `description`.

Example line:

Tag

Zowe core component image tags must be a combination of the following information in this format: `<version>-<linux-distro>[-<cpu-arch>][-sources][.<customize-build>]`.

- **version**: must follow semantic versioning or partial semantic versioning with major or major + minor. It may also be `latest` or `lts`. For example, `1`, `1.23`, `1.23.0`, `lts`, `latest`, etc.
- **linux-distro**: for example, `ubi`, `ubuntu`, etc.
- **cpu-arch**: for example, `amd64`, `s390x`, etc.
- **customize-build**: string sanitized by converting non-letters and non-digits to dashes. For example, `pr-1234`, `users-john-fix123`, etc.
- **Source Build**: must be a string `-sources` appended to the end of the tag.
  - If this is a source build, the tag must contain full version number (major+minor+patch) information.
  - Linux Distro information is recommended.
  - Must NOT contain customize build information.
  - For example: `1.23.0-ubi-sources`.

For example, these are valid image tags:

- latest
- latest-ubuntu
- latest-ubuntu-sources
- latest-ubi
- latest-ubi-sources
- lts
- lts-ubuntu
- lts-ubi
- 1
- 1-ubuntu
- 1-ubi
- 1.23
- 1.23-ubuntu
- 1.23-ubi
- 1.23.0
- 1.23.0-ubuntu
- 1.23.0-ubuntu-amd64

- 1.23.0-ubuntu-sources
- 1.23.0-ubi
- 1.23.0-ubi-s390x
- 1.23.0-ubi-sources
- 1.23.0-ubuntu.pr-1234
- 1.23.0-ubi.users-john-test1

The same image tag pattern is recommended for Zowe extensions.

Files and Directories

These file(s) and folder(s) are **REQUIRED** for all Zowe components:

- `/licenses` folder holds all license-related files. It MUST include at least the license information for current application. It's recommended to include a license notice file for all pedigree dependencies. All licenses files must be in UTF-8 encoding.
- `/component/README.md` provides information about the application for end-user.
- `/component/manifest.(yaml|yml|json)` provides basic information of the component. The format of this file is defined at Zowe component manifest. Components must use the same manifest file as when it's running on z/OS.

These file(s) and folder(s) are *recommended*:

- `/component/bin/<lifecycle-scripts>` must remain the same as what it is when running on z/OS.

User `zowe`

In the Dockerfile, a `zowe` user and group must be created. The `zowe` user `UID` and group `GID` must be defined as `ARG` and with default values of `UID=20000` and `GID=20000`. Example commands:

`USER zowe` must be specified before the first `CMD` or `ENTRYPOINT`.

If you use Zowe base images, `zowe` user and group are already created.

Multi-Stage Build

A multi-stage build is recommended to keep images small and concise. Learn more from Use multi-stage builds.

Runtime

This section is mainly for information. No actions are required for components except where it's specified explicitly.

The below sections are mainly targeting Kubernetes or OpenShift environments. Starting Zowe containers in a Docker environment with `docker-compose` is in a planning stage and may change some of the requirements.

General rules

Components MUST:

- NOT be started as root user in the container.

- listen to only ONE port in the container except for API Mediation Layer Gateway.
- be cloud-vendor neutral and must NOT rely on features provided by a specific cloud vendor.
- NOT rely on host information such as `hostIP`, `hostPort`, `hostPath`, `hostNetwork`, `hostPID` and `hostIPC`.
- accept `zowe.yaml` as a configuration file, the same as when running on z/OS.

Persistent Volume(s)

- This persistent volume MUST be created:
  - `zowe-workspace` mounted to `/home/zowe/instance/workspace`.

Files and Directories

In the runtime, the Zowe content is organized in this structure:

- `/home/zowe/runtime` is a shared volume initialized by the `zowe-launch-scripts` container.
- `/home/zowe/runtime/components/<component-id>` is a symbolic link to the `/component` directory. `<component-id>` is the `name` entry defined in `/component/manifest.(yaml|yml|json)`.
- `/home/zowe/instance/zowe.yaml` is a Zowe configuration file and MUST be mounted from a ConfigMap.
- `/home/zowe/instance/logs` is the logs directory of Zowe instance. This folder will be created automatically by `zowe-launch-scripts` container.
- `/home/zowe/instance/workspace` is the persistent volume mounted to every Zowe component container.
  - Components writing to this directory should be aware of the potential conflicts of same-time writing by multiple instances of the same component.
  - Components writing to this directory must NOT write container-specific information to this directory as it may potentially be overwritten by another container.
- `/home/zowe/keystore` is the directory where certificate is mounted. With a typical setup (by using `zwe migrate for kubernetes` command), this folder contains `keystore.p12`, `truststore.p12`, `keystore.key`, `keystore.cer` and `ca.cer`.
- Any confidential environment variables, for example, a Redis password, in `zowe.yaml` must be extracted and stored as Secrets. These configurations must be imported back as environment variables.

ConfigMap and Secrets

- `zowe.yaml` must be stored in a ConfigMap and be mounted under `/home/zowe/instance` directory.
- All certificates must be stored in Secrets. Those files will be mounted under the `/home/zowe/keystore` directory.
- Secrets must be defined manually by a system administrator. Zowe Helm Chart and Zowe Operator do NOT define the content of Secrets.

`ompzowe/zowe-launch-scripts` Image and initContainers

- The `zowe-docker-release.jfrog.io/ompzowe/zowe-launch-scripts:latest-ubuntu` or `zowe-docker-release.jfrog.io/ompzowe/zowe-launch-scripts:latest-ubi` image contains necessary scripts to start Zowe components in Zowe context.
- This image has a `/component` directory and it will be used to prepare `/home/zowe/runtime` and `/home/zowe/instance` volumes to help Zowe component start.
- In Kubernetes and OpenShift environments this step is defined with `initContainers` specification.

Command Override

- Component `CMD` and `ENTRYPOINT` directives will be overwritten with the Zowe launch script used to start it in Zowe context.
- Components running in Zowe context requires to be started with `bash` with argument `/home/zowe/runtime/bin/internal/run-zowe.sh -c /home/zowe/instance`. Here is example start command:

Environment Variables

These runtime environment variable(s) are **REQUIRED** to start Zowe components.

- `ZWE_POD_NAMESPACE`: holds the current Kubernetes namespace. This variable can be *optional* if the service account `automountServiceAccountToken` attribute is `true`. The value of this variable can be assigned to `metadata.namespace` (which default value is `zowe`) in `Pod` `spec` section:

These runtime environment variable(s) are **OPTIONAL** to start Zowe components.

- `ZWE_POD_CLUSTERNAME`: holds the Kubernetes cluster name. This variable has default value `cluster.local`. If your cluster name is not default value, you should pass the variable to all workloads. The value of this variable can be assigned in `Pod` `spec` section:

CI/CD

Build, Test and Release

- Zowe core component and extension images MUST be built, tested, and released on their own cadence.
- The component CI/CD pipeline MUST NOT rely on the Zowe level CI/CD pipeline and Zowe release schedule.
- Zowe core component images must be tested. This includes starting the component and verifying the runtime container works as expected.
- It is recommended to build snapshot images before release. Zowe core components MUST publish snapshot images to the `zowe-docker-snapshot.jfrog.io` registry with proper tags.
- Zowe core component images MUST be released before Zowe is released.
- Zowe core components MUST publish release images to both `zowe-docker-release.jfrog.io` and Docker Hub registry under `ompzowe/` prefix.
- Release images MUST also update relevant major/minor version tags and the `latest` tag. For example, when a component releases a `1.2.3` image, the component CI/CD pipeline MUST also tag the image as `1.2`, `1`, and `latest`. Update the `lts` tag when it is applicable.
- Zowe core component release images MUST be signed by Zowe committer(s).

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Onboarding Overview

As an API developer, you can onboard a REST API service to Zowe™ API Mediation Layer (API ML). Onboarding your REST service to Zowe™ API Mediation Layer makes your service discoverable by the API ML Discovery Service, enables routing through the API Gateway, and makes service information and API documentation available through the API Catalog.

The specific method you use to onboard a REST API to Zowe API ML depends on the programming language or framework used to build your REST service.

> **NOTE**
>
> To streamline the process of onboarding new REST API services to the Zowe API ML, see Onboarding a REST API service with the YAML Wizard

This Onboarding Overview article addresses the following topics:

- Prerequisites
- Service Onboarding Guides to onboard your REST service with API ML
- Verify successful onboarding to API ML
- Using the Sample REST API Service to learn how to onboard a REST service to API ML

Prerequisites

Ensure that you meet the following prerequisites before you onboard your service:

- A running instance of Zowe

  Note: For static onboarding, access to Zowe runtime is required to create the static service definition.

- A certificate that is trusted by Zowe and certificate(s) to trust Zowe services

  Zowe uses secured communication over TLSv1.2. As such, the protocol version and the certificate is required. For more information, see Certificate management in API Mediation Layer and Zowe API ML TLS requirements

- A REST API-enabled service that you want to onboard

  If you do not have a specific REST API service, you can use the sample service.

  Your service should be documented in a valid `OpenApi 2.0/3.0` Swagger JSON format.

- Access to the Zowe artifactory

- Either the *Gradle* or *Maven* build automation system

Service Onboarding Guides

Services can be updated to support API Mediation Layer natively by updating the service code. Use one of the following guides to onboard your REST service to Zowe API Mediation Layer:

Recommended guides for services using Java

- Onboard an API service with the Plain Java Enabler (PJE)
- Onboard a Spring Boot based REST API Service
- Onboard a Micronaut based REST API service

Recommended guides for services using Node.js

- Onboard a Node.js based REST API Service

Recommended guides for services using Python

- Onboard a Python based REST API Service

Guides for Static Onboarding and Direct Call Onboarding

Use one of the following guides if your service is not built with Java, or you do not want to change your codebase or use the previously mentioned libraries:

- Onboard a REST API using static definition without code changes
- Onboard a REST API directly calling Zowe Discovery Service

Documentation for legacy enablers

Enabler version 1.2 and previous versions are no longer supported.

> **TIP**
>
> We recommend you use the enabler version 1.3 or higher to onboard your REST API service to Zowe API Medaition Layer.

Verify successful onboarding to API ML

Verifying that your service was successfully onboraded to API ML can be done by ensuring service registration in the API ML Discovery Service or visibility of the service in the API ML Catalog.

Verifying service discovery through Discovery Service

Verify that your service is discovered by the Discovery Service with the following procedure.

1. Issue a HTTP GET request to the Discovery Service endpoint `/eureka/apps` to get service instance information:

   Note: The endpoint is protected by client certificate verification. A valid trusted certificate must be provided with the HTTP GET request.

2. Check your service metadata.

   Response example:

> **TIPS:**
>
> - Ensure that addresses and user credentials for individual API ML components correspond to your target runtime environment.
> - If you work with local installation of API ML and you use our dummy identity provider, enter `user` for both `username` and `password`. If API ML was installed by system administrators, ask them to provide you with actual addresses of API ML components and the respective user credentials.

Verifying service discovery through the API Catalog

Services may not be immediately visible in the API Catalog. We recommend you wait for 2 minutes as it may take a moment for your service to be visible in the Catalog. If your service still does not appear in the Catalog, ensure that your configuration settings are correct.

1. Check to see that your API service is displayed in the API Catalog UI, and that all information including API documentation is correct.

2. Ensure that you can access your API service endpoints through the Gateway.

Sample REST API Service

To demonstrate the concepts that apply to REST API services, we use an example of a Spring Boot REST API service. This example is used in the REST API onboarding guide REST APIs without code changes required (static onboarding).

You can build this service using instructions in the source code of the Spring Boot REST API service example.

The Sample REST API Service has a base URL. When you start this service on your computer, the *service base URL* is: `http://localhost:8080`.

> **NOTE**
>
> If a service is deployed to a web application server, the base URL of the service (application) has the following format: `https://application-server-hostname:port/application-name`.

This sample service provides one API that has the base path `/v2`, which is represented in the base URL of the API as `http://localhost:8080/v2`. In this base URL, `/v2` is a qualifier of the base path that was chosen by the developer of this API. Each API has a base path depending on the particular implementation of the service.

This sample API has only one single endpoint:

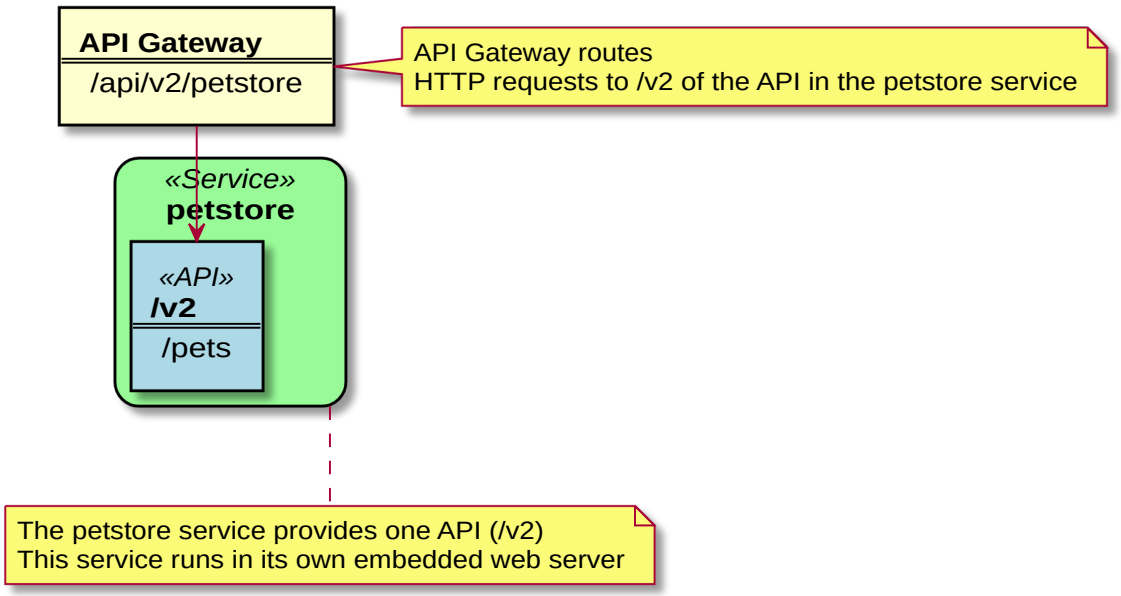
- `/pets/{id}` - *Find pet by ID*.

This endpoint in the sample service returns information about a pet when the `{id}` is between 0 and 10. If `{id}` is greater than 0 or a non-integer, an error is returned. These are conditions set in the sample service.

> **TIP**
>
> Access `localhost:8080/v2/pets/1` to see what this REST API endpoint does. You should get the following response:

> **NOTE**
>
> The onboarding guides demonstrate how to add the Sample REST API Service to Zowe API Mediation Layer to make the service available through the `petstore` service ID.

The following diagram shows the relations between the Sample REST API Service and its corresponding API, REST API endpoint, and API Gateway:



This sample service provides a Swagger document in JSON format at the following URL:

The Swagger document is used by the API Catalog to display API documentation.

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Managing certificates in Zowe API Mediation Layer

Review details of certificate management in Zowe API Mediation Layer (API ML). This article decribes both how to manage certificates when running on localhost, as well as certificate management using Zowe runtime on z/OS. Additional information is provided about the API ML truststore and keystore, and API ML SAF keyring.

- Managing certificates in Zowe API Mediation Layer
  - Running on localhost
    - How to start API ML on localhost with full HTTPS
    - Certificate management guide
    - Generate a certificate for a new service on localhost
    - Add a service with an existing certificate to API ML on localhost
    - Service registration to Discovery Service on localhost
  - Zowe runtime on z/OS
    - Import the local CA certificate to your browser
    - Generate a keystore and truststore for a new service on z/OS
    - Add a service with an existing certificate to API ML on z/OS
      - Procedure if the service is not trusted
  - Truststore and keystore or SAF keyring
    - API ML truststore and keystore
    - API ML SAF Keyring

Running on localhost

How to start API ML on localhost with full HTTPS

The api-layer repository contains pre-generated certificates that can be used to start API ML with HTTPS on your computer. The certificates are not trusted by your browser so you can either ignore the security warning, or generate your own certificates and add them to the truststore of your browser or system.

For more information about certificates, see TLS Certificates for localhost.

> **NOTE**
>
> When running on localhost, only the combination of using a keystore and truststore is supported.

Certificate management guide

Zowe API Mediation Layer provides a guide that can be used to generate a keystore and truststore using the Zowe local certificate authority on Windows, Mac, Linux, and z/OS.

This guide is maintained in the `zowe/api-layer` repository keystore/README.md, and uses a combination of openssl and java keytool.

Generate a certificate for a new service on localhost

To generate a certificate for a new service on localhost, see Generating certificate for a new service on localhost.

Add a service with an existing certificate to API ML on localhost

For information about adding a service with an existing certificate to API ML on localhost, see Trust certificates of other services.

Service registration to Discovery Service on localhost

To register a new service to the Discovery Service using HTTPS, provide a valid client certificate that is trusted by the Discovery Service.

Zowe runtime on z/OS

Certificates for the API ML local CA and API ML service are managed by installing the Zowe runtime on z/OS. For more information see Installing the Zowe runtime on z/OS.

There are two ways to set up certificates on a z/OS machine:

- Certificates in UNIX files (truststore and keystore)
- Certificates in SAF keyring

For detailed instructions about how to set up certificates during installation, see the following articles:

- Use PKCS12 certificates
- Use JCERACFS certificates in a keyring

Follow the procedure in the applicable section in this article during installation.

Import the local CA certificate to your browser

Trust in the API ML server is a necessary precondition for secure communication between a browser or API Client application. Ensure this trust through the installation of a Certificate Authority (CA) public certificate. By default, API ML creates a local CA. Import the CA public certificate to the truststore for REST API clients and to your browser. You can also import the certificate to your root certificate store.

> **NOTES**
>
> - If a SAF keyring is being used and set up with `ZWEKRING` JCL, the procedure to obtain the certificate does not apply. It is recommended that you work with your security system administrator to obtain the certificate. Start the procedure at step 2.
> - The public certificate in the PEM format is stored at `<KEYSTORE_DIRECTORY>/local_ca/localca.cer`, where `<KEYSTORE_DIRECTORY>` is defined in a customized `zowe.yaml` file during the installation step that generates Zowe certificates. The certificate is stored in UTF-8 encoding so you need to transfer it as a binary file. Since this is the certificate to be trusted by your browser, it is recommended to use a secure connection for transfer.

> - Windows currently does not recognize the PEM format. For Windows, use the P12 version of the `local_cer`.

Follow these steps:

1. Download the local CA certificate to your computer. Use one of the following methods to download the local CA certificate to your computer:

   - **Use Zowe CLI (Recommended)**
     Issue the following command:

   - **Use `sftp`**
     Issue the following command:

   To verify that the file has been transferred correctly, open the file. The following heading and closing should appear:

2. Import the certificate to your root certificate store and trust it.

   - **For Windows**, run the following command:

     Note: Ensure that you open the terminal as **administrator**. This will install the certificate to the Trusted Root Certification Authorities.

   - **For macOS**, run the following command:

   - **For Firefox**, manually import your root certificate via the Firefox settings, or force Firefox to use the Windows truststore.

     Note: Firefox uses its own certificate truststore.

     Create a new Javascript file firefox-windows-truststore.js at `C:\Program Files (x86)\Mozilla Firefox\defaults\pref` with the following content:

Generate a keystore and truststore for a new service on z/OS

You can generate a keystore and truststore for a new service using the local CA in the keystore directory.

> **NOTE**
>
> This procedure applies to a UNIX file keystore and truststore only. For the SAF keyring option, it is recommended that you perform the actions manually using your security system commands.

Use the `zwe` command available in the zowe distribution package and execute following example.

Example:

- **cert-alias**
  Specifies a unique string to identify the key entry. All keystore entries (key and trusted certificate entries) are accessed via unique aliases. Since the keystore has only one certificate, you can omit this parameter and use the default value `localhost`.

- **service-keystore-directory**
  Specifies the repository of security certificates plus the corresponding private keys. The `<keystore_path>` is the path

excluding the extension to the keystore that is generated. It can be an absolute path or a path relative to the current working directory. The key store is generated in PKCS12 format with the `.p12` extension. Ensure that the path is in an existing directory where your service expects the keystore.

Example: `/opt/myservice/keystore/`.

- **service-name**
  Specifies the name of the service for which you want to generate keystore. A keystore will be created in the directory with the same name. **Example:** `my-new-service`.

- **keystore-password**
  Specifies the keystore password.

- **ca-keystore-password**
  Specifies the local certificate authority keystore password.

- **ca-alias**
  Specifies the local certificate authority alias in the keystore. Zowe CA is stored under the `local_ca` alias.

Add a service with an existing certificate to API ML on z/OS

API Mediation Layer requires validation of the certificate of each service accessed by API Mediation Layer. API Mediation Layer requires validation of the full certificate chain.

> **NOTE**
>
> This procedure applies only to UNIX file keystore/truststore. For the SAF keyring option, we recommend you perform the actions manually using your security system commands.

Import the public certificate of the CA that has signed the certificate of the service to the API ML truststore.

> **NOTE**
>
> Validation fails if a service does not provide intermediate CA certificates to the API ML. This can be circumvented by importing the intermediate CA certificates to the API ML truststore.

Procedure if the service is not trusted

If your service is not trusted, you may receive a response with the HTTP status code 502 Bad Gateway and a JSON response in the standardized format for error messages. The following request is an example of when this error response may occur.

Example:

In this example, you receive a similar response:

The message has the key `apiml.common.tlsError`, and message number `AML0105`. The content explains details about the message.

If you receive this message, import the certificate of your service or the CA that signed it to the truststore of the API Mediation Layer as described previously.

Truststore and keystore or SAF keyring

There are two options for how certificates are stored when running Zowe on z/OS:

- API ML truststore and keystore
- API ML SAF keyring

API ML truststore and keystore

A *keystore* is a repository of security certificates consisting of either authorization certificates or public key certificates with corresponding private keys (PK), used in TLS encryption. A *keystore* can be stored in Java specific format (JKS) or use the standard format (PKCS12). The Zowe API ML uses PKCS12 to enable the keystores to be used by other technologies in Zowe (Node.js).

API ML SAF Keyring

As an alternative to using a keystore and truststore, API ML can read certificates from a *SAF keyring*. The user running the API ML must have rights to access the keyring. From the java perspective, the keyring behaves as the `JCERACFKS` keystore. The path to the keyring is specified as `safkeyring://user_id/key_ring_id`. The content of the SAF keyring is equivalent to the combined contents of the keystore and the truststore.

> **NOTE**
>
> When using JCERACFKS as the keystore type, ensure that you have IRRRacf.jar in following location:

Review the characteristics of following elements of the API ML SAF keyring:

The API ML local certificate authority (CA)

- The API ML local CA contains a local CA certificate and a private key that needs to be securely stored.
- The API ML local certificate authority is used to sign certificates of services.
- The API ML local CA certificate is trusted by API services and clients.

The API ML keystore or API ML SAF Keyring

- The server certificate of the Gateway (with PK)can be signed by the local CA or an external CA.
- The server certificate of the Discovery Service (with PK) can be signed by the local CA.
- The server certificate of the Catalog (with PK) can be signed by the local CA.
- The API ML keystore is used by API ML services.

The API ML truststore or API ML SAF Keyring

- Local CA public certificate
- External CA public certificate (optional)
- Can contain self-signed certificates of API Services that are not signed by the local or external CA
- Used by API ML services

Zowe core services

- Services can use the same keystore and truststore or the same keyring as API ML for simpler installation and management.
- When using a keystore and truststore, services have to have rights to access and read them on the filesystem.
- When using a keyring, the user of the service must have authorization to read the keyring from the security system.
- Alternatively, services can have individual stores for higher security.

API service keystore or SAF keyring (for each service)

- The API service keystore contains a server and client certificate signed by the local CA.

API service truststore or SAF keyring (for each service)

- (Optional) The API service truststore contains a local CA and external CA certificates.

Client certificates

- A client certificate is a certificate that is used for validation of the HTTPS client. The client certificate of a Discovery Service client can be the same certificate as the server certificate of the services which the Discovery Service client uses.

Version: v3.2.x LTS

Quick Start for Development

To validate that a service is working properly with the API Mediation Layer, you first need to have a running instance of API Mediation Layer. Choose from the following options:

- Install Zowe and validate against a Zowe instance of API Mediation Layer
  - For this setup you can either run Zowe without certificates, or preferably with certificates generated by installation in the keystore.
- Run API Mediation Layer in Codespace or on a local machine directly.
  - The details are available in API Mediation Layer repository
- Run API Mediation Layer in containers.
  - The details are available in Docker for API Mediation Layer
- Run API Mediation Layer as Java services on z/OS.
  - This part is not documented but is possible. You would need to build the services first, then upload them to the mainframe

To learn more about the certificate setup options for API Mediation Layer with respect to the Development purposes consult Certificate Management in Zowe API Mediation Layer.

Version: v3.2.x LTS

Deploying API Mediation Layer locally

General information

For development purposes, it is possible to deploy API ML locally. For more information, follow the instruction in the file Run API Mediation Layer locally.

Dummy Authentication Provider

The `Dummy Authentication Provider` implements simple authentication for development purposes using dummy credentials (username: `user`, password `user`). The `Dummy Authentication Provider` makes it possible for the API Gateway to run without authenticating with the z/OSMF service.

Use the following property of the API Gateway to enable the `Dummy Authentication Provider`:

Version: v3.2.x LTS

Libraries for onboarding APIs to Zowe API ML

APIs can be onboarded to Zowe API Mediaiton Layer with any of the following enablers:

- Onboarding an API service with the Plain Java Enabler (PJE)
  Applies to either REST APIs or GraphQL APIs
- Onboarding a Spring Boot based REST API Service
- Onboarding a Micronaut based REST API service
- Onboarding a Node.js based REST API service
- Onboarding a Python based REST API service
- Onboarding a REST or GraphQL API without code changes required

Version: v3.2.x LTS

Onboarding an API service with the Plain Java Enabler (PJE)

This article is part of a series of onboarding guides, which outline the process of onboarding API services to the Zowe API Mediation Layer (API ML).

ROLE: API SERVICE DEVELOPER

REST or GraphQL API services can be onboarded to the API ML using the Plain Java Enabler (PJE). This enabler is built without a dependency on Spring Cloud, Spring Boot, or SpringFramework.

TIP

For more information about the range of option to onboard API services with API ML, see the Onboarding Overview.

Introduction

Zowe API ML is a lightweight API management system based on the following Netflix components:

- Eureka - a discovery service used for services registration and discovery
- Spring CLoud Gateway - reverse proxy / API Gateway

The API ML Discovery Service component uses Netflix/Eureka as a services` registry. Eureka endpoints are used to register a service with the API ML Discovery Service.

The API ML provides onboarding enabler libraries. The libraries are JAR artifacts available through an artifactory. Using these libraries is the recommended approach to onboard a REST or GraphQL service with the API ML.

The PJE library serves the needs of Java developers who are not using either Spring Boot or the Spring Framework. If Spring Boot or the Spring framework are used in the project you would like to onboard, see the Onboarding Overview for the corresponding enablers.

Additionally, this enabler is not intended for use in projects that depend on Spring Cloud Netflix components. Configuration settings in the PJE and Spring Cloud Netflix Eureka Client are different. Using the two configuration settings in combination makes the result state of the discovery registry unpredictable.

TIP

The Plain Java Enabler supports the use of the API Mediation Layer Message Service. For more information about the Message Service, see Using API Mediation Layer Message Service.

Onboarding your REST or GraphQL service with API ML

The following steps outline the overall process to onboard a service with the API ML using the PJE. Each step is described in further detail in this article.

- Onboarding an API service with the Plain Java Enabler (PJE)
  - Introduction
  - Onboarding your REST or GraphQL service with API ML
  - Prerequisites
  - Configuring your project
    - Gradle build automation system
    - Maven build automation system
    - Service identification
    - Administrative endpoints
    - API info
    - API routing information
    - Authentication parameters
    - API Security
    - SAF Keyring configuration
    - Eureka Discovery Service
    - Custom Metadata
  - Registering your service with API ML
  - Validating the discoverability of your API service by the Discovery Service
  - Troubleshooting
    - Log messages during registration problems

Prerequisites

Ensure that the prerequisites from the Onboarding Overview are met.

- The REST or GraphQL API service to onboard is written in Java
- The service is enabled to communicate with API ML Discovery Service over a TLS v1.2 secured connection

:::noteNotes:

- This documentation is valid for API ML version `ZoweApimlVersion 3.0.0` and higher. We recommend that you check the Zowe Artifactory for the latest stable versions.
  - Following this guide enables REST or GraphQL services to be deployed on a z/OS environment. Deployment to a z/OS environment, however, is not required. As such, you can first develop on a local machine before you deploy on z/OS.
- The API Mediation Layer provides the sample application using the Plain Java Enabler in the api-layer repository :::

Configuring your project

Use either *Gradle* or *Maven* build automation systems to configure the project with the service to be onboarded. Use the appropriate configuration procedure that corresponds to your build automation system.

> **NOTE**

> You can use either the Zowe Artifactory or an artifactory of your choice. If you decide to build the API ML from source, you are required to publish the enabler artifact to your artifactory. Publish the enabler artifact by using the *Gradle* tasks provided in the source code.

Gradle build automation system

<details>
<summary>Click here for the procedure to use Gradle as your build automation system.</summary>

Follow these steps:

1. Create a `gradle.properties` file in the root of your project if one does not already exist.
2. In the `gradle.properties` file, set the URL of the specific artifactory containing the PJE artifact. Provide the corresponding credentials to gain access to the Maven repository.
3. Add the following *Gradle* code block to the `repositories` section of your `build.gradle` file:
4. In the same `build.gradle` file, add the necessary dependencies for your service. If you use the Java enabler from the Zowe Artifactory, add the following code block to your `build.gradle` script. Replace the `$zoweApimlVersion` with the proper version of the enabler, for example: `1.3.0`:
5. In your project home directory, run the `gradle clean build` command to build your project. Alternatively, you can run `gradlew` to use the specific gradle version that is working with your project.

</details>

Maven build automation system

<details>
<summary>Click here for the procedure to use Maven as your build automation system.</summary>

Follow these steps:

1. Add the following *XML* tags within the newly created `pom.xml` file:

   Tip: If you want to use snapshot version, replace `libs-release` with `libs-snapshot` in the repository url and change snapshots->enabled to `true`.
2. Add the proper dependencies:
3. In the directory of your project, run the `mvn clean package` command to build the project.

</details>

Configuring your service

To configure your service, create the configuration file `service-configuration.yml` in your service source tree resources directory. The default path for a java application is `src/main/resources`. The `service-configuration.yml` file is used to set the application properties and eureka metadata. Application properties are for your service runtime. For example, the `ssl` section specifies the keystore and trustore. The eureka metadata is used for registration with API Mediation Layer.

> **NOTE**
>
> To externalize service onboarding configuration, see: Externalizing onboarding configuration.

The following code snippet shows an example of `service-configuration.yml`. Some parameters which are specific for your service deployment are in `${parameterValue}` format. For your service configuration file, provide actual values or externalize your onboarding configuration.

Examples:

REST API

▾ Click here for an example of a REST API yaml file.

GraphQL API

▾ Click here for an example of a GraphQL API yaml file.

Optional metadata section

The following snippet presents additional optional metadata that can be added.

Example:

The onboarding configuration parameters are broken down into the following groups:

- Onboarding an API service with the Plain Java Enabler (PJE)
  - Introduction
  - Onboarding your REST or GraphQL service with API ML
  - Prerequisites
  - Configuring your project
    - Gradle build automation system
    - Maven build automation system
    - Service identification
    - Administrative endpoints
    - API info
    - API routing information
    - Authentication parameters
    - API Security
    - SAF Keyring configuration

    - Eureka Discovery Service
    - Custom Metadata
  - Registering your service with API ML
  - Validating the discoverability of your API service by the Discovery Service
  - Troubleshooting
    - Log messages during registration problems

Service identification

- **serviceId**

  The `serviceId` uniquely identifies one or more instance of a microservice in the API ML and is used as part of the service URL path in the API ML Gateway address space. Additionally, the API ML Gateway uses the `serviceId` for routing to the API service instances. When two API services use the same `serviceId`, the API Gateway considers the services as clones of each other. An incoming API request can be routed to either of them through utilized load balancing mechanism.

  Important! Ensure that the `serviceId` is set properly with the following considerations:

  - The same `servicedId` should only be set for multiple API service instances for API scalability.
  - The `servicedId` value must only contain lowercase alphanumeric characters.
  - The `servicedId` cannot contain more than 40 characters.

  Example:

  - If the `serviceId` is `sampleservice`, the service URL in the API ML Gateway address space appears as the following path:

- **title**

  Specifies the human readable name of the API service instance. This value is displayed in the API Catalog when a specific API service instance is selected. This parameter can be externalized and set by the customer system administrator.

  Tip: We recommend that service developer provides a default value of the `title`. Use a title that describes the service instance so that the end user knows the specific purpose of the service instance.

- **description**

  Specifies a short description of the API service. This value is displayed in the API Catalog when a specific API service instance is selected. This parameter can be externalized and set by the customer system administrator.

  Tip: Describe the service so that the end user understands the function of the service.

- **baseUrl**

  Specifies the base URL for the following administrative endpoints:

  - **homePageRelativeUrl**
  - **statusPageRelativeUrl**
  - **healthCheckRelativeUrl**

Use the following format to include your service name in the URL path:

`protocol://host:port/servicename`

Note: Ensure that the `baseUrl` does not end with a trailing `/`. Inclusion of `/` causes a malformed URL if any of the above administrative endpoints begin with a `/`. It is expected that each administrative endpoint begins with a `/`. Warnings will be logged if this recommendation is not followed.

- **serviceIpAddress** (Optional)

  Specifies the service IP address and can be provided by a system administrator in the externalized service configuration. If this parameter is not present in the configuration file or is not set as a service context parameter, it is resolved from the hostname part of the `baseUrl`.

- **preferIpAddress** (Optional)

  Set the value of this parameter to `true` to advertise a service IP address instead of its hostname.

Administrative endpoints

Administrative endpoint properties use the following format:

- **homePageRelativeUrl**

  Specifies the relative path to the home page of your service.

  Start this path with `/`. If your service has no home page, leave this parameter blank.

  Examples:

  - `homePageRelativeUrl:` This service has no home page
  - `homePageRelativeUrl: /` This service has a home page with URL `${baseUrl}/`

- **statusPageRelativeUrl**

  Specifies the relative path to the status page of your service.

  Start this path with `/`.

  Example:

  `statusPageRelativeUrl: /application/info`

  This results in the URL: `${baseUrl}/application/info`

- **healthCheckRelativeUrl**

  Specifies the relative path to the health check endpoint of your service.

  Start this path with `/`.

  Example:

  `healthCheckRelativeUrl: /application/health`

This results in the URL: `${baseUrl}/application/health`

API info

Services can provide multiple APIs. Add API info parameters for each API that your service wants to expose on the API ML.

Information properties of a single API are in the following format:

REST API

GraphQL API

- **apiInfo.apiId**

  Specifies the API identifier that is registered in the API ML installation. The API ID uniquely identifies the API in the API ML. The `apiId` can be used to locate the same APIs that are provided by different service instances. The API developer defines this ID. The `apiId` must be a string of up to 64 characters that uses lowercase alphanumeric characters and a dot: `.` .

- **apiInfo.version**

  Specifies the api `version`. This parameter is used to correctly retrieve the API documentation according to requested version of the API.

- **apiInfo.gatewayUrl**

  Specifies the base path at the API Gateway where the API is available. Ensure that this value is the same path as the `gatewayUrl` value in the `routes` sections that apply to this API.

- **apiInfo.swaggerUrl** (Optional)

  Specifies the Http or Https address where the Swagger JSON document is available.

- **apiInfo.graphqlUrl** (Optional)

  Specifies the Http or Https address where the GraphQL server is available.

Parameters Specific for REST API

- **apiInfo.documentationUrl** (Optional)

  Specifies the link to the external documentation. A link to the external documentation can be included along with the Swagger documentation.

- **apiInfo.defaultApi** (Optional)

  Specifies that this API is the default one shown in the API Catalog. If no apiInfo fields have `defaultApi` set to `true`, the default API is the one with the highest API `version`.

- **apiInfo.codeSnippet** (Optional)

Specifies the customized code snippet for a specific endpoint (API operation). The snippet is displayed in the API Catalog under the specified operation, after executing the request using the *Try it out* functionality. When specifying this configuration, you need to provide the following parameters:

- **`endpoint`**
  The endpoint that represents the API operation of the customized snippet
- **`language`**
  The language of the snippet
- **`codeBlock`**
  The content of the snippet to be displayed in the API Catalog

API routing information

The API routing group provides the required routing information used by the API ML Gateway when routing incoming requests to the corresponding API service. A single route can be used to direct calls to multiple resources or API endpoints. The route definition provides rules used by the API ML Gateway to rewrite the URL in the Gateway address space. Currently, the routing information consists of two parameters per route: The `gatewayUrl` and `serviceUrl`. These two parameters together specify a rule for how the API service endpoints are mapped to the API Gateway endpoints.

API routing information properties are in the following format:

Example:

- **routes**

  Specifies the container element for the route.

- **routes.gatewayUrl**

  The `gatewayUrl` parameter specifies the portion of the gateway URL which is replaced by the `serviceUrl` path part.

- **routes.serviceUrl**

  The `serviceUrl` parameter provides a portion of the service instance URL path which replaces the `gatewayUrl` part.

Examples:

- is routed to:
- API major version 1:

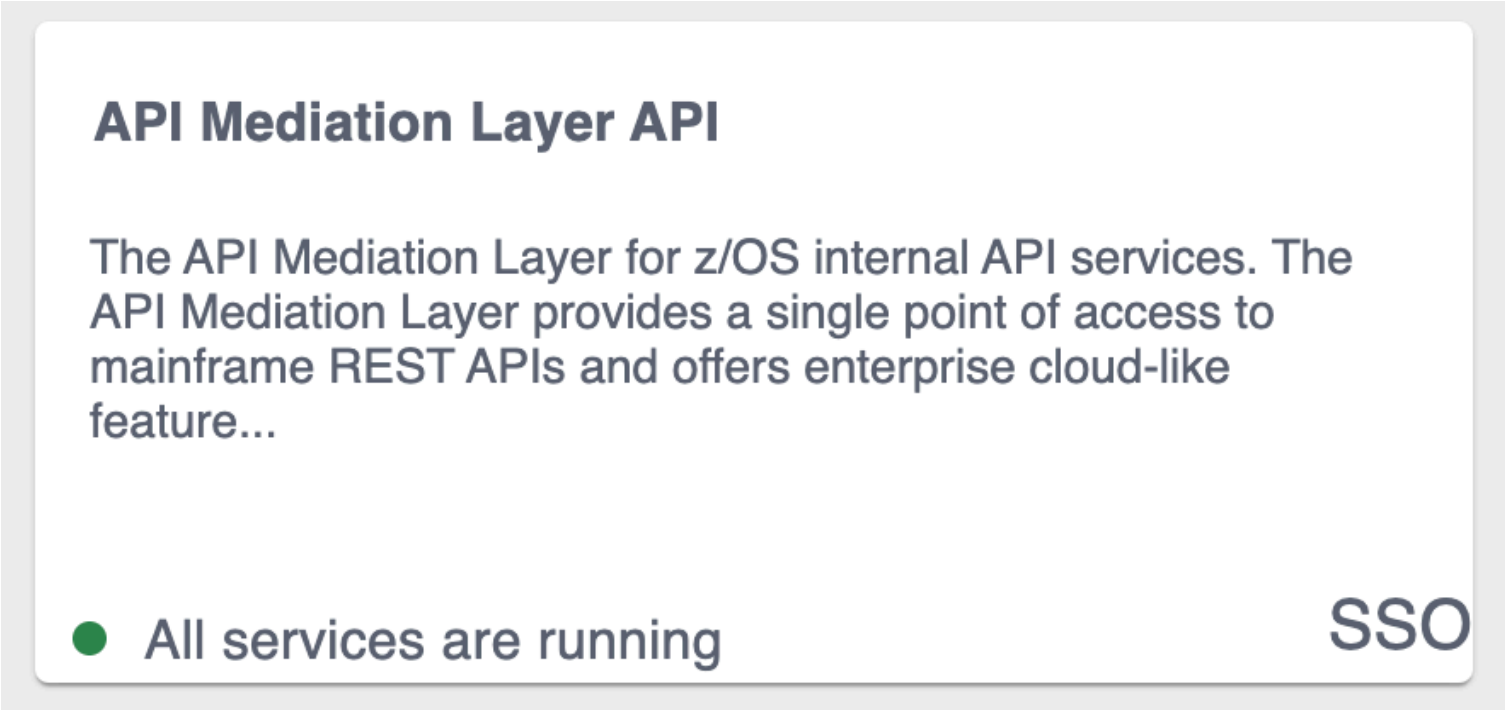
  is routed to:

- APIs docs major version 1:

  is routed to:

API Catalog information

The API ML Catalog UI displays information about discoverable services registered with the API ML Discovery Service. Information displayed in the Catalog is defined by the metadata provided by your service during registration. The following image is an example of a tile in the API Catalog:



The Catalog groups correlated services in the same tile if these services are configured with the same `catalog.tile.id` metadata parameter.

The following yaml presents an example of the configuration of a service tile in the Catalog:

Example:

- **catalog.tile.id**

  Specifies the unique identifier for the product family of API services. This is a value used by the API ML to group multiple API services into a single tile. Each unique identifier represents a single API dashboard tile in the Catalog.

  Tip: Specify a value that does not interfere with API services from other products. We recommend that you use your company and product name as part of the ID.

- **catalog.tile.title**

  Specifies the title of the product family of the API service. This value is displayed in the API Catalog dashboard as the tile title.

- **catalog.tile.description**

  The detailed description of the API services product family. This value is displayed in the API Catalog UI dashboard as the tile description.

- **catalog.tile.version**

  specifies the semantic version of this API Catalog tile.

  Note: Ensure that you increase the version number when you introduce changes to the API service product family details.

Authentication parameters

These parameters are not required. Default values are used when parameters are not specified.

API Security

Services onboarded with the API ML act as both a client and a server. When communicating to API ML Discovery service, a service acts as a client. When the API ML Gateway is routing requests to a service, the service acts as a server. These two roles have different requirements. The Zowe API ML Discovery Service communicates with its clients in secure Https mode. As such, TLS/SSL configuration setup is required when a service is acting as a server. In this case, the system administrator decides if the service will communicate with its clients securely or not.

Client services need to configure several TLS/SSL parameters in order to communicate with the API ML Discovery service. When an enabler is used to onboard a service, the configuration is provided in the `ssl` section/group in the same *YAML* file that is used to configure the Eureka parameters and the service metadata.

For more information about API ML security, see API ML security overview.

TLS/SSL configuration consists of the following parameters:

- **verifySslCertificatesOfServices**

  This parameter makes it possible to prevent server certificate validation.

  Important! Ensure that this parameter is set to `true` in production environments. Setting this parameter to `false` in production environments significantly degrades the overall security of the system.

- **protocol**

  Specifies the TLS protocol version currently used by Zowe API ML Discovery Service.

  Tip: We recommend you use `TLSv1.2` as your security protocol

- **keyAlias**

  Specifies the `alias` used to address the private key in the keystore.

- **keyPassword**

  Specifies the password associated with the private key.

- **keyStore**

  Specifies the keystore file used to store the private key. When using keyring, the value should be set to the SAF keyring location. For information about required certificates, see Zowe API ML TLS requirements.

If you have an issue with loading the keystore file in your environment, try to provide the absolute path to the keystore file. The sample keystore file for local deployment is in api-layer repository

- **keyStorePassword**

  Specifies the password used to unlock the keystore.

- **keyStoreType**

Specifies the type of the keystore.

- **trustStore**

  Specifies the truststore file used to keep other parties public keys and certificates. When using keyring, this value should be set to the SAF keyring location. For information about required certificates, see Zowe API ML TLS requirements.

  If you have an issue with loading the truststore file in your environment, try to provide the absolute path to the truststore file. The sample truststore file for local deployment is in api-layer repository

- **trustStorePassword: password**

  Specifies the password used to unlock the truststore.

- **trustStoreType: PKCS12**

  Specifies the truststore type. The default for this parameter is PKCS12.

Note: Ensure that you define both the keystore and the truststore even if your server is not using an Https port.

SAF Keyring configuration

You can choose to use SAF keyring instead of keystore and truststore for storing certificates. For information about required certificates, see Zowe API ML TLS requirements. For information about running Java on z/OS with keyring, see SAF Keyring.

Make sure that the enabler can access and read the keyring. Please refer to documentation of your security system for details.

The following example shows enabler configuration with keyrings.

Example:

Eureka Discovery Service

The Eureka Discovery Service parameters group contains a single parameter used to address Eureka Discovery Service location. An example is presented in the following snippet:

Example:

- **discoveryServiceUrls**

  Specifies the public URL of the Discovery Service. The system administrator at the customer site defines this parameter. It is possible to provide multiple values in order to utilize fail over and/or load balancing mechanisms.

Custom Metadata

For information about custom metadata, see the topic Custom Metadata.

Registering your service with API ML

The following steps outline the process of registering your service with API ML. Each step is described in detail in this article. The process describes the integration with the usage of the Java application server. The guideline is tested with the Tomcat application server. The specific steps that apply for other application servers may differ.

1. Add a web application context listener class
2. Register a web application context listener
3. Load service configuration
4. Register with Eureka discovery service
5. Unregister your service

Follow these steps:

1. Implement and add a web application context listener class:

   `implements javax.servlet.ServletContextListener`

   The web application context listener implements two methods to perform necessary actions at application start-up time as well as when the application context is destroyed:

   - The `contextInitialized` method invokes the `apiMediationClient.register(config)` method to register the application with API Mediation Layer when the application starts.
   - The `contextDestroyed` method invokes the `apiMediationClient.unregister()` method when the application shuts down. This unregisters the application from the API Mediation Layer.

2. Register a web application context listener.

   Add the following code block to the deployment descriptor `web.xml` to register a context listener:

3. Load the service configuration.

   Load your service configuration from a file `service-configuration.yml` file. The configuration parameters are described in the preceding section, Configuring your service.

   Use the following code as an example of how to load the service configuration.

   Example:

   Note: The `ApiMediationServiceConfigReader` class also provides other methods for loading the configuration from two files, `java.util.Map` instances, or directly from a string. Check the `ApiMediationServiceConfigReader` class JavaDoc for details.

4. Register with Eureka Discovery Service.

   Use the following call to register your service instance with Eureka Discovery Service:

   Example:

5. Unregister your service.

   Use the `contextDestroyed` method to unregister your service instance from Eureka Discovery Service in the following format:

Example:

Click here for a full example of a context listener class implementation.

Example:

Validating the discoverability of your API service by the Discovery Service

Once you are able to build and start your service successfully, you can use the option of validating that your service is registered correctly with the API ML Discovery Service.

Follow these steps:

1. Validate successful onboarding.
2. Check that you can access your API service endpoints through the Gateway.
3. (Optional) Check that you can access your API service endpoints directly outside of the Gateway.

Specific addresses and user credentials for the individual API ML components depend on your target runtime environment.

> **NOTE**
>
> If you are working with local installation of API ML and you are using our dummy identity provider, enter `user` for both `username` and `password`. If API ML was installed by system administrators, ask them to provide you with actual addresses of API ML components and the respective user credentials.

> **TIP**
>
> Wait for the Discovery Service to discover your service. This process may take a few minutes after your service was successfully started.

Troubleshooting

Log messages during registration problems

When an Enabler connects to the Discovery service and fails, an error message prints to the Enabler log. The default setting does not suppress these messages as they are useful to resolve problems during the Enabler registration. Possible reasons for failure include the location of Discovery service is not correct, the Discovery Service is down, or the TLS certificate is invalid.

These messages continue to print to the Enabler log, while the Enabler retries to connect to the Discovery Service. To fully suppress these messages in your logging framework, set the log levels to `OFF` on the following loggers:

com.netflix.discovery.DiscoveryClient, com.netflix.discovery.shared.transport.decorator.RedirectingEurekaHttpClient

Some logging frameworks provide other tools to suppress repeated messages. Consult the documentation of the logging framework you use to find out what tools are available. The following example demonstrates how the Logback framework can be used to suppress repeated messages.

Example:

Add the following code to your configuration file if you use XML configuration:

Version: v3.2.x LTS

API Mediation Layer onboarding configuration

This article describes the process of configuring a REST service to onboard with the Zowe API Mediation Layer using the API ML Plain Java Enabler.

> **ROLE: API SERVICE DEVELOPER**

Review how to provide basic configuration of a service to onboard to the API ML. You can externalize configuration parameters for subsequent customization by a systems administrator.

Introduction

The API ML Plain Java Enabler (PJE) is a library which helps to simplify the process of onboarding a REST service with the API ML. This article describes how to provide and externalize the Zowe API ML onboarding configuration of your REST service using the PJE. For detailed instructions about how to onboard your API service using the Plain Java Enabler, see Onboarding a REST API service with the Plain Java Enabler (PJE).

The PJE is the most universal Zowe API ML enabler. This enabler uses only Java, and does not use advanced Inversion of Control (*IoC*) or Dependency Injection (*DI*) technologies. The PJE enables you to onboard any REST service implemented in Java, avoiding dependencies, versions collisions, unexpected application behavior, and unnecessarily large service executables.

Service developers provide onboarding configuration as part of the service source code. While this configuration is valid for the development system environment, it is likely to be different for an automated integration environment. Typically, system administrators need to deploy a service on multiple sites that have different system environments and requirements such as security.

The PJE supports both the service developer and the system administrator with the functionality of externalizing the service onboarding configuration.

The PJE provides a mechanism to load API ML onboarding service configuration from one or two *YAML* files.

Configuring a REST service for API ML onboarding

In most cases, the API ML Discovery Service, Gateway, and service endpoint addresses are not known at the time of building the service executables. Similarly, security material such as certificates, private/public keys, and their corresponding passwords depend on the specific deployment environment, and are not intended to be publicly accessible. Therefore, to provide a higher level of flexibility, the PJE implements routines to build service onboarding configuration by locating and loading one or two *YAML* file sources:

- **internal *service-configuration.yml***

  The first configuration file is typically internal to the service deployment artifact. This file must be accessible on the service `classpath`. This file contains basic API ML configuration based on values known at development time. Usually, this basic API ML configuration is provided by the service developer and is located in the `/resources` folder of the Java project source tree. This file is usually found in the deployment artifacts under `/WEB-INF/classes`. The

configuration contained in this file is provided by the service developer or builder. As such, the configuration will not match every possible production environment and the corresponding requirements of the environment.

- **external or additional *service-configuration.yml***

  The second configuration file is used to externalize the configuration. This file can be stored anywhere on the local file system, as long as that the service has access to that location. This file is provided by the service deployer/system administrator and contains the correct parameter values for the specific production environment.

At service start-up time, both *YAML* configuration files are merged, where the externalized configuration (if provided) has higher priority.

The values of parameters in both files can be rewritten by Java system properties or servlet context parameters that were defined during service installation/configuration, or at start-up time.

In the *YAML* file, standard rewriting placeholders for parameter values use the following format:

`${apiml.parameter.key}`

The actual values are taken from [key, value] pairs defined as Java system properties or servlet context parameters. The system properties can be provided directly on a command line. The servlet context parameters can be provided in the service `web.xml` or in an external file.

The specific approach of how to provide the servlet context to the user service application depends on the application loading mechanism and the specific Java servlet container environment.

Example:

If the service is deployed in a Tomcat servlet container, you can configure the context by placing an *XML* file with the same name as the application deployment unit into `_$CATALINA_BASE/conf/[enginename]/[hostname]/_`.

Other containers provide different mechanisms for the same purpose.

Plain Java Enabler service onboarding API

You can initialize your service onboarding configuration using different methods of the Plain Java Enabler class `ApiMediationServiceConfigReader`:

Automatic initialization of the onboarding configuration by a single method call

The following code block shows automatic initialization of the onboarding configuration by a single method call:

This method receives the `ServletContext` parameter, which holds a map of parameters that provide all necessary information for building the onboarding configuration. The following code block is an example of Java Servlet context configuration.

Example:

The two parameters corresponding to the location of the configuration files are:

- `apiml.config.location`
  is parameter describes the location of the basic configuration file.

- `apiml.config.additional-location`
  This parameter describes the location of the external configuration file.

The method in this example uses the provided configuration file names in order to load them as *YAML* files into the internal Java configuration object of type *ApiMediationServiceConfig*.

The other context parameters with the *apiml* prefix are used to rewrite values of properties in the configuration files.

Validating successful onboarding with API Mediation Layer

To ensure that you successfully onboarded a service with the API Mediation Layer, follow these steps:

1. Validate successful onboarding. Follow the procedure described in Verify successful onboarding to API ML.

2. Check that you can access your API service endpoints through the Gateway.

3. (Optional) Check that you can access your API service endpoints directly outside of the Gateway.

Loading YAML configuration files

YAML configuration files can be loaded either as a single *YAML* file, or by merging two *YAML* files. Use the `loadConfiguration` method described later in this article that corresponds to your service requirements.

After successfully loading a configuration file, the loading method `loadConfiguration` uses Java system properties to substitute corresponding configuration properties.

Loading a single YAML configuration file

To build your configuration from multiple sources, load a single configuration file, and then rewrite parameters as needed using values from another configuration source. See: Loading and merging two YAML configuration files described later in this article.

Use the following method to load a single *YAML* configuration file:

This method receives a single *String* parameter and can be used to load an internal or an external configuration file.

> **NOTE**
>
> This method first attempts to load the configuration as a Java resource. If the file is not found, the method attempts to resolve the file name as an absolute. If the file name still cannot be found, this method attempts to resolve the file as a relative path. When the file is found, the method loads the contents of the file and maps them to internal data classes. After loading the configuration file, the method attempts to substitute/rewrite configuration property values with corresponding Java System properties.

Loading and merging two YAML configuration files

To load and merge two configuration files, use the following method:

where:

- **String internalConfigurationFileName**
  references the basic configuration file name.
- **String externalizedConfigurationFileName**
  references the external configuration file name.

> **NOTE**
>
> The external configuration file takes precedence over the basic configuration file in order to match the target deployment environment. After loading and before merging, each configuration will be separately patched using Java System properties.

The following code block presents an example of how to load and merge onboarding configuration from *YAML* files.

Example:

Version: v3.2.x LTS

Onboarding a Spring Boot based REST API Service

This article is part of a series of onboarding guides, which outline the process of onboarding API services to the Zowe API Mediation Layer (API ML).

ROLE: API SERVICE DEVELOPER

Review how to onboard your REST API service built with the Spring Boot framework with the Zowe API Mediation Layer.

NOTE

Before API ML version 1.2, the API ML provided an integration enabler based on Spring Cloud Netflix components. From version 1.3 and later, the API ML uses a new implementation based on the Plain Java Enabler (PJE) that is not backwards compatible with the previous enabler versions. API ML core services (Discovery Service, Gateway, and API Catalog) support both the old and new enabler versions.

TIP

For more information about how to utilize another onboarding method, see the Onboarding overview.

Outline of onboarding a REST service using Spring Boot

The following steps outline the overall process to onboard a REST service with the API ML using a Spring Boot enabler. Each step is described in further detail in this article.

- Onboarding a Spring Boot based REST API Service
  - Outline of onboarding a REST service using Spring Boot
  - Configuring your project
    - Gradle build automation system
    - Maven build automation system
  - Configuring your Spring Boot based service to onboard with API ML
    - Sample API ML Onboarding Configuration
    - Authentication properties
    - API ML Onboarding Configuration Sample
    - SAF Keyring configuration
    - Custom Metadata
  - Registering and unregistering your service with API ML
    - Unregistering your service with API ML
    - Basic routing
  - Adding API documentation
  - Validating the discoverability of your API service by the Discovery Service
  - Troubleshooting

- Log messages during registration problems

Configuring your project

Use either *Gradle* or *Maven* as your build automation system to manage your project builds.

> **NOTE**
>
> You can download the selected enabler artifact from the Zowe Artifactory for latest stable versions.. Alternatively, if you decide to build the API ML from source, it is necessary to publish the enabler artifact to your Artifactory. Publish the enabler artifact by using the *Gradle* tasks provided in the source code.

Gradle build automation system

Click here for the procedure to use Gradle as your build automation system.

Follow these steps:

1. Create a `gradle.properties` file in the root of your project if one does not already exist.
2. In the `gradle.properties` file, set the URL of the specific Artifactory containing the *SpringEnabler* artifact.
3. Add the following *Gradle* code block to the `repositories` section of your `build.gradle` file:
4. In the same `build.gradle` file, add the necessary dependencies for your service. If you use the *SpringEnabler* from the Zowe Artifactory, add the following code block to your `build.gradle` script:

   Use the corresponding artifact according to the Zowe APIML version you are using.

   - Use the latest version of the following artifact:

   Notes:

   - You may need to add additional dependencies as required by your service implementation.
   - Replace `zoweApimlVersion` with the latest update of the major version according to your Zowe installation.
5. In your project home directory, run the `gradle clean build` command to build your project. Alternatively, you can run `gradlew` to use the specific gradle version that is working with your project.

Maven build automation system

Click here for the procedure to use Maven as your build automation system.

Follow these steps:

1. Add the following *XML* tags within the newly created `pom.xml` file:

Tip: If you want to use snapshot version, replace libs-release with libs-snapshot in the repository url and change snapshots->enabled to true.

2. Add the proper dependencies
    - Use the latest version of the following artifact:

    Notes:

    - Replace `zoweApimlVersion` with the latest update of the major version according to your Zowe installation.
3. In the directory of your project, run the `mvn clean package` command to build the project.

Configuring your Spring Boot based service to onboard with API ML

To configure a Spring Boot based service, it is useful to first understand how API ML enabled service Spring Boot based configuration relates to configuration using the Plain Java Enabler.

Spring Boot expects to find the default configuration of an application in an `application.yml` file that is placed on the classpath. Typically `application.yml` contains Spring Boot specific properties such as properties that are used to start a web application container including TLS security, different spring configuration profiles definitions, and other properties. This `application.yml` must contain the Plain Java Enabler API ML service configuration under the `apiml.service` prefix. The API ML configuration under this prefix is necessary to synchronize the configuration of `apiml.service` with the spring `server` configuration.

Configuration properties belong to two categories:

- Service related properties which include endpoints, relative paths, or API documentation definitions.
- Environment related properties which include host names, ports, context etc.

Execution environment related properties should be provided by additional configuration mechanisms that are specific to the target execution environment. Execution environment related properties for development deployments on a local machine differ with those properties on a mainframe system.

- In a development environment, provide execution environment related properties in an additional `YAML` file with the system property in the following format:
- On the mainframe system, provide additional configuration properties and values for existing configuration properties through Java system properties.

  Execution environments for local development deployments and mainframe deployment are described in detail later in this article.

Follow these steps:

1. Provide a configuration section for onboarding with API ML in the `application.yml` file.

- If you have already onboarded your service with API ML, copy and paste the contents of your existing API ML onboarding configuration file. The default of the API ML onboarding configuration file is the `service-configuration.yml` in the `application.yml` file under the `apiml.service` prefix.
- If you have not yet onboarded your REST service with API ML, use the Sample API Onboarding Configuration to get started.

2. If you are reusing your existing API ML onboarding configuration, modify the API ML related properties of the `application.yml` file.

   a) Remove certain properties under the `apiml.service` section, which must be externalized. Properties for removal are described in the following sample of API ML onboarding configuration.

   b) Provide the following additional properties under the `apiml` section:

   These additional properties are contained in the following sample.

Sample API ML Onboarding Configuration

In the following sample API ML onboarding configuration, properties prefixed with `###` (3 hashtags) indicate that their value must be provided as `-Dsystem.property.key=PROPERTY_VALUE` defined in the mainframe execution environment. The `-Dsystem.property.key` must be the same as the flattened path of the YAML property which is commented out with `###`. These properties must not be defined (uncommented) in your default service YAML configuration file.

Example:

In this example from the YAML configuration file, when the application service is run on the mainframe, provide your mainframe hostname value on the Java execution command line in the following format:

Since this value is provided in the Java execution command line, leave the property commented out in the `application.yml`.

For development purposes, you can replace or add any property by providing the same configuration structure in an external YAML configuration file. When running your application, provide the name of the external/additional configuration file on the command line in the following format:

A property notation provided in the format `-Dproperty.key=PROPERTY_VALUE` can be used for two purposes:

- To provide a runtime value for any `YAML` property if `${property.key}` is used as its value (after `:`) in the YAML configuration file

  Example:

- To add a property to configuration if the property does not already exist

  Example:

> **NOTE**
>
> System properties provided with `-D` notation on the command line will not replace properties defined in any of the YAML configuration files.

Authentication properties

These parameters are not required. If a parameter is not specified, a default value is used.

API ML Onboarding Configuration Sample

Some parameters which are specific for your service deployment are written in `<fill-your-parameterValue>` format. For your service configuration file, provide actual values or externalize your configuration using `-D` java commandline parameters.

<details>
<summary>Click here for a full example of API service configuration.</summary>

</details>

> **TIP**
>
> To determine if your configuration is complete, set the logging level to `debug` and run your application. Setting the logging level to 'debug' enables you to troubleshoot issues with certificates for HTTPS and connections with other services.

3. Provide the suitable parameter corresponding to your runtime environment:

- For a local machine runtime environment, provide the following parameter on your command line:

  At runtime, Spring will merge the two `YAML` configuration files, whereby the properties in the external file have higher priority.

- For a mainframe execution environment, provide environment specific configuration properties. Define these configuration properties and provide them using Java System Properties on the application execution command line.

  Important! Ensure that the default configuration contains only properties which are not dependent on the deployment environment. Do not include security sensitive data in the default configuration.

  Note: For details about the configuration properties, see Configuring your service in the article *Onboarding an API service with the Plain Java Enabler (PJE)*.

SAF Keyring configuration

You can choose to use a SAF keyring instead of keystore and truststore for storing certificates. For information about required certificates, see Zowe API ML TLS requirements. For information about running Java on z/OS with a keyring, see SAF Keyring. Make sure that the enabler can access and read the keyring. Please refer to documentation of your security system for details.

The following example shows enabler configuration with keyrings:

Custom Metadata

For information about customizing metadata to add to the instance information registered in the Discovery Service, see Customizing Metadata.

Registering and unregistering your service with API ML

Onboarding a REST service to the API ML means registering the service with the API ML Discovery Service. The registration is triggered automatically by Spring after the service application context is fully initialized by firing a `ContextRefreshed` event.

To register your REST service with API ML using a Spring Boot enabler, annotate your application `main` class with `@EnableApiDiscovery`.

Unregistering your service with API ML

Unregistering a service onboarded with API ML is done automatically at the end of the service application shutdown process in which Spring fires a `ContextClosed` event. The Spring onboarding enabler listens for this event and issues an `unregister` REST call to the API ML Discovery Service.

Basic routing

For information about basic routing in the API ML, see API ML Basic Routing

Adding API documentation

Use the following procedure to add Swagger API documentation to your project.

Follow these steps:

1. Add a SpringFox Swagger dependency.
    - For *Gradle*, add the following dependency in `build.gradle`:
        - For *Maven*, add the following dependency in `pom.xml`:
2. Add a Spring configuration class to your project.

   Example:
3. Customize this configuration according to your specifications. For more information about customization properties, see Springdoc configuration.

Validating the discoverability of your API service by the Discovery Service

Once you build and start your service successfully, you can use the option of validating that your service is registered correctly with the API ML Discovery Service.

Follow these steps:

1. Validate successful onboarding
2. Check that you can access your API service endpoints through the Gateway.
3. (Optional) Check that you can access your API service endpoints directly outside of the Gateway.

Specific addresses and user credentials for the individual API ML components depend on your target runtime environment.

> **NOTE**
>
> If you are working with local installation of API ML and you are using our dummy identity provider, enter `user` for both `username` and `password`. If API ML was installed by system administrators, ask them to provide you with actual addresses of API ML components and the respective user credentials.

> **TIPS:**
>
> - Wait for the Discovery Service to fully register your service. This process may take a few minutes after your service was successfully started.
> - The Spring Boot Enabler supports the use of the API Mediation Layer Message Service. For more information about the Message Service, see Using API Mediation Layer Message Service.

Troubleshooting

Log messages during registration problems

When an Enabler connects to the Discovery Service and fails, an error message prints to the Enabler log. The default setting does not suppress these messages as they are useful to resolve problems during the Enabler registration. Possible reasons for failure include the location of Discovery Service is not correct, the Discovery Service is down, or the TLS certificate is invalid. These messages continue to print to the Enabler log, while the Enabler retries to connect to the Discovery Service.

To fully suppress these messages in your logging framework, set the log levels to `OFF` on the following loggers:

Some logging frameworks provide other tools to suppress repeated messages. Consult the documentation of the logging framework you use to find out what tools are available. The following example demonstrates how the Logback framework can be used to suppress repeated messages.

Example:

Add the following code to your configuration file if you use XML configuration:

Version: v3.2.x LTS

Onboarding a Micronaut based REST API service

This article is part of a series of onboarding guides, which outline the process of onboarding API services to the Zowe API Mediation Layer (API ML).

> **ROLE: API SERVICE DEVELOPER**

One option to onboard a REST service to the Zowe API Mediation Layer is by using the Micronaut framework.

While using the Spring framework to develop a JVM-based service to register to the API ML is the recommended method, you can use the procedure described in this article to onboard a service using the Micronaut framework.

> **NOTE**
>
> For more information about onboarding API services with the API ML, see the Onboarding Overview.

For Micronaut-related documentation, see the Micronaut website.

- Onboarding a Micronaut based REST API service
  - Set up your build automation system
  - Configure the Micronaut application
    - Add API ML configuration
    - Add Micronaut configuration
    - (Optional) Set up logging configuration
  - Validate successful registration

Set up your build automation system

Currently, the only build automation system for use with onboarding a Micronaut based service is *Gradle*.

1. Create a `gradle.properties` file in the root of your project if one does not already exist.
2. In the `gradle.properties` file, set the URL of the specific Artifactory containing the *SpringEnabler* artifact.
3. Add the following *Gradle* code block to the `repositories` section of your `build.gradle` file:
4. In the `build.gradle` file, add the micronaut enabler as a dependency:
5. (Optional) Add a shadow plug-in to create a runnable jar file. Update the `gradle.build file` with a plugin:
6. Specify the main class with the following script:
7. Define the output jar file.

   Add the following script to define the output of the jar file:

   The following example shows a sample `gradle.build` file:

Example:

8. (Optional) Create a shadow jar.

   To create a shadow jar, execute the gradle `shadowJar` task. For this sample, the plugin produces the jar `micronaut-enabler-1.0.jar` in `build/libs` directory.

   You can now run your application with the command `java -jar micronaut-enabler-1.0.jar`.

9. Start the application.

   From the root directory of your project, start the application with the **`gradle run`** command.

Configure the Micronaut application

Use a yaml file to configure your Micronaut application. Create the following two sections in your yaml file:

- `apiml` for API ML configuration
- `micronaut` for micronaut configuration

Add API ML configuration

Use the following procedure to add API ML configuration to the application.yaml.

Follow these steps:

1. Add the following configuration to the `apiml` section in the yaml file:

   - **fill.your.service**
     Specifies the ID of your service

2. Add SSL-resolving properties as shown in the following example. Ensure that you structure the nested objects within `apiml.service` as arrays. Be sure to include `-` (hyphen) before `enabled` thereby indicating the first element of the array.

Example:

> **NOTE**
>
> For a sample of this configuration, see API ML Onboarding Configuration Sample.

The yaml now contains configuration to register to the API Mediation Layer.

Add Micronaut configuration

Once you complete API ML configuration, add configuration to provide correct mapping between API ML and micronaut parameters.

1. Add the following yaml snippet with the micronaut configuration parameters:

- **apiml.service.serviceId**
  Specifies the ID of your service

- **apiml.service.port**
  Specifies the port on which the service listens

- **apiml.service.ssl[0].keyPassword**
  Specifies the password that protects the key in keystore

- **apiml.service.ssl[0].keyStoreType**
  Specifies the type of the keystore, (Example: PKCS12)

- **apiml.service.ssl[0].keyStore**
  Specifies the location of the keystore

- **apiml.service.ssl[0].keyAlias**
  Specifies the alias under which the key is stored in the keystore

- **apiml.service.ssl[0].trustStorePassword**
  Specifies the password that protects the certificates in the truststore

- **apiml.service.ssl[0].trustStore**
  Specifies the location of the truststore

- **apiml.service.ssl[0].trustStoreType**
  Specifies the type of the truststore, (Example: PKCS12)

- **apiml.service.ssl[0].ciphers**
  Specifies the list of ciphers that user wants to enable for TLS communication

- **apiml.service.ssl[0].protocol**
  Specifies the type of SSL/TLS protocol (Example: TLSv1.2)

(Optional) Set up logging configuration

Set up custom logging configuration to have more structured output and better control of logs.

Create a `logback.xml` file in the `resources` folder and include the `application.yml`. Update the `logback.xml` file with the following configuration:

Validate successful registration

After you complete the configuration, ensure that your application is visible within Zowe API ML. For more information, see Validating the discoverability of your API service by the Discovery Service, which describes the validation procedure common for all enablers.

Version: v3.2.x LTS

Onboarding a Node.js based REST API service

This article is part of a series of onboarding articles, which outline the process of onboarding REST API services to the Zowe API Mediation Layer (API ML).

> **ROLE: API SERVICE DEVELOPER**

Review this article to onboard a REST service based on NodeJS with the Zowe API Mediation Layer by using the Node.js Enabler.

> **NOTE**
>
> For more information about onboarding API services with the API ML, see the Onboarding Overview.

Introduction

The API ML onboarding Node.js enabler is an NPM package which helps to simplify the process of onboarding a REST service written in Node.js with the API ML.

For more information about how to utilize another API ML enablers, see the Onboarding Overview.

Onboarding your Node.js service with API ML

The following steps outline the overall process to onboard a REST service with the API ML using the onboarding Node.js enabler. Each step is described in further detail in this article.

- Onboarding a Node.js based REST API service
  - Introduction
  - Onboarding your Node.js service with API ML
  - Prerequisites
  - Installing the npm dependency
  - Configuring your service
  - Registering your service with API ML
  - Validating the discoverability of your API service by the Discovery Service

Prerequisites

Ensure that you meet the following prerequisites:

- You satisfy the prerequisites from the Onboarding Overview.
- The REST API service to onboard is written in Node.js.
- The service is enabled to communicate with API ML Discovery Service over a TLS v1.2 secured connection.

Installing the npm dependency

Install the onboarding Node.js enabler package as a dependency of your service. Run the following npm command from your project directory:

> **NOTE**
>
> If you have a multi-module project, you have to run the npm command from the submodule where your Node.js project is located.

Configuring your service

Create a yaml file named `service-configuration.yml` inside a `/config` directory at the same level of your `index.js`, and add the following configuration properties.

The following example shows a sample configuration.

Example:

Registering your service with API ML

To register your service with API ML, use the following procedure.

1. Inside your Node.js service `index.js`, add the following code block to register your service with Eureka:
2. Start your Node.js service and verify that the service is registered to the Zowe API Mediation Layer.

Validating the discoverability of your API service by the Discovery Service

Once you build and start your service successfully, you can use the option of validating that your service is registered correctly with the API ML Discovery Service.

1. Validate successful onboarding
2. Check that you can access your API service endpoints through the Gateway.
3. (Optional) Check that you can access your API service endpoints directly outside of the Gateway.

Specific addresses and user credentials for the individual API ML components depend on your target runtime environment.

> **NOTES:**
>
> - If you are working with a local installation of API ML, and you are using our dummy identity provider, enter `user` for both `username` and `password`. If API ML was installed by system administrators, ask them to provide you with actual addresses of API ML components and the respective user credentials.

- Wait for the Discovery Service to fully register your service. This process may take a few minutes after your service starts successfully.

Version: v3.2.x LTS

Onboarding a Python based REST API service

This article is part of a series of onboarding articles, which outline the process of onboarding REST API services to Zowe API Mediation Layer (API ML).

ROLE: API SERVICE DEVELOPER

REST services based on Python can be onboarded with Zowe API ML using the Python Enabler.

> **NOTE**
>
> For more information about the range of options to onboard API services with API ML, see the Onboarding Overview.

Introduction

The API ML onboarding Python enabler is a Python package which helps to simplify the process of onboarding a REST service written in Python with API ML.

Follow the steps described in this article to onboard a REST API service with API ML using the onboarding Python enabler.

Prerequisites

Ensure that you meet the following prerequisites:

- You satisfy the prerequisites from the Onboarding Overview.
- The REST API service to onboard is written in Python.
- The service is enabled to communicate with API ML Discovery Service over a TLS v1.2 secured connection.

Installing the Python dependency

Install the onboarding Python enabler package as a dependency of your service. Run the following pip command from your project directory:

> **NOTE**
>
> If you have a multi-module project, ensure that you run the pip command from the submodule where your Python project is located.

Configuring your service

Create a yaml file named `service-configuration.yml` inside the `/config` directory at the same level of your `app.py`. Add the configuration properties as presented in the following configuration example.

Example:

Registering your service with API ML

To register your service with API ML, use the following procedure:

1. Inside your Python service `app.py`, add the following script to register your service with Eureka:

2. Start your Python service and verify that the service is registered to Zowe API Mediation Layer.

Validating the discoverability of your API service by the Discovery Service

Once you build and start your service successfully, you can validate that your service is registered correctly with the API ML Discovery Service.

1. Validate successful onboarding.

2. Check that you can access your API service endpoints through the Gateway.

3. (Optional) Check that you can access your API service endpoints directly outside the Gateway.

Specific addresses and user credentials for the individual API ML components depend on your target runtime environment.

> **NOTES:**
>
> - If you are working with a local installation of API ML, and you are using the provided dummy identity provider, enter `user` for both `username` and `password`. If API ML was installed by system administrators, ask them to provide you with actual addresses of API ML components and the respective user credentials.
> - Wait for the Discovery Service to fully register your service. This process may take a few minutes after your service starts successfully.

Version: v3.2.x LTS

Onboarding a REST or GraphQL API without code changes required

This article is part of a series of onboarding guides, which outline the process of onboarding API services to the Zowe API Mediation Layer (API ML).

ROLE: API SERVICE DEVELOPER

Review this article to onboard an existing REST or GraphQL API service to the Zowe™ API Mediation Layer without changing the code of the API service. This form of onboarding is also refered to as, "static onboarding".

NOTE

When developing a new service, it is not recommended to onboard a service using this method, as this method is non-native to the API Mediation Layer. For a complete list of methods to onboard a service natively to the API Mediation Layer, see the Service onboarding guides in the *Onboarding overview*.

The following procedure outlines the steps to onboard an API service through the API Gateway in the API Mediation Layer without requiring code changes.

- Onboarding a REST or GraphQL API without code changes required
  - Identify the APIs that you want to expose
  - Define your service and API in YAML format
  - Route your API
  - Customize configuration parameters
  - Add and validate the definition in the API Mediation Layer running on your machine
  - Add a definition in the API Mediation Layer in the Zowe runtime
  - (Optional) Check the log of the API Mediation Layer
  - (Optional) Reload the services definition after the update when the API Mediation Layer is already started

TIP

For more information about the structure of APIs and which APIs to expose in the Zowe API Mediation Layer, see the Onboarding Overview.

Identify the APIs that you want to expose

The first step in API service onboarding is to identify the APIs that you want to expose.

Follow these steps:

1. Identify the following parameters of your API service:
   - Hostname

- Port
- (Optional) base path where the service is available. This URL is called the base URL of the service.

Example:

In the sample service described in the Onboarding Overview, the URL of the service is: `http://localhost:8080`.

2. Identify the API of the service that you want to expose through the API Gateway.

   Example:

   The API provided by the sample service is a second version of the Pet Store API. All the endpoints to be onboarded are available through `http://localhost:8080/v2/` URL. This API is therefore available at the path `/v2` relative to base URL of the service. There is no version 1 in this case.

3. Choose the `service ID` of your service. The `service ID` identifies the service uniquely in the API Gateway. The `service ID` is an alphanumeric string in lowercase ASCII.

   Example:

   In the sample service, the `service ID` is `petstore`.

4. Decide which URL to use to make this API available in the API Gateway. This URL is referred to as the gateway URL and is composed of the API type and the major version. The usually used types are: `api`, `ui` and `ws` but you can use any valid URL element you want.

   Example:

   In the sample service, we provide a REST API. The first segment is `/api` as the service provides only one REST API. To indicate that this is version 2, the second segment is `/v2`. This version is required by the Gateway. If your service does not have a version, use `v1` on the Gateway.

Define your service and API in YAML format

After you identify the APIs you want to expose, you need to define your service and API in YAML format as presented in the following sample `petstore` service example.

Example:

To define your service in YAML format, provide the following definition in a YAML file as in the following sample `petstore` service. This configuration is the minimal configuration necessary for the Gateway to properly route the requests to the application and to show the Service in the Catalog UI.

> **NOTE**
>
> For more details about configuration, see Customize configuration parameters.

In this example, a suitable name for the file is `petstore.yml`.

> **NOTES:**

- The filename does not need to follow specific naming conventions but it requires the `.yml` extension.
- The file can contain one or more services defined under the `services:` node.
- Each service has a service ID. In this example, the service ID is `petstore`. The service id is used as a part of the request URL towards the Gateway. It is removed by the Gateway when forwarding the request to the service.
- The service can have one or more instances. In this case, only one instance `http://localhost:8080` is used.
- One API is provided and the requests with the relative base path `api/v2` at the API Gateway (full gateway URL: `https://gateway:port/serviceId/api/v2/...`) are routed to the relative base path `/v2` at the full URL of the service (`http://localhost:8080/v2/...`).
- The file on USS should be encoded in ASCII to be read correctly by the API Mediation Layer.

TIPS:

- There are more examples of API definitions at this link.
- For more details about how to use YAML format, see this link.

Route your API

Routing is the process of sending requests from the API Gateway to a specific API service. Route your API by using the same format as in the following `petstore` example. The configuration parameters are explained in Customize configuration parameters. Gateway URL format:

NOTE

The API Gateway differentiates major versions of an API.

Example:

When the configuration parameters are:

To access API version 2 of the service `petstore`, gateway URL will be:

It will be routed to:

To access resource `pets` of the `petstore` version 2 API, gateway URL will be:

It will be routed to:

NOTE

This method enables you to access the service through a stable URL, and move the service to another machine without changing the gateway URL. Accessing a service through the API Gateway also enables you to have multiple instances of the service running on different machines to achieve high-availability.

Customize configuration parameters

This part contains a more complex example of the configuration and an explanation of all the possible parameters:

REST API

<details>
<summary>Click here for a sample yaml file for a REST API.</summary>
</details>

GraphQL API

<details>
<summary>Click here for a sample yaml file for a GraphQL API.</summary>
</details>

- **serviceId**

  This parameter specifies the service instance identifier that is registered in the API Mediation Layer installation. The service ID is used in the URL for routing to the API service through the Gateway. The service ID uniquely identifies the service in the API Mediation Layer. The system administrator at the customer site defines this parameter.

  > **CAUTION**
  > Ensure that the service ID is set properly with the following considerations:

  - When two API services use the same service ID, the API Gateway considers the services to be clones (i.e. two instances for the same service). An incoming API request can be routed to either of them.
  - The same service ID should be set only for multiple API service instances for API scalability.
  - The service ID value must contain only lowercase alphanumeric characters.
  - The service ID cannot contain more than 40 characters.
  - The service ID is linked to security resources. Changes to the service ID require an update of security resources.

  Examples:

  - If the customer system administrator sets the service ID to `monitoringpr1`, the API URL in the API Gateway appears as the following URL:

    `https://gateway:port/monitoringpr1/api/v1/...`

  - If customer system administrator sets the service ID to `authenticationprod1`, the API URL in the API Gateway appears as the following URL:

    `http://gateway:port/authenticationprod1/api/v1/...`

- **title**

  This parameter specifies the human readable name of the API service instance (for example, `Monitoring Prod` or `systemInfo LPAR1`). This value is displayed in the API catalog when a specific API service instance is selected. This parameter is externalized and set by the customer system administrator.

Tip: We recommend that you provide a specific default value of the `title`. Use a title that describes the service instance so that the end user knows the specific purpose of the service instance.

- **description**

  This parameter specifies a short description of the API service.

  Examples:

  - `Monitoring Service - Production Instance`
  - `System Info Service running on LPAR1`

  This value is displayed in the API Catalog when a specific API service instance is selected. This parameter is externalized and set by the customer system administrator.

  > **TIP**
  > Describe the service so that the end user knows the function of the service.

- **instanceBaseUrls**

  This parameter specifies a list of base URLs to your service's resource. It will be the prefix for the following URLs:

  - **homePageRelativeUrl**
  - **statusPageRelativeUrl**
  - **healthCheckRelativeUrl**

  Examples:

  - `- http://host:port/ftpservice` for an HTTP service
  - `- https://host:port/source-code-mngmnt` for an HTTPS service

  You can provide one URL if your service has one instance. If your service provides multiple instances for the high-availability then you can provide URLs to these instances.

  Examples:

  - `- https://host1:port1/source-code-mngmnt`
  - `- https://host2:port2/source-code-mngmnt`

- **homePageRelativeUrl**

  This parameter specifies the relative path to the homepage of your service. The path should start with `/`. If your service has no homepage, omit this parameter. The path is relative to the instanceBaseUrls.

  Examples:

  - `homePageRelativeUrl: /` The service has homepage with URL `${baseUrl}/`
  - `homePageRelativeUrl: /ui/` The service has homepage with URL `${baseUrl}/ui/`
  - `homePageRelativeUrl:` The service has homepage with URL `${baseUrl}`

- **statusPageRelativeUrl**

This parameter specifies the relative path to the status page of your service. Start this path with `/`. If you service doesn't have a status page, omit this parameter. The path is relative to the instanceBaseUrls.

Example:

```
statusPageRelativeUrl: /application/info
```

the result URL will be:

```
${baseUrl}/application/info
```

- **healthCheckRelativeUrl**

  This parameter specifies the relative path to the health check endpoint of your service. Start this URL with `/`. If your service does not have a health check endpoint, omit this parameter. The path is relative to the instanceBaseUrls.

  Example:

  ```
  healthCheckRelativeUrl: /application/health
  ```

  This results in the URL:

  ```
  ${baseUrl}/application/health
  ```

- **routes**

  The following parameters specify the routing rules between the Gateway service and your service. Both specify how the API endpoints are mapped to the API Gateway endpoints.

  - **routes.gatewayUrl**

    The *gatewayUrl* parameter sets the target endpoint on the Gateway. This is the portion of the final URL that is Gateway specific.

    Example:

    For the petstore example, the full Gateway URL would be:

    ```
    https://gatewayUrl:1345/petstore/api/v2/pets/1
    ```

    In this case, the URL that will be called on the service is:

    ```
    http://localhost:8080/v2/pets/1
    ```

  - **routes.serviceRelativeUrl**

    The *serviceRelativeUrl* parameter points to the target endpoint on the service. This is the base path on the service called through the Gateway.

- **authentication**

  The information about the possible ways to integrate authentication are available in Single Sign On Integration for Extenders article.

- **apiInfo**

  This section defines APIs that are provided by the service. Currently, only one API is supported.

  - **apiInfo.apiId**

    This parameter specifies the API identifier that is registered in the API Mediation Layer installation. The API ID uniquely identifies the API in the API Mediation Layer. The same API can be provided by multiple services. The API ID can be used to locate the same APIs that are provided by different services.

    The creator of the API defines this ID. The API ID needs to be a string of up to 64 characters that uses lowercase alphanumeric characters and a dot: `.`.

    Tip: We recommend that you use your organization as the prefix.

    Examples:

    - `zowe.file`
    - `ca.sysview`
    - `ibm.zosmf`

  - **apiInfo.gatewayUrl**

    This parameter specifies the base path at the API Gateway where the API is available. Ensure that this path is the same as the *gatewayUrl* value in the *routes* sections.

  - **apiInfo.swaggerUrl**

    (Optional) This parameter specifies the HTTP or HTTPS address where the Swagger JSON document is available.

  - **apiInfo.graphqlUrl**

    (Optional) This parameter specifies the HTTP or HTTPS address where GraphQL server is available.

  Specific for REST API

  - **apiInfo.documentationUrl**

    (Optional) This parameter specifies a URL to a website where external documentation is provided. This can be used when neither *swaggerUrl* not *graphqlUrl* are provided.

  - **apiInfo.version**

    (Optional) This parameter specifies the actual version of the API in semantic versioning format. This can be used when *swaggerUrl* is not provided.

  - **apiInfo.defaultApi**

    (Optional) This parameter specifics that the API is the default one to show in the API Catalog. If this not set to true for any API, or multiple APIs have it set to true, then the default API becomes the API with the highest major version as seen in `apiInfo.version`.

  - **apiInfo.codeSnippet** (Optional)

specifies the customized code snippet for a specific endpoint (API operation). The snippet is displayed in the API Catalog under the specified operation, after executing the request using the *Try it out* functionality. This can be used when swaggerUrl is not provided. When specifying this configuration, you need to provide the following parameters:

- `endpoint`
  The endpoint that represents the API operation of the customized snippet
- `language`
  The language of the snippet
- `codeBlock`
  The content of the snippet to be displayed in the API Catalog

- **customMetadata**

  Custom metadata are described here.

- **catalogUiTileId**

  This parameter specifies the unique identifier for the API services group. This is the grouping value used by the API Mediation Layer to group multiple API services together into "tiles". Each unique identifier represents a single API Catalog UI dashboard tile. Specify the value based on the ID of the defined tile.

- **catalogUiTile**

  This section contains definitions of tiles. Each tile is defined in a section that has its tile ID as a key. A tile can be used by multiple services.

  - **catalogUiTile.{tileId}.title**

    This parameter specifies the title of the API services product family. This value is displayed in the API Catalog UI dashboard as the tile title.

  - **catalogUiTile.{tileId}.description**

    This parameter specifies the detailed description of the API Catalog UI dashboard tile. This value is displayed in the API Catalog UI dashboard as the tile description.

- **additionalServiceMetadata**

  This section contains a list of changes that allows adding or modifying metadata parameters for the corresponding service.

  - **additionalServiceMetadata.serviceId**

    This parameter specifies the service identifier for which metadata is updated.

  - **additionalServiceMetadata.mode**

    This parameter specifies how the metadata are updated. The following modes are available:

    UPDATE

    Only missing parameters are added. Already existing parameters are ignored.

FORCE_UPDATE

All changes are applied. Existing parameters are overwritten.

- **additionalServiceMetadata.{updatedParameter}**

  This parameter specifies any metadata parameters that are updated.

Add and validate the definition in the API Mediation Layer running on your machine

After you define the service in YAML format, you are ready to add your service definition to the API Mediation Layer ecosystem.

The following procedure describes how to add your service to the API Mediation Layer on your local machine.

Follow these steps:

1. Copy or move your YAML file to the `config/local/api-defs` directory in the directory with API Mediation Layer.
2. Start the API Mediation Layer services.

   Tip: For more information about how to run the API Mediation Layer locally, see Running the API Mediation Layer on Local Machine.
3. Run your Java application.

   Tip: Wait for the services to be ready. This process may take a few minutes.
4. Validate successful onboarding

   You successfully defined your Java application if your service is running and you can access the service endpoints. The following example is the service endpoint for the sample application:

   `https://localhost:10010/petstore/api/v2/pets/1`

Add a definition in the API Mediation Layer in the Zowe runtime

After you define and validate the service in YAML format, you are ready to add your service definition to the API Mediation Layer running as part of the Zowe runtime installation on z/OS.

Follow these steps:

1. Locate the Zowe instance directory. The Zowe instance directory is the directory from which Zowe was launched, or else was passed as an argument to the SDSF command used to start Zowe. If you are unsure which instance directory a particular Zowe job is using, open the `JESJCL` spool file and navigate to the line that contains `STARTING EXEC ZWESLSTC,INSTANCE=`. This is the fully qualified path to the instance directory.

> **NOTE**

> The `${zoweInstanceDir}` symbol is used in following instructions.

2. Add the fully qualified zFS path of your YAML file to `ZWE_STATIC_DEFINITIONS_DIR` in `zowe.yaml`.

   - To hold your YAML file outside of the instance directory, add `ZWE_STATIC_DEFINITIONS_DIR` variable to the `zowe.environments` section of `zowe.yaml`. Append the fully qualified zFS path of the YAML file to the `ZWE_STATIC_DEFINITIONS_DIR` variable. You may specify multiple zFS paths, separating each path by a semicolon.

   - To place your YAML file within the instance directory, copy your YAML file to the `${zoweInstanceDir}/workspace/api-mediation/api-defs` directory.

   > **NOTES:**
   > - The `${zoweInstanceDir}/workspace/api-mediation/api-defs` directory is created the first time that Zowe starts. If you have not yet started Zowe, this directory might be missing.
   > - The user ID `ZWESVUSR` that runs the Zowe started task must have permission to read the YAML file.

3. Ensure that your application that provides the endpoints described in the YAML file is running.

4. Restart Zowe runtime or follow steps in section (Optional) Reload the services definition after the update when the API Mediation Layer is already started which allows you to add your static API service to an already running Zowe.

5. Validate successful onboarding

You successfully defined your Java application if your service is running and you can access its endpoints. The endpoint displayed for the sample application is:

(Optional) Check the log of the API Mediation Layer

The API Mediation Layer log can contain messages based on the API ML configuration. The API ML prints the following messages to its log when the API definitions are processed:

> **NOTE**
>
> If these messages are not displayed in the log, ensure that the API ML debug mode is active.

(Optional) Reload the services definition after the update when the API Mediation Layer is already started

The following procedure enables you to refresh the API definitions after you change the definitions when the API Mediation Layer is already running.

Follow these steps:

1. Use a REST API client to issue a `POST` request to the Discovery Service (port 10011):

   `http://localhost:10011/discovery/api/v1/staticApi`

The Discovery Service requires authentication by a client certificate. If the API Mediation Layer is running on your local machine, the certificate is stored at `keystore/localhost/localhost.pem`.

This example uses the HTTPie command-line HTTP client and is run with Python 3 installed:

Alternatively, it is possible to use curl to issue the POST call if it is installed on your system:

2. Check if your updated definition is effective.

> **NOTE**
>
> It can take up to 30 seconds for the API Gateway to pick up the new routing.

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Optional features to use with onboarded APIs

The following features are available to use with APIs that have been onboarded to Zowe API Mediation Layer:

- Using API Mediation Layer Message Service
  This feature is available for use with the Plain Java and Spring Boot Enablers.
- Customizing Metadata (optional)

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Using API Mediation Layer Message Service

The API ML Message Service component unifies and stores REST API error messages and log messages in a single file. The Message Service component enables users to mitigate the problem of message definition redundancy which helps to optimize the development process.

- Message Definition
- Creating a message
- Mapping a message
  - API ML Logger

Message Definition

API ML uses a customizable infrastructure to format both REST API error messages and log messages. `yaml` files make it possible to centralize both API error messages and log messages. Messages have the following definitions:

- Message `key` - a unique ID in the form of a dot-delimited string that describes the reason for the message. The `key` enables the UI or the console to show a meaningful and localized message.

  > **TIPS:**
  > - We recommend using the format `org.zowe.sample.apiservice.{TYPE}.greeting.empty` to define the message key. `{TYPE}` can be the api or log keyword.
  > - Use the message `key` and not the message `number`. The message `number` makes the code less readable, and increases the possibility of errors when renumbering values inside the `number`.

- Message `number` - a typical mainframe message ID (excluding the severity code)
- Message `type` - There are two Massage types:
  - REST API error messages: `ERROR`
  - Log messages: `ERROR`, `WARNING`, `INFO`, `DEBUG`, or `TRACE`
- Message `text` - a description of the issue
- Message `reason` - A reason for why this issue occured
- Message `action` - What should I as a user do to correct the problem

The following example shows the message definition.

Example:

Creating a message

Use the following classes when you create a message:

- `org.zowe.apiml.message.core.MessageService` - lets you create a message from a file.
- `org.zowe.apiml.message.yaml.YamlMessageService` - implements `org.zowe.apiml.message.core.MessageService` so that `org.zowe.apiml.message.yaml.YamlMessageService` can read message information from a `yaml` file, and create a message with message parameters.

Use the following process to create a message.

Follow these steps:

1. Load messages from the `yaml` file.

   Example:

2. Use the `Message createMessage(String key, Object... parameters);` method to create a message.

   Example:

Mapping a message

You can map the `Message` either to a REST API response or to a log message.

When you map a REST API response, use the following methods:

- `mapToView` - returns a UI model as a list of API Message, and can be used for Rest API error messages
- `mapToApiMessage` - returns a UI model as a single API Message

The following example is a result of using the `mapToView` method.

Example:

The following example is the result of using the `mapToApiMessage` method.

Example:

API ML Logger

The `org.zowe.apiml.message.log.ApimLogger` component controls messages through the Message Service component.

The following example uses the `log` message definition in a `yaml` file.

Example:

When you map a log message, use `mapToLogMessage` to return a log message as text. The following example is the output of the `mapToLogMessage`.

Example:

Use the `ApimlLogger` to log messages which are defined in the yaml file.

Example:

The following example shows the output of a successful `ApimlLogger` usage.

Example:

Customizing Metadata (optional)

Additional metadata can be added to the instance information that is registered in the Discovery Service in the `customMetadata` section. This information is propagated from the Discovery Service to the onboarded services (clients). In general, additional metadata do not change the behavior of the client. Some specific metadata can configure the functionality of the API Mediation Layer. Such metadata are generally prefixed with the `apiml.` qualifier. We recommend you define your own qualifier, and group all metadata you wish to publish under this qualifier. If you use the Spring enabler, ensure that you include the prefix `apiml.service` before the parameter name.

- **customMetadata.apiml.enableUrlEncodedCharacters**
  When this parameter is set to `true`, the Gateway allows encoded characters to be part of URL requests redirected through the Gateway. The default setting of `true` is the recommended setting. Change this setting to `false` only if you do not want certain encoded characters in your application's requests.

  > **IMPORTANT**
  > When the expected encoded character is an encoded slash or backslash (`%2F`, `%5C`), make sure the Gateway is also configured to allow encoded slashes. For more information, see Zowe runtime in Zowe server-side installation overview.

  > **NOTE**
  > If you use the Spring enabler, use the following parameter name:
  > `apiml.service.customMetadata.apiml.enableUrlEncodedCharacters`

- **customMetadata.apiml.connectTimeout**
  The value in milliseconds that specifies a period in which API ML should establish a single, non-managed connection with this service. If omitted, the default value specified in the API ML Gateway service configuration is used.

  > **NOTE**
  > If you use the Spring enabler, use the following parameter name:
  > `apiml.service.customMetadata.apiml.connectTimeout`

- **customMetadata.apiml.readTimeout**
  The value in milliseconds that specifies the time of inactivity between two packets in response from this service to API ML. If omitted, the default value specified in the API ML Gateway service configuration is used.

  > **NOTE**
  > If you use the Spring enabler, use the following parameter name:
  > `apiml.service.customMetadata.apiml.readTimeout`

- **customMetadata.apiml.connectionManagerTimeout**
  HttpClient employs the HTTP connection manager to manage access to HTTP connections. The purpose of an HTTP connection manager is to create new HTTP connections, to manage the life cycle of persistent connections, and to synchronize access to persistent connections. Internally, the HTTP connection manager works with managed

connections which serve as proxies for real connections. `connectionManagerTimeout` specifies a period in which managed connections with API ML are to be established. The value is in milliseconds. If omitted, the default value specified in the API ML Gateway service configuration is used.

> **NOTE**
>
> If you use the Spring enabler, use the following parameter name:
> `apiml.service.customMetadata.apiml.connectionManagerTimeout`

- **customMetadata.apiml.okToRetryOnAllOperations**
  Specifies whether all operations can be retried for this service. The default value is `false`. The `false` value allows retries for only `GET` requests if a response code of `503` is returned. Setting this value to `true` enables retry requests for all methods, which return a `503` response code. Enabling retry can impact server resources resulting from buffering of the request body.

  > **NOTE**
  >
  > If you use the Spring enabler, use the following parameter name:
  > `apiml.service.customMetadata.apiml.okToRetryOnAllOperations`

- **customMetadata.apiml.corsEnabled**
  When this parameter is set to `true`, CORS handling by the Gateway is enabled on the service level for all service routes.

  For more information, refer to enabling CORS with Custom Metadata on the Gateway: Customizing Cross-Origin Resource Sharing (CORS). Additional information can be found in this article about Cross-Origin Resource Sharing (CORS).

  > **NOTE**
  >
  > If you use the Spring enabler, use the following parameter name:
  > `apiml.service.customMetadata.apiml.corsEnabled`

- **customMetadata.apiml.gatewayAuthEndpoint**
  Specifies the Gateway authentication endpoint used by the ZAAS Client configuration. The default value is `/api/v1/gateway/auth`. For more information about ZAAS Client, see ZAAS Client.

  > **NOTE**
  >
  > If you use the Spring enabler, use the following parameter name:
  > `apiml.service.customMetadata.apiml.gatewayAuthEndpoint`

- **customMetadata.apiml.gatewayPort**
  Specifies the Gateway port used by the ZAAS Client configuration. The default value is `10010`. For more information about ZAAS Client, see ZAAS Client.

  > **NOTE**

> If you use the Spring enabler, use the following parameter name:
> `apiml.service.customMetadata.apiml.gatewayPort`

- **customMetadata.apiml.corsAllowedOrigins**
  Optionally, service can specify which origins are to be accepted by the Gateway during CORS handling. When this parameter is not set, the accepted origins are `*` by default. You can provide a comma-separated list of values to explicitly limit the accepted origins.

  > **NOTE**
  > If you use the Spring enabler, use the following parameter name:
  > `apiml.service.customMetadata.apiml.corsAllowedOrigins`

  For more information, refer to enabling CORS with Custom Metadata on the Gateway: Customizing Cross-Origin Resource Sharing (CORS).

  - **customMetadata.apiml.lb.type**
    This parameter is part of the load balancing configuration for the Deterministic Routing capability. Through this parameter, the service can specify which load balancing schema the service requires. If this parameter is not specified, the service is routed using the basic round robin schema. This parameter can be set to the following values:

  - **`headerRequest`**
    This value applies the Header Request load balancing schema. Clients can call the API Gateway and provide a special header with the value of the requested instanceId. The Gateway understands this as a request from the client for routing to a specific instance. Clients have several possibilities for understanding the topology of service instances, such as via the `/eureka/apps` endpoint on the Discovery service, or the `/gateway/services` endpoint on the Gateway. In either case, the information is provided. The client can then request a specific instance by using the special header described below.

    The header name is `X-InstanceId`, and the sample value is `discoverable-client:discoverableclient:10012`. This is identical to `instanceId` property in the registration of the Discovery service.

    In combination with enabling Routed instance header, the client can achieve sticky session functionality. (The term, 'sticky session' refers to the feature of many load balancing solutions to route the requests for a particular session to the same physical machine that serviced the first request for that session). The benefit of this approach is that there is no session on the Gateway, and the client ultimately decides whether or not to go to a specific instance. This method uses the following sequence:

    a. The client calls API Gateway and gets routed to a service.
    b. The client reads the `X-InstanceId` header value from the response to understand the service was routed to.
    c. For all subsequent requests, the client provides the `X-InstanceId` header with previously read value to get routed to the same instance of the service.

  - **`authentication`**
    This value applies the Authentication load balancing schema. This is a sticky session functionality based on the ID of the user. The user ID is understood from the Zowe SSO token on the client's request. Requests without the token are routed in a round robin fashion. The user is first routed in a round robin fashion, and then the routed instance Id is cached. The instance information is used for subsequent requests to route the client to the cached

target service instance. This session's default expiration time is 8 hours. After the session expires, the process initiates again.

In default configuration, this cache is stored on each Gateway instance. You can choose to distribute this cache between the Gateway's instances. To do so, follow the steps described in Distributing the load balancer cache.

- **customMetadata.apiml.lb.cacheRecordExpirationTimeInHours**
  When the property `customMetadata.apiml.lb.type` is set to `authentication`, the user can also define the expiration time for the selected instance information that is cached. This property aims to prevent any discrepancy which might occur if the required target server is no longer available. The default value is 8 hours.

- **customMetadata.apiml.gateway.applyRateLimiterFilter**
  When this parameter is set to `true`, the rate limiter is applied to the request for this service. When enabling this filter, you can also define the following properties:

  - `customMetadata.apiml.gateway.rateLimiterCapacity`
    Defines the total number of requests that can be allowed at one time per user
  - `customMetadata.apiml.gateway.rateLimiterTokens`
    Defines the number of requests that are added to the service’s allowance at regular intervals
  - `customMetadata.apiml.gateway.rateLimiterRefillDuration`
    Sets the time interval (in minutes) at which new requests (or tokens) are added.

  When no values are provided, global values defined in the Gateway are applied. For more information about the default configuration, see Customizing gateway rate limiter filer.

- **customMetadata.apiml.response.compress**
  When this parameter is set to `true`, API ML compresses content for all responses from this services using GZIP. API ML also adds the `Content-Encoding` header with value `gzip` to responses.

- **customMetadata.apiml.response.compressRoutes**
  When the `customMetadata.apiml.response.compress` parameter is set to `true`, this parameter allows services to further limit the compressed routes. The parameter accepts ant style routes deliminated by `,` . The expectation is to provide the absolute paths.

  If relative paths are provided, the starting `/` is added. If the beginning of the pattern does not need to be specifically defined, use `**/{pathYouAreInterestedIn}`

  Examples:

  - `/service/**`
    Compresses all paths starting with /service/

  - `/service/api/v1/compress,/service/api/v1/custom-compress`
    Compresses the specific two routes

  - `/\*\*/compress/\*\*`
    Compresses all paths that contain `compress` as a specific path

- **customMetadata.apiml.response.headers**
  (Optional) A service can specify headers that are added to the response by the Gateway. When this parameter is not set or is empty, no headers are added. Header names and header values are separated by `:`. Multiple headers can

be added, delimited by `,`. If a header with the same name already exists in the response, the Gateway overwrites the value of the header.

Examples:

- `Strict-Transport-Security:max-age=1234; includeSubDomains`
  Sets a header with name `Strict-Transport-Security` and value `max-age=1234; includeSubDomains`.
- `Strict-Transport-Security:max-age=1234; includeSubDomains, X-Frame-Options:SAMEORIGIN`
  Sets two headers:

  a. Header with name `Strict-Transport-Security` and value `max-age=1234; includeSubDomains`.
  b. Header with name `X-Frame-Options` and value `SAMEORIGIN.

- **customMetadata.apiml.headersToIgnore**
  (Optional) A service can specify headers that are removed from the request to the southbound service by the Gateway. When this parameter is not set or is empty, no headers are removed. Multiple headers can be removed, delimited by `,`.

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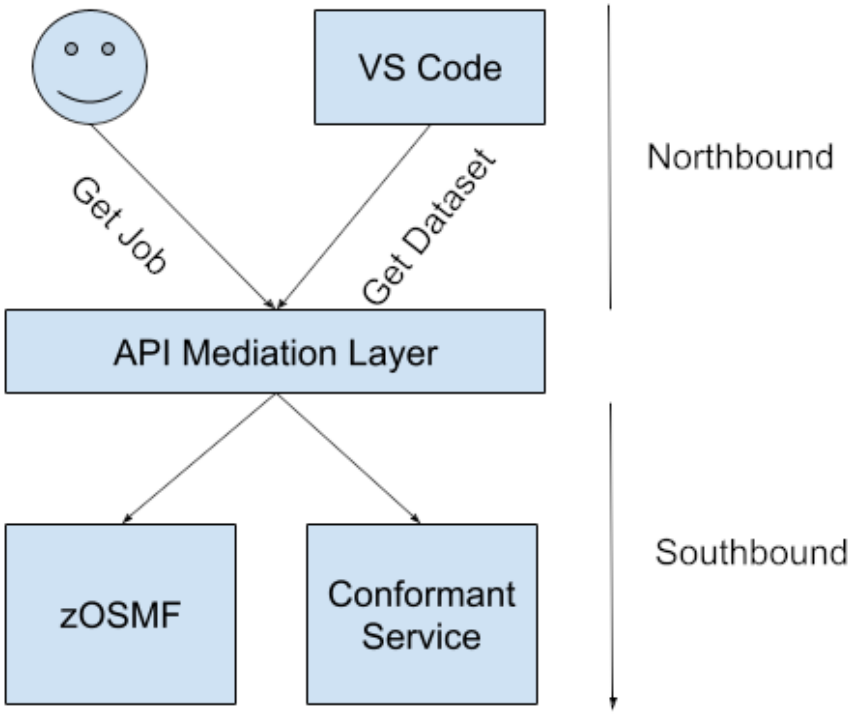
API ML Routing Overview

The API Mediation Layer (API ML) in Zowe acts as a Level 7 Load Balancer, using the API Gateway to route requests to backend services. The routing feature supports both single and multiple API ML instances.

The following diagram shows a request for a specific job from a customer and the services involved in the delivery of the request.



Key Concepts

- **Service**

  A service provides one or more APIs and is identified by a service ID. Note that sometimes the term "service name" refers to the service ID.

  The default service ID is provided by the service developer in the service configuration file.

  A system administrator can replace the service ID with a specific name of the deployment environment using additional configuration that is external to the service deployment unit. Typically, this name is configured in a JAR or WAR file. Ensure that you detail how to specify the name in your service documentation.

  Services are deployed using one or more service instances, which share the same service ID and implementation.

- **Instance**
  Refers to the instance of a specific service providing one or more APIs

- **Service ID**
  The unique identifier for each service

- **Instance Routing**
  Routes requests based on service instances

- **Versioning**
  Supports routing to specific service versions

Basic Routing

In basic routing, requests are routed using the service ID and optionally, the service version:

Example: `https://gateway-url/api/v1/service-id`

Routing Mechanism Routing can be configured for either single or multiple API ML instances

- **Single API ML Instance**
  Uses Eureka metadata for direct routing to a service based on the service ID

- **Multiple API ML Instances**
  Uses Eureka metadata for service discovery and load balancing

Implementation Details
Routing configuration is defined in Eureka metadata. Ensure proper setup for accurate routing. The following yaml file is an example of Eureka metadata configuration:

This part of the service metadata configuration defines how the request coming from the upstream (northbound) service will be accepted and then passed to the downstream (southbound) service.

The following shows service URL tansformations if the downstream (southbound) service has the contextPath zosmf:

- The request `https://apiml/zosmf/ui/v1/desktop` from the user is transformed to `https://service/zosmf/desktop`
- The request `https://apiml/zosmf/api/v1/desktop` from the user is transformed to `https://service/zosmf/api/v1/desktop`
- The request `https://apiml/zosmf/ws/v1/desktop` from the user is transformed to `https://service/zosmf/ws/desktop`

Instance Routing
API ML supports routing to multiple instances of the same service, thereby distributing requests based on load balancing policies. Ensure each service instance registers with a unique instance ID in Eureka.

Versioning
API ML makes it possible to specify the version of a service in the route. If a version is not specified, the latest version is used by default. Version specified routing provides flexibility in deploying and updating services without affecting existing clients.

Example Usage
The following URL is an example of routing to a specific version of a service:

Note that if no version is specified, as in the following example, the request defaults to the latest service version:

Deployments

Deployment can be for single or multiple instances.

- **A single instance** of the API Mediation Layer with one or more instances of the services onboarded
- **Multiple instances** of the API Mediation Layer in High Availability setup with one or more instances of the services onboarded

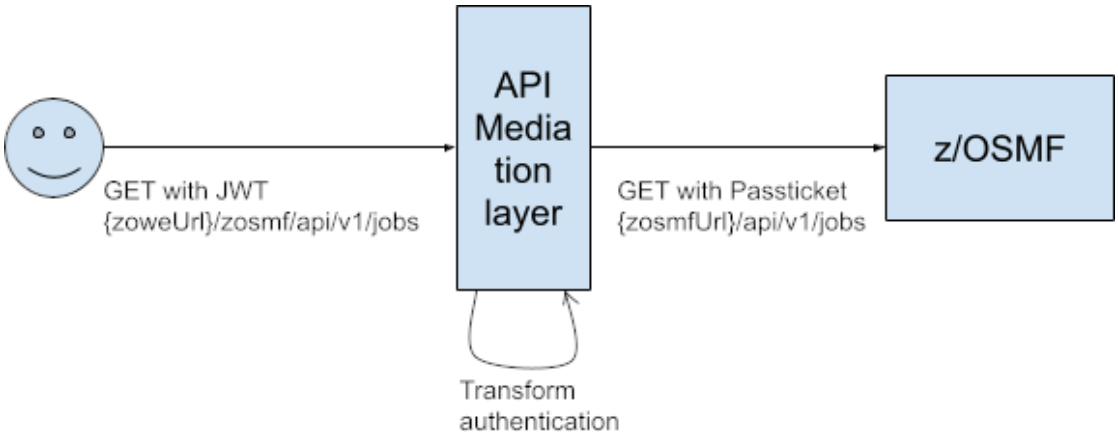
The onboarded services may be onboarded in one or more instances and the APIs that the services provide may be versioned. API Mediation Layer supports distinction on the major version boundary.

Making a GET call to a service through single instance of API ML

When there is one instance of the API Mediation Layer in the system, the API ML is expected to be the entry point to the system. The following diagrams show the process of making a `GET` call to a service available on a single instance.

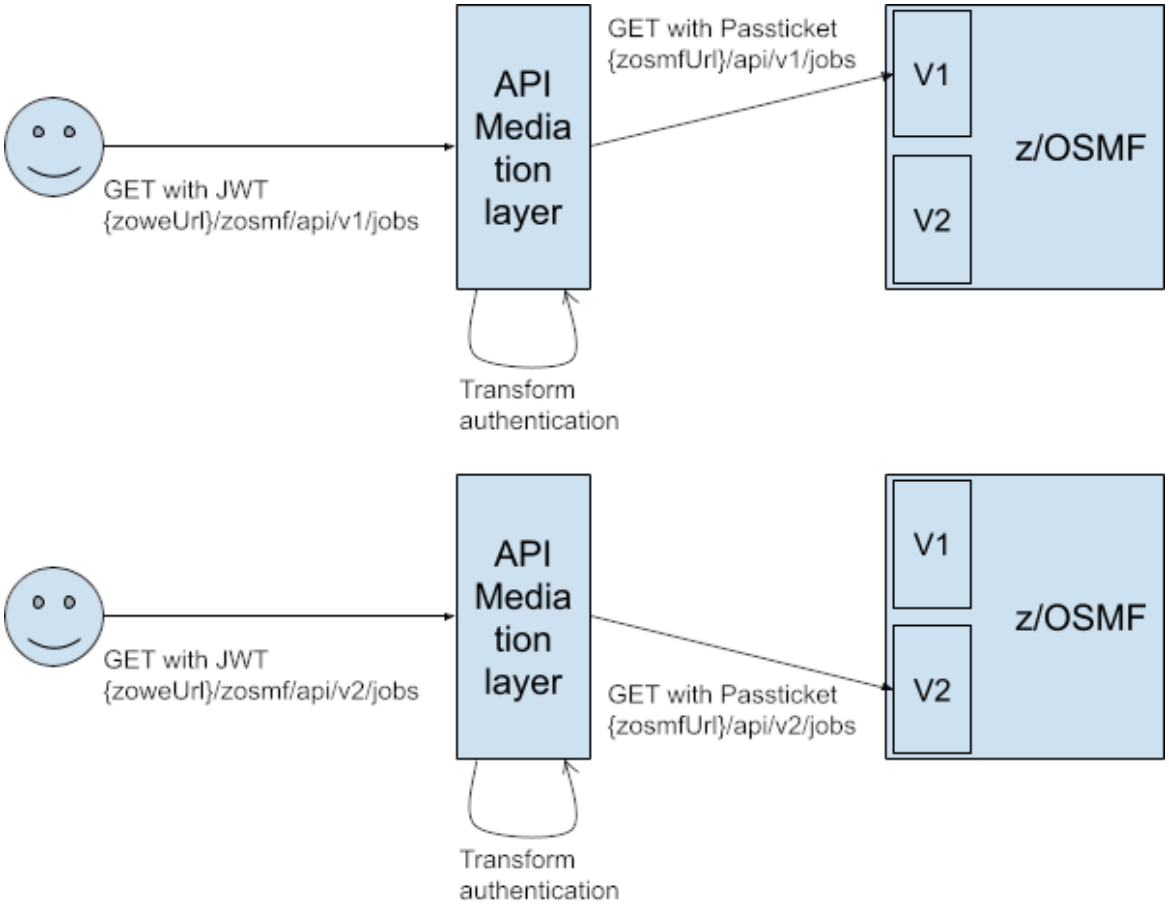
A GET call to a service with a single version on a single instance

The following diagram shows the flow of a `GET` request through different involved components to the z/OSMF service deployed on one LPAR with one instance. z/OSMF in this case does not version the API.



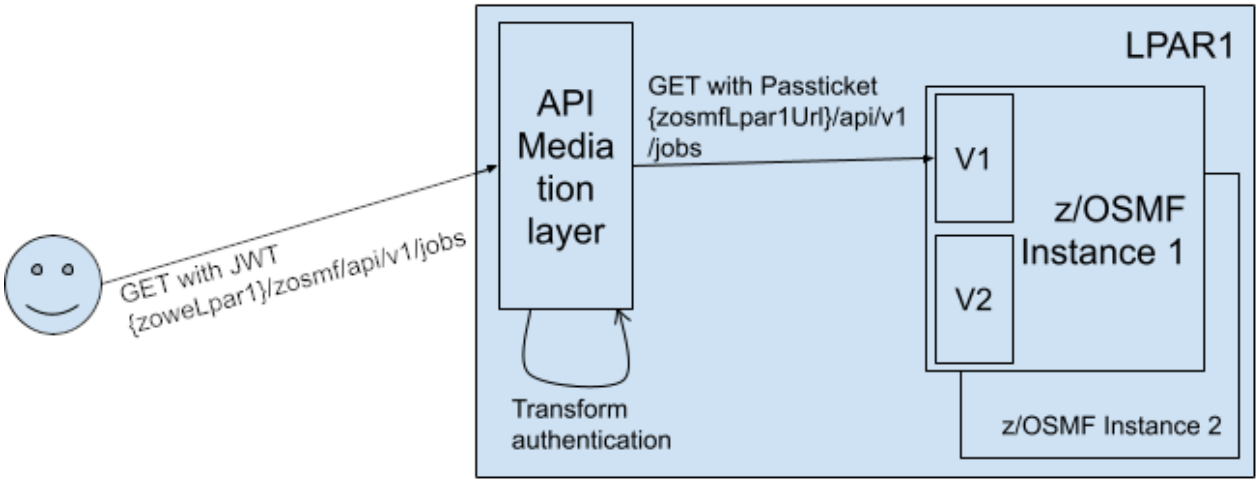
A GET call to a service with multiple versions on a single instance

The following diagram shows the flow of a `GET` request through different involved components to the z/OSMF service deployed on one LPAR with one instance. In this case, z/OSMF versions the API and the request is intended for a specific major version.



GET calls to multiple instances of a service

The following diagram shows the flow of a `GET` request through different involved components to the z/OSMF service deployed on one LPAR with multiple instances. In this case, z/OSMF versions the API and the request is intended for a specific major version.

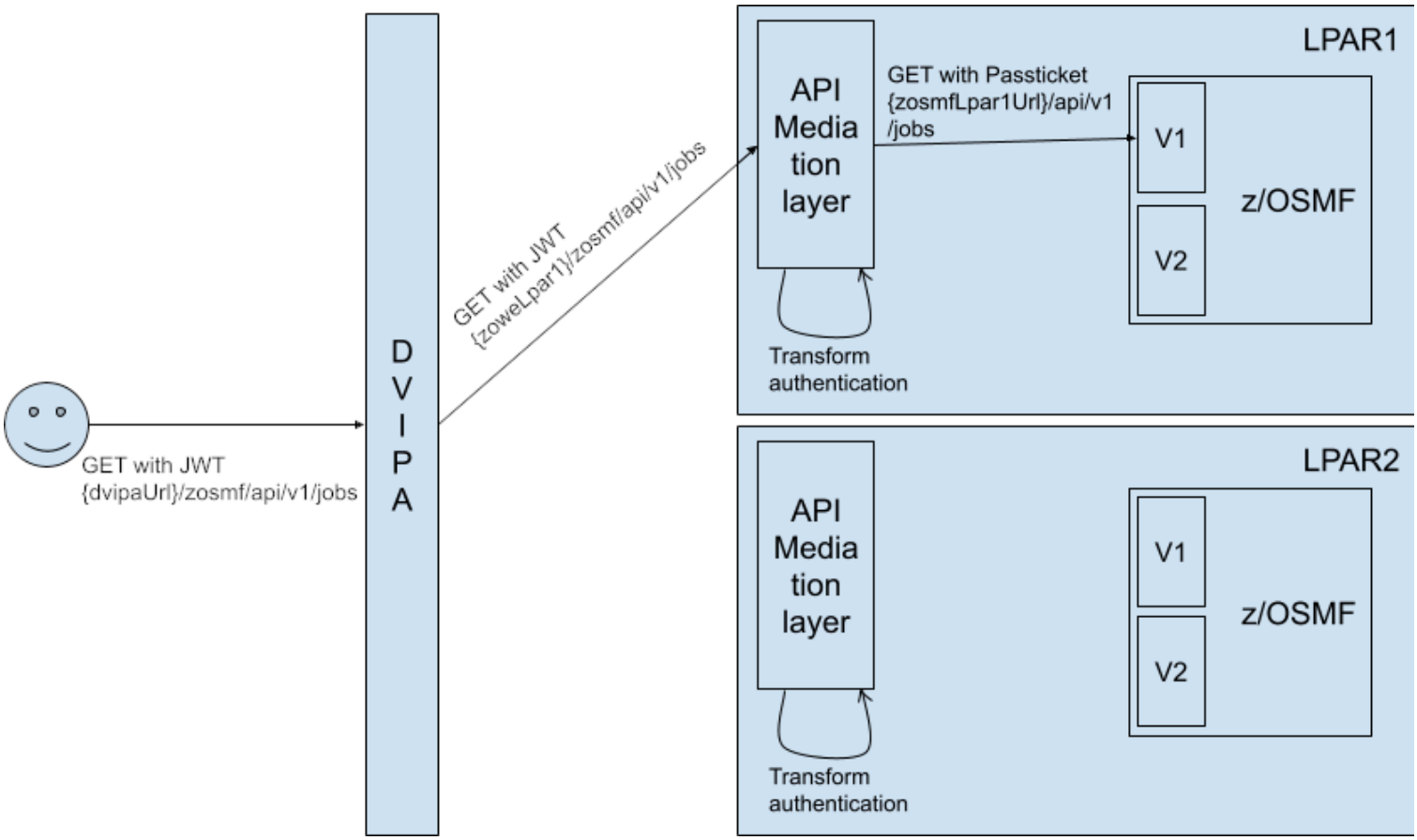


A GET call to a service through multiple API Mediation Layer Instances

When there are multiple API Mediation Layer Instances in the system, DVIPA is expected as the load balancer which distributes requests to API Mediation Layer instances. API Mediation Layer subsequently distributes the requests to the running instances of the specific service. The following diagrams shows the flow of a single request.

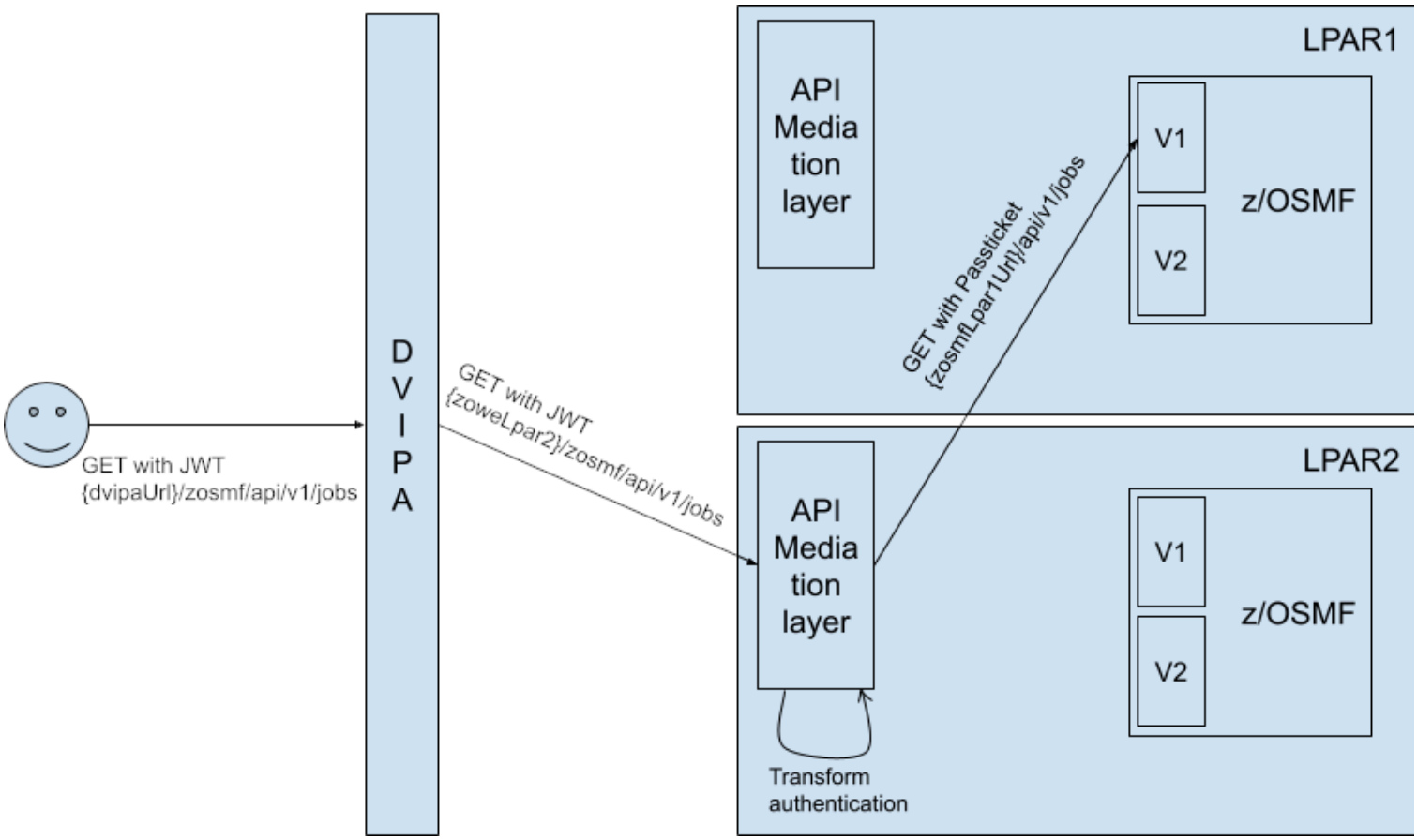
Same LPAR Multiple API Mediation Layer Instances

The following diagram shows the flow of the `GET` request through different involved components to the z/OSMF service deployed on multiple LPARs with multiple instances on one LPAR, and one instance on another LPAR. In this case, z/OSMF versions the API and the request is intended for a specific major version. DVIPA randomly selects one of the available API Mediation Layer instances, which then randomly selects one of the available service instances (in this case on the same LPAR).



Different LPAR Multiple API Mediation Layer Instances

The following diagram shows the flow of the `GET` request through different involved components to the z/OSMF service deployed on multiple LPARs with multiple instances on one LPAR, and one instance on another LPAR. In this case, z/OSMF versions the API and the request is intended for a specific major version. DVIPA randomly selects one of the available API Mediation Layer instances, which subsequently randomly selects one of the available service instances regardless whether the instance resides on the same LPAR. In this case the selected instance is on another LPAR.



Advanced Configuration

Advanced routing configurations can include custom load balancing rules, fallback options, and route-specific policies. Refer to the detailed configuration guide for more advanced settings and examples.

By default, routing through the API Mediation Layer selects the instance to route to in Round-robin fashion for each specific request. It is possible to change this behavior to assign a specific user to a specific instance or to change the behavior by providing the option to go to a specific instance of a service.

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Understanding service routing through the Gateway

As an extender of API Mediation Layer, review how service routing thorough the Gateway works

> **REQUIRED ROLES: ZOWE EXTENDER, APPLICATION DEVELOPER**

Choose from the following routing methods:

- Understanding service routing through the Gateway
  - Routing with versioning
  - Routing without versioning

Service instances provide information about routing to the API Gateway via Eureka metadata.

Routing with versioning

For basic routing, the `gatewayUrl` and `sericeUrl` are specified with the corresponding version:

Example:

routes:

- gatewayUrl: "ui/v1" serviceUrl: "/helloworld"
- gatewayUrl: "api/v1" serviceUrl: "/helloworld/v1"
- gatewayUrl: "api/v2" serviceUrl: "/helloworld/v2"

In this example, the service has a service ID of `helloworldservice` that exposes the following endpoints:

- **UI**
  `https://gateway/helloworldservice/ui/v1` routed to `https://hwServiceHost:port/helloworld/`
- **API major version 1**
  `https://gateway/helloworldservice/api/v1` routed to `https://hwServiceHost:port/helloworld/v1`
- **API major version 2**
  `https://gateway/helloworldservice/api/v2` routed to `https://hwServiceHost:port/helloworld/v2`

This type of routing has the following features:

- The gatewayUrl is matched against the prefix of the URL path used at the Gateway `https://gateway/urlPath`, where `urlPath` is `serviceId/prefix/resourcePath`.
- The service ID is used to find the service host and port.
- The `serviceUrl` is used to prefix the `resourcePath` at the service host.

> **NOTE**

> The service ID is not included in the routing metadata, but the service ID is in the basic Eureka metadata.

Routing without versioning

This method of routing is similar to the previous method, but does not use the version part of the URL. This approach is useful for services that handle versioning themselves with different granularity.

One example that only uses a service ID is z/OSMF.

Example:

z/OSMF URL through the Gateway has the following format:

`https://gateway:10010/ibmzosmf/api/restjobs/jobs/...`

- **ibmzosmf**
  Specifies the service ID.

- **/restjobs/1.0/...**
  Specifies the rest of the endpoint segment.

  Note that no version is specified in this URL.

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Routing Websocket based APIs

As an API developer using Zowe, you can route WebSocket APIs through the API Mediation Layer. For details about Websocket routing from the client side, see Routing with websockets.

> **REQUIRED ROLES: ZOWE EXTENDER, APPLICATION DEVELOPER**

To accept Websockets, it is necessary that the API Mediation Layer is aware that a Websocket connection is required. To inform the API Mediation Layer, the issuer of the call to the API needs to add the `(/ws/...)` prefix in the URL of the called API.

Example of a valid URL for a Websocket API:

`https://gatewayUrl/exampleService/ws/v1/communicate`

Configure the service for Websockets

The configuration relevant for Websockets is contained within the routes section in the configuration. A complete example using a WebSocket that is statically onboarded is available in the API ML repo.

Example:

- **ws**
  Specifies a WebSocket connection as presented in the beginning of the Gateway URL.

> **NOTE**
>
> The `serviceRelativeUrl` is customizable and does not have to contain `ws`.
>
> **Example:**
> It is possible to access via the URL `https://gatewayUrl/exampleService/ws/v1/communicate` on the actual server that would appear as the URL `https://serverUrl/exampleService/ui/communicate`.

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Creating an Extension for API ML

Zowe allows extenders to define their own extension for API ML. Follow the steps in this article to create your extension and add it to the API Gateway classpath.

> **NOTE**
>
> The `api-sample-extension-package` contains a sample `manifest.yml` and the `apiml-sample-extension` JAR that contains the extension.

Follow these steps:

1. Create a JAR file from your extension. See the API ML sample extension to model the format of the JAR.
2. Create a `manifest.yml` with the following structure. See the sample `manifest.yml` to model the format of the yaml file.

For more information, see Packaging z/OS extensions.

Example:

The extension directory `<instance>/workspace/gateway/sharedLibs/` is then added to the API Gateway class path as part of the Zowe instance preparation.

> **NOTE**
>
> The paths defined under `gatewaySharedLibs` can either be a path to the directory where the extensions JARs are located, or a path to the files.

Example:

After the JAR file and `manifest.yml` are customized according to your application, the extension is extracted, scanned and added to the extension directory during the Zowe instance preparation. When the API Gateway starts, the the API Gateway consumes the sample extension.

The extension should now be correctly added to the API Gateway classpath.

Call the REST endpoint for validation

Follow these steps to validate that you can call the REST endpoint defined in the controller via the API Gateway:

1. Call the `https://<hostname>:<gatewayPort>/api/v1/greeting` endpoint though Gateway.
2. Verify that you receive the message, `Hello, I'm a sample extension!` as the response.

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Implementing a new SAF IDT provider

As a Zowe API ML user, you can use the API Gateway to apply your own SAF Identity Token (IDT) provider by implementing an existing interface.

- How to create a SAF IDT provider
- How to integrate your extension with API ML
- How to use an existing SAF IDT provider
- How to use the SAF IDT provider

To configure SAF IDT on z/OS, see Configure signed SAF Identity tokens (IDT).

How to create a SAF IDT provider

To create your own implementation of the SAF IDT provider, follow these steps:

1. Implement the existing `org.zowe.apiml.gateway.security.service.saf.SafIdtProvider` interface.

The `SafIdtProvider` interface contains the `generate` and `verify` methods. The `generate` method can be overridden by your SAF IDT implementation to generate the SAF token on behalf of the specified user. The `verify` method can be overridden to verify that the provided SAF token is valid.

2. Register a bean in order to use the implemented SAF IDT provider.

Example:

You created a SAF IDT provider.

How to integrate your extension with API ML

To use your SAF IDT provider as an extension of API ML, see Create an extension for API ML.

How to use the SAF IDT provider

To use the newly created SAF IDT provider, it is necessary to set the parameter `apiml.authentication.scheme` to `safIdt` in your service configuration. Your application then properly recognizes the SAF IDT scheme and fills the `X-SAF-Token` header with the token produced by your SAF IDT provider.

How to use an existing SAF IDT provider

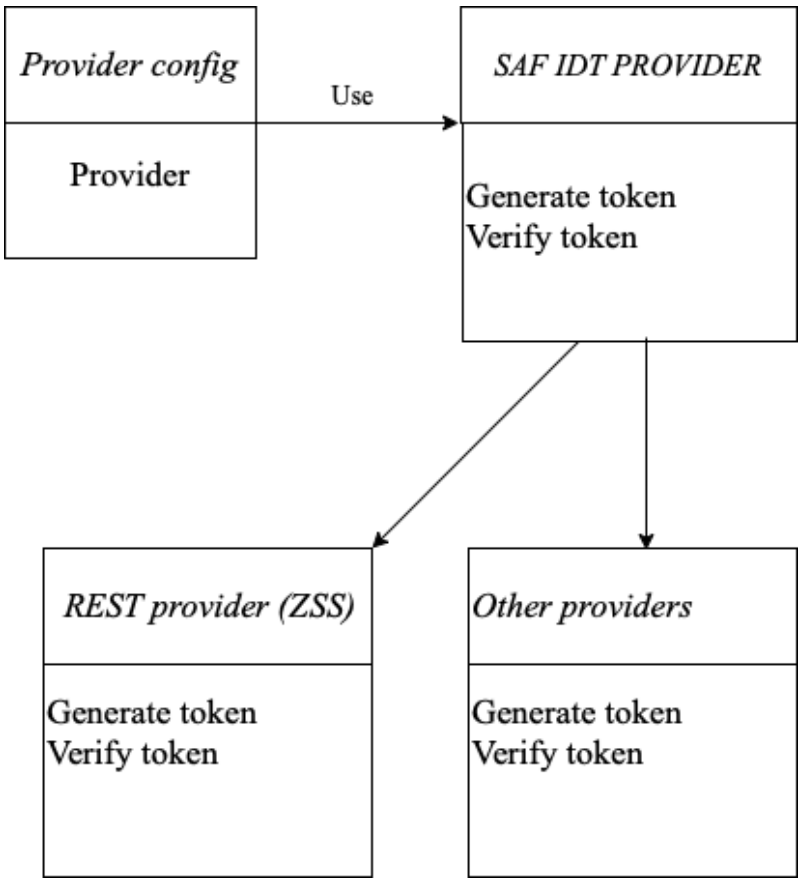
You can generate and verify an existing SAF token by using an implementation of the SAF IDT provider that utilizes a ZSS solution.

SafRestAuthenticationService is an example of the SAF IDT provider implementation which uses REST as a method of communication.

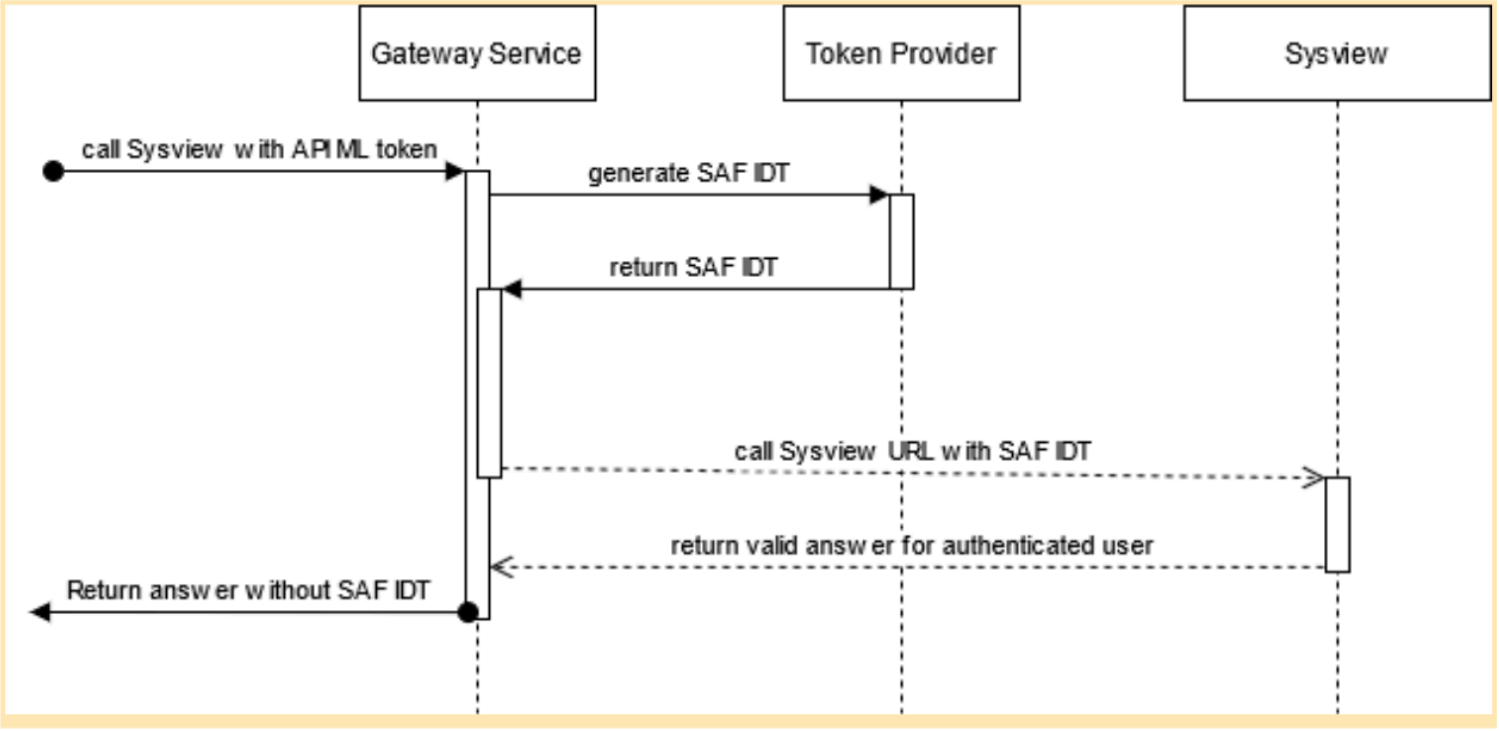
To use `SafRestAuthenticationService` ensure that `ZWE_configs_apiml_security_saf_provider` is set to `rest`. (This is the default value) Set the following environment parameters in `zowe.yaml`:

- `ZWE_configs_apiml_security_saf_urls_authenticate=https://${ZWE_haInstance_hostname}:${ZWE_components_gateway_port}/zss/api/v1/saf/authenticate`
- `ZWE_configs_apiml_security_saf_urls_verify=https://${ZWE_haInstance_hostname}:${ZWE_components_gateway_port}/zss/api/v1/saf/verify`

These ZSS endpoints are used by the `SafRestAuthenticationService` to generate and validate the SAF token.



The following diagram illustrates how communication using the SAF IDT provider works:


Gateway Service
Token Provider
Sysview
call Sysview with API ML token
generate SAF IDT
return SAF IDT
call Sysview URL with SAF IDT
return valid answer for authenticated user
Return answer without SAF IDT

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Single Sign On Integration for Extenders

> **ROLE: INFRASTRUCTURE APPLICATION DEVELOPER**

As an infrastructure application developer, review the ways a service can integrate with API Mediation Layer (API ML) and participate in the Single Sign On for REST APIs on the z/OS platform.

> **NOTE**
>
> This article does not cover the client methods to call API ML and authenticate. For more information about API ML authentication, see the Single Sign On Overview in the User Guide.

To integrate with API Mediation Layer and leverage Single Sign On, choose from the following three possible methods:

- Accepting JWT token (recommended)
- Accepting SAF IDT token
- Accepting PassTicket

Additional possibilities can potentially be leveraged to enable Single Sign On but are **not** properly integrated with the standard API ML:

- Bypassing authentication for the service
  Note: This option is for SSO only if the service does not have an authenticated endpoint.
- Accepting client certificates via x509 scheme
- Accepting z/OSMF LTPA token

Service configuration is generally provided in the yaml file when using one of the enablers outlined in this section. Key to general configuration is the `authentication` object. The `scheme` property under the `authentication` object states what type of authentication the service expects and is shared across all types of authentication.

Example:

- **authentication.scheme**
  Specifies a service authentication scheme. The following schemes participate in single sign on are supported by the API Gateway: `zoweJwt`, `safIdt`, `httpBasicPassTicket`. Two additional schemes that do not properly participate but may be relevant are `bypass`, and `x509`.

In the event that there is an issue with authentication, API ML sets `X-Zowe-Auth-Failure` error headers which are passed to downstream services. In addition, any `X-Zowe-Auth-Failure` error headers coming from an upstream service are also passed to the downstream services without setting valid headers. The `X-Zowe-Auth-Failure` error header contains details about the error and suggests potential actions.

Accepting JWT

Accepting JSON Web Tokens (JWT) is the recommended method for integrating. No configuration is needed on the user's side.

- When a Zowe JWT is provided, this scheme value specifies that the service accepts the Zowe JWT. No additional processing is done by the API Gateway.
- When a client certificate is provided, the certificate is transformed into a Zowe JWT, and the downstream service performs the authentication.
- If the downstream service needs to consume the JWT from a custom HTTP request header to participate in the Zowe SSO, it is possible to provide a header in the Gateway configuration.
- The HTTP header is then added to each request towards the downstream service and contains the Zowe JWT to be consumed by the service. For more information, see Enabling single sign on for extending services via JWT configuration.

Accepting SAF IDT

Using the scheme value `safIdt` specifies that the service accepts SAF IDT, and expects that the token produced by the SAF IDT provider implementation is in the `X-SAF-Token` header. It is necessary to provide a service APPLID in the `authentication.applid` parameter.

- `<applid>`
  Specifies the `APPLID` value that is used by the API service for PassTicket support (e.g. `OMVSAPPL`).

For more information, see Implement a SAF IDT provider.

Accepting PassTickets

Using the scheme value `httpBasicPassTicket` specifies that a service accepts PassTickets in the Authorization header of the HTTP requests using the basic authentication scheme. It is necessary to provide a service APPLID in the `authentication.applid` parameter to prevent PassTicket generation errors and to make sure API Mediation Layer can generate PassTickets with the given APPLID.

- When a JWT is provided, the service validates the Zowe JWT to use for PassTicket generation.
- When a client certificate is provided, the service validates the certificate by mapping the certificate to a mainframe user to use for PassTicket generation.
- If the downstream service needs to consume the user ID and the PassTicket from custom HTTP request headers (i.e. to participate in the Zowe SSO), it is possible to provide the headers in the Gateway configuration.
- The HTTP headers are then added to each request towards the downstream service. The headers contain the user ID and the PassTicket to be consumed by the service. For more information about the custom HTTP request headers, see Adding a custom HTTP Auth header to store Zowe JWT.

- `<applid>`
  Specifies the `APPLID` value that is used by the API service for PassTicket support (e.g. `OMVSAPPL`).

For more information, see Enabling single sign on for extending services via PassTicket configuration.

Bypassing authentication for the service

Using the scheme value `bypass` specifies that the token is passed unchanged to the service.

> **NOTE**
>
> This is the default scheme when no authentication parameters are specified.

Accepting client certificates via x509 scheme

While it is possible to integrate with client certificates by setting the scheme with the value `x509`, this approach is not recommended. We recommend that you use any of the previously described methods, whereby API ML will validate the certificate for you and ideally provide a Zowe JWT.

The `x509` scheme value specifies that a service accepts client certificates forwarded in the HTTP header only. The Gateway service extracts information from a valid client certificate. For validation, the certificate needs to be trusted by API Mediation Layer. Extended Key Usage must either be empty or needs to contain a Client Authentication (1.3.6.1.5.5.7.3.2) entry. To use this scheme, it is also necessary to specify which headers to include. Specify these parameters in `headers`. This scheme does not relate to the certificate used in the TLS handshake between API ML and the downstream service, but rather the certificate that is forwarded in the header that authenticates the user.

- **authentication.headers**
  When the `x509` scheme is specified, use the `headers` parameter to select which values to send to a service. Use one of the following values:
  - `X-Certificate-Public`
    The public part of client certificate base64 encoded
  - `X-Certificate-DistinguishedName`
    The distinguished name from client certificate
  - `X-Certificate-CommonName`
    The common name from the client certificate

Accepting z/OSMF LTPA token

Using the scheme value `zosmf` specifies that a service accepts z/OSMF LTPA (Lightweight Third-Party Authentication). This scheme should only be used for a z/OSMF service used by the API Gateway Authentication Service, and other z/OSMF services that are using the same LTPA key.

> **TIP**
>
> For more information about z/OSMF Single Sign-on, see Establishing a single sign-on environment.

Forwarding x509 client certificate

When client uses a x509 client certificates for authentication, the certificate can be forwarded to a downstream service. This is an alternative to the Bypassing authentication for the service option for client certificates.

The following steps outline the x509 client certificate forwarding flow:

1. A client sends a request to the API Gateway secured by a client certificate.

2. The API Gateway extracts the client certificate from the request and puts this certificate into the `Client-Cert` header.
3. The API Gateway forwards the request to the downstream service. The request is secured by the Zowe server certificate.
4. The downstream service must validate the Zowe server certificate in the request to verify the certificate's origin and extract the original client certificate from the header. This validation makes it possible for the service to then perform the authentication.

Both the API ML Gateway and the downstream service must conform to the following requirements to support x509 certificate forwarding:

API ML Gateway Requirements

- Enable client certificate forwarding in the `zowe.yaml`
- The API Gateway must trust the client certificate's issuer. As such, the API Gateway truststore must contain the client issuer's certificate.

Downstream service requirements

- The downstream service must indicate that it supports forwarded client certificates in the meta-information used in the onboarding process. The property `apiml.service.supportClientCertForwarding` must be set to `true`.
- To validate the Zowe server certificate used by the API Gateway, the service must be aware of the Zowe server certificate chain. This chain is available via the `/certificates` endpoint provided by every API Gateway instance.

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ZAAS Client

The ZAAS client is a plain Java library that provides authentication through a simple unified interface without the need for detailed knowledge of the REST API calls presented in this section. The Client function has only a few dependencies including Apache HTTP Client, Lombok, and their associated dependencies. The client contains methods to perform the following actions:

- To obtain a JWT token
- To validate and get details from a JWT token
- To invalidate the JWT token
- To obtain a PassTicket

This article contains the following topics:

- Pre-requisites
- API Documentation
  - Obtain a JWT token (`login`)
  - Validate and get details from the token (`query`)
  - Invalidate a JWT token (`logout`)
  - Obtain a PassTicket (`passTicket`)
- Getting Started (Step by Step Instructions)

Pre-requisites

- Java SDK version 1.8.
- An active instance of the API ML Gateway Service.
- A property file which defines the keystore or truststore certificates.

API Documentation

The plain java library provides the `ZaasClient` interface with following public methods:

This Java code enables your application to add the following functions:

- **Obtain a JWT token (`login`)**
- **Validate and get details from the token (`query`)**
- **Invalidate a JWT token (`logout`)**
- **Obtain a PassTicket (`passTicket`)**

Obtain a JWT token (`login`)

To integrate login, call one of the following methods for login in the `ZaasClient` interface:

- If the user provides credentials in the request body, call the following method from your API:

- If the user provides credentials as Basic Auth, use the following method:

These methods return the JWT token as a String. This token can then be used to authenticate the user in subsequent APIs.

> **NOTE**
>
> Both methods automatically use the truststore file to add a security layer, which requires configuration in the `ConfigProperties` class.

Validate and get details from the token (`query`)

Use the `query` method to get the details embedded in the token. These details include creation time of the token, expiration time of the token, and the user who the token is issued to.

Call the `query` method from your API in the following format:

In return, you receive the `ZaasToken` Object in JSON format.

This method automatically uses the truststore file to add a security layer, which you configured in the `ConfigProperties` class.

The `query` method is overloaded, so you can provide the `HttpServletRequest` object that contains the token in the `apimlAuthenticationToken` cookie or in an Authorization header. You then receive the `ZaasToken` Object in JSON format.

Validate the OIDC token (`validateOidc`)

Use the `validateOidc` method to get the validity information about the OIDC token.

Call the `validateOidc` method from your API in the following format:

In return, you receive the `ZaasOidcValidationResult` Object in JSON format.

This method automatically uses the truststore file to add a security layer, which you configured in the `ConfigProperties` class.

Invalidate a JWT token (`logout`)

The `logout` method is used to invalidate the JWT token. The token must be provided in the Cookie header and must follow the format accepted by the API ML.

Call the `logout` method from your API in the following format:

If the token is successfully invalidated, you receive a `204` HTTP status code in return.

Obtain a PassTicket (`passTicket`)

The `passTicket` method has an added layer of protection. To use this method, call the method of the interface, and provide a valid APPLID of the application and JWT token as input.

The APPLID is the name of the application (up to 8 characters) that is used by security products to differentiate certain security operations (like PassTickets) between applications.

This method has an added layer of security, whereby you do not have to provide an input to the method since you already initialized the `ConfigProperties` class. As such, this method automatically fetches the truststore and keystore files as an input.

In return, this method provides a valid pass ticket as a String to the authorized user.

> **TIP**
>
> For additional information about PassTickets in API ML see Enabling single sign on for extending services via PassTicket configuration.

Getting Started (Step by Step Instructions)

To use this library, use the procedure described in this section.

Follow these steps:

1. Add `zaas-client` as a dependency in your project.
   You will need to specify the version of the `zaas-client` you want. `zaas-client` versioning following the semantic versioning format of `major.minor.patch`. For example, `1.22.0`.

   Click here for procedural details using Gradle.

   Gradle:

   i. Create a `gradle.properties` file in the root of your project if one does not already exist.

   ii. In the `gradle.properties` file, set the URL of the specific Artifactory containing the *SpringEnabler* artifact.

   iii. Add the following *Gradle* code block to the `repositories` section of your `build.gradle` file:

   iv. Add the following *Gradle* dependency:

   Click here for procedural details using Maven.

   Maven:

   i. Add the following *XML* tags within the newly created `pom.xml` file:

   Tip: If you want to use snapshot version, replace libs-release with libs-snapshot in the repository url and change snapshots->enabled to true.

   ii. Then add the following *Maven* dependency:

2. In your application, create your Java class which will be used to create an instance of `ZaasClient`, which enables you to use its method to login, query, and to issue a PassTicket.

3. To use `zaas-client`, provide a property file for configuration.

   Tip: Check `org.zowe.apiml.zaasclient.config.ConfigProperites` to see which properties are required in the property file.

   Configuration Properties:

   Note: If `httpOnly` property is set to true, the ZAAS Client will access the API ML via HTTP protocol without TLS. This meant for z/OS configuration with AT-TLS that will ensure that TLS and the required client certificates are used.

4. Create an instance of `ZaasClient` in your class and provide the `configProperties` object.

   Example:

You can now use any method from `ZaasClient` in your class.

Example:

For login, use the following code snippet:

The following codeblock is an example of a `SampleZaasClientImplementation`.

Example:

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Advanced Server Configuration

The Zowe's App Server and ZSS rely on many required or optional parameters to run, which includes setting up networking, deployment directories, plugin locations, and more.

Configuration file

The servers use a YAML file for configuration. The global schema describes the parts of configuration that are common between servers.

The App Server specifically is configured by the `components.app-server` section of the YAML, and that section follows this App-server schema.

ZSS is instead configured by the `components.zss` section, following the ZSS schema.

The App server can additionally use environment variables to override the YAML file.

Environment variables (app-server only)

CLI arguments take precedence over the configuration file, but are overridden by the CLI arguments. The format is `ZWED_key=value`, where `ZWED_` is a prefix for any configuration object.

The attributes specified will be put within the `components.app-server` subsection of the Zowe configuration.

The key maps to a JSON object attribute, so to set the value of a nested object, such as the https configuration, you need multiple values.

For example:

In Environment variable format, this is specified as

The key names are syntax sensitive.

- They are case-sensitive.
- All ASCII characters except `"` are allowed in the object attribute names.
  - An encoding scheme is used for many symbols because environment variables can only have names with the characters `A`-`Z`, `a`-`z`, `0`-`9`, `_`, `.`, and `-`.
  - The scheme is _x followed by 2 hex numbers will be converted to the corresponding ASCII character, such as _x41 mapping to `A`.
- `_` is used as the object separator, so an escape sequence is used if `_` is actually needed for the key.
  - Single leading and trailing _ are treated as literal `_`.
  - `__` will be maps to literal `_`
  - `___` maps to literal `-`
  - `_____` maps to literal `.`

The types of the values are syntax-sensitive.

- Numbers are treated as numbers, not strings.
- `false` and `true` are treated as boolean.
- Commas are for arrays. An array of length 1 has a comma at the end.
- Strings can have quotes, but otherwise everything that is not an array, boolean, or number is a string.
- Objects are never values, they are the keys.

Parameter details

Below is some more detail on certain parameters than can be covered within the json-schema.

Configuration directories

When running, the App Server will access the server's settings and read/modify the contents of its resource storage.

All of this data is stored within a hierarchy of a few folders, which is correspond to scopes:

- Product: The contents of this folder are not meant to be modified, but used as defaults for a product.
- Site: The contents of this folder are intended to be shared across multiple App Server instances, perhaps on a network drive.
- Instance: This folder represents the broadest scope of data within the given App Server instance.
- Group: Multiple users can be associated into one group, so that settings are shared among them.
- User: When authenticated, users have their own settings and storage for the Apps that they use.

These directories dictate where the Configuration Dataservice will store content.

Directories example

App configuration

This section does not cover any dynamic runtime inclusion of Apps, but rather Apps defined in advance.

In the configuration file, a directory can be specified which contains JSON files which tell the server what App is to be included and where to find it on disk. The backend of these Apps use the Server's Plugin structure, so much of the server-side references to Apps use the term Plugin.

To include Apps, be sure to define the location of the Plugins directory in the configuration file, via the top-level attribute *pluginsDir*

> **NOTE**
>
> In this example, the directory for these JSON files is /defaults/plugins. Yet, in order to separate configuration files from runtime files, the App Server will initialize by copying the contents of this folder into the defined instance directory, of which the default is `~/.zowe/workspace/app-server`. So, the example configuration file uses the latter directory.

Plug-ins directory example

Logging configuration

For more information, see Logging Utility.

ZSS Configuration

ZSS is configured by the same Zowe YAML file used by the App server, within the `components.zss` section of the file. The ZSS schema for components.zss be found here. More information about the configuration can be found in its README file.

Connecting ZSS to App Server

The App Server can connect to ZSS either directly or through the API Mediation Layer Gateway when that is running.

The connection information is stored within the object `components.app-server.agent`, which describes whether the Gateway is involved, or if not, on which host and port can ZSS be found. For more information, see the agent section of the schema

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Zowe Application Framework overview

You can create application plug-ins to extend the capabilities of the Zowe™ Application Framework. An application plug-in is an installable set of files that present resources in a web-based user interface, as a set of RESTful services, or in a web-based user interface and as a set of RESTful services.

Read the following topics to get started with extending the Zowe Application Framework.

How Zowe Application Framework works

Read the following topics to learn how Zowe Application Framework works:

- Creating application plug-ins
- Plug-ins definition and structure
- Dataservices
- Zowe Desktop and window management
- Configuration Dataservice
- URI Broker
- Application-to-application communication
- Error reporting UI
- Logging utility

Tutorials

The following tutorials are available in Github.

- **Stand up a local version of the Example Zowe Application Server**

  > **GITHUB REPO:**
  > zlux-app-server

- **Internationalization in Angular Templates in Zowe Application Server**

  > **GITHUB SAMPLE REPO:**
  > sample-angular-app (Internationalization)

- **App to app communication**

  > **GITHUB SAMPLE REPO :**
  > sample-angular-app (App to app communication)

- **Using the Widgets Library**

> **GITHUB SAMPLE REPO:**
>
> sample-angular-app (Widgets)

- **Configuring user preferences (configuration dataservice)**

> **GITHUB SAMPLE REPO:**
>
> sample-angular-app (configuration dataservice)

Samples

Zowe allows extensions to be written in any UI framework through the use of an Iframe, or Angular and React natively. In this section, code samples of various use-cases will be provided with install instructions.

> **TROUBLESHOOTING SUGGESTIONS:**
>
> If you are running into issues, try these suggestions:
>
> - Restart the Zowe Server/ VM.
> - Double check that the name in the plugins folder matches your identifier in `pluginDefinition.json` located in the Zowe root.
> - After logging into the Zowe desktop, use the Chrome or Firefox developer tools and navigate to the "network" tab to see what errors you are getting.
> - Check each file with `cat <filename>` to be sure it wasn't corrupted while uploading. If files were corrupted, try uploading using a different method like SCP or SFTP.

Sample Iframe App

> **GITHUB SAMPLE REPO:**
>
> sample-iframe-app

Sample Angular App

> **GITHUB SAMPLE REPO:**
>
> sample-angular-app

Sample React App

> **GITHUB SAMPLE REPO:**
>
> sample-react-app

User Browser Workshop Starter App

GITHUB SAMPLE REPO:

workshop-starter-app

This sample is included as the first part of a tutorial detailing communication between separate Zowe apps.

It should be installed on your system before starting the User Browser Workshop App Tutorial

The App's scenario is that it has been opened to submit a task report to a set of users who can handle the task. In this case, it is a bug report. We want to find engineers who can fix this bug, but this App does not contain a directory listing for engineers in the company, so we need to communicate with some App that does provide this information. In this tutorial, you must build an App which is called by this App in order to list engineers, is able to be filtered by the office that they work from, and is able to submit a list of engineers which would be able to handle the task.

After installing this app on your system, follow directions in the User Browser Workshop App Tutorial to enable app-to-app communication.

Version: v3.2.x LTS

Plug-ins definition and structure

The Zowe™ Application Server (`zlux-app-server`) enables extensiblity with application Plugins. Application Plugins are a subcategory of the unit of extensibility in the server called a *plugin*.

The files that define a Plugin are located in the `pluginsDir` directory.

pluginDefinition.json

This file describes an application Plugin to the Zowe Application Server. (A Plugin is the unit of extensibility for the Zowe Application Server. An application Plugin is a Plugin of the type "Application", the most common and visible type of Plugin.) A definition file informs the server whether the application Plugin has server-side dataservices, client-side web content, or both. The attributes of this file are defined within the pluginDefinition json-schema document

Application Plugin filesystem structure

An application Plugin can be loaded from a filesystem that is accessible to the Zowe Application Server, or it can be loaded dynamically at runtime. When accessed from a filesystem, there are important considerations for the developer and the user as to where to place the files for proper build, packaging, and operation.

Root files and directories

The root of an application Plugin directory contains the pluginDefinition.json file, and the following other files and directories.

Dev and source content

Aside from demonstration or open source application Plugins, the following directories should not be visible on a deployed server because the directories are used to build content and are not read by the server.

nodeServer

When an application Plugin has router-type dataservices, they are interpreted by the Zowe Application Server by attaching them as ExpressJS routers. It is recommended that you write application Plugins using Typescript, because it facilitates well-structured code. Use of Typescript results in build steps because the pre-transpilation Typescript content is not to be consumed by NodeJS. Therefore, keep server-side source code in the `nodeServer` directory. At runtime, the server loads router dataservices from the lib directory.

webClient

When an application Plugin has the *webContent* attribute in its definition, the server serves static content for a client. To optimize loading of the application Plugin to the user, use Typescript to write the application Plugin and then package it using Webpack. Use of Typescript and Webpack result in build steps because the pre-transpilation Typescript and the pre-webpack content are not to be consumed by the browser. Therefore, separate the source code from the served content by placing source code in the `webClient` directory.

Runtime content

At runtime, the following set of directories are used by the server and client.

lib

The `lib` directory is where router-type dataservices are loaded by use in the Zowe Application Server. If the JS files that are loaded from the `lib` directory require NodeJS modules, which are not provided by the server base (the modules `zlux-server-framework` requires are added to `NODE_PATH` at runtime), then you must include these modules in `lib/node_modules` for local directory lookup or ensure that they are found on the `NODE_PATH` environment variable. `nodeServer/node_modules` is not automatically accessed at runtime because it is a dev and build directory.

web

The `web` directory is where the server serves static content for an application Plugin that includes the *webContent* attribute in its definition. Typically, this directory contains the output of a webpack build. Anything you place in this directory can be accessed by a client, so only include content that is intended to be consumed by clients.

Packaging applications as compressed files

Application Plugin files can be served to browsers as compressed files in brotli (.br) or gzip (.gz) format. The file must be below the application's `/web` directory, and the browser must support the compression method. If there are multiple compressed files in the `/web` directory, the Zowe Application Server and browser perform runtime negotiation to decide which file to use.

Default user configuration

Configuration Dataservice default settings for users can be packaged within a Plugin.
This is done by putting content within the `/config/storageDefaults` folder, and more on that subject can be found here

App-to-App Communication

App-to-App communication behaviors can be statically defined or dynamically created at runtime. Static definitions help as a form of documentation and to be able to depend upon them, so it is recommended that these be packaged with a Plugin if you wish other's to be able to use App-to-App communication on your App.
This page describes the subject in more detail.
In summary, App-to-App Actions and Recognizers can be stored within an App's `/config/actions` and `/config/recognizers` folders, respectively, where the filenames much match the identifiers of Apps.

Documentation

In order for Zowe servers to pick up documentation to present to UIs, they must be in a uniform place.

The **/doc** folder of any Plugin can contain at its root any READMEs or documents that an administrator or developer may care about when working with a Plugin for the first time.

The **/doc/swagger** folder on the other hand, will be used to store .yaml extension Swagger 2.0 files that document the APIs of a Plugin's dataservices if they exist.

Other folders may exist, such as **/doc/ui** to document help behavior that may be shown in a UI, but is not implemented at this time.

Location of Plugin files

The files that define a Plugin are located in the `plugins` directory.

pluginsDir directory

At startup, the server reads from the `plugins` directory. The server loads the valid Plugins that are found by the information that is provided in the JSON files.

Within the `pluginsDir` directory are a collection of JSON files. Each file has two attributes, which serve to locate a Plugin on disk:

location: This is a directory path that is relative to the server's executable (such as `zlux-app-server/bin/start.sh`) at which a `pluginDefinition.json` file is expected to be found.

identifier: The unique string (commonly styled as a Java resource) of a Plugin, which must match what is in the `pluginDefinition.json` file.

Application Dataservices

See Dataservices

Application Configuration Data

The App server has a component for managing an App's configuration & user data, organized by scope such as user, group, and server instance. For more information, see Configuration Dataservice Documentation.

Version: v3.2.x LTS

Building plugin apps

You can build a plugin app by using the following steps as a model. Alternatively, you can follow the Sample Angular App tutorial.

Plugins can have any build process desired as long as it doesn't conflict with the packaging structure. The basic requirement for a plugin app is that static web content must be in a `/web` directory, and server and other backend files must be in a `/lib` directory.

Before you can build a plugin app you must install all prerequisites.

Building web content

1. On the computer where the virtual desktop is installed, use the the following command to specify a value for the `MVD_DESKTOP_DIR` environment variable:

   Where `<path>` is the install location of the virtual desktop.

2. Navigate to `/<plugin_dir>/webClient`. If there is no `/webClient` directory, proceed to the **Building server content** section below.

3. Run the `npm install` command to install any application dependencies. Check for successful return code.

4. Run one of the following commands to build the application code:

   - Run the `npm run build` command to generate static content in the `/web` directory. (You can ignore warnings as long as the build is successful.)
   - Run the `npm run start` command to compile in real-time. Until you stop the script, it compiles code changes as you make them.

Building app server content

1. Navigate to the plugin directory. If there is no `/nodeServer` directory in the plugin directory, proceed to the **Building Javascript content (*.js files)** section below.

2. Run the `npm install` command to install any application dependencies. Check for successful return code.

3. Run one of the following commands to build the application code:

   - Run the `npm run build` command to generate static content in the `/lib` directory.
   - Run the `npm run start` command to compile in real-time. Until you stop the script, it compiles code changes as you make them.

Building zss server content

1. Clone the zss repository and its submodule zowe-common-c.

2. Make a build script that compiles your C code with -Wc,dll and -Wl,dll, and other flags as seen in this zowe example
3. Include a ZSS .x file to link zss server APIs to your plugin, as seen in this zowe example
4. Ensure that the build output ends up in the /lib folder as a .so file that has the z/OS program control (`+p`) extended attribute.

Tagging plugin files on z/OS

When Zowe App Framework is installed on z/OS developers should tag their plugin files according to the file content. Tagging files helps programs on z/OS understand how to interpret those files, most importantly to know whether a file is encoded using EBCDIC (Extended Binary Coded Decimal Interchange Code). If you are unsure if a plugin you are using is tagged, it can be checked and set using the `chtag` command. If you want to set the tags, it can be done in bulk with the help of these programs:

- Autotag: This free, open-source application is not part of Zowe. You can download the binary from here for example https://anaconda.org/izoda/autotag. Source: https://github.com/RocketSoftware/autotag
- The Zowe tagging script: This script tags by file extension. It might not work for all cases, but can be altered to suit your needs. Source: https://github.com/zowe/zowe-install-packaging/blob/master/scripts/tag-files.sh

Building Javascript content (*.js files)

Unlike Typescript, Javascript is an interpreted language and does not need to be built. In most cases, reloading the page should build new code changes. For Iframes or other JS-based apps, close and open the app.

Installing

Follow the steps described in Installing plugins to add your built plugin to the Zowe desktop.

Packaging

For more information on how to package your Zowe app, developers can see Plugins definition and structure.

Version: v3.2.x LTS

Installing Plugins

Plugins can be added or removed from the Zowe App Server, as well as upgraded. There are two ways to do these actions: By REST API or by filesystem. The instructions below assume you have administrative permissions either to access the correct REST APIs or to have the necessary permissions to update server directories & files.

NOTE: Plugins must be pre-built, and follow the directory structure, and have all dependencies met to be successfully installed. Read the appServer or install-app log files within the Zowe instance's `<logDirectory>` directory, (ex `~/.zowe/log/install-app.log`) if a plugin does not show in the Zowe desktop, but has been installed successfully.

By filesystem

The App server uses directories of JSON files, described in the server configuration document. Defaults are located in the folder `zlux-app-server/defaults/plugins`, but the server reads the list of plugins instead from the instance directory, at `<workspaceDirectory>/app-server/plugins` (for example, `~/.zowe/workspace/app-server/plugins` which includes JSON files describing where to find a plugin. Adding or removing JSONs from this folder will add or remove plugins upon server restart, or you can use REST APIs and cluster mode to add or remove plugins without restarting).

Adding/Installing

Plugins must be packaged as Components. You can install a plugin by running the component installer, `zwe components install`. For more information, try the help command `zwe components install --help`.

Removing

Plugins are hidden from the Desktop when a component is disabled. If a component is removed, the plugins from the component will be removed too.

Upgrading

Currently, only one version of a plugin can exist per server. So, to upgrade, you either upgrade the plugin within its pre-existing directory by rebuilding it (with more up to date code), or you alter the locator JSON of that app to point to the content of the upgraded version.

Modifying without server restart (Exercise to the reader)

The server's reading of the locator JSONs and initializing of plugins only happens during bootstrapping at startup. However, in cluster mode the bootstrapping happens once per worker process. Therefore, it is possible to manage plugins without a server restart by killing & respawning all worker processes without killing the cluster master process. This is what the REST API does, internally. To do this without the REST API, it may be possible to script knowing the parent process ID, and running a kill command on all child processes of the App server cluster process.

By REST API

The server REST APIs allow plugin management without restarting the server - you can add, remove, and upgrade plugins in real-time. However, removal or upgrade must be done carefully as it can disrupt users of those plugins.

This swagger file documents the REST API for plugin management

The API only works when RBAC is configured, and an RBAC-compatible security plugin is being used. An example of this is zss-auth, and use of RBAC is described in this documentation and in the wiki.

NOTE: If you do not see your plugin in the Zowe desktop check the appServer and install-app log files within the Zowe instance's `<logDirectory>` directory to troubleshoot the problem. If you are building your own desktop extension then you need to pre-build your plugin with the correct directory structure, and meet all dependencies.

Plugin management during development

Below are some tasks developers can do to work with plugins. These should not be done in production, as plugins are managed automatically at the component level.

Installing

When running the app-server without zowe server infrastructure and tooling, it's still possible to install plugins directly. To add or install a plugin, run the script `zlux-app-server/bin/install-app.sh` providing the location to a plugin folder. For example:

```
./install-app.sh /home/john/zowe/sample-angular-app
```

This will generate a JSON file `<workspaceDirectory>/app-server/plugins/org.zowe.zlux.sample.angular.json` that contains the plugin's ID and its location on disk. These JSON files tell the Desktop where to find apps and are the glue between the Zowe instance's desktop and the plugin code itself held in its directory.

. For example, if we were to install the sample angular-app in the folder `/home/john/zowe/sample-angular-app`, then the JSON would be:

Removing

To remove a plugin, locate the server's instance plugin directory `<workspaceDirectory>/app-server/plugins` (for example, `~/.zowe/workspace/app-server/plugins`) and remove the locator JSON that is associated with that plugin. Remove the plugin's content by deleting it from the file system if applicable.

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Embedding plugins

Add these imports to a component where you want to embed another plugin:

Inject Angular2PluginEmbedActions into your component constructor:

In the component template prepare a container where you want to embed the plugin:

In the component class add a reference to the container:

In the component class add a reference to the embedded instance:

Everything is ready to start embedding, you just need to know the pluginId that you want to embed:

How to interact with embedded plugin

If the main component of embedded plugin declares Input and Output properties then you can interact with it. ApplicationManager provides methods to set Input properties and get Output properties of the embedded plugin. Suppose, that the embedded plugin declares Input and Output properties like this:

Obtain a reference to ApplicationManager in your component constructor:

Note: We are unable to inject `ApplicationManager` with `@Inject()` until an AoT-compiler issue with namespaces is resolved: angular/angular#15613

Now you can set `sampleInput` property, obtain `sampleOutput` property and subscribe to it:

How to destroy embedded plugin

There is no special API to destroy embedded plugin. If you want to destroy the embedded plugin just clear the container for the embedded plugin and set `embeddedInstance` to null:

How to style a container for the embedded plugin

It is hard to give a universal recipe for a container style. At least, the container needs `position: "relative"` because the embedded plugin may have absolutely positioned elements. Here is sample styles you can start with if your component utilizes flexbox layout:

Applications that use embedding

Workflow app demonstrates advanced usage.

Version: v3.2.x LTS

Dataservices

Dataservices are dynamic backend components of Zowe™ plug-in applications. You can optionally add them to your applications to make the application do more than receive static content from the proxy server. Each dataservice defines a URL space that the server can use to run extensible code from the application. Dataservices are mainly intended to create REST APIs and WebSocket channels.

Defining dataservices

You define dataservices in the application's `pluginDefinition.json` file. Each application requires a definition file to specify how the server registers and uses the application's backend. You can see an example of a `pluginDefinition.json` file in the top directory of the sample-angular-app.

In the definition file is a top level attribute called `dataServices`, for example:

To define your dataservice, create a set of keys and values for your dataservice in the `dataservices` array.

Schema

The documentation on dataservice types and parameters for each are specified within the pluginDefinition.json json-schema document

Defining Java dataservices

In addition to other types of dataservice, you can use Java (also called java-war) dataservices in your applications. Java dataservices are powered by Java Servlets.

To use a Java dataservice you must meet the prerequisites, define the dataservice in your plug-in definition, and define the Java Application Server library to the Zowe Application Server.

Prerequisites

- Install a Java Application Server library. In this release, Tomcat is the only supported library.
- Make sure your plug-in's compiled Java program is in the application's `/lib` directory, in either a `.war` archive file or a directory extracted from a `.war` archive file. Extracting your file is recommended for faster start-up time.

Defining Java dataservices

To define the dataservice in the `pluginDefinition.json` file, specify the type as `java-war`, for example:

To access the service at runtime, the plug-in can use the Zowe dataservice URL standard:
`/ZLUX/plugins/[PLUGINID]/services/[SERVICENAME]/[VERSIONNUMBER]`

Using the example above, a request to get users might be:
`/ZLUX/plugins/[PLUGINID]/services/javaservlet/1.0.0/users`

Note: If you extracted your servlet contents from a `.war` file to a directory, the directory must have the same name as the file would have had. Using the example above, `javaservlet.war` must be extracted to a directory named `\javaservlet`.

Defining Java Application Server libraries

In the `zlux-app-server/zluxserver.json` file, use the example below to specify Java Application Server library parameters:

Specify the following parameters in the `languages.java` object:

- `runtimes` (object) - The name and location of a Java runtime that can be used by one or more services. Used to load a Tomcat instance.
  - `name` (object) - The name of the runtime.
    - `home` (string) - The path to the runtime root. Must include `/bin` and `/lib` directories.
- `ports` (array`<number>`)(Optional) - An array of port numbers that can be used by instances of Java Application Servers or microservices. Must contain as many ports as distinct servers that will be spawned, which is defined by other configuration values within `languages.java`. Either `ports` or `portRange` is required, but `portRange` has a higher priority.
- `portRange` (array`<number>`)(Optional) - An array of length 2, which contains a start number and end number to define a range of ports to be used by instances of application servers or microservices. You will need as many ports as distinct servers that will be spawned, which is defined by other configuration values within `languages.java`. Either `ports` or `portRange` is required, but `portRange` has a higher priority.
- `war` (object) - Defines how the Zowe Application Server should handle `java-war` dataservices.
  - **defaultGrouping** (string)(Optional) - Defines how services should be grouped into instances of Java Application Servers. Valid values: `appserver` or `microservice`. Default: `appserver`. `appserver` means 1 server instance for all services. `microservice` means one server instance per service.
  - **pluginGrouping** (array`<object>`)(Optional) - Defines groups of plug-ins to have their `java-war` services put within a single Java Application Server instance.
    - **plugins** (Array`<string>`) - Lists the plugins by identifier which should be put into this group. Plug-ins with no `java-war` services are skipped. Being in a group excludes a plugin from being handled by `defaultGrouping`.
    - **runtime** (string)(Optional) - States the runtime to be used by the Tomcat server instance, as defined in `languages.java.runtimes`.
  - **javaAppServer** (object) - Java Application Server properties.
    - **type** (string) - Type of server. In this release, `tomcat` is the only valid value.
    - **path** (string) - Path of the server root, relative to `zlux-app-server/lib`. Must include `/bin` and `/lib` directories.
    - **config** (string) - Path of the server configuration file, relative to `zlux-app-server/lib`.
    - **https** (object) - HTTPS parameters.
      - **key** (string) - Path of a private key, relative to `zlux-app-server/lib`.
      - **certificate** (string) - Path of an HTTPS certificate, relative to `zlux-app-server/lib`.

Java dataservice logging

The Zowe Application Server creates the Java Application Server instances required for the `java-war` dataservices, so it logs the stdout and stderr streams for those processes in its log file. Java Application Server logging is not managed by Zowe at this time.

Java dataservice limitations

Using Java dataservices with a Zowe Application Server installed on a Windows computer, the source and Java dataservice code must be located on the same storage volume.

To create multiple instances of Tomcat on non-Windows computers, the Zowe Application Server establishes symbolic links to the service logic. On Windows computers, symbolic links require administrative privilege, so the server establishes junctions instead. Junctions only work when the source and destination reside on the same volume.

Using dataservices with RBAC

If your administrator configures the Zowe Application Framework to use role-based access control (RBAC), then when you create a dataservice you must consider the length of its paths.

To control access to dataservices, administrators can enable RBAC, then use a z/OS security product such as RACF to map roles and authorities to a System Authorization Facility (SAF) profile. For information on RBAC, see Controlling access to dataservices.

SAF profiles have the following format:

`<product>.<instance id>.SVC.<pluginid_with_underscores>.<service>.<HTTP method>.<dataservice path with forward slashes '/' replaced by periods '.'>`

For example, to access this dataservice endpoint:

`/ZLUX/plugins/org.zowe.foo/services/baz/_current/users/fred`

Users must have READ access to the following profile:

`ZLUX.DEFAULT.SVC.ORG_ZOWE_FOO.BAZ.POST.USERS.FRED`

Profiles cannot contain more than 246 characters. If the path section of an endpoint URL makes the profile name exceed limit, the path is trimmed to only include elements that do not exceed the limit. For example, imagine that each path section in this endpoint URL contains 64 characters:

`/ZLUX/plugins/org.zowe.zossystem.subsystems/services/data/_current/aa..a/bb..b/cc..c/dd..d`

So `aa..a` is 64 "a" characters, `bb..b` is 64 "b" characters, and so on. The URL could then map to the following example profile:

`ZLUX.DEFAULT.SVC.ORG_ZOWE_ZOSSYSTEM_SUBSYSTEMS.DATA.GET.AA..A.BB..B`

The profile ends at the `BB..B` section because adding `CC..C` would put it over 246 characters. So in this example, all dataservice endpoints with paths that start with `AA..A.BB..B` are controlled by this one profile.

To avoid this issue, we recommend that you maintain relatively short endpoint URL paths.

Dataservice APIs

Dataservice APIs can be categorized as Router-based or ZSS-based, and either WebSocket or not.

Router-based dataservices

Each Router dataservice can safely import Express, express-ws, and bluebird without requiring the modules to be present, because these modules exist in the proxy server's directory and the *NODE_MODULES* environment variable can include this directory.

HTTP/REST Router dataservices

Router-based dataservices must return a (bluebird) Promise that resolves to an ExpressJS router upon success. For more information, see the ExpressJS guide on use of Router middleware: Using Router Middleware.

Because of the nature of Router middleware, the dataservice need only specify URLs that stem from a root '/' path, as the paths specified in the router are later prepended with the unique URL space of the dataservice.

The Promise for the Router can be within a Factory export function, as mentioned in the `pluginDefinition` specification for *routerFactory* above, or by the module constructor.

An example is available in the Sample Angular App.

WebSocket Router dataservices

ExpressJS routers are fairly flexible, so the contract to create the Router for WebSockets is not significantly different.

Here, the express-ws package is used, which adds WebSockets through the ws package to ExpressJS. The two changes between a WebSocket-based router and a normal router are that the method is 'ws', as in `router.ws(<url>, <callback>)`, and the callback provides the WebSocket on which you must define event listeners.

See the ws and express-ws topics on www.npmjs.com for more information about how they work, as the API for WebSocket router dataservices is primarily provided in these packages.

An example is available in `zlux-server-framework/plugins/terminal-proxy/lib/terminalProxy.js`

Router dataservice context

Every router-based dataservice is provided with a `Context` object upon creation that provides definitions of its surroundings and the functions that are helpful. The following items are present in the `Context` object:

serviceDefinition

The dataservice definition, originally from the `pluginDefinition.json` file within a plug-in.

serviceConfiguration

An object that contains the contents of configuration files, if present.

logger

An instance of a Zowe Logger, which has its component name as the unique name of the dataservice within a plug-in.

makeSublogger

A function to create a Zowe Logger with a new name, which is appended to the unique name of the dataservice.

addBodyParseMiddleware

A function that provides common body parsers for HTTP bodies, such as JSON and plaintext.

plugin

An object that contains more context from the plug-in scope, including:

- **pluginDef**: The contents of the `pluginDefinition.json` file that contains this dataservice.
- **server**: An object that contains information about the server's configuration such as:
  - **app**: Information about the product, which includes the *productCode* (for example: `ZLUX`).
  - **user**: Configuration information of the server, such as the port on which it is listening.

Router storage API

ZSS based dataservices

ZSS dataservices much like zlux router services can be used to implement REST or websocket APIs. Each service is associated with a URL which when requested will call a function to handle the request or websocket message event.

HTTP/REST ZSS dataservices

ZSS REST dataservices are registered into ZSS with a service installer function, where `initializerName` is the function name located in the dll `libraryName`. The `methods` list what HTTP methods are expected of this dataservice. Example:

The service installer is given `DataService`, which includes context such as the above definition plus a `loggingIdentifier`. The service is also given `HttpServer`, a reference to ZSS and its configuration. To register the dataservice, you must make an `HttpService` object like

Then you must assign properties to the dataservice, such as

- authType: What type of authentication and authorization checks should be done before calling this service. values such as `SERVICE_AUTH_NONE` when the service does not need securty or `SERVICE_AUTH_NATIVE_WITH_SESSION_TOKEN` when the service should be protected by ZSS's cookie are valid.
- serviceFunction: The function within this dataservice that will be called whenever a request is received.
- runInSubtask: (TRUE/FALSE) Whether to run the service function in a subtask or not whenever a request is received.
- doImpersonation: (TRUE/FALSE) When true, the service function will be ran as the authenticated user, rather than the server user. This is recommended whenever possible to keep permissions management in line with the users own permissions.

Example of service installer:

When a request is received, the service function is called with the `HttpService` and `HttpResponse` objects. `HttpService` is used to store and retrieve cached data and access the storage API. `HttpRequest` is a pointer within the response object, and utilities exist to help with parsing it.

Example of request handling:

ZSS dataservice context and structs

Headers to important dataservice structs include

- HttpResponse
- HttpRequest
- HttpService
- HttpServer
- Json handling
- DataService context
- Utilities
- Data structures

ZSS storage API

The DataService struct contains two Storage structs, `localStorage` and `remoteStorage`. They implement the same API for getting, setting, and removing data, but manage the data in different locations. `localStorage` stores data within the ZSS server, for high speed access. `remoteStorage` stores data in the Caching Service, for high availability state storage.

Usage example: Sample angular app storage test api: https://github.com/zowe/sample-angular-app/blob/v1.23.0-RC1/zssServer/src/storage.c

Documenting dataservices

It is recommended that you document your RESTful application dataservices in OpenAPI (Swagger) specification documents. The Zowe Application Server hosts Swagger files for users to view at runtime.

To document a dataservice, take the following steps:

1. Create a `.yaml` or `.json` file that describes the dataservice in valid Swagger 2.0 format. Zowe validates the file at runtime.

2. Name the file with the same name as the dataservice. Optionally, you can include the dataservice version number in the format: `<name>_<number>`. For example, a Swagger file for a dataservice named `user` must be named either `users.yaml` or `users_1.1.0.yaml`.

3. Place the Swagger file in the `/doc/swagger` directory below your application plug-in directory, for example:

   `/sample-angular-app/doc/swagger/hello.yaml`

At runtime, the Zowe Application Server does the following:

- Dynamically substitutes known values in the files, such as the hostname and whether the endpoint is accessible using HTTP or HTTPS.

- Builds documentation for each dataservice and for each application plug-in, in the following locations:

  - Dataservice documentation: `/ZLUX/plugins/<app_name>/catalogs/swagger/servicename`
  - Application plug-in documentation: `/ZLUX/plugins/<app_name>/catalogs/swagger`

- In application plug-in documentation, displays only stubs for undocumented dataservices, stating that the dataservice exists but showing no details. Undocumented dataservices include non-REST dataservices such as WebSocket services.

Version: v3.2.x LTS

Authentication API

This topic describes the web service API for user authentication.

The authentication mechanism of the ZLUX server allows for an administrator to gate access to services by a given auth handler, while on the user side the authentication structure allows for a user to login to one or more endpoints at once provided they share the same credentials given.

Handlers

The auth handlers are a type of zlux server plugin (type=nodeAuthentication) which are categorized by which kind of authentication they can provide. Whether it's to z/OS via `type=saf` or theoretical authentication such as Facebook or Amazon cloud, the handler API is abstract to handle different types of security needs.

Handler installation

Auth handler plugins are installed like any other plugin.

Handler configuration

The server top-level configuration attribute `dataserviceAuthentication` states properties about which plugins to use and how to use them.

For example,

The `dataserviceAuthentication` attribute has the following properties:

- defaultAuthentication: Which authentication category to choose by default, in case multiple are installed.
- rbac: Whether or not the server should do authority checks in addition to authentication checks when requesting a dataservice.

Handler context

These plugins are given an object, `context`, in the constructor. Context has attributes to help the plugin know about the server configuration, provide a named logger, and more. The parameters include:

- pluginDefinition: The object describing the plugin's definition file
- pluginConf: An object that gives the plugin its configuration from the Config Service internal storage
- serverConfiguration: The object describing the server's current configuration
- context: An object holding contextual objects
  - logger: A logger with the name of the plugin's ID

Handler capabilities

A handler's constructor should return a capabilities object that states which capabilities the plugin has. If a capabilities object is not returned, it is assumed that only the authenticate and authorize functions are implemented, for backward compatibility support. The capabilities object should include:

- canGetCategories: (true/false) If the getCategories() function exists, which returns a string array of categories of auth the plugin can support given the server context. This is useful if the plugin can support multiple categories conditionally.
- canLogout: (true/false) If the logout(request, sessionState) function exists. Used to clear state and cookies when a session should be ended.
- canGetStatus: (true/false) If the getStatus(sessionState) function exists
- canRefresh: (true/false) If the refreshStatus(request, sessionState) function exists, which is used to renew a session that has an expiration limit.
- canAuthenticate: (true/false) If the authenticate(request, sessionState):Promise function exists (Required, assumed)
- canAuthorized: (true/false) If the *authorized(request, sessionState, options) function exists (Required, assumed)
- haCompatible: (true/false) Used to be sure that a plugin has no state that would be lost in a high availibility environment.
- canGenerateHaSessionId: (true/false) If generateHaSessionId(request) exists, which is used to set the value used for an app-server session for a user. When not in a high availability environment, the app-server generates its own session ID.
- canResetPassword: (true/false) If passwordRest(request, sessionState) exists
- proxyAuthorizations: (true/false) If the addProxyAuthorizations(req1, req2Options, sessionState) function exists

Examples

sso-auth, which conditionally implements the saf, zss, and apiml security types: https://github.com/zowe/zlux-server-framework/tree/v2.x/master/plugins/sso-auth

High availability (HA)

Some auth handlers are not capable of working in a high availability environment. In these environments, there can be multiple zlux servers and there may not be a safe and secure way to share session state data. This extends to the zlux server cookie as well, which is not sharable between multiple servers by default. Therefore, high availability has the following two requirements from an auth handler plugin:

1. The plugin must state that it is HA capable by setting the capability flag `haCompatible=true`, usually indicating that the plugin has no state data.
2. A plugin must have capability `canGenerateHaSessionId=true` so that the zlux server cookie is sharable between multiple zlux servers.

REST API

Check status

Returns the current authentication status of the user to the caller.

Response example:

Every key in the response object is a registered auth type. The value object is guaranteed to have a Boolean field named "authenticated" which indicates that at least one plugin in the category was able to authenticate the user.

Each item also has a field called "plugins", where every property value is a plugin-specific object.

Authenticate

Authenticates the user against authentication back-ends.

Request body example:

The categories parameter is optional. If omitted, all auth plugins are invoked with the username and password Response example:

First-level keys are authentication categories or types. "success" means that all of the types requested have been successful. For example typeA successful AND typeB successful AND ...

Second-level keys are auth plugin IDs. "success" on this level means that there's at least one successful result in that auth type. For example, pluginA successful OR pluginB successful OR ...

User not authenticated or not authorized

The response received by the browser when calling any service, when the user is either not authenticated or not allowed to access the service.

Not authenticated

The client is supposed to address this by showing the user a login form which will later invoke the login service for the plugin mentioned and repeat the request.

Not authorized

There's no general way for the client to address this, except than show the user an error message.

Refresh status

If you have an active session, some auth plugins may be able to renew the session. Not all plugins support this action, so while the call may return successful, if there is an associated expiration time you may notice that the expiration time has not changed or been reset.

Response example:

Logout

When you have an active session, you can terminate it early with a logout. This should remove cookies and tell the server to clear any cache it had about a session.

Password changes

Some auth plugins will allow you to change your password. Depending on the backing security (such as SAF), you may need to provide your current password to change it.

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Internationalizing applications

You can internationalize Zowe™ application plug-ins using Angular and React frameworks. Internationalized applications display in translated languages and include structures for ongoing translation updates.

The steps below use the Zowe Sample Angular Application and Zowe Sample React Application as examples. Your applications might have slightly different requirements, for example the React Sample Application requires the react-i18next library, but your application might require a different React library.

For detailed information on Angular or React, see their documentation. For detailed information on specific internationalization libraries, see their documentation. You can also reference the Sample Angular Application internationalization tutorial, and watch a video on how to internationalize your Angular application.

After you internationalize your application, you can view it by following steps in Changing the desktop language.

Internationalizing Angular applications

Zowe applications that use the Angular framework depend on `.xlf` formatted files to store static translated content and `.json` files to store dynamic translated content. These files must be in the application's `web/assets/i18n` folder at runtime. Each translated language will have its own file.

To internationalize an application, you must install Angular-compatible internationalization libraries. Be aware that libraries can be better suited to either static or dynamic HTML elements. The examples in this task use the ngx-i18nsupport library for static content and angular-l10n for dynamic content.

To internationalize Zowe Angular applications, take the following steps:

1. To install internationalization libraries, use the `npm` command, for example:

   Note `--save-dev` commits the library to the application's required libraries list for future use.

2. To support the CLI tools and to control output, create a `webClient/tsconfig.i18n.json` typescript file and add the following content:

   For example, see this file in the Sample Angular Application.

3. In the static elements in your HTML files, tag translatable content with the i18n attribute within an Angular template, for example:

   The attribute should include a message ID, for example the `@@welcome` above.

4. To configure static translation builds, take the following steps:

   a. In the `webClient/package.json` script, add the following line:

   b. In the in `webClient` directory, create a `xliffmerge.json` file, add the following content, and specify the codes for each language you will translate in the `languages` parameter:

When you run the i18n script, it reads this file and generates a `messages.[lang].xlf` file in the `src/assets/i18n directory` for each language specified in the `languages` parameter. Each file contains the untranslated text from the i18n-tagged HTML elements.

5. Run the following command to run the i18n script and extract i18n tagged HTML elements to `.xlf` files:

   Note If you change static translated content, you must run the `npm run build` command to build the application, and then re-run the `npm run i18n` command to extract the tagged content again.

6. In each `.xlf` file, replace `target` element strings with translated versions of the `source` element strings. For example:

7. Run the following command to rebuild the application:

   When you switch the Zowe Desktop to one of the application's translated languages, the application displays the translated strings.

8. For dynamic translated content, follow these steps:

   a. Import and utilize angular-l10n objects within an Angular component, for example:

   b. In the related Angular template, you can implement `myDynamicMessage` as an ordinary substitutable string, for example:

9. Create logic to copy the translation files to the `web/assets` directory during the webpack process, for example in the sample application, the following JavaScript in the `copy-webpack-plugin` file copies the files:

   Note: Do not edit files in the `web/assets/i18n` directory. They are overwritten by each build.

Internationalizing React applications

To internationalize Zowe applications using the React framework, take the following steps:

Note: These examples use the recommended react-i18next library, which does not differentiate between dynamic and static content, and unlike the Angular steps above does not require a separate build process.

1. To install the React library, run the following command:

   ```
   npm install --save-dev react-i18next
   ```

2. In the directory that contains your `index.js` file, create an `i18n.js` file and add the translated content, for example:

3. Import the `i18n` file from the previous step into `index.js` file so that you can use it elsewhere, for example:

4. To internationalize a component, include the `useTranslation` hook and reference it to substitute translation keys with their translated values. For example:

Internationalizing application desktop titles

To display the translated application name and description in the Desktop, take the following steps:

1. For each language, create a `pluginDefinition.i18n.<lang_code>.json` file. For example, for German create a `pluginDefinition.i18n.de.json` file.

2. Place the `.json` files in the `web/assets/i18n` directory.

3. Translate the `pluginShortNameKey` and `descriptionKey` values in the application's `pluginDefinition.json` file. For example, for the file below you would translate the values `"sampleangular"` and `"sampleangulardescription"`:

4. Add the translated values to the translation file. For example, the German translation file example, `pluginDefinition.i18n.de.json`, would look like this:

5. Create logic to copy the translation files to the `web/assets` directory during the webpack process. For example, in the Sample Angular Application the following JavaScript in the `webClient/webpack.config.js` file copies files to the `web/assets` directory:

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Zowe Desktop and window management

The Zowe™ Desktop is a web component of Zowe, which is an implementation of `MVDWindowManagement`, the interface that is used to create a window manager.

The code for this software is in the `zlux-app-manager` repository.

The interface for building an alternative window manager is in the `zlux-platform` repository.

Window Management acts upon Windows, which are visualizations of an instance of an application plug-in. Application plug-ins are plug-ins of the type "application", and therefore the Zowe Desktop operates around a collection of plug-ins.

Note: Other objects and frameworks that can be utilized by application plug-ins, but not related to window management, such as application-to-application communication, Logging, URI lookup, and Auth are not described here.

Loading and presenting application plug-ins

Upon loading the Zowe Desktop, a GET call is made to `/plugins?type=application`. The GET call returns a JSON list of all application plug-ins that are on the server, which can be accessed by the user. Application plug-ins can be composed of dataservices, web content, or both. Application plug-ins that have web content are presented in the Zowe Desktop UI.

The Zowe Desktop has a taskbar at the bottom of the page, where it displays each application plug-in as an icon with a description. The icon that is used, and the description that is presented are based on the application plug-in's `PluginDefinition`'s `webContent` attributes.

Plug-in management

Application plug-ins can gain insight into the environment in which they were spawned through the Plugin Manager. Use the Plugin Manager to determine whether a plug-in is present before you act upon the existence of that plug-in. When the Zowe Desktop is running, you can access the Plugin Manager through `ZoweZLUX.PluginManager`

The following are the functions you can use on the Plugin Manager:

- getPlugin(pluginID: string)
  - Accepts a string of a unique plug-in ID, and returns the Plugin Definition Object (DesktopPluginDefinition) that is associated with it, if found.

Application management

Application plug-ins within a Window Manager are created and acted upon in part by an Application Manager. The Application Manager can facilitate communication between application plug-ins, but formal application-to-application communication should be performed by calls to the Dispatcher. The Application Manager is not normally directly accessible by application plug-ins, instead used by the Window Manager.

The following are functions of an Application Manager:

Function	Description
`spawnApplication(plugin: DesktopPluginDefinition, launchMetadata: any): Promise<MVDHosting.InstanceId>;`	Opens an application instance into the Window Manager, with or without context on what actions it should perform after creation.
`killApplication(plugin:ZLUX.Plugin, appId:MVDHosting.InstanceId): void;`	Removes an application instance from the Window Manager.
`showApplicationWindow(plugin: DesktopPluginDefinitionImpl): void;`	Makes an open application instance visible within the Window Manager.
`isApplicationRunning(plugin: DesktopPluginDefinitionImpl): boolean;`	Determines if any instances of the application are open in the Window Manager.

Windows and Viewports

When a user clicks an application plug-in's icon on the taskbar, an instance of the application plug-in is started and presented within a Viewport, which is encapsulated in a Window within the Zowe Desktop. Every instance of an application plug-in's web content within Zowe is given context and can listen on events about the Viewport and Window it exists within, regardless of whether the Window Manager implementation utilizes these constructs visually. It is possible to create a Window Manager that only displays one application plug-in at a time, or to have a drawer-and-panel UI rather than a true windowed UI.

When the Window is created, the application plug-in's web content is encapsulated dependent upon its framework type. The following are valid framework types:

- "*angular2*": The web content is written in Angular, and packaged with Webpack. Application plug-in framework objects are given through @injectables and imports.
- "*iframe*": The web content can be written using any framework, but is included through an iframe tag. Application plug-ins within an iframe can access framework objects through *parent.RocketMVD* and callbacks.
- "*react*": The web content is written in React, Typescript, and packaged with Webpack. App framework objects are provided via the ReactMVDResources object

In the case of the Zowe Desktop, this framework-specific wrapping is handled by the Plugin Manager.

Viewport Manager

Viewports encapsulate an instance of an application plug-in's web content, but otherwise do not add to the UI (they do not present Chrome as a Window does). Each instance of an application plug-in is associated with a viewport, and operations to act upon a particular application plug-in instance should be done by specifying a viewport for an application plug-in, to differentiate which instance is the target of an action. Actions performed against viewports should be performed through the Viewport Manager.

The following are functions of the Viewport Manager:

Function	Description
`createViewport(providers: ResolvedReflectiveProvider[]): MVDHosting.ViewportId;`	Creates a viewport into which an application plug-in's webcontent can be embedded.
`registerViewport(viewportId: MVDHosting.ViewportId, instanceId: MVDHosting.InstanceId): void;`	Registers a previously created viewport to an application plug-in instance.
`destroyViewport(viewportId: MVDHosting.ViewportId): void;`	Removes a viewport from the Window Manager.
`getApplicationInstanceId(viewportId: MVDHosting.ViewportId): MVDHosting.InstanceId	null;`	

Injection Manager

When you create Angular application plug-ins, they can use injectables to be informed of when an action occurs. iframe application plug-ins indirectly benefit from some of these hooks due to the wrapper acting upon them, but Angular application plug-ins have direct access.

The following topics describe injectables that application plug-ins can use.

Plug-in definition

Provides the plug-in definition that is associated with this application plug-in. This injectable can be used to gain context about the application plug-in. It can also be used by the application plug-in with other application plug-in framework objects to perform a contextual action.

Logger

Provides a logger that is named after the application plug-in's plugin definition ID.

Launch Metadata

If present, this variable requests the application plug-in instance to initialize with some context, rather than the default view.

Viewport Events

Presents hooks that can be subscribed to for event listening. Events include:

`resized: Subject<{width: number, height: number}>`

Fires when the viewport's size has changed.

Window Events

Presents hooks that can be subscribed to for event listening. The events include:

Event	Description
`maximized: Subject<void>`	Fires when the Window is maximized.
`minimized: Subject<void>`	Fires when the Window is minimized.
`restored: Subject<void>`	Fires when the Window is restored from a minimized state.
`moved: Subject<{top: number, left: number}>`	Fires when the Window is moved.
`resized: Subject<{width: number, height: number}>`	Fires when the Window is resized.
`titleChanged: Subject<string>`	Fires when the Window's title changes.

Window Actions

An application plug-in can request actions to be performed on the Window through the following:

Item	Description
`close(): void`	Closes the Window of the application plug-in instance.
`maximize(): void`	Maximizes the Window of the application plug-in instance.
`minimize(): void`	Minimizes the Window of the application plug-in instance.
`restore(): void`	Restores the Window of the application plug-in instance from a minimized state.
`setTitle(title: string):void`	Sets the title of the Window.
`setPosition(pos: {top: number, left: number, width: number, height: number}): void`	Sets the position of the Window on the page and the size of the window.
`spawnContextMenu(xPos: number, yPos: number, items: ContextMenuItem[]): void`	Opens a context menu on the application plug-in instance, which uses the Context Menu framework.
`registerCloseHandler(handler: () => Promise<void>): void`	Registers a handler, which is called when the Window and application plug-in instance are closed.

Framework API examples

The following are examples of how you would access the Window Actions API to begin an App in maximized mode upon start-up.

Angular

1. Import `Angular2InjectionTokens` from `'pluginlib/inject-resources'`
2. Within the constructor of your App, in the arguments, do `@Optional()` `@Inject(Angular2InjectionTokens.WINDOW_ACTIONS) private windowActions: Angular2PluginWindowActions`
3. Then inside the constructor, check that window actions exist and then execute the action
4. Depending on your App layout, certain UI elements may not have loaded so to wait for them to load, one may want to use something like Angular's NgOnInit directive.

React

1. Similar to how we do things in Angular, except the Window Actions (& other Zowe resources) are located in the `resources` object. So if we were using a React.Component, we could have a constructor with `constructor(props){ super(props); ... }`
2. Then accessing Window Actions would be as simple as `this.props.resources.windowActions`

IFrames

1. Iframes are similar to Angular & React, but require a different import step. Instead to use Window Actions (& other Zowe resources), we have to import the Iframe adapter. The Iframe adapter is located in `zlux-app-manager/bootstrap/web/iframe-adapter.js` so something like a relative path in my JS code will suffice,

```
<script type="text/javascript" src="../../../org.zowe.zlux.bootstrap/web/iframe-adapter.js"></script>
```

2. Then to use Window Actions would be as simple as `await windowActions.minimize();`

NOTE: The Iframe adapter is not yet feature-complete. If you are attempting to use an event supported by Angular or React, but not yet supported in Iframes, try to use the `window.parent.ZoweZLUX` object instead.

Version: v3.2.x LTS

Configuration Dataservice

The Configuration Dataservice is an essential component of the Zowe™ Application Framework, which acts as a JSON resource storage service, and is accessible externally by REST API and internally to the server by dataservices.

The Configuration Dataservice allows for saving preferences of applications, management of defaults and privileges within a Zowe ecosystem, and bootstrapping configuration of the server's dataservices.

The fundamental element of extensibility of the Zowe Application Framework is a *plug-in*. The Configuration Dataservice works with data for plug-ins. Every resource that is stored in the Configuration Service is stored for a particular plug-in, and valid resources to be accessed are determined by the definition of each plug-in in how it uses the Configuration Dataservice.

The behavior of the Configuration Dataservice is dependent upon the Resource structure for a plug-in. Each plug-in lists the valid resources, and the administrators can set permissions for the users who can view or modify these resources.

1. Resource Scope
2. REST API
    i. REST Query Parameters
    ii. REST HTTP Methods
        a. GET
        b. PUT
        c. DELETE
    iii. Administrative Access & Group
3. App API
4. Internal and Bootstrapping
5. Packaging Defaults
6. Plugin Definition
7. Aggregation Policies
8. Examples

Resource Scope

Data is stored within the Configuration Dataservice according to the selected *Scope*. The intent of *Scope* within the Dataservice is to facilitate company-wide administration and privilege management of Zowe data.

When a user requests a resource, the resource that is retrieved is an override or an aggregation of the broader scopes that encompass the *Scope* from which they are viewing the data.

When a user stores a resource, the resource is stored within a *Scope* but only if the user has access privilege to update within that *Scope*.

Scope is one of the following, from broadest scope (Plugin) to narrowest scope (User):

Scope	YAML Configuration Parameter	Default Location	Description
Plugin	N/A	`<zowe.extensionDirectory>/<plugin-name>/config/storageDefaults`	Configuration defaults that come with a plugin. Cannot be modified.
Product	N/A	`<zowe.runtimeDirectory>`	Configuration defaults that come with the product. Cannot be modified.
Site	components.app-server.siteDir	`<zowe.workspaceDirectory>/app-server/site`	Data that can be used between multiple Zowe instances.
Instance	components.app-server.instanceDir	`<zowe.workspaceDirectory>/app-server`	Data within an individual Zowe instance.
User	components.app-server.usersDir	`<zowe.workspaceDirectory>/app-server/users`	Data for individual users.

Note: While Authorization tuning can allow for settings such as GET from Instance to work without login, *User* scope queries will be rejected if not logged in due to the requirement to pull resources from a specific user.

When you specify *Scope User*, the service manages configuration for your particular username, using the authentication of the session. This way, the *User* scope is always mapped to your current username.

Consider a case where a user wants to access preferences for their text editor. One way they could do this is to use the REST API to retrieve the settings resource from the *Instance* scope.

The *Instance* scope might contain editor defaults set by the administrator. But, if there are no defaults in *Instance*, then the data in *Group* and *User* would be checked.

Therefore, the data the user receives would be no broader than what is stored in the *Instance* scope, but might have only been the settings they saved within their own *User* scope (if the broader scopes do not have data for the resource).

Later, the user might want to save changes, and they try to save them in the *Instance* scope. Most likely, this action will be rejected because of the preferences set by the administrator to disallow changes to the *Instance* scope by ordinary users.

REST API

When you reach the Configuration Service through a REST API, HTTP methods are used to perform the desired operation.

The HTTP URL scheme for the configuration dataservice is:

`<Server>/plugins/com.rs.configjs/services/data/<plugin ID>/<Scope>/<resource>/<optional subresources>?<query>`

Where the resources are one or more levels deep, using as many layers of subresources as needed.

Think of a resource as a collection of elements, or a directory. To access a single element, you must use the query parameter "name="

REST query parameters

Name (string)

Get or put a single element rather than a collection.

Recursive (boolean)

When performing a DELETE, specifies whether to delete subresources too.

Listing (boolean)

When performing a GET against a resource with content subresources, `listing=true` will provide the names of the subresources rather than both the names and contents.

REST HTTP methods

Below is an explanation of each type of REST call.

Each API call includes an example request and response against a hypothetical application called the "code editor".

GET

GET `/plugins/com.rs.configjs/services/data/<plugin>/<scope>/<resource>?name=<element>`

- This returns JSON with the attribute "content" being a JSON resource that is the entire configuration that was requested. For example:

`/plugins/com.rs.configjs/services/data/org.openmainframe.zowe.codeeditor/user/sessions/default?name=tabs`

The parts of the URL are:

- Plugin: org.openmainframe.zowe.codeeditor
- Scope: user
- Resource: sessions
- Subresource: default
- Element = tabs

The response body is a JSON config:

GET `/plugins/com.rs.configjs/services/data/<plugin>/<scope>/<resource>`

This returns JSON with the attribute `content` being a JSON object that has each attribute being another JSON object, which is a single configuration element.

GET `/plugins/com.rs.configjs/services/data/<plugin>/<scope>/<resource>`

(When subresources exist.)

This returns a listing of subresources that can, in turn, be queried.

PUT

PUT `/plugins/com.rs.configjs/services/data/<plugin>/<scope>/<resource>?name=<element>`

Stores a single element (must be a JSON object `{...}`) within the requested scope, ignoring aggregation policies, depending on the user privilege. For example:

`/plugins/com.rs.configjs/services/data/org.openmainframe.zowe.codeeditor/user/sessions/default?name=tabs`

Body:

Response:

DELETE

DELETE `/plugins/com.rs.configjs/services/data/<plugin>/<scope>/<resource>?recursive=true`

Deletes all files in all leaf resources below the resource specified.

DELETE `/plugins/com.rs.configjs/services/data/<plugin>/<scope>/<resource>?name=<element>`

Deletes a single file in a leaf resource.

DELETE `/plugins/com.rs.configjs/services/data/<plugin>/<scope>/<resource>`

- Deletes all files in a leaf resource.
- Does not delete the directory on disk.

Administrative access and group

By means not discussed here, but instead handled by the server's authentication and authorization code, a user might be privileged to access or modify items that they do not own.

In the simplest case, it might mean that the user is able to do a PUT, POST, or DELETE to a level above *User*, such as *Instance*.

The more interesting case is in accessing another user's contents. In this case, the shape of the URL is different. Compare the following two commands:

GET `/plugins/com.rs.configjs/services/data/<plugin>/user/<resource>`

Gets the content for the current user.

GET `/plugins/com.rs.configjs/services/data/<plugin>/users/<username>/<resource>`

Gets the content for a specific user if authorized.

This is the same structure that is used for the *Group* scope. When requesting content from the *Group* scope, the user is checked to see if they are authorized to make the request for the specific group. For example:

GET `/plugins/com.rs.configjs/services/data/<plugin>/group/<groupname>/<resource>`

Gets the content for the given group, if the user is authorized.

Application API

Retrieves and stores configuration information from specific scopes.

Note: This API should only be used for configuration administration user interfaces.

`ZLUX.UriBroker.pluginConfigForScopeUri(pluginDefinition: ZLUX.Plugin, scope: string, resourcePath:string, resourceName:string): string;`

A shortcut for the preceding method, and the preferred method when you are retrieving configuration information, is simply to "consume" it. It "asks" for configurations using the *User* scope, and allows the configuration service to decide which configuration information to retrieve and how to aggregate it. (See below on how the configuration service evaluates what to return for this type of request).

`ZLUX.UriBroker.pluginConfigUri(pluginDefinition: ZLUX.Plugin, resourcePath:string, resourceName:string): string;`

Internal and bootstrapping

Some dataservices within plug-ins can take configuration that affects their behavior. This configuration is stored within the Configuration Dataservice structure, but it is not accessible through the REST API.

Within the instance configuration directory of a zLUX installation, each plugin may optionally have an `_internal` directory. An example of such a path would be:

`~/.zowe/workspace/app-server/ZLUX/pluginStorage/<pluginName>/_internal`

Within each `_internal` directory, the following directories might exist:

- `services/<servicename>`: Configuration resources for the specific service.
- `plugin`: Configuration resources that are visible to all services in the plug-in.

The JSON contents within these directories are provided as Objects to dataservices through the dataservice context Object.

Packaging Defaults

The best way to provide default settings for a plugin is to include it as part of the plugin's package.
It's easy to distribute to users, requires no configuration steps, and is read-only from the server.
To package, all content must be stored within the `/config/storageDefaults` directory of your plugin.
Within, non-leaf resources are folders, and leaf resources are files, regardless of JSON or binary.
The `_internal` folder and content is also permitted.

Plug-in definition

Because the Configuration Dataservices stores data on a per-plug-in basis, each plug-in must define their resource structure to make use of the Configuration Dataservice. The resource structure definition is included in the plug-in's `pluginDefinition.json` file.

For each resource and subresource, you can define an `aggregationPolicy` to control how the data of a broader scope alters the resource data that is returned to a user when requesting a resource from a narrower Scope.

For example:

Aggregation policies

Aggregation policies determine how the Configuration Dataservice aggregates JSON objects from different Scopes together when a user requests a resource. If the user requests a resource from the *User* scope, the data from the User scope might replace or be merged with the data from a broader scope such as *Instance*, to make a combined resource object that is returned to the user.

Aggregation policies are defined by a plug-in developer in the plug-in's definition for the Configuration Service, as the attribute `aggregationPolicy` within a resource.

The following policies are currently implemented:

- **NONE**: If the Configuration Dataservice is called for *Scope User*, only user-saved settings are sent, unless there are no user-saved settings for the query, in which case the dataservice attempts to send data that is found at a broader scope.
- **OVERRIDE**: The Configuration Dataservice obtains data for the resource that is requested at the broadest level found, and joins the resource's properties from narrower scopes, overriding broader attributes with narrower ones, when found.

Examples

zlux-app-manager VT Terminal App

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URI Broker

The URI Broker is an object in the application plug-in web framework, which facilitates calls to the Zowe™ Application Server by constructing URIs that use the context from the calling application plug-in.

1. Accessing the URI Broker
    i. Natively
    ii. In an iframe
2. Functions
    i. Accessing an application plug-in's dataservices
        a. HTTP dataservice URI
        b. Websocket dataservice URI
    ii. Accessing the application plug-in's configuration resources
        a. Standard configuration access
        b. Scoped configuration access
    iii. Accessing static content
    iv. Accessing the application plug-in's root
    v. Server queries
        a. Accessing a list of plug-ins

Accessing the URI Broker

The URI Broker is accessible independent of other frameworks involved such as Angular, and is also accessible through iframe. This is because it is attached to a global when within the Zowe Desktop. For more information, see Zowe Desktop and window management. Access the URI Broker through one of two locations:

Natively:

`window.ZoweZLUX.uriBroker`

In an iframe:

`window.parent.ZoweZLUX.uriBroker`

Functions

The URI Broker builds the following categories of URIs depending upon what the application plug-in is designed to call.

Accessing an application plug-in's dataservices

Dataservices can be based on HTTP (REST) or Websocket. For more information, see Dataservices.

HTTP Dataservice URI

`pluginRESTUri(plugin:ZLUX.Plugin, serviceName: string, relativePath:string): string`

Returns: A URI for making an HTTP service request.

Websocket Dataservice URI

`pluginWSUri(plugin: ZLUX.Plugin, serviceName:string, relativePath:string): string`

Returns: A URI for making a Websocket connection to the service.

Accessing application plug-in's configuration resources

Defaults and user storage might exist for an application plug-in such that they can be retrieved through the Configuration Dataservice.

There are different scopes and actions to take with this service, and therefore there are a few URIs that can be built:

Standard configuration access

`pluginConfigUri(pluginDefinition: ZLUX.Plugin, resourcePath:string, resourceName?:string): string`

Returns: A URI for accessing the requested resource under the user's storage.

Scoped configuration access

`pluginConfigForScopeUri(pluginDefinition: ZLUX.Plugin, scope: string, resourcePath:string, resourceName?:string): string`

Returns: A URI for accessing a specific scope for a given resource.

Accessing static content

Content under an application plug-in's `web` directory is static content accessible by a browser. This can be accessed through:

`pluginResourceUri(pluginDefinition: ZLUX.Plugin, relativePath: string): string`

Returns: A URI for getting static content.

For more information about the `web` directory, see Application plug-in filesystem structure.

Accessing the application plug-in's root

Static content and services are accessed off of the root URI of an application plug-in. If there are other points that you must access on that application plug-in, you can get the root:

`pluginRootUri(pluginDefinition: ZLUX.Plugin): string`

Returns: A URI to the root of the application plug-in.

Server queries

A client can find different information about a server's configuration or the configuration as seen by the current user by accessing specific APIs.

Accessing a list of plug-ins

`pluginListUri(pluginType: ZLUX.PluginType): string`

Returns: A URI, which when accessed returns the list of existing plug-ins on the server by type, such as "Application" or "all".

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Application-to-application communication

Zowe™ application plug-ins can opt-in to various application framework abilities, such as the ability to have a Logger, the ability to use a URI builder utility, and more.

The ability for one appliccation plug-in to communicate with another is an ability that is unique to Zowe environments with multiple application plug-ins. The application framework provides constructs that facilitate this ability.

The constructs are: the Dispatcher, Actions, Recognizers, Registry, and the features that utilize them such as the framework's Context menu.

1. Why use application-to-application communication?
2. Actions
3. Recognizers
4. Dispatcher
5. Registry
6. Pulling it all together in an example

Why use application-to-application communication?

When working with computers, people often use multiple applications to accomplish a task. For example, a person might check their email before opening a bank statement in a browser. In many environments, the relationship between one application and another is not well defined. For example, you may open one program to learn of a situation, which is then resolved by opening a different program and typing in content. The application framework attempts to solve this problem by creating structured messages that can be sent from one application plug-in to another.

An application plug-in has a context of the information that it contains. This context can be used to invoke an action on another application plug-in that is better suited to handle some of the information discovered in the first application plug-in. Well-structured messages facilitate the process of determining which application plug-in is best suited to handle a given situation, while also explaining, in detail, what that application plug-in should do.

This way, rather than finding out that an attachment with the extension ".dat" was not meant for a text editor, but rather for an email client, one application plug-in may be able to invoke an action on an application plug-in that is capable of opening of an email.

Actions

To manage communication from one application plug-in to another, a specific structure is needed. In the application framework, the unit of application-to-application communication is an Action. The typescript definition of an Action is as follows:

An Action has a specific structure of data that is passed, to be filled in with the context at runtime, and a specific target to receive the data.

The Action is dispatched to the target in one of several modes, for example: to target a specific instance of an application plug-in, an instance, or to create a new instance.

The Action can be less detailed than a message. It can be a request to minimize, maximize, close, launch, and more. Finally, all of this information is related to a unique ID and localization string such that it can be managed by the framework.

Action target modes

When you request an Action on an application plug-in, the behavior is dependent on the instance of the application plug-in you are targeting. You can instruct the framework to target the application plug-in with a target mode from the `ActionTargetMode` `enum`:

Action types

The application framework performs different operations on application plug-ins depending on the type of an Action. The behavior can be quite different, from simple messaging to requesting that an application plug-in be minimized. The types are defined by an `enum`:

Loading actions

Actions can be created dynamically at runtime, or saved and loaded by the system at login.

App2App via URL

Another way the Zowe Application Framework invokes Actions is via URL Query Parameters, with parameters formatted in JSON. This feature enables users to bookmark a set of application-to-application communication actions (in the form of a URL) that will be executed when opening the webpage. Developers creating separate web apps can build a link that will open the Zowe Desktop and do specific actions in Apps, for example, opening a file in the Editor.

The App2App via URL feature allows you to:

1. Specify one or more actions that will be executed upon login, allowing you to bookmark a series of actions that you can share with someone else.

2. Specify actions that are declared by plugins (when formatter is equal to a known action ID) or actions that you have custom-made (when formatter = 'data').

3. Customize the action type, mode, and target plugin (when the formatter is equal to an existing action ID).

Samples

Query parameter format:

`?app2app={pluginId}:{actionType}:{actionMode}:{formatter}:{contextData}&app2app={pluginId}:{actionType}:{actionMode}:{formatter}:{contextData}`

- `pluginId` - application identifier, e.g. `'org.zowe.zlux.ng2desktop.webbrowser'`
- `actionType` - `'launch' | 'message'`
- `actionMode` - `'create' | 'system'`
- `formatter` - `'data'` | actionId
- `contextData` - context data in form of JSON

- `windowManager` - `'MVD' | undefined` : (Optional) While in standalone mode, controls whether to use the Zowe (MVD) window manager or the deprecated simple window manager. Default is MVD.
- `showLogin` - `true | false` : (Optional) While in standalone mode, controls whether to show Zowe's login page if credentials are not retrieved from a previous Desktop session, or if to disable it and load the application anyway (ideal solution for apps with their own login experiences). Default is true.

Note that some of these parameters are shared with single app mode, therefore, you may need to adjust pluginId and app2app parameters as follows

(desktop mode)

(single app mode)

Dynamically

You can create Actions by calling the following Dispatcher method: `makeAction(id: string, defaultName: string, targetMode: ActionTargetMode, type: ActionType, targetPluginID: string, primaryArgument: any):Action`

Saved on system

Actions can be stored in JSON files that are loaded at login. The JSON structure is as follows:

Recognizers

Actions are meant to be invoked when certain conditions are met. For example, you do not need to open a messaging window if you have no one to message. Recognizers are objects within the application framework that use the context that the application plug-in provides to determine if there is a condition for which it makes sense to execute an Action. Each recognizer has statements about what condition to recognize, and when that statement is met, which Action can be executed at that time. The invocation of the Action is not handled by the Recognizer; it simply detects that an Action can be taken.

Recognition clauses

Recognizers associate a clause of recognition with an action, as you can see from the following class:

A clause, in turn, is associated with an operation, and the subclauses upon which the operation acts. The following operations are supported:

Loading Recognizers at runtime

You can add a Recognizer to the application plug-in environment in one of two ways: by loading from Recognizers saved on the system, or by adding them dynamically.

Dynamically

You can call the Dispatcher method, `addRecognizer(predicate:RecognitionClause, actionID:string):void`

Saved on system

Recognizers can be stored in JSON files that are loaded at login. The JSON structure is as follows:

clause can take on one of two shapes:

Or,

Where this one can again, have subclauses.

Recognizer example

Recognizers can be as simple or complex as you write them to be, but here is an example to illustrate the mechanism:

In this case, the Recognizer detects whether it is possible to run the `org.zowe.explorer.openmember` Action when the TN3270 Terminal application plug-in is on the screen ISRUDSM (an ISPF panel for browsing PDS members).

Dispatcher

The dispatcher is a core component of the application framework that is accessible through the Global `ZLUX` Object at runtime. The Dispatcher interprets Recognizers and Actions that are added to it at runtime. You can register Actions and Recognizers on it, and later, invoke an Action through it. The dispatcher handles how the Action's effects should be carried out, acting in combination with the Window Manager and application plug-ins to provide a channel of communication.

Registry

The Registry is a core component of the application framework, which is accessible through the Global `ZLUX` Object at runtime. It contains information about which application plug-ins are present in the environment, and the abilities of each application plug-in. This is important to application-to-application communication, because a target might not be a specific application plug-in, but rather an application plug-in of a specific category, or with a specific featureset, capable of responding to the type of Action requested.

Pulling it all together in an example

The standard way to make use of application-to-application communication is by having Actions and Recognizers that are saved on the system. Actions and Recognizers are loaded at login, and then later, through a form of automation or by a user action, Recognizers can be polled to determine if there is an Action that can be executed. All of this is handled by the Dispatcher, but the description of the behavior lies in the Action and Recognizer that are used. In the Action and Recognizer descriptions above, there are two JSON definitions: One is a Recognizer that recognizes when the Terminal application plug-in is in a certain state, and another is an Action that instructs the MVS Explorer to load a PDS member for editing. When you put the two together, a practical application is that you can launch the MVS Explorer to edit a PDS member that you have selected within the Terminal application plug-in.

Version: v3.2.x LTS

Configuring IFrame communication

The Zowe Application Framework provides the following shared resource functions through a ZoweZLUX object: `pluginManager`, `uriBroker`, `dispatcher`, `logger`, `registry`, `notificationManager`, and `globalization`

Like REACT and Angular apps, IFrame apps can use the ZoweZLUX object to communicate with the framework and other apps. To enable communication in an IFrame app, you must add the following javascript to your app, for example in your `index.html` file:

`logger.js` is the javascript version of `logger.ts` and is capable of the same functions, including access to the `Logger` and `ComponentLogger` classes. The `Logger` class determines the behavior of all the `ComponentLoggers` created from it. `ComponentLoggers` are what the user implements to perform logging.

`Iframe-adapter.js` is designed to mimic the ZoweZLUX object that is available to apps within the virtual-desktop, and serves as the middle-man for communication between IFrame apps and the Zowe desktop.

You can see an implementation of this functionality in the sample IFrame app.

The version of ZoweZLUX adapted for IFrame apps is not complete and only implements the functions needed to allow the Sample IFrame App to function. The `notificationManager`, `logger`, `globalization`, `dispatcher`, `windowActions`, `windowEvents`, and `viewportEvents` are fully implemented. The `pluginManager` and `uriBroker` are only partially implemented. The `registry` is not implemented.

Unlike REACT and Angular apps, in IFrame apps the ZoweZLUX and initialization objects communicate with Zowe using the browser's onmessage and postmessage APIs. That means that communication operations are asynchronous, and you must account for this in your app, for example by using Promise objects and `await` or `then` functions.

Version: v3.2.x LTS

Error reporting UI

The `zLUX Widgets` repository contains shared widget-like components of the Zowe™ Desktop, including Button, Checkbox, Paginator, various pop-ups, and others. To maintain consistency in desktop styling across all applications, use, reuse, and customize existing widgets to suit the purpose of the application's function and look.

Ideally, a program should have little to no logic errors. Once in a while a few occur, but more commonly an error occurs from misconfigured user settings. A user might request an action or command that requires certain prerequisites, for example: a proper ZSS-Server configuration. If the program or method fails, the program should notify the user through the UI about the error and how to fix it. For the purposes of this discussion, we will use the Workflow application plug-in in the `zlux-workflow` repository.

ZluxPopupManagerService

The `ZluxPopupManagerService` is a standard popup widget that can, through its `reportError()` method, be used to display errors with attributes that specify the title or error code, severity, text, whether it should block the user from proceeding, whether it should output to the logger, and other options you want to add to the error dialog. `ZluxPopupManagerService` uses both `ZluxErrorSeverity` and `ErrorReportStruct`.

ZluxErrorSeverity

`ZluxErrorSeverity` classifies the type of report. Under the popup-manager, there are the following types: error, warning, and information. Each type has its own visual style. To accurately indicate the type of issue to the user, the error or pop-up should be classified accordingly.

ErrorReportStruct

`ErrorReportStruct` contains the main interface that brings the specified parameters of `reportError()` together.

Implementation

Import `ZluxPopupManagerService` and `ZluxErrorSeverity` from widgets. If you are using additional services with your error prompt, import those too (for example, `LoggerService` to print to the logger or `GlobalVeilService` to create a visible semi-transparent gray veil over the program and pause background tasks). Here, widgets is imported from `node_modules\@zlux\` so you must ensure zLUX widgets is used in your `package-lock.json` or `package.json` and you have run `npm install`.

```
import { ZluxPopupManagerService, ZluxErrorSeverity } from '@zlux/widgets';
```

Declaration

Create a member variable within the constructor of the class you want to use it for. For example, in the Workflow application plug-in under `\zlux-workflow\src\app\app\zosmf-server-config.component.ts` is a `ZosmfServerConfigComponent` class with the pop-up manager service variable. To automatically report the error to the console, you must set a logger.

Usage

Now that you have declared your variable within the scope of your program's class, you are ready to use the method. The following example describes an instance of the `reload()` method in Workflow that catches an error when the program attempts to retrieve a configuration from a `configService` and set it to the program's `this.config`. This method fails when the user has a faulty zss-Server configuration and the error is caught and then sent to the class' `popupManager` variable from the constructor above.

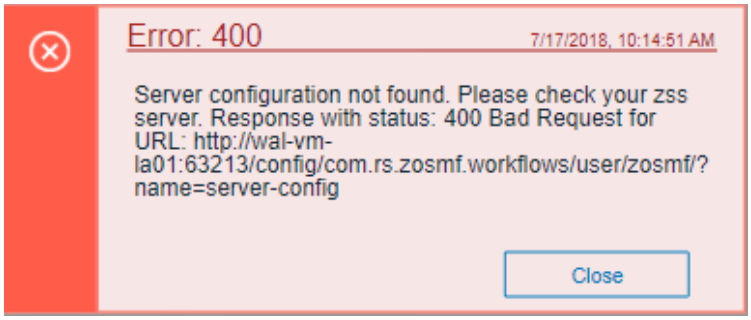
Here, the `errorMessage` clearly describes the error with a small degree of ambiguity as to account for all types of errors that might occur from that method. The specifics of the error are then generated dynamically and are printed with the `err.toString()`, which contains the more specific information that is used to pinpoint the problem. The `this.popupManager.report()` method triggers the error prompt to display. The error severity is set with `ZluxErrorSeverity.ERROR` and the `err.status.toString()` describes the status of the error (often classified by a code, for example: `404`). The optional parameters in `options` specify that this error will block the user from interacting with the application plug-in until the error is closed or it until goes away on its own. `globalVeilService` is optional and is used to create a gray veil on the outside of the program when the error is caused. You must import `globalVeilService` separately (see the `zlux-workflow` repository for more information).

HTML

The final step is to have the recently created error dialog display in the application plug-in. If you do `this.popupManager.report()` without adding the component to your template, the error will not be displayed. Navigate to your component's `.html` file. On the Workflow application plug-in, this file will be in `\zlux-workflow\src\app\app\zosmf-server-config.component.html` and the only item left is to add the popup manager component alongside your other classes.

```
<zlux-popup-manager></zlux-popup-manager>
```

So now when the error is called, the new UI element should resemble the following:



The order in which you place the pop-up manager determines how the error dialog will overlap in your UI. If you want the error dialog to overlap other UI elements, place it at the end of the `.html` file. You can also create custom styling through a CSS template, and add it within the scope of your application plug-in.

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Logging utility

The `zlux-shared` repository provides a logging utility for use by dataservices and web content for an application plug-in.

Logging objects

The logging utility is based on the following objects:

- **Component Loggers**: Objects that log messages for an individual component of the environment, such as a REST API for an application plug-in or to log user access.
- **Destinations**: Objects that are called when a component logger requests a message to be logged. Destinations determine how something is logged, for example, to a file or to a console, and what formatting is applied.
- **Logger**: Central logging object, which can spawn component loggers and attach destinations.

Logger IDs

Because Zowe™ application plug-ins have unique identifiers, both dataservices and an application plug-in's web content are provided with a component logger that knows this unique ID such that messages that are logged can be prefixed with the ID. With the association of logging to IDs, you can control verbosity of logs by setting log verbosity by ID.

Accessing logger objects

Logger

The core logger object is attached as a global for low-level access.

App Server

NodeJS uses `global` as its global object, so the logger is attached to: `global.COM_RS_COMMON_LOGGER`

Web

(Angular App Instance Injectible). See **Logger** in Zowe Desktop and window management.

(others) Browsers use `window` as the global object, so the logger is attached to: `window.COM_RS_COMMON_LOGGER`

Component logger

Component loggers are created from the core logger object, but when working with an application plug-in, allow the application plug-in framework to create these loggers for you. An application plug-in's component logger is presented to dataservices or web content as follows.

App Server

See **Router Dataservice Context** in the topic Dataservices.

Logger API

The following constants and functions are available on the central logging object.

Attribute	Type	Description	Arguments
`makeComponentLogger`	function	Returns an existing logger of this name, or creates a new component logger if no logger of the specified name exists - Automatically done by the application framework for dataservices and web content	`componentIDString`
`setLogLevelForComponentName`	function	Sets the verbosity of an existing component logger	`componentIDString`, `logLevel`

Component Logger API

The following constants and functions are available to each component logger.

Attribute	Type	Description	Arguments
`CRITICAL`	const	Is a const for `logLevel`	
`SEVERE`	const	Is a const for `logLevel`	
`WARN`	const	Is a const for `logLevel`	
`WARNING`	const	Is a const for `logLevel`	
`INFO`	const	Is a const for `logLevel`	
`DEBUG`	const	Is a const for `logLevel`	
`FINE`	const	Is a const for `logLevel`	
`FINER`	const	Is a const for `logLevel`	
`TRACE`	const	Is a const for `logLevel`	
`FINEST`	const	Is a const for `logLevel`	
`log`	function	Used to write a log, specifying the log level	`logLevel`, `messageString`
`critical`	function	Used to write a CRITICAL log.	`messageString`

Attribute	Type	Description	Arguments
`severe`	function	Used to write a SEVERE log.	`messageString`
`warn`	function	Used to write a WARNING log.	`messageString`
`info`	function	Used to write an INFO log.	`messageString`
`debug`	function	Used to write a FINE log.	`messageString`
`trace`	function	Used to write a TRACE log.	`messageString`
`makeSublogger`	function	Creates a new component logger with an ID appended by the string given	`componentNameSuffix`

Log Levels

An enum, `LogLevel`, exists for specifying the verbosity level of a logger. The mapping is:

Level	Number
CRITICAL	0
WARNING	1
INFO	2
DEBUG	3
FINER	4
TRACE	5

> **NOTE**
>
> The default log level for a logger is **INFO**.

Logging verbosity

Using the component logger API, loggers can dictate at which level of verbosity a log message should be visible. You can configure the server or client to show more or less verbose messages by using the core logger's API objects.

Example: You want to set the verbosity of the org.zowe.foo application plug-in's dataservice, bar to show debugging information.

```
logger.setLogLevelForComponentName('org.zowe.foo.bar',LogLevel.DEBUG)
```

Configuring logging verbosity

The application plug-in framework provides ways to specify what component loggers you would like to set default verbosity for, such that you can easily turn logging on or off.

Server startup logging configuration

The server configuration file allows for specification of default log levels, as a top-level attribute `logLevel`, which takes key-value pairs where the key is a regex pattern for component IDs, and the value is an integer for the log levels.

For example:

For more information about the server configuration file, see Zowe Application Framework (zLUX) configuration.

Using log message IDs

To make technical support for your application easier, create IDs for common log messages and use substitution to generate them. When you use IDs, people fielding support calls can identify and solve problems more quickly. IDs are particularly helpful if your application is translated, because it avoids users having to explain problems using language that the tech support person might not understand.

To use log message IDs, take the following steps:

1. Depending on how your application is structured, create message files in the following locations:
   - Web log messages: `{plugin}/web/assets/i18n/log/messages_{language}.json`
   - App server log messages: `{plugin}/lib/assets/i18n/log/messages_{language}.json`
2. In the files, create ID-message pairs using the following format:

   Where "id#" is the message ID and "value#" is the text. For example:

3. Reference the IDs in your code, for example:

   Which compiles to:

   Or in another supported language, such as Russian:

Message ID logging examples

Server core: https://github.com/zowe/zlux-server-framework/blob/v2.x/master/plugins/config/lib/assets/i18n/log/messages_en.json

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Developing for Zowe CLI

Extend Zowe™ CLI by developing plug-ins and contributing code to Zowe CLI core or existing plug-ins.

How to contribute

Contribute to Zowe CLI in the following ways:

- Add new commands, options, or other improvements to the core CLI.
- Develop a Zowe CLI plug-in.

You might want to contribute to Zowe CLI to accomplish the following objectives:

- Provide new scriptable functionality for yourself, your organization, or to a broader community.
- Make use of Zowe CLI infrastructure (such as profiles and programmatic APIs).
- Participate in the Zowe CLI community space.

Getting started

If you want to start working with the code immediately, review the Readme file in the Zowe CLI core repository and the Zowe contribution guidelines. To review a sample plug-in that adheres to the guidelines for contributing to Zowe CLI projects, see the zowe-cli-sample-plugin GitHub repository.

Contribution guidelines

The Zowe CLI contribution guidelines contain standards and conventions for developing Zowe CLI plug-ins.

The guidelines contain critical information about working with the code, running/writing/maintaining automated tests, developing consistent syntax in your plug-in, and ensuring that your plug-in integrates with Zowe CLI properly.

For more information about ...	See:
General guidelines that apply to contributing to Zowe CLI and plug-ins	Contribution guidelines
Conventions and best practices for creating packages and plug-ins for Zowe CLI	Package and plug-in guidelines
Guidelines for running tests on Zowe CLI	Testing guidelines
Guidelines for running tests on the plug-ins that you build	Plug-in testing guidelines
Versioning conventions for Zowe CLI and plug-ins	Versioning guidelines

Plug-in development overview

At a high level, a plug-in must have `imperative-framework` configuration (see a sample here). This configuration is discovered by `imperative-framework` through the package.json `imperative` key.

A Zowe CLI plug-in minimally contains the following:

1. Programmatic API: Node.js programmatic APIs to be called by your handler or other Node.js applications.
2. Command definition: The syntax definition for your command.
3. Handler implementation: To invoke your programmatic API to display information in the format that you defined in the definition.

Imperative CLI Framework documentation

Imperative CLI Framework documentation is a key source of information to learn about the features of Imperative CLI Framework, the code framework that you use to build plug-ins for Zowe CLI. Refer to these supplementary documents during development to learn about specific features such as:

- Auto-generated help
- JSON responses
- User profiles
- Logging, progress bars, experimental commands, and more
- Authentication mechanisms

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Tutorials

To better understand how to extend Zowe CLI and Zowe CLI plug-ins, read through the Extend tutorials.

The following topics are covered in the tutorials:

1. Setting up: Clone the project and prepare your local environment.
2. Installing a plug-in: Install the sample plug-in to Zowe CLI and run as-is.
3. Extending a plug-in: Extend the sample plug-in with a new command by creating a programmatic API, definition, and handler.
4. Creating a new plug-in: Create a new CLI plug-in that uses Zowe CLI programmatic APIs and a diff package to compare two data sets.
5. Implementing user profiles: Implement user profiles with the plug-in.

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Setting up your development environment

Before you follow the development tutorials for creating a Zowe™ CLI plug-in, follow these steps to set up your environment.

Prerequisites

Install Zowe CLI.

Initial setup

Clone and build your project

1. Create a local development folder named `zowe-tutorial` to clone and build all projects in this folder.
2. Clone `zowe-cli-sample-plugin` and build from source.

   Clone the repository into your development folder to match the following structure:

   i. Open a terminal and enter `cd zowe-tutorial` to change directory into your `zowe-tutorial` folder.
   ii. Enter `git clone https://github.com/zowe/zowe-cli-sample-plugin` to clone the `zowe-cli-sample-plugin` repository.
   iii. Enter `cd zowe-cli-sample-plugin` to change directory into your `zowe-cli-sample-plugin` folder.
   iv. Enter `npm install` to install all dependencies and modules for the project.
   v. Enter `npm run build` to create a production build.

Optional step: Run automated tests

We recommend running automated tests on all code changes.

To run automated tests:

1. Use Visual Studio Code or your file explorer to copy the content in the `example_properties.yaml` file to the `custom_properties.yaml` file.
2. Use a text editor to edit the properties within `custom_properties.yaml` to contain valid system information for your site.
3. In a terminal, enter `cd zowe-cli-sample-plugin` to change directory into your `zowe-cli-sample-plugin` folder.
4. Enter `npm run test` to run the automated test.

Next steps

After you complete your setup, follow the Installing the sample plug-in tutorial to install this sample plug-in to Zowe CLI.

Installing the sample plug-in

This tutorial covers installing and running the Zowe™ CLI sample plug-in, which adds a command to the CLI to list the contents of a directory on your computer.

Before you begin, set up your local environment to install a plug-in.

Installing the sample plug-in to Zowe CLI

To install the Zowe CLI sample plug-in:

1. Open a terminal and enter `cd zowe-tutorial` to change directory into your `zowe-tutorial` folder.

   See Initial setup for instructions on creating the `zowe-tutorial` folder.

2. Issue the following command to install the sample plug-in to Zowe CLI:

   The Zowe CLI Sample Plug-in is installed.

Viewing the installed plug-in

Open a terminal and issue the `zowe --help` command to return information for the installed `zowe-cli-sample` command group:

```
$ zowe

DESCRIPTION
-----------

  Welcome to Zowe CLI!

  Zowe CLI is a command line interface (CLI) that provides a simple and
  streamlined way to interact with IBM z/OS.

  For additional Zowe CLI documentation, visit https://zowe.github.io/docs-site.

  For Zowe CLI support, visit https://zowe.org.


USAGE
-----

  zowe [group]

GROUPS
------

  diagnostics              Run diagnostics
  plugins                  Install and manage plug-ins
  profiles                 Create and manage configuration profiles
  provisioning | pv        Perform z/OSMF provisioning tasks on Published
                           Templates in the Service Catalog and Provisioned
                           Instances in the Service Registry.
  zos-console | console    Issue z/OS console commands and collect responses
  zos-files | files        Manage z/OS data sets
  zos-jobs | jobs          Manage z/OS jobs
  zos-tso | tso            Issue TSO commands and interact with TSO address spaces
  zosmf                    Interact with z/OSMF
  zowe-cli-sample | zcsp Zowe CLI sample plug-in
```

Using the installed plug-in

Open a terminal and issue the `zowe zowe-cli-sample list directory-contents` command:

```
$ zowe zowe-cli-sample list directory-contents
We just got a valid z/OSMF status response from system = [redacted].ca.com

mode  size  birthed                                          lastModified                                     name
16822       Thu Sep 20 2018 09:52:20 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 10:06:10 GMT-0400 (Eastern Daylight Time) .git
33206 297   Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) .gitignore
16822       Thu Sep 20 2018 09:54:20 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 10:04:48 GMT-0400 (Eastern Daylight Time) .idea
33206       Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) .npmignore
33206 211   Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) .npmrc
33206 6855  Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) CICD-TEMPLATE.md
33206 1609  Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) CONTRIBUTING.md
16822       Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 09:51:28 GMT-0400 (Eastern Daylight Time) docs
16822       Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) jenkins
33206 36028 Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 09:40:07 GMT-0400 (Eastern Daylight Time) Jenkinsfile
16822       Thu Sep 20 2018 10:06:27 GMT-0400 (Eastern Daylight Time) Thu Sep 20 2018 10:06:28 GMT-0400 (Eastern Daylight Time) lib
```

Testing the installed plug-in

1. Open a terminal and enter `cd zowe-tutorial/zowe-cli-sample-plugin` to run automated tests against the plug-in.

2. Issue the following command:

   The command runs the automated unit and system tests defined in the `__tests__` folder. Test results are displayed in the terminal with the count of passed and failed tests. Failed tests are identified in the results.

Next steps

You successfully installed a plug-in to Zowe CLI! Next, try the Extending a plug-in tutorial to learn about developing new commands for this plug-in.

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Extending a plug-in

Before you begin, be sure to complete the Installing the sample plug-in tutorial.

Overview

This tutorial uses the Typicode REST API as a guide for how to build a Zowe CLI plug-in that interacts with REST APIs on the mainframe.

At the end of this tutorial, you are able to use the following new command from the Zowe CLI interface:

The completed source for this tutorial can be found on the `typicode-todos` branch of the `zowe-cli-sample-plugin` repository.

Creating a Typescript interface for the Typicode response data

First, create a Typescript interface to map the response data from a server:

1. Within `zowe-cli-sample-plugin/src/api`, create a folder named `doc` to contain the interface. The interface specifies the properties that we expect from the JSON response.
2. In the `doc` folder, create a file named `ITodo.ts`.
3. Edit the `ITodo.ts` file to contain the following code:

Creating a programmatic API

Next, create a Node.js API for the command handler to use.

This API can also be used in any Node.js application.

1. Create a file named `Typicode.ts` in the `zowe-cli-sample-plugin/src/api` directory.
2. Edit the `Typicode.ts` file to contain the following code:

   The `Typicode` class provides two programmatic APIs, `getTodos` and `getTodo`, to get an array of `ITodo` objects or a specific `ITodo`, respectively.

   The Node.js APIs use `@zowe/imperative` infrastructure to provide logging, parameter validation, and to call a REST API. See the Imperative CLI Framework documentation for more information.

Exporting the interface and programmatic API for other Node.js applications

Edit the zowe-cli-sample-plugin/src/index.ts file to contain the following code:

This allows a separate, standalone Node.js application to use APIs from the sample Typicode plug-in to get data from the REST API at jsonplaceholder.typicode.com.

The following code is an example of how a Node.js application could import classes from your API to interact with the Typicode REST API:

Verify that you can build the programmatic API

In your terminal, issue `npm run build` in your terminal to verify a clean compilation and confirm that no lint errors are present.

At this point, you have a programmatic API that can be used by your handler or another Node.js application. Next, define the command syntax for the command that uses your programmatic Node.js APIs.

Creating a command definition

This tutorial creates the following command in Zowe CLI:

Defining the syntax of your command

1. Navigate to `zowe-cli-sample-plugin/src/cli/list` and create a folder titled `typicode-todos`.
2. In this folder, create a file named `TypicodeTodos.definition.ts`.

   Edit the `TypicodeTodos.definition.ts` file to contain the following code:

   The `TypicodeTodos.definition.ts` file describes the syntax of your command.

Adding a command to a command group

Add the newly created `TypicodeTodosDefinition` to the `list` command group to enable users to list to-dos by running the `zowe zowe-cli-sample list typicode-todos` command.

1. In `zowe-cli-sample-plugin/src/cli/list/List.definition.ts`, add the following code below other `import` statements near the top of the file:
2. To the children array, add `TypicodeTodosDefinition`.

   For example:

   The command is added to the `list` command group.

Creating a command handler

1. In the `typicode-todos` folder, create the file `TypicodeTodos.handler.ts`.
2. Add the following code to the `TypicodeTodos.handler.ts` file:

   The `if` statement checks if a user provides an `--id` flag. If yes, the command handler calls `getTodo`. Otherwise, the command handler calls `getTodos`.

   If the Typicoce API throws an error, the error is forwarded to `@zowe/imperative` to log the error and display an error message in the terminal.

Verify that you can build your plug-in

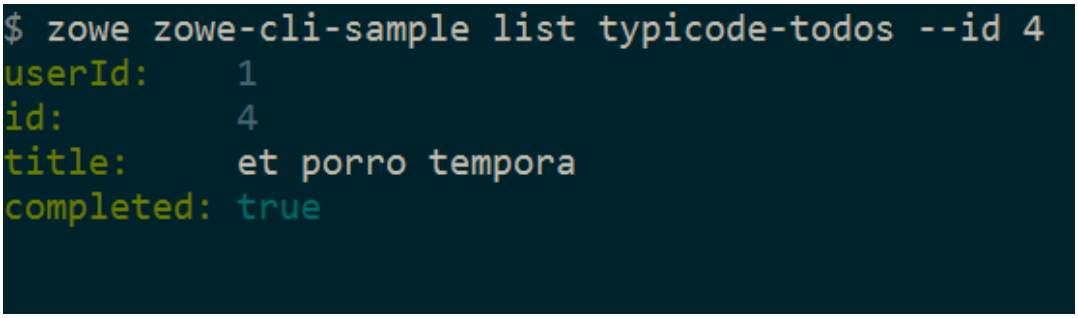
Issue `npm run build` to verify a clean compilation and confirm that no lint errors are present.

You now have a command definition, the command has been added to the `list` command group, and you have a handler.

Using the installed plug-in

Issue the command `zowe zowe-cli-sample list typicode-todos`.

Refer to `zowe zowe-cli-sample list typicode-todos --help` for more information about your command and to see how text in the command definition is presented to the end user. You can also see how to use your optional `--id` flag:



Summary

You extended an existing Zowe CLI plug-in by introducing a Node.js programmatic API, and you created a command definition with a handler.

For an official Zowe CLI plug-in, you would also add JSDoc to your code and create automated tests.

Next steps

Try the Developing a new plug-in tutorial next to create a new plug-in for Zowe CLI.

Version: v3.2.x LTS

Developing a new Zowe CLI plug-in

Before you begin, complete the Extending an existing plug-in tutorial.

Overview

The advantage of Zowe CLI and of the CLI approach in mainframe development is that it allows for combining different developer tools for new and interesting uses.

This tutorial demonstrates how to create a brand new Zowe CLI plug-in that uses Node.js to create a client-side API.

After following all the steps, you will have created a data set diff utility plug-in called **Files Util Plug-in**. This plug-in takes in any two data sets, or files, and returns a plain text output in the terminal showing how they differ. This tutorial also shows you how you can integrate your new plug-in with a third-party utility to make your output colorful and easier to read, as shown in the image at the bottom of this page.

If you are ready to create your own unique Zowe CLI plug-in, refer to the notes at the end of each tutorial step for guidance.

If you are interested in creating a credential manager plug-in, see the Zowe CLI secrets for kubernetes plug-in repository.

Setting up the new sample plug-in project

Download the sample plug-in source and delete the irrelevant content to set up your plug-in project:

1. Open a terminal and run the command `mkdir zowe-tutorial`.

   > **NOTE**
   >
   > All the files created through this tutorial are saved in this tutorial directory.

2. Enter `cd zowe-tutorial` to change directory into your `zowe-tutorial` folder.

3. Download the source code zip file from the Zowe CLI sample plug-in repository.

4. In your File Explorer, extract the zip file to the `zowe-tutorial` folder.

5. Rename the `zowe-cli-sample-plugin-master` directory to `files-util`.

   This is the project directory used throughout the rest of this tutorial.

6. Delete all content within the following folders:

   - `src/api`
   - `src/cli`
   - `docs` folders
   - `__tests__/__system__/api`

- `__tests__/__system__/cli`
- `__tests__/api`
- `__tests__/cli`

7. Return to your terminal and run `cd files-util` to enter the project directory.
8. Enter `git init` to set up a new Git repository.
9. Enter `git add --all` to *stage* (track) all files in the current directory with Git.
10. Enter `git commit --message "Initial commit"` to save a snapshot of the staged files in your repository.
11. Run `npm install` to install third-party dependencies defined in the `package.json` file of your Node.js project.

    When successful, a progress bar displays. Once the plug-in is installed, a message displays the status of the packages in the `node_modules` directory.

    > **NOTE**
    >
    > If vulnerabilities are found in any of the installed dependencies, refer to npm Docs for how to fix them.

> **TO CREATE A UNIQUE PLUG-IN**
>
> Change the `files-util` directory to a name applicable for your project.

Updating `package.json`

Change the name property in the `package.json` file to the plug-in name.

Open the `package.json` file in a text editor and replace the name field with the following information:

This tutorial uses `@zowe/files-util` as the tutorial plug-in name.

> **TO CREATE A UNIQUE PLUG-IN**
>
> Replace `@zowe/files-util` with a unique plug-in name. This allows you to publish the plug-in under that name to the `npm` registry in the future. For information regarding npm scoping, see the npm documentation.

Adjusting Imperative CLI Framework configuration

Define json configurations for the plug-in to Imperative.

Change the `src/pluginDef.ts` file to contain the following configurations:

When successful, the `src/pluginDef.ts` file contains the new configurations.

> **TO CREATE A UNIQUE PLUG-IN**

Change the plug-in name, display name, and description according to your project.

Adding third-party packages

Install third-party packages as dependencies for the plug-in's client-side API:

1. Run `npm install --save-exact diff` to install the diff package (which includes methods for comparing text).
2. Run `npm install --save-dev @types/diff` to install the typescript type definitions for the diff package as a development dependency.

   When successful, the `diff` and `@types/diff` packages are added to the dependency list in the `package.json` file.

> **TO CREATE A UNIQUE PLUG-IN**
>
> Instead of the `diff` package, install the package(s) that are required for your API, if any.

Creating a Node.js client-side API

Create a client-side API that compares the contents of two data sets on the mainframe:

1. In the `src/api` directory, create a file named `DataSetDiff.ts`.
2. Copy and paste the following code into the `DataSetDiff.ts` file:
3. In the `src` directory, replace the contents of the `index.ts` file with the following code in order to make the API available for other developers to import:

   When successful, the `index.ts` file contains the new code.

> **TO CREATE A UNIQUE PLUG-IN**
>
> The file name and code in Step 2 may be entirely different if you want to implement an API to do something else.

Building your plug-in source

Confirm that your project builds successfully:

1. Due to missing license headers, you will come across linting errors. Run `npm run lint:fix` to resolve the errors automatically.

   When successful, no errors are returned, although an unrelated warning might display. Additionally, the `lib` directory contains the built javascript files.

2. In the terminal, run `npm run build` to verify there are no errors.

   This command builds your typescript files by looking at the configuration details in `tsconfig.json` and placing the output javascript files in the `lib` directory.

The `lib` directory is configurable by modifying this value in the `tsconfig.json` file.

> **TO CREATE A UNIQUE PLUG-IN**
>
> Follow these same steps.

Creating a Zowe CLI command

To define the command that calls the client-side API:

1. In `src/cli`, create a folder named `diff`.
2. In the `diff` directory, create a file named `Diff.definition.ts`.
3. Copy and paste the following code into the `Diff.definition.ts` file:
4. In the `diff` folder, create a folder named `data-sets`.
5. In the `data-sets` folder, create the following two files:
   - `DataSets.definition.ts`
   - `DataSets.handler.ts`
6. Copy and paste the following code into the `DataSets.definition.ts` file:
7. Copy and paste the following code into the `DataSets.handler.ts` file:

   When successful, the `Diff.definition.ts`, `DataSets.definition.ts`, and `DataSets.handler.ts` files contain the new code.

> **NOTE**
>
> If you are adding multiple commands to your CLI plug-in, consider moving the code that creates a session into a base handler class that can be shared across multiple commands. See the sample plugin code for an example of how this can be done.

> **TO CREATE A UNIQUE PLUG-IN**
>
> Refer to file names specific to your project. Your code likely follows the same structure, but command name, handler, definition, and other information would differ.

Trying your command

Before you test your new command, confirm that you are able to connect to the mainframe.

In order for the client-side API to reach the mainframe (to fetch data sets), Zowe CLI needs a z/OSMF profile for access. See Team configurations for information.

Once the connection between Zowe CLI and z/OSMF is confirmed, build and install the plug-in before running it for the first time:

1. Repeat the steps in Building your plug-in source.

   As you make changes, repeat these steps to make sure the changes are reflected in the working plug-in.

2. Issue the following command to install **Files Util Plug-in** into Zowe CLI:

   A success message displays if installed correctly.

   > **NOTE**
   >
   > If you encounter installation errors due to conflicting profiles or command groups, uninstall the sample plug-in or modify the profile definition in the `src/pluginDef.ts` file.

3. Replace the data set names with valid mainframe data set names on your system:

   The raw diff output displays as a command response:

   When successful, the output displays plain text diffs of the entered data sets.

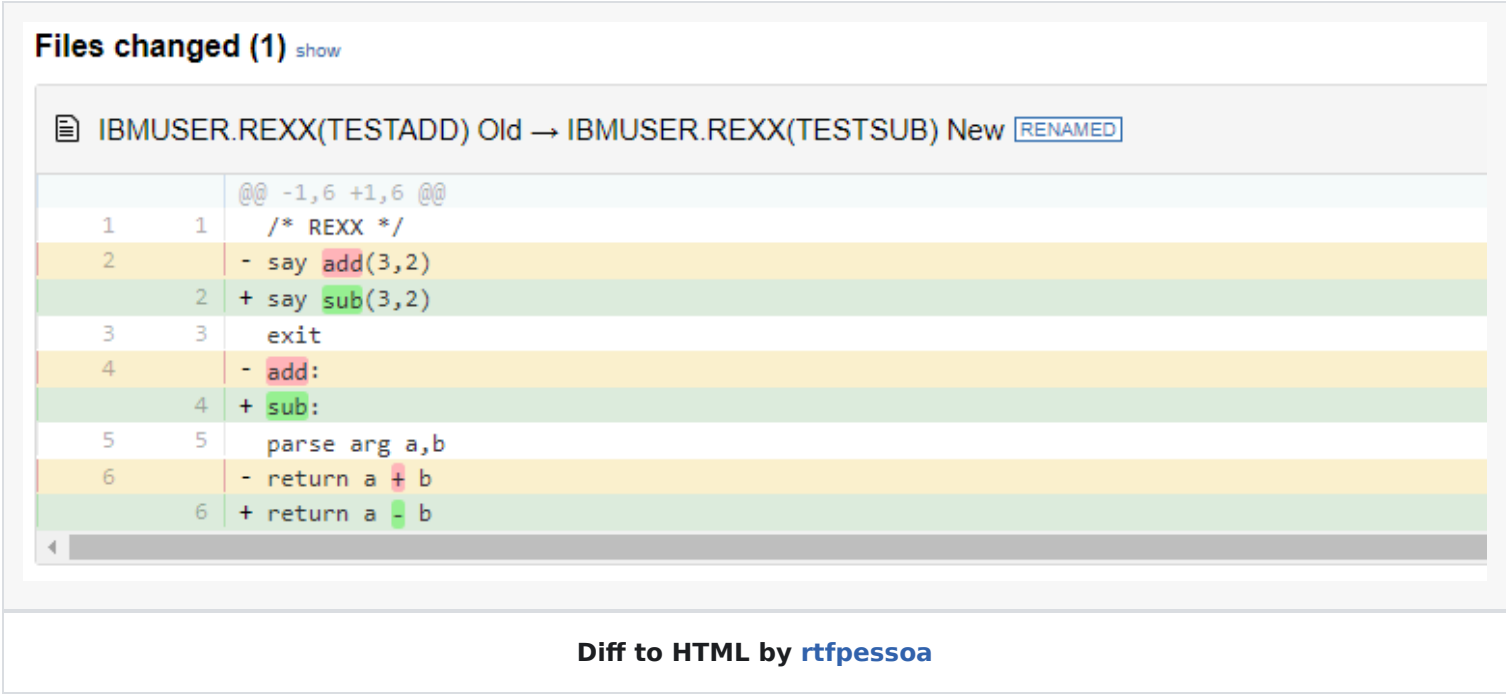
> **TO CREATE A UNIQUE PLUG-IN**
>
> Use Step 3 to run your new command. Note that the command is different based on the plug-in name in the `src/pluginDef.ts` file.

Bringing together new tools

You have created a simple CLI plug-in that provides plain text diffs of two data sets. But you may not want to end there.

Depending on the complexity of your changes, it can be difficult to identify data set differences with plain text.

To help fix this, you can extend **Files Util Plug-in** to create a more visual output. For this tutorial, use diff2html to generate side-by-side diffs that make it easier to compare changes, as seen in the image below.



Diff to HTML by rtfpessoa

1. Run `npm install --global diff2html-cli` to install `diff2html`.

   > **NOTE**
   >
   > Zowe is not associated with `diff2html-cli`.

2. To pipe your Zowe CLI plug-in output to `diff2html`, run the following command with your information:

   When successful, this launches a web browser that displays side-by-side diffs using HTML.

For a unique plug-in, consider integrating with more modern tools that make outputs easier to read or manage, or that can use outputs in scripts.

Next steps

Try the Implementing profiles in a plug-in tutorial to learn about defining new profiles with your plug-in.

Version: v3.2.x LTS

Implementing profiles in a plug-in

Users of your plug-in communicate with the mainframe by specifying connection information in a configuration profile.

For profiles to work with services other than z/OSMF, SSH, and TSO, developers must define profile types and the profile structure for their plug-in in a special file. This plug-in definition file ultimately allows an end user to add the plug-in profile — and its connection details — to their team configuration.

When creating profile types for a plug-in, apply the following code as a template to the plug-in definition file. Modify the template as necessary by changing values and/or adding more properties.

Editing the plug-in definition file

You can specify the plug-in definition file name and location in your plug-in's `package.json` file. For example:

- `pluginDef.js`

  The runtime file

- `src/pluginDef.ts`

  Location of your definition source

Edit the `pluginDef.ts` file (or your equivalent) to define profile types for your plug-in:

1. Use a text editor to open the `pluginDef.ts` file.
2. In the `pluginDef.ts` file, add the following profile definition:
3. Replace `someproduct` in `type: "someproduct"` with your plug-in profile name.

   This property represents the name of the profile type option that might be required on commands that allow users to select a profile from their team configuration. (Zowe CLI has profile types for z/OSMF, SSH, and TSO.)

   - For example, the `zowe zosmf check status --zosmf-profile` command includes an option that specifies a z/OSMF profile from the user's team configuration. For your plug-in, the profile type that you define can be used in a commands to specify a profile for your plug-in.

   This value is used in team configuration to create a plug-in profile to connect to the mainframe.
4. Update the title and description for your plug-in.
5. Add any needed properties to allow users to configure plug-in settings.

   Each option property in the template includes an `optionDefinition`. For a reference of `optionDefinition` attributes, see the `ICommandOptionDefinition` interface.
6. Set the `includeInTemplate` property to `true` to dictate that this property is included in any generated team configuration.

If set to `false` or not included, end users will have to add the property themselves when editing their team configuration.

7. Set the `secure` property to `true` to ensure that any value the end user specifies for this property is stored by default in their secure credential store. Otherwise the value is stored as plain text.

   The profile has been defined as needed.

Version: v3.2.x LTS

Authentication mechanisms

As an extender, you can change the way Zowe CLI uses various mechanisms of authentication when communicating with the mainframe.

Zowe CLI accepts various methods, or mechanisms, of authentication when communicating with the mainframe, and the method that the CLI ultimately follows is based on the service it is communicating with.

However, some services can accept multiple methods of authentication. When multiple methods are provided (in a profile or command) for a service, the CLI follows an *order of precedence* to determine which method to apply. Extenders can modify this order for their plug-in.

To learn the authentication methods used for different services and their order of precedence, refer to the following table.

Service	Order of precedence
API Mediation Layer **Note**: To avoid errors, update profiles for services routed through API ML to store base path instead of port number	1. username, password 2. API ML token 3. PEM certificate
Db2, FTP, most other services	username, password
SSH	1. SSH key 2. username, password
ZOSMF direct connection	1. username, password 2. PEM certificate

Version: v3.2.x LTS

Creating plug-in lifecycle actions

As a developer, you might want your plug-in to perform certain tasks immediately after install and just before uninstall.

Many different types of tasks can make up these *plug-in lifecycle actions*, including the following examples:

- Post-install actions:
  - An initial check
  - Additional setup
  - Adding the plug-in as an override of Zowe CLI's built-in credential manager
- Pre-uninstall actions:
  - Revert specialized setup
  - Removing the plug-in as an override of Zowe CLI's built-in credential manager

Creating and using lifecycle actions is optional, but they can be useful tools. Lifecycle actions can automate a manual process intended for the plug-in user to carry out. They can also avoid the need to create commands with uses limited to post-install and pre-uninstall tasks.

> **NOTE**
>
> When creating a plug-in to override Zowe CLI's built-in credential manager, it is necessary to implement a post-install action to configure your plug-in as the credential manager.

Implementing lifecyle actions

To add the `pluginLifeCycle` property to your plug-in definition file and include a plug-in class to implement lifecycle functions:

1. Navigate to the plug-in definition file.

   The path to this file is the value for the `configurationModule` property in the plug-in `package.json` file.

2. In the plug-in definition file, use the `pluginLifeCycle` property to add the path to the javascript file the plug-in uses to implement the class containing lifecycle functions.

   The `pluginLifeCycle` property is defined in this file.

   The class defined by this property extends the `AbstractPluginLifeCycle` class found in the Imperative package of utility functions.

3. In the plug-in lifecycle functions class you created, add instructions for both the `postInstall` and `preUninstall` functions.

   If implemented correctly, Zowe CLI calls the `postInstall` function of the plug-in immediately after the plug-in has been installed. Similarly, the `preUninstall` function is called immediately before the Zowe CLI uninstalls the plug-in.

NOTE

If your plug-in needs to perform an operation at only post-install or pre-uninstall, implement the other action to simply return to Zowe CLI without taking any action.

Version: v3.2.x LTS

Extending Zowe Explorer

You can extend the possibilities of Zowe Explorer by creating you own extensions. For more information on how to create your own Zowe Explorer extension, see Extensions for Zowe Explorer.

Version: v3.2.x LTS

Information roadmap for Zowe Client SDKs

This roadmap outlines information resources that are applicable to the various user roles who are interested in Zowe Client Software Development Kits (SDKs) which is a Zowe component still under development. These resources provide information about various subject areas, such as learning basic skills, installation, developing, and troubleshooting for Zowe Client SDKs.

Troubleshooting and support

- **Submit an issue**

  If you have an issue that is specific to Zowe SDKs, you can submit an issue against the `zowe-cli` repo.

Community resources

- **Slack channel**

  Join the #zowe-cli Slack channel to ask questions about Zowe CLI and Zowe SDKs, propose new ideas, and interact with the Zowe community.

- **Zowe CLI squad meetings**

  You can join one of the Zowe CLI squad meetings to discuss Zowe SDKs issues and contibute to Zowe SDKs.

- **Zowe Blogs on Medium**

  Read a series of blogs about Zowe on Medium to explore use cases, best practices, and more.

- **Community Forums**

  Look for discussion on Zowe topics on the Open Mainframe Project Community Forums.

Version: v3.2.x LTS

Developing for Zowe SDKs

The Zowe SDKs are open source. You can contribute to add features, enhancements, and bug fixes to the source code.

The functionality is currently limited to the interfaces provided by IBM z/OSMF. As a plug-in developer, you can enhance the SDK by creating a package that exposes programmatic APIs for your service.

Contributing to Zowe Client SDKs

For detailed contribution guidelines, see the following documents:

- Node.js SDK guidelines
- Kotlin SDK guidelines
- **Coming soon! Python SDK guidelines**

Community resources

- Join the #zowe-cli Slack channel to ask questions about Zowe CLI and Zowe SDKs, propose new ideas, and interact with the Zowe community.
- You can join one of the Zowe CLI squad meetings to discuss Zowe SDKs issues and contibute to Zowe SDKs.
- Read a series of blogs about Zowe on Medium to explore use cases, best practices, and more.
- Look for discussion on Zowe topics on the Open Mainframe Project Community Forums.

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Troubleshooting Zowe

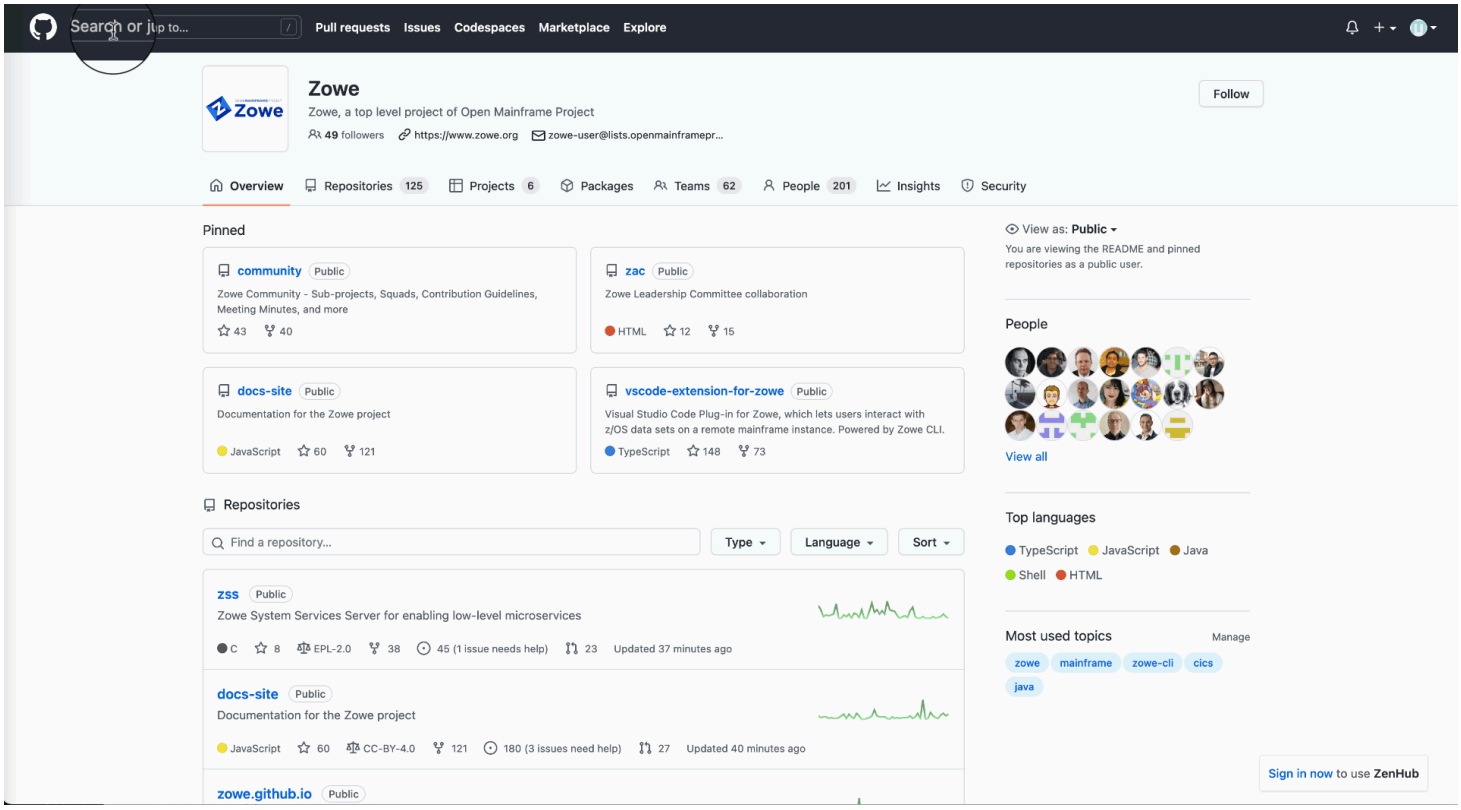
To isolate and resolve Zowe™ problems, you can use the troubleshooting and support information.

How to start troubleshooting

When you run into some issues and are looking for troubleshooting tips, the following steps may help you.

1. Search the error message or error code in your error log by using the Search bar in the Zowe Docs site. If there is an existing solution, follow the instructions to troubleshoot.

2. If no solution is available or the existing solutions cannot apply to your problem, you could search the keywords, error messages, or error code in the Zowe GitHub repository. If you find a closed issue or pull request, try troubleshooting by using the information shared in the item's Conversation section. If the issue is still open, post your question or comment to prompt a discussion on your problem.



3. If your problem is not solved, try the following options:
    - Create an issue in the Zowe GitHub repository with a detailed description of the problem you have encountered.
    - Bring up your questions to the corresponding channels as shown below:
        - Zowe API ML Slack channel

        - Zowe Chat Slack channel
        - Zowe CLI Slack channel
        - Zowe Documentation Slack channel
        - Zowe Explorer for VS Code channel
    - Reach out to your available Zowe support team for assistance.

Known problems and solutions

Some common problems with Zowe are documented in the Zowe Docs **Troubleshoot** section, along with their solutions or workarounds. If you have a problem with Zowe installation and components, review the problem-solution topics to determine whether a solution is available to the problem that you are experiencing.

You can also find error messages and codes, must-gathers, and information about how to get community support in these topics.

Troubleshooting Zowe server-side components

- Troubleshooting Zowe Launcher
- Troubleshooting Zowe z/OS component startup
- Troubleshooting API Mediation Layer
- Troubleshooting Zowe Application Framework

Troubleshooting Zowe client-side components

- Troubleshooting Zowe CLI
- Troubleshooting Zowe Explorer
- Troubleshooting Zowe Chat
- Troubleshooting Zowe Explorer plug-in for IntelliJ IDEA

Verifying a Zowe release's integrity

Following a successful install of a Zowe release, the Zowe runtime directory should contain the code needed to launch and run Zowe. If the contents of the Zowe runtime directory have been modified, this may result in unpredictable behavior. To assist with this, Zowe provides the ability to validate the integrity of a Zowe runtime directory. See Verify Zowe runtime directory for more information.

Understanding the Zowe release

Knowing which version of Zowe you are running might help you isolate the problem. Also, the Zowe version number is needed by the Zowe community enlisted to help you. To learn how to find the version number, see Understanding the Zowe release.

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Understanding Zowe release versions

Zowe releases

Zowe uses *semantic versioning* for its releases, also known as SemVer. In semantic versioning, each release has a unique ID made up of three numbers that are separated by periods:

Each time a new release is created, the release ID is incremented. Each number represents the content change since the previous release. For example:

- `2.5.0` represents the fifth minor release since the second major release.
- `2.5.1` represents the first patch to the `2.5.0` release.
- `2.6.0` is the first minor release to be created after `2.5.1`.

To see the Zowe release schedule, see Zowe PI Schedule and Releases.

Major release

Major releases are required for a "*breaking*" *change*, or a modification that requires updates to avoid disruptions in your applications. Major releases also can be used to indicate to the community a significant content update over and above what would be included in a minor release.

Conformance programs

Zowe V1 is associated with the Zowe V1 conformance program. Offerings that extend Zowe and achieve the Zowe V1 conformance badge remain compatible with Zowe throughout its Version 1 lifetime. A major release increment because of incompatibility is sometimes referred to as a "breaking" change.

SMP/E builds

Each major release has its own SMP/E Functional Module ID (FMID) in the format `AZWE00V`, where `V` represents the major version. The first SMP/E build for Zowe V3 has a Functional Module ID (FMID) of `AZWE003`, which was created with content from the 3.0.0 release.

Subsequent minor and patch releases to V3 are delivered as SMP/E PTF SYSMODs. Because of the size of the content, two co-requisite PTFs are created for each Zowe release.

Minor release

A minor release indicates that new functionality is added but the code is compatible with an earlier version.

Patch

A patch is usually reserved for a bug fix to a minor release.

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Checking your Zowe version release number

Once Zowe is installed and running, you will likely update Zowe and Zowe plug-ins regularly as new major and minor releases come out.

To keep track of which release is running as you troubleshoot an issue, the commands and file listed here can help.

Server side

To see the version of a Zowe release, run the `zwe version` command in USS:

The `zwe version` command returns a single line with the Zowe release number:

Using other commands

Add the `debug` or `trace` options to the `zwe version` command to show more information.

Using the `debug` mode:

The `debug` mode shows the unique build identifier for the installed version of Zowe. Run this when you want to replicate a bug for testing or troubleshooting.

Using the `trace` mode:

The `trace` mode shows the location where the convenience build was extracted (such as `<RUNTIME_DIR>`). Run this when you want to confirm the location of your Zowe runtime directory.

Using the `manifest` file

Find the version number of your Zowe release in the `manifest.json` file.

1. Extract the PAX file for the Zowe convenience build to `<RUNTIME_DIR>`.
2. Navigate to `<RUNTIME_DIR>` to locate the `manifest.json` file.
3. Open the `manifest.json` file.

   The Zowe version is listed at the beginning of the file:

Client side

Zowe CLI

1. Open the Zowe CLI.
2. Run the following command:

   The Zowe CLI version number is returned.

Zowe CLI plug-ins

1. Open the Zowe CLI.
2. Run the following command:

   A list of the installed Zowe CLI plug-ins are returned, along with the version number for each plug-in.

Zowe Explorer for Visual Studio Code

1. Open Visual Studio Code and click the **Extensions** icon.

   The **Extensions Side Bar** displays.

2. In the **Search** bar, enter `Zowe Explorer`.
3. In the **Side Bar**, select `Zowe Explorer` from the search results.

   An **Editor** tab displays the Zowe Explorer marketplace details. The version number is located next to the Zowe Explorer name.

Zowe Explorer for Visual Studio Code Extensions

1. Open Visual Studio Code and click the **Extensions** icon.

   The **Extensions Side Bar** displays.

2. In the **Search** bar, enter the name of the Zowe Explorer extension.
3. In the **Side Bar**, select the entered Zowe Explorer extension from the search results.

   An **Editor** tab displays the Zowe Explorer extension's marketplace details. The version number is located next to the Zowe Explorer extension's name.

Zowe Explorer plug-in for IntelliJ IDEA

See the guide for instructions.

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Gathering Information for Support or Troubleshooting

If you need to contact a support group for Zowe, they will likely need a variety of information from you to help you. This page details a list of items you should gather to the best of your ability to provide to your support group. You may also find this list useful for independent troubleshooting.

Describe your environment

- Zowe version number:
- Install method (pax, smpe, kubernetes, github clone):
- Operating system (z/OS, kubernetes, etc) and OS version:
- Node.js version number (Shown in logs, or via `node --version`):
- Java version number (Shown in logs, or via `java -version`):
- z/OSMF version:
- Browser:
- Are you accessing the Desktop from the APIML Gateway? (Recommended):
- What is the output of log message ZWES1014I:
- Environment variables in use:

Tips on gathering this information

A lot of this information can be gathered automatically using the `zwe` command `zwe support`. Otherwise, you can gather some of the information in the ways below.

z/OS release level

To find the z/OS release level, issue the following command in SDSF:

Zowe version

Locate the file `manifest.json` within the zowe installation directory. At the top, you will find the version number.

Describe your issue

Do you think your issue is a bug? If so, try to list the steps to reproduce it, and what you expect to happen instead.

Provide the logs

When running Zowe servers on z/OS, the joblog has the most information. Depending on what support group you are contacting, you may want to sanitize the logs as they can contain basic system information like hostnames, usernames, and network configuration.

Ensure that your logs were captured with long enough record length to be read by support. Zowe commonly writes lines as long as 500 characters, especially when tracing.

Enabling debugging and tracing

There are several debug modes in the Zowe servers, and support groups may ask for you to turn some on. Below are some tracing you can turn on when needed:

- When running a `zwe` command, you can run it with `--trace` to get the most output from it.
- `zwe` startup tracing can be set via the zowe configuration file property `zowe.launchScript.logLevel="trace"`. You can see the property in the example file here
- app-server tracing can be enabled by setting various loggers in the property `components.app-server.logLevels` in the zowe configuration file. The full list is documented here. More information
- zss-tracing tracing can be enabled by setting various loggers in the property `components.zss.logLevels` in the zowe configuration file. The full list is documented here. More information
- discovery, gateway, api-catalog and other servers can have tracing enabled by setting `debug: true` within their zowe configuration file section, such as `components.gateway.debug=true`

You may find more detail within the Mediation Layer and Application Framework troubleshooting categories.

Screenshots

If you have an issue in the browser, its often helpful to show the issue via screenshots.

Version: v3.2.x LTS

Verify Zowe runtime directory

Zowe ships a `zwe support verify-fingerprints` command to help you verify authenticity of your runtime directory. This command collects and calculates hashes for all files located in Zowe runtime directory and compare the hashes shipped with Zowe. With this utility, you are able to tell what files are modified, added, or deleted from original Zowe build.

Here is an example for successful verification:

If this verification fails, the script will exit with code 181 and display error messages like `Number of different files: 1`. You can optionally pass `--debug` or `-v` parameter to instruct this command to verbosely display which files are different.

Version: v3.2.x LTS

Troubleshooting Kubernetes environments

The following topics contain information that can help you troubleshoot problems when you encounter unexpected behavior installing and using Zowe™ containers in a Kubernetes environment.

ISSUE: Deployment and ReplicaSet failed to create pod

Problem:

If you are using OpenShift and see these error messages in `ReplicaSet` Events:

That means the Zowe ServiceAccount `zowe-sa` doesn't have any SecurityContextConstraint attached.

Solution:

You can run this command to grant a certain level of permission, for example, `privileged`, to `zowe-sa` ServiceAccount:

ISSUE: Failed to create services

Problem:

If you are using OpenShift and apply services, you may see this error:

Solution:

To fix this issue, you can simply find and comment out this line in the `Service` definition files:

With OpenShift, you can define a `PassThrough` `Route` to let Zowe handle TLS connections.

Version: v3.2.x LTS

Diagnosing Return Codes

If one of the Zowe servers ends abnormally with a return code, then this return code may be used as a clue to determine the cause of the failure. The meaning of a return code depends upon which program generated it; many return codes can originate from operating system utilities rather than from Zowe itself, but some may originate from Zowe too. Knowing which program generated the return code is important to finding the relevant documentation on the code. For example, if you tried to run the `app-server` and received a return code from a failure, it could have originated from, in order of execution, the Launcher, shell code and shell utilities such as `cat` or `mkdir`, `zwe`, and finally the app-server itself.

Return codes that can arise from any of the servers due to the chain of events that start Zowe may be found in the following documentation:

- Zowe launcher error codes
- The z/OS shell and programs called from the shell such as `cat`, `mkdir`, `node` or `java`:
  - Return codes ("errno"): https://www.ibm.com/docs/en/zos/2.5.0?topic=codes-return-errnos
  - Reason codes ("errnojr"): https://www.ibm.com/docs/en/zos/2.5.0?topic=codes-reason-errnojrs
- `zwe` error codes are documented specific to each `zwe` subcommand visible within the `--help` option of `zwe` or on the zwe reference page. Searching for "ZWEL" plus your error code in the search bar of the documentation website will likely bring you to the appropriate page.

Error codes for the specific Zowe servers may be found in their own troubleshooting sections.

Version: v3.2.x LTS

Troubleshooting certificate configuration

As an API Mediation Layer user, you may encounter problems when configuring certificates. Review the following article to troubleshoot errors or warnings that can occur when configuring certificates.

- PKCS12 server keystore generation fails in Java 8 SR7FP15, SR7 FP16, and SR7 FP20
- Eureka request failed when using entrusted signed z/OSMF certificate
- Zowe startup fails with empty password field in the keyring setup
- Certificate error when using both an external certificate and Single Sign-On to deploy Zowe
- Browser unable to connect due to a CIPHER error
- API Components unable to handshake
- Java z/OS components of Zowe unable to read certificates from keyring
- Java z/OS components of Zowe cannot load the certificate private key pair from the keyring
- Exception thrown when reading SAF keyring {ZWED0148E}
- ZWEAM400E Error initializing SSL Context when using Java 11
- Failed to load JCERACFKS keyring when using Java 11

PKCS12 server keystore generation fails in Java 8 SR7FP15, SR7 FP16, and SR7 FP20

Symptoms

Some Zowe Desktop applications do not work when Zowe creates a PKCS12 keystore. A message may appear in the log such as the following:

- ZWES1060W Failed to init TLS environment, rc=1(Handle is not valid)
- ZWES1065E Failed to configure https server. Check agent https setting.

These messages indicate that ZSS cannot read the generated keystore. As such, parts of Zowe are not functional.

Solutions

This error results from the incompatibility between Java and GSK regarding cryptography.

Try one of the following options if you are affected by this error:

- Temporarily downgrade Java, for example to Java 8 SR7FP10, and generate the PKCS12 keystore again.
- Upgrade Zowe to a later version 2.11.0 or a newer version in which this issue is fixed.

> **NOTE**
>
> - This error will not occur if you already have an existing keystore created with a proper Java version, or are using keyrings.
> - If you do not plan to use Zowe Desktop, you can disable the ZSS component to avoid receiving ZSS component errors in the log.

Eureka request failed when using entrusted signed z/OSMF certificate

Symptoms

A problem may occur when using the entrusted signed z/OSMF certificate, whereby the ZLUX AppServer cannot register with Eureka. Logs indicate that the cause is the self-signed certificate:

Solution

The error indicates that the keyring does not exist or cannot be found.

Review the keyring information and confirm the corresponding certificate authorities. Ensure that you specify the `certificateAuthorities` variable with the correct keyring label, and the label of the connected CA in the `zowe.certificate` section of your `zowe.yaml` file.

For example, if the keyring label is `ZoweKeyring` and the LABLCERT of the connected CA is `CA Internal Cert`, the `certificateAuthorities` variable should be `certificateAuthorities: safkeyring://ZWESVUSR/ZoweKeyring&CA Internal Cert`.

Zowe startup fails with empty password field in the keyring setup

Symptoms

The certificate appears to be correct, but the Gateway and the Discovery Service fail during start. The setup of the keyring certificate does not require a value for `password` in the `zowe.certificate.keystore.password` and `zowe.certificate.truststore.password`.

Solution

The password is only used for USS PKCS12 certificate files. The keyring is protected by SAF permissions. Note that in some configurations, Zowe does not work if the password value is empty in the keyring configuration. We recommended that you assign a value to `password` as shown in the following example:

Example:

Certificate error when using both an external certificate and Single Sign-On to deploy Zowe

Symptom:

You used an external certificate and Single Sign-On to deploy Zowe. When you log in to the Zowe Desktop, you encounter an error similar to the following:

Solution:

This issue might occur when you use a Zowe version of 1.12.0 or later. To resolve the issue, you can download your external root certificate and intermediate certificates in PEM format. Then, add the following parameter in the `zowe.yaml`

file.

`environments.ZWED_node_https_certificateAuthorities: "/path/to/zowe/keystore/local_ca/localca.cer-ebcdic","/path/to/carootcert.pem","/path/to/caintermediatecert.pem"`

Recycle your Zowe server. You should be able to log in to the Zowe Desktop successfully now.

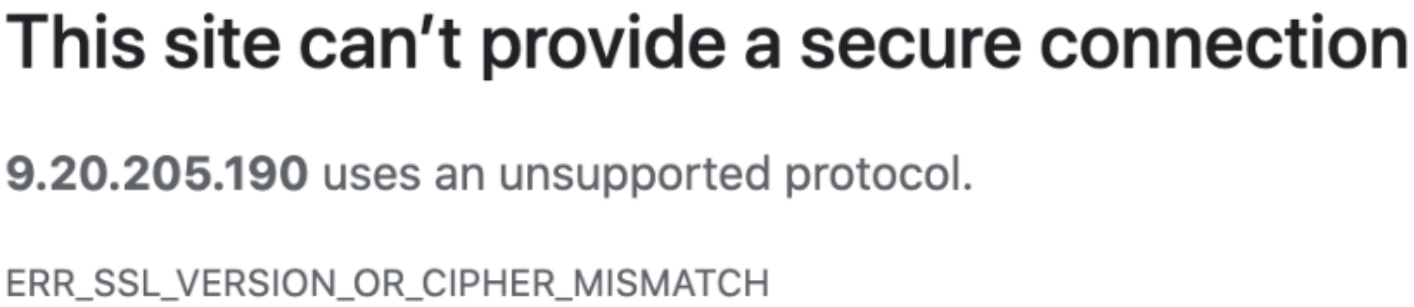
Browser unable to connect due to a CIPHER error

Symptom:

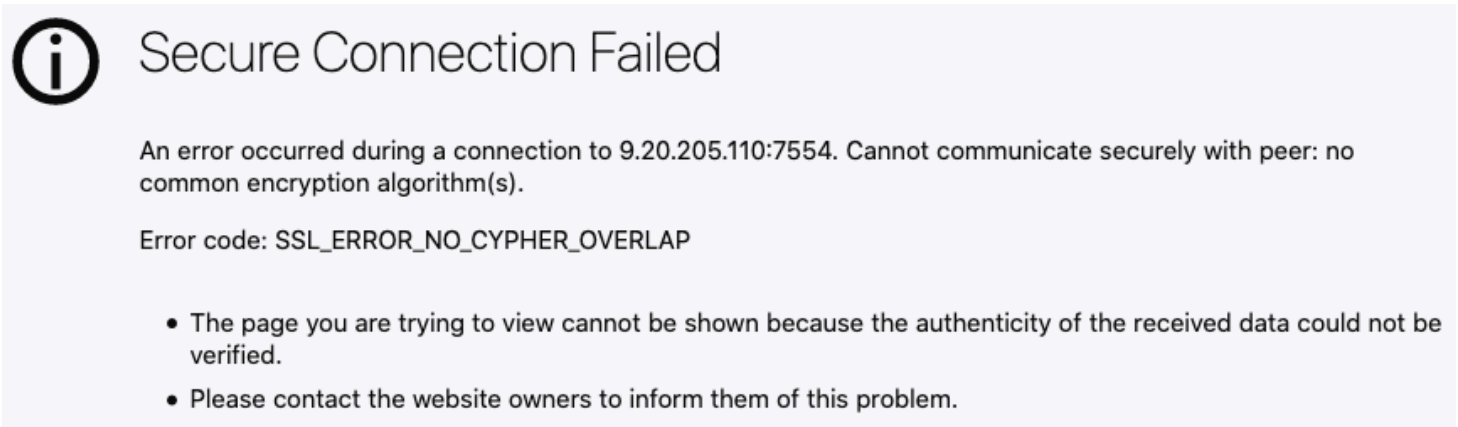
When connecting to the API Mediation Layer, the web browser throws an error saying that the site is unable to provide a secure connection because of an error with ciphers.

The error shown varies depending on the browser. For example,

- For Google Chrome:



- For Mozilla Firefox:



Solution:

Remove `GCM` as a disabled `TLS` algorithm from the Java runtime being used by Zowe.

To do this, first locate the `$JAVA_HOME/lib/security/java.security` file. You can find the value of `$JAVA_HOME` in one of the following ways.

- Method 1: By looking at the `java.home` value in the `zowe.yaml` file used to start Zowe.

For example, if the `zowe.yaml` file contains the following line,

then, the `$JAVA_HOME/lib/security/java.security` file will be `/usr/lpp/java/J8.0_64/lib/security/java.security`.

- Method 2: By inspecting the `STDOUT` JES spool file for the `ZWESLSTC` started task that launches the API Mediation Layer.

In the `java.security` file, there is a parameter value for `jdk.tls.disabledAlgorithms`.

Example:

Note: This line may have a continuation character `\` and be split across two lines due to its length.

Edit the parameter value for `jdk.tls.disabledAlgorithms` to remove `GCM`. If, as shown in the previous example, the line ends `<224, GCM`, remove the preceding comma so the values remain as a well-formed list of comma-separated algorithms:

Example:

Note: The file permissions of `java.security` might be restricted for privileged users at most z/OS sites.

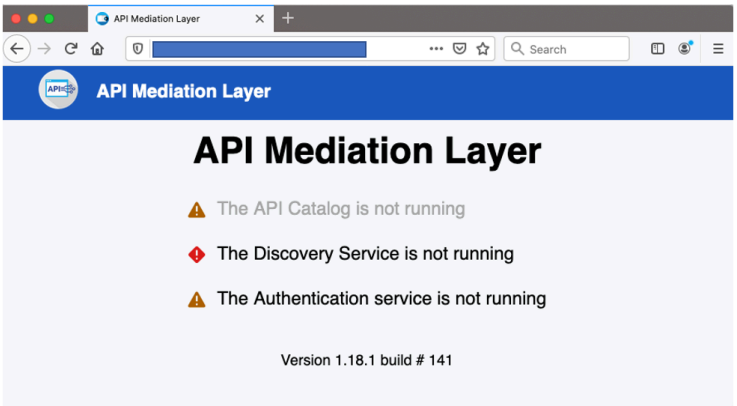
After you remove `GCM`, restart the `ZWESLSTC` started task for the change to take effect.

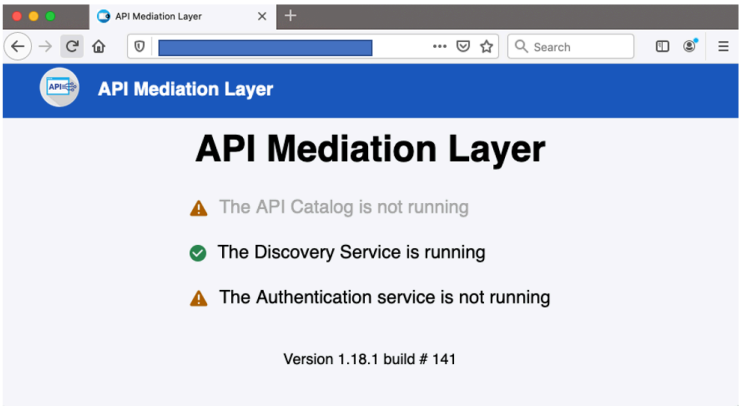
API Components unable to handshake

Symptom:

The API Mediation Layer address spaces ZWE1AG, ZWE1AC and ZWE1AD start successfully and are visible in SDSF, however they are unable to communicate with each other.

Externally, the status of the API Gateway homepage displays **!** icons against the API Catalog, Discovery Service and Authentication Service (shown on the left side image below) which do not progress to green tick icons as normally occurs during successful startup (shown on the right side image below).





The Zowe desktop is able to start but logon fails.

The log contains messages to indicate that connections are being reset. For example, the following message shows that the API Gateway `ZWEAG` is unable to connect to the API Discovery service, by default 7553.

The Zowe desktop is able to be displayed in a browser but fails to logon.

Solution:

Check that the Zowe certificate has been configured as a client certificate, and not just as a server certificate. For more informtion, see More detail can be found in Configuring certificates overview.

Java z/OS components of Zowe unable to read certificates from keyring

Symptom:

Java z/OS components of Zowe are unable to read certificates from a keyring. This problem may appear as an error as in the following example where Java treats the SAF keyring as a file.

Example:

Solution:

Apply the following APAR to address this issue:

- APAR IJ31756

Java z/OS components of Zowe cannot load the certificate private key pair from the keyring

Symptom:

API ML components configured with SAF keyring are not able to start due to an unrecoverable exception. The exception message notifies the user that the private key is not properly padded.

Example:

Solution:

Make sure that the private key stored in the keyring is not encrypted by a password, or that the private key integrity is not protected by a password. This is not related to SAF keyrings themselves, which are not usually protected by password, but rather to is related to the concrete certificate private key pair stored in the SAF keyring.

Exception thrown when reading SAF keyring {ZWED0148E}

Symptom:

If you see one or more of the following messages in the logs, the cause is keyring configuration.

- ZWED0148E - Exception thrown when reading SAF keyring, e= Error: R_datalib call failed: function code: 01, SAF rc: `number`, RACF rc: `number`, RACF rsn: `number`
- java.io.IOException: R_datalib (IRRSDL00) error: profile for ring not found (`number`, `number`, `number`)

You may also see the following log message:

`ZWES1060W Failed to init TLS environment, rc=1(Handle is not valid)`

Note: This log message can have other causes too, such as lack of READ permission to resources in the CRYPTOZ class.

Solution:

1. Refer to table 2 (DataGetFirst) of the Return and Reason Codes to determine the specific problem.
2. Check your keyring (such as with a LISTRING command) and your zowe configuration file's `zowe.certificate` section to spot and resolve the issue.

Example: If ZWED0148E contains the following message, it indicates that Zowe's local certificate authority (local CA) `ZoweCert`, the certificate `jwtsecret`, or the Zowe certificate `localhost` does not exist in the Zowe keyring.

Zowe's local CA certificate has its default name `ZoweCert`. Zowe Desktop hardcodes this certificate in the configuration scripts.

If you are using your own trusted CA certificate in the keyring, and the name is different from the default one, this error will occur. To resolve the issue, you must match the names in the Zowe configuration.

If you are using Zowe's local CA certificate and you still receive **ZWED0148E**, you may find the following message in the same log.

In this case, ensure that the label names exactly match the names in TSO when confirming your keyring. Any difference in spaces, capitalization, or other places throw the error.

ZWEAM400E Error initializing SSL Context when using Java 11

Symptom:

API ML components configured with SAF keyring are not able to start due to an unrecoverable exception. The message indicates that `safkeyring` is an unknown protocol.

Examples:

Solution:

Starting with Java 11, the safkeyring URLs are dependent on the type of RACF keystore as presented in the following table.

URL	Keystore
JCECCARACFKS	`safkeyringjcecca://ZWESVUSR/ZOWERING`
JCERACFKS	`safkeyringjce://ZWESVUSR/ZOWERING`
JCEHYBRIDRACFKS	`safkeyringjcehybrid://ZWESVUSR/ZOWERING`

Failed to load JCERACFKS keyring when using Java 11

Symptom:

API ML components do not start properly because they fail to load the JCERACFKS keyring. The exception message indicates that the keyring is not available. The keyring, however, is configured correctly and the STC user can access it.

Examples:

Solution:

In Java 11 releases before 11.0.17.0, the `IBMZSecurity` security provider is not enabled by default. Locate the `java.security` configuration file in the `$JAVA_HOME/conf/security` USS directory and open the file for editing. Modify the list of security providers and insert `IBMZSecurity` on second position. The list of enabled security providers should resemble the following series:

For more information see the steps in Enabling the IBMZSecurity provider.

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Troubleshooting startup of Zowe z/OS components

Review the following topics for information that can help you troubleshoot problems when installing Zowe z/OS components or starting Zowe's `ZWESLSTC` started task.

How to check if `ZWESLSTC` startup is successful

The `ZWESLSTC` started task on z/OS brings up a number of address spaces. There is no single message that **Zowe has launched and is ready to run** as the sequence of address spaces initialization is environment-dependent. Note that the message ID `ZWED0021I` is typically the last one that is logged. More details on each subsystem and their startup messages are described in the following sections.

- Troubleshooting startup of Zowe z/OS components
  - How to check if `ZWESLSTC` startup is successful
    - Check the startup of API Mediation Layer
    - Check the startup of Zowe Desktop
    - Check the startup of Zowe System Services

The most complete way to check that Zowe started successfully is to check that each component successfully completed its initialization. Each component writes messages to the JES `SYSPRINT` and writes severe errors to the `STDERR` job spool file.

To learn more about the Zowe components and their role, see Zowe Architecture. It is possible to configure Zowe to bring up only a subset of its components by using the `components.<NAME>.enabled: boolean` variables in the `zowe.yaml` file.

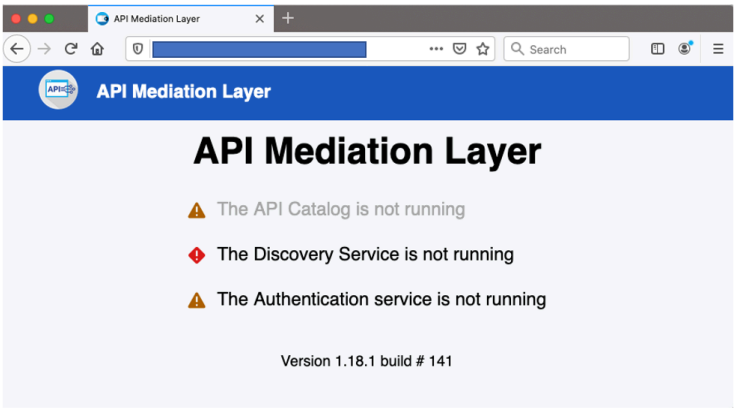
Check the startup of API Mediation Layer

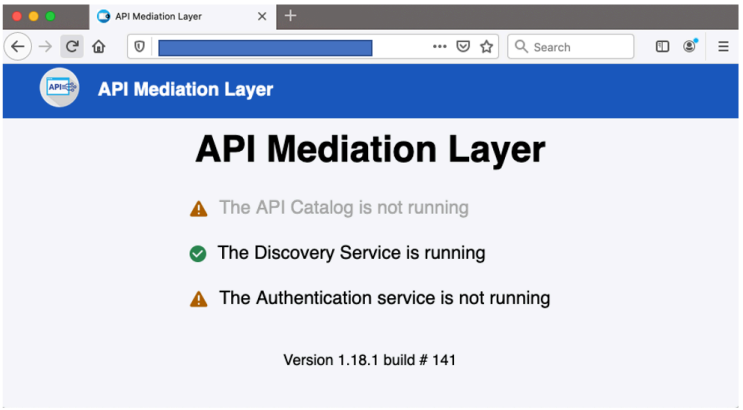
The API Mediation Layer has four address spaces: API Catalog, API Gateway, API Discovery and Caching Service.

To check whether the API Mediation Layer is fully initialized, look for the message `ZWEAM000I`. Each component writes a successful startup message `ZWEAM000I` to JES as shown in the following example. The message also indicates the CPU of seconds spent. In a normal startup of API ML components, each component writes a `ZWEAM000I` message as in the following example:

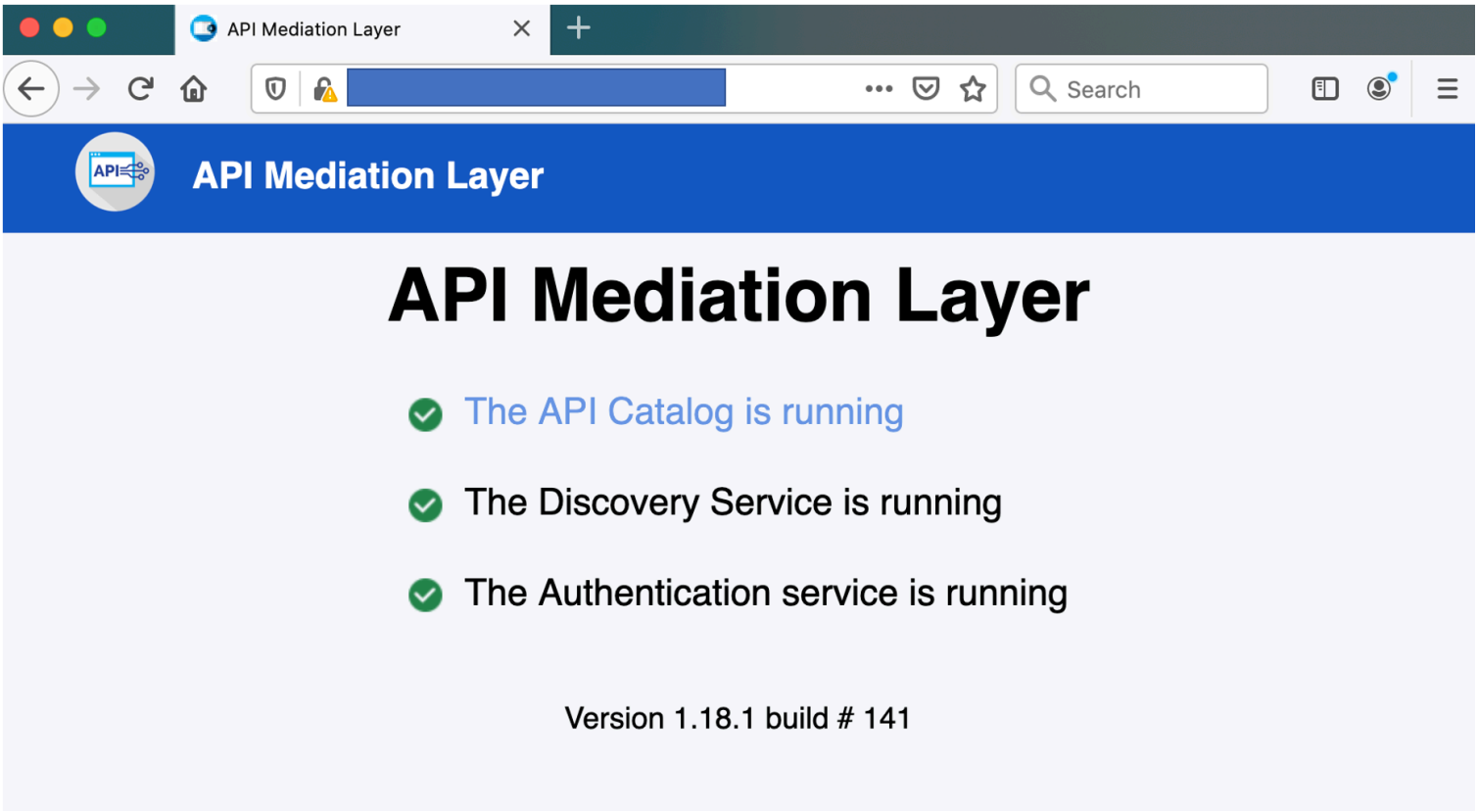
Example:

In addition to looking for `ZWEAM000I` in the JES log, you can also log in to the Gateway homepage and check the service status indicator. The Gateway home page is accessible on the externalPort. The default value for this port is `7554`. If there is a red or yellow tick beside one of its three services, the components are still starting.





When all services are fully initialized, three green ticks are displayed.



Check the startup of Zowe Desktop

During startup, Zowe Desktop loads its plug-ins and writes the message `ZWED0031I` when completed.

The `ZWED0031I` message includes a count of the number of loaded plug-ins as well as the total number of plug-ins, for example `Plugins successfully loaded: 100% (19/19)`. A failed plug-in load will not abort the launch of the Desktop.

If Zowe Desktop is started together with the API Gateway, the Zowe Desktop will register itself with the API Gateway. This step must be completed before a user is able to successfully log in to the Zowe Desktop. The message `ZWED0021I` indicates successful registration between the Zowe Desktop and the API Gateway.

Example:

If you try to log into the Zowe Desktop too early before the Eureka client registration is complete, you may receive the message that **Authentication failed** on the login page. This is due to an incomplete API ML handshake. If

authentication fails, wait for the registration to complete as indiciated by the `ZWED0021I` message.

In addition to spooling to the JES `SYSPRINT` file for the Zowe `ZWESLSTC` task, the Zowe Desktop writes messages to `zowe.logDirectory/zssServer-yyyy-mm-dd-hh-ss.log`.

Check the startup of Zowe System Services

The zssServer is used for system services for the Zowe Desktop.

The zssServer registers itself with the cross memory server running under the address space `ZWESISTC`. You can use the attach message ID `ZWES1014I` to check that this has occurred successfully. If this message contains a nonzero return code in the `cmsRC=` value, then a failure occurred. For more information on how to diagnose these, see ZSS server unable to communicate with ZIS.

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Troubleshooting Zowe API Mediation Layer

As an API Mediation Layer user, you may encounter problems with how the API ML functions. This article presents known API ML issues and their solutions.

> **NOTE**
>
> To troubleshoot errors or warnings that can occur when configuring certificates, see the article Troubleshooting certificate configuration.

Install API ML without Certificate Setup

For testing purposes, it is not necessary to set up certificates when configuring the API Mediation Layer. You can configure Zowe without certificate setup and run Zowe with `verify_certificates: DISABLED`.

> **IMPORTANT:**
>
> For production environments, certificates are required. Ensure that certificates for each of the following services are issued by the Certificate Authority (CA) and that all keyrings contain the public part of the certificate for the relevant CA:
>
> - z/OSMF
> - Zowe
> - The service that is onboarded to Zowe

Enable API ML Debug Mode

Use debug mode to activate the following functions:

- Display additional debug messages for API ML
- Enable changing log level for individual code components
- Gather atypical debug information

When on z/OS, API ML log messages are written to the STC job log.

> **IMPORTANT:**
>
> We highly recommend that you enable debug mode only when you want to troubleshoot issues. Disable debug mode when you are not troubleshooting. Running in debug mode while operating API ML can adversely affect its performance and create large log files that consume a large volume of disk space.

Follow these steps:

1. Open the file `zowe.yaml`.
2. For each component, find the `components.*.debug` parameter and set the value to `true`:

By default, debug mode is disabled, and the `components.*.debug` is set to `false`.

3. Restart Zowe™.

   You enabled debug mode for the API ML core services (API Catalog, API Gateway and Discovery service).

4. (Optional) Reproduce a bug that causes issues and review debug messages. If you are unable to resolve the issue, create an issue here.

Change the Log Level of Individual Code Components

You can change the log level of a particular code component of the API ML internal service at run time.

Follow these steps:

1. Enable API ML Debug Mode as described in Enable API ML Debug Mode. This activates the application/loggers endpoints in each API ML internal service (Gateway, Discovery service, and Catalog).

2. List the available loggers of a service by issuing the **GET** request for the given service URL:

   - **scheme**

     Specifies the API ML service scheme (http or https)

   - **hostname**

     Specifies the API ML service hostname

   - **port**

     Specifies the TCP port where API ML service listens on. The port is defined by the configuration parameter MFS_GW_PORT for the Gateway, MFS_DS_PORT for the Discovery service (by default, set to gateway port + 1), and MFS_AC_PORT for the Catalog (by default, set to gateway port + 2).

   Note: For the Catalog you can list the available loggers by issuing a **GET** request for the given service URL in the following format:

   Tip: One way to issue REST calls is to use the http command in the free HTTPie tool: https://httpie.org/.

   Example:

3. Alternatively, extract the configuration of a specific logger using the extended **GET** request:

   - **{name}**

     Specifies the logger name

4. Change the log level of the given component of the API ML internal service. Use the **POST** request for the given service URL:

   The **POST** request requires a new log level parameter value that is provided in the request body:

   - **level**

Specifies the new log level: **OFF**, **ERROR**, **WARN**, **INFO**, **DEBUG**, **TRACE**

Example:

Gather atypical debug information

- **ZWE_configs_debug**
  This property can be used to unconditionally add active debug profiles.

For more information, see Adding active profiles in the Spring documentation.

- **ZWE_configs_sslDebug**
  This property can be used to enable the SSL debugging. This property can also assist with determining what exactly is happening at the SSL layer.

This property uses the `-Djavax.net.debug` Java parameter when starting the Gateway component. By setting `ZWE_configs_sslDebug` to `ssl`, all SSL debugging is turned on. The `ZWE_configs_sslDebug` parameter also accepts other values that can enable a different level of tracing.

For more information, see the article ***Debugging Utilities*** in the IBM documentation.

> **NOTE**
>
> This property can also be enabled for other API ML components.

Services that are not running appear to be running

Services that are not running appear to be running. The following message is displayed in the Discovery service:

EMERGENCY! EUREKA MAY BE INCORRECTLY CLAIMING INSTANCES ARE UP WHEN THEY'RE NOT. RENEWALS ARE LESSER THAN THRESHOLD AND HENCE THE INSTANCES ARE NOT BEING EXPIRED JUST TO BE SAFE.

Cause:

This message is expected behavior of the Discovery service. If a service is incorrectly terminated without properly unregistering from Eureka, the service initially enters *eviction status* for a brief timeframe before the service is deregistered. Failure to properly terminate occurs when a service fails to respond to three consecutive heartbeat renewals. After the three heartbeat renewals are returned without a response, the Eureka Discovery service keeps the service in *eviction status* for one additional minute. If the service does not respond within this minute, the Eureka service unregisters this unresponsive service. When more than 15 percent of currently registered services are in *eviction status*, *self preservation mode* is enabled. In *self preservation mode*, no services in eviction status are deregistered. As a result, these services continue to appear to be running even though they are not running.

Solution:

Use one of the following options to exit self preservation mode:

- **Restart the services that appear to be running**
  Relaunch the services that appear to be registered. After the message disappears, close each of the services one at

a time. Allow for a 3-minute period between closing each service. The procedure for restarting services that are not part of Zowe is specific to the services and is documented in the service documentation.

- **Restart the Discovery service**
  Manually restart the Discovery service. The new instance will not be in self preservation mode. In a few minutes, the running services re-register.

  Note:

  The Discovery service can be stopped with the following command:
  `F <instance-job-name>,APPL=STOP(<component_name>)`

  The Discovery service can be started again with the following command:
  `F <instance-job-name>,APPL=START(<component_name>)`

  Example:

- **Adjust the threshold of services in eviction status**
  Change the frequency of the Discovery service from entering self preservation mode by adjusting the threshold of services in eviction status.

  Note: The default threshold is .85. This results in the Discovery service entering self preservation mode when 15 percent of currently registered services are in *eviction status*.

  Example:

  This threshold limit causes the Discovery service to enter self preservation mode when less than 30 percent of services are not responding.

Debug and Fix Common Problems with SSL/TLS Setup

Review tips described in the blog post Troubleshooting SSL/TLS setup with Zowe Certificate Analyzer to find out how you can use the Zowe Certificate Analyzer to address the following common issues with SSL/TLS setup:

- How to verify if the API ML server certificate is trusted by your service
- How to get a CA certificate in the correct format
- How to perform a TLS handshake with debug logs
- How to debug remote services
- How to enable mutual authentication using a client certificate
- How to add a trusted certificate to a SAF Key ring

SDSF Job search fails

Search for jobs using SDSF failed for prefix and owner : exc.sdsf_invocation_failed 8 (Issue does not impace ZD&T boxes)

Solution:

You must be authorized to use SDSF with REXX on your z/OS system. For authorization, activate the SDSF RACF class and add the following 3 profiles to your system:

- `GROUP.ISFSORIG`
- `GROUP.ISFSPROG.SDSF`
- `ISF.CONNECT.`

Users must belong to a group that has READ access to these profiles.

This is quite a complex area and you should ask your systems programmer for advice. On most systems, the GROUP.* profiles are not required and it is sufficient to have the following ISF profile defined:

class profile SDSF ISF.CONNECT.** (G)

Known Issues with API ML

API ML stops accepting connections after z/OS TCP/IP stack is recycled

Symptom:

When z/OS TCP/IP stack is restarted, it is possible that the internal services of API Mediation Layer (Gateway, Catalog, and Discovery service) stop accepting all incoming connections, go into a continuous loop, and write numerous error messages in the log.

Sample message:

The following message is a typical error message displayed in STDOUT:

Solution:

Restart API Mediation Layer.

Tip: To prevent this issue from occurring, it is strongly recommended not to restart the TCP/IP stack while API ML is running.

API ML throws I/O error on GET request and cannot connect to other services

Symptom:

The API ML services are running but they are in the DOWN state and not working properly. The following exceptions can be found in the log: `java.net.UnknownHostException` and `java.net.NoRouteToHostException`.

Sample message:

See the following message for full exceptions.

Solution:

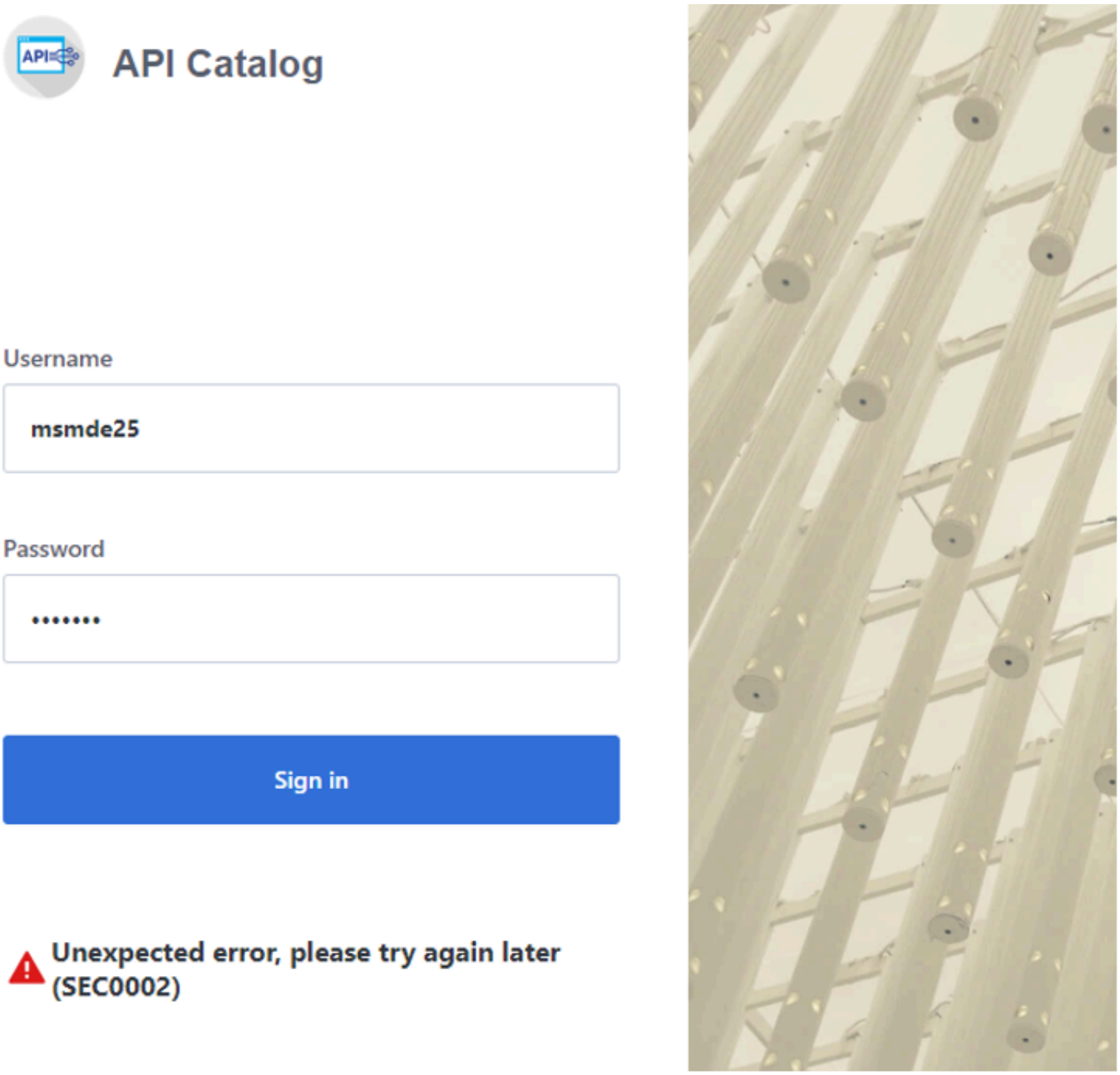
The Zowe started task needs to run under a user with sufficient privileges. As a workaround, you can try to run the started task under the same user ID as z/OSMF (typically IZUSVR).

The hostname that is displayed in the details of the exception is a valid hostname. You can validate that the hostname is valid by using `ping` command on the same mainframe system. For example, `ping system.lvn.broadcom.net`. If it is valid, then the problem can be caused by insufficient privileges of your started task that is not allowed network access.

You can fix it by setting up the security environment as described in the Zowe documentation.

SEC0002 error when logging in to API Catalog

SEC0002 error typically appears when users fail to log in to API Catalog. The following image shows the API Catalog login page with the SEC0002 error.



The error is caused by failed z/OSMF authentication. To determine the reason authentication failed, open the ZWESLSTC joblog and look for a message that contains `ZosmfAuthenticationProvider`. The following is an example of the message that contains `ZosmfAuthenticationProvider`:

Check the rest of the message, and identify the cause of the problem. The following list provides the possible reasons and solutions for the z/OSMF authentication issue:

Connection refused

In the following message, failure to connect to API Catalog occurs when connection is refused:

The reason for the refused connection message is either invalid z/OSMF configuration or z/OSMF being unavailable. The preceding message indicates that z/OSMF is not on the 127.0.0.1:1443 interface.

Solution:

Configure z/OSMF

Make sure that z/OSMF is running and is on 127.0.0.1:1443 interface, and try to log in to API Catalog again. If you get the same error message, change z/OSMF configuration.

Follow these steps:

1. Locate the z/OSMF PARMLIB member IZUPRMxx.

   For example, locate IZUPRM00 member in SYS1.PARMLIB.

2. Change the current `HOSTNAME` configuration to `HOSTNAME('*')`.

3. Change the current `HTTP_SSL_PORT` configuration to `HTTP_SSL_PORT('1443')`.

   Important! If you change the port in the z/OSMF configuration file, all your applications lose connection to z/OSMF.

For more information, see Syntax rules for IZUPRMxx.

If changing the z/OSMF configuration does not fix the issue, reconfigure Zowe.

Follow these steps:

1. Open `.zowe_profile` in the home directory of the user who installed Zowe.
2. Modify the value of the `ZOWE_ZOSMF_PORT` variable.
3. Reinstall Zowe.

Missing z/OSMF host name in subject alternative names

In following message, failure to connect to API Catalog is caused by a missing z/OSMF host name in the subject alternative names:

Solutions:

Fix the missing z/OSMF host name in subject alternative names using the following methods:

Note: Apply the insecure fix only if you use API Catalog for testing purposes.

- Secure fix
- Insecure fix

Secure fix

Follow these steps:

1. Obtain a valid certificate for z/OSMF and place it in the z/OSMF keyring. For more information, see Configure the z/OSMF Keyring and Certificate.

2. Re-create the Zowe keystore by deleting it and re-creating it. For more information, see Zowe certificate configuration overview and the corresponding sub-articles in this section. The Zowe keystore directory is the value of the `KEYSTORE_DIRECTORY` variable in the `zowe.yaml` file that is used to launch Zowe.

Insecure fix

Follow these steps:

1. Re-create the Zowe keystore by deleting it and re-creating it.
2. In the `zowe.yaml` file that used to launch Zowe, ensure the property `zowe.verifyCertificates` is set to `DISABLED` or `NONSTRICT`. The default value is `STRICT` which ensures that Zowe validates the certificate authority's signing chain is trusted, and that the IP address for Zowe's servers match the certificate's subject alternative name.

Important! Disabling `zowe.verifyCertificates` may expose your server to security risks. Ensure that you contact your system administrator before disabling these certificates and use these options only for troubleshooting purposes.

Invalid z/OSMF host name in subject alternative names

In the following message, failure to connect to API Catalog is caused by an invalid z/OSMF host name in the subject alternative names:

Solutions:

Fix the invalid z/OSMF host name in the subject alternative names using the following methods:

- Request a new certificate
- Re-create the Zowe keystore

Request a new certificate

Request a new certificate that contains a valid z/OSMF host name in the subject alternative names.

Re-create the Zowe keystore

Re-create the Zowe keystore by deleting it and re-creating it. For more information, see Importing a file-based PKCS12 certificate. The Zowe keystore directory is the value of the `KEYSTORE_DIRECTORY` variable in the `zowe.yaml` file that is used to launch Zowe.

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Error Message Codes

The following error message codes may appear on logs or API responses. Use the following message code references and the corresponding reasons and actions to help troubleshoot issues.

API mediation utility messages

ZWEAM000I

%s started in %s seconds

Reason:

The service started.

Action:

No action required.

ZWEAM001I

API Mediation Layer started

Reason:

All key API Mediation Layer services started.

Action:

No action required.

API mediation common messages

ZWEAO102E

Gateway not yet discovered. The Transform service cannot perform the request

Reason:

The Transform service was requested to transform a url, but the Gateway instance was not discovered.

Action:

Do not begin performing requests until the API Mediation Layer fully initializes after startup. Check that your Discovery service is running and that all services (especially the Gateway) are discovered correctly.

ZWEAO104W

GatewayInstanceInitializer has been stopped due to exception: %s

Reason:

An unexpected exception occurred while retrieving the Gateway service instance from the Discovery Service.

Action:

Check that both the service and the Gateway can register with Discovery. If the services are not registering, investigate the reason why. If no cause can be determined, create an issue.

ZWEAO105W

Gateway HTTP Client per-route connection limit (maxConnectionsPerRoute) of %s has been reached for the '%s' route.

Reason:

Too many concurrent connection requests were made to the same route.

Action:

Further connections will be queued until there is room in the connection pool. You may also increase the per-route connection limit via the gateway start-up script by setting the Gateway configuration for maxConnectionsPerRoute.

ZWEAO106W

Gateway HTTP Client total connection limit (maxTotalConnections) of %s has been reached.

Reason:

Too many concurrent connection requests were made.

Action:

Further connections will be queued until there is room in the connection pool. You may also increase the total connection limit via the gateway start-up script by setting the Gateway configuration for maxTotalConnections.

ZWEAO400E

The structure of the request is invalid: %s

Reason:

A value in the request is missing or contains an invalid value.

Action:

Fix the request and try again.

ZWEAO401E

Unknown error in HTTPS configuration: '%s'

Reason:

An Unknown error occurred while setting up an HTTP client during service initialization, followed by a system exit.

Action:

Start the service again in debug mode to get a more descriptive message. This error indicates it is not a configuration issue.

ZWEAO402E

The request has not been applied because it lacks valid authentication credentials.

Reason:

The accessed resource requires authentication. The request is missing valid authentication credentials or the token expired.

Action:

Review the product documentation for more details about acceptable authentication. Verify that your credentials are valid and contact security administrator to obtain valid credentials.

ZWEAO404E

The service can not find the requested resource.

Reason:

Action:

ZWEAO405E

The request method has been disabled and cannot be used for the requested resource.

Reason:

Action:

ZWEAO415E

The media format of the requested data is not supported by the service, so the service has rejected the request.

Reason:

Action:

ZWEAO500E

The service has encountered a situation it doesn't know how to handle. Please contact support for further assistance. More details are available in the log under the provided message instance ID

Reason:

Action:

ZWEAO503E

The server is not ready to handle the request: %s

Reason:

The service is not ready to handle the request, it is being initialized or waiting for another service to start.

Action:

Repeat the request later. Please contact support for further assistance.

Common service core messages

ZWEAM100E

Could not read properties from: '%s'

Reason:

The Build Info properties file is empty or null.

Action:

The jar file is not packaged correctly. Please submit an issue.

ZWEAM101E

I/O Error reading properties from: '%s' Details: '%s'

Reason:

I/O error reading `META-INF/build-info.properties` or `META-INF/git.properties`.

Action:

The jar file is not packaged correctly. Please submit an issue.

ZWEAM102E

Internal error: Invalid message key '%s' is provided. Please create an issue with this message.

Reason:

Message service is requested to create a message with an invalid key.

Action:

Create an issue with this message.

ZWEAM103E

Internal error: Invalid message text format. Please create an issue with this message.

Reason:

Message service is requested to create a message with an invalid text format.

Action:

Create an issue with this message.

ZWEAM104E

The endpoint you are looking for '%s' could not be located

Reason:

The endpoint you are looking for could not be located.

Action:

Verify that the URL of the endpoint you are trying to reach is correct.

ZWEAG120E

Invalid username or password for URL '/gateway/api/v1/auth/login'

Reason:

The username or password is invalid.

Action:

Provide a valid username and password.

ZWEAG140E

The 'applicationName' parameter name is missing.

Reason:

The application name is not provided.

Action:

Provide the 'applicationName' parameter.

ZWEAG141E

The generation of the PassTicket failed. Reason: %s

Reason:

An error occurred in the SAF Auth Service. Review the reason in the error message.

Action:

Supply a valid user and application name, and check that corresponding permissions have been set up. For more information, see Enabling single sign on for extending services via PassTicket configuration.

ZWEAM400E

Error initializing SSL Context: '%s'

Reason:

An error occurred while initializing the SSL Context.

Action:

Refer to the specific message to identify the exact problem. Possible causes include:

- Incorrect security algorithm
- The keystore is invalid or corrupted
- The certificate is invalid or corrupted

ZWEAM500W

The service is not verifying the TLS/SSL certificates of the services

Reason:

This is a warning that the SSL Context will be created without verifying certificates.

Action:

Stop the service and set the verifySslCertificatesOfServices parameter to `true`, and then restart the service. Do not use this option in a production environment.

ZWEAM501W

Service is connecting to Discovery service using the non-secure HTTP protocol.

Reason:

The service is connecting to the Discovery Service using the non-secure HTTP protocol.

Action:

For production use, start the Discovery Service in HTTPS mode and configure the services accordingly.

ZWEAM502E

Error reading secret key: '%s'

Reason:

A key with the specified alias cannot be loaded from the keystore.

Action:

Ensure that the configured key is present, in the correct format, and not corrupt.

ZWEAM503E

Error reading secret key: '%s'

Reason:

Error reading secret key.

Action:

Refer to the specific message to identify the exact problem. Possible causes include:

- An incorrect security algorithm
- The keystore is invalid or corrupted
- The certificate is invalid or corrupted

ZWEAM504E

Error reading public key: '%s'

Reason:

Error reading secret key.

Action:

Refer to the specific message to identify the exact problem. Possible causes include:

- An incorrect security algorithm
- The keystore is invalid or corrupted
- The certificate is invalid or corrupted

ZWEAM505E

Error initializing SSL/TLS context: '%s'

Reason:

Error initializing SSL/TLS context.

Action:

Refer to the specific message to identify the exact problem. Possible causes include:

- An incorrect security algorithm
- The keystore is invalid or corrupted
- The certificate is invalid or corrupted

ZWEAM506E

Truststore Password configuration parameter is not defined

Reason:

Your truststore password was not set in the configuration.

Action:

Ensure that the parameter server.ssl.trustStorePassword contains the correct password for your truststore.

ZWEAM507E

Truststore configuration parameter is not defined but it is required

Reason:

The truststore usage is mandatory, but the truststore location is not provided.

Action:

If a truststore is required, define the truststore configuration parameter by editing the server.ssl.truststore, server.ssl.truststorePassword and server.ssl.truststoreType parameters with valid data. If you do not require a truststore, change the trustStoreRequired boolean parameter to `false`.

ZWEAM508E

Keystore not found, server.ssl.keyStore configuration parameter is not defined

Reason:

Your keystore path was not set in the configuration.

Action:

Ensure that the correct path to your keystore is contained in the parameter server.ssl.keyStore in the properties or yaml file of your service.

ZWEAM509E

Keystore password not found, server.ssl.keyStorePassword configuration parameter is not defined

Reason:

Your keystore password was not set in the configuration.

Action:

Ensure that the correct password to your keystore in the parameter server.ssl.keyStorePassword is contained in the properties or yaml file of your service.

ZWEAM510E

Invalid key alias '%s'

Reason:

The key alias was not found.

Action:

Ensure that the key alias provided for the key exists in the provided keystore.

ZWEAM511E

There was a TLS request error accessing the URL '%s': '%s'

Reason:

The Gateway refuses to communicate with the requested service.

Action:

Possible actions regarding to message content:

- Message: The certificate is not trusted by the API Gateway. Action: Verify trust of the certificate is the issue by disabling certificate verification and retry the request.
- Message: Certificate does not match any of the subject alternative names. Action: Verify that the hostname which the certificate is issued for matches the hostname of the service.
- Message: Unable to find the valid certification path to the requested target. Action: Import the root CA that issued services' certificate to API Gateway truststore.
- Message: Verify the requested service supports TLS. Action: Ensure the requested service is running with TLS enabled.
- Message: Review the APIML debug log for more information. Action: Enable APIML debug mode and retry the request, then review the APIML log for TLS errors.

ZWEAM600W

Invalid parameter in metadata: '%s'

Reason:

An invalid apiInfo parameter was found while parsing the service metadata.

Action:

Remove or fix the referenced metadata parameter.

ZWEAM700E

No response received within the allowed time: %s

Reason:

No response was received within the allowed time.

Action:

Verify that the URL you are trying to reach is correct and all services are running.

ZWEAM701E

The request to the URL '%s' has failed: %s caused by: %s

Reason:

The request failed because of an internal error.

Action:

Refer to specific exception details for troubleshooting. Create an issue with this message.

Security common messages

ZWEAT100E

Token is expired for URL '%s'

Reason:

The validity of the token is expired.

Action:

Obtain a new token by performing an authentication request.

ZWEAT103E

Could not write response: %s

Reason:

A message could not be written to the response.

Action:

Please submit an issue with this message.

ZWEAT403E

The user is not authorized to the target resource: %s

Reason:

The service has accepted the authentication of the user but the user does not have access rights to the resource.

Action:

Contact your security administrator to give you access.

ZWEAT409E

The platform returned error: %s

Reason:

The platform responded with unknown errno code.

Action:

Please submit an issue with this message.

ZWEAT410E

The platform returned error: %s

Reason:

The specified password is incorrect.

Action:

Provide correct password.

ZWEAT411E

The platform returned error: %s

Reason:

The platform returned error, specified in the error message.

Action:

Contact your security administrator with the message.

ZWEAT412E

The platform returned error: %s

Reason:

The specified password is expired.

Action:

Contact your security administrator to reset your password.

ZWEAT413E

The platform returned error: %s

Reason:

The new password is not valid.

Action:

Provide valid password.

ZWEAT414E

The platform returned error: %s

Reason:

The user name access has been revoked.

Action:

Contact your security administrator to unsuspend your account.

ZWEAT415E

The platform returned error: %s

Reason:

The user name does not exist in the system.

Action:

Provide correct user name.

ZWEAT416E

The platform returned error: %s

Reason:

The specified user name or password is invalid.

Action:

Provide correct user name or password.

ZWEAT500E

Failed to parse the client certificate forwarded from the Gateway. Hostname is %s. Error message is %s. The client certificate was %s

Reason:

The string sent by the Gateway was not recognized as a valid DER-encoded certificate in Base64 printable form.

Action:

Ensure that forwarding of the client certificate is also enabled in the Gateway. Check for any error messages from the Gateway.

ZWEAT501E

Failed to get trusted certificates from the Gateway. Unexpected response from %s endpoint. Status code: %s. Response body: %s

Reason:

The response status code is different from expected 200 OK.

Action:

Ensure that the parameter apiml.security.x509.certificatesUrls is correctly configured with the complete URL to the Gateway certificates endpoint. Test the URL manually.

ZWEAT502E

Invalid URL specified to get trusted certificates from the Gateway. URL is %s. Error message: %s

Reason:

The parameter apiml.security.x509.certificatesUrls is not correctly configured with the complete URL to the Gateway certificates endpoint.

Action:

Ensure that the parameter apiml.security.x509.certificatesUrls is correctly configured.

ZWEAT503E

An error occurred during retrieval of trusted certificates from the Gateway. The certificate endpoint is %s. Error message: %s

Reason:

Communication with the Gateway was interrupted or an error occurred during processing of the response.

Action:

Check the provided error message. Contact the support.

ZWEAT504E

Failed to parse the trusted certificates provided by the Gateway. Certificate endpoint is %s. Error message %s

Reason:

The string sent by the Gateway was not recognized as a valid DER-encoded certificates in Base64 printable form.

Action:

Check that the URL configured in apiml.security.x509.certificatesUrls responds with valid DER-encoded certificates in the Base64 printable form.

ZWEAT601E

z/OSMF service name not found. Set parameter apiml.security.auth.zosmf.serviceId to your service ID.

Reason:

The parameter zosmfserviceId was not configured correctly and could not be validated.

Action:

Ensure that the parameter apiml.security.auth.zosmf.serviceId is correctly entered with a valid z/OSMF service ID.

ZWEAT602E

The SAF provider `endpoint` supports only the resource class 'ZOWE', but the current one is '%s'

Reason:

The parameter `apiml.security.authorization.provider` is set to `endpoint`

Action:

Change the SAF provider to another one to use this endpoint

ZWEAT603E

Endpoint `%s` is not properly configured

Reason:

The application cannot call the endpoint to check the SAF resource of the user

Action:

Verify the state of ZSS and IZS, then check if parameters `apiml.security.authorization.endpoint.*` are matching.

ZWEAT604E

Passwords do not match

Reason:

Re-entered password does not match for password update.

Action:

Enter the same value as the one entered for new password.

ZWEAT605E

Invalid body provided in request to create personal access token

Reason:

The request body is not valid

Action:

Use a valid body in the request. Format of a message: `{validity: int , scopes: [string]}`.

ZWEAT606E

Body in the HTTP request for Personal Access Token does not contain scopes

Reason:

The request body is not valid

Action:

Provide a list of services for which this token will be valid

ZWEAT608E

Error mapping between distributed and mainframe identity. Reason: %s %s

Reason:

Unexpected error occurred when mapping between distributed and mainframe identity

Action:

Contact Broadcom support.

ZWEAT609W

Mapping between distributed and mainframe identity failed. Reason: %s

Reason:

Mapping between distributed and mainframe identity failed.

Action:

ZWEAT610E

Missing registry name configuration.

Reason:

The registry name configuration is required to correctly map distributed user name from the OIDC access token.

Action:

Make sure that 'components.gateway.apiml.security.oidc.registry' is correctly set in 'zowe.yaml'.

Security client messages

ZWEAS100E

Authentication exception: '%s' for URL '%s'

Reason:

A generic failure occurred while authenticating.

Action:

Refer to the specific message to troubleshoot.

ZWEAS101E

Authentication method '%s' is not supported for URL '%s'

Reason:

The HTTP request method is not supported for the URL.

Action:

Use the correct HTTP request method that is supported for the URL.

ZWEAS103E

API Gateway Service is not available by URL '%s' (API Gateway is required because it provides the authentication functionality)

Reason:

The security client cannot find a Gateway instance to perform authentication. The API Gateway is required because it provides the authentication functionality.

Action:

Check that both the service and Gateway are correctly registered in the Discovery service. Allow some time after the services are discovered for the information to propagate to individual services.

ZWEAS104E

Authentication service is not available by URL '%s'

Reason:

The Authentication service is not available.

Action:

Make sure that the Authentication service is running and is accessible by the URL provided in the message.

ZWEAS105E

Authentication is required for URL '%s'

Reason:

Authentication is required.

Action:

Provide valid authentication.

ZWEAS120E

Invalid username or password for URL '%s'

Reason:

The username or password is invalid.

Action:

Provide a valid username and password.

ZWEAS121E

Authorization header is missing, or the request body is missing or invalid for URL '%s'

Reason:

The authorization header is missing, or the request body is missing or invalid.

Action:

Provide valid authentication.

ZWEAS123E

Invalid token type in response from Authentication service.

Reason:

Could not retrieve the proper authentication token from the Authentication service response.

Action:

Review your APIML authentication provider configuration and ensure your Authentication service is working.

ZWEAS130E

Token is not valid for URL '%s'

Reason:

The token is not valid.

Action:

Provide a valid token.

ZWEAS131E

No authorization token provided for URL '%s'

Reason:

No authorization token is provided.

Action:

Provide a valid authorization token.

ZAAS client messages

ZWEAS100E

Token is expired for URL

Reason:

The application using the token kept it for longer than the expiration time

Action:

When this error occurs it is necessary to get a new JWT token.

ZWEAS120E

Invalid username or password

Reason:

Provided credentials weren't recognized

Action:

Try with different credentials

ZWEAS121E

Empty or null username or password values provided

Reason:

One of the credentials was null or empty

Action:

Try with full set of credentials

ZWEAS122E

Empty or null authorization header provided

Reason:

The authorization header was empty or null

Action:

Try again with a valid authorization header

ZWEAS170E

An exception occurred while trying to get the token

Reason:

General exception. There are more pieces of information in the message

Action:

Log the message from the exception and then handle the exception based on the information provided there.

ZWEAS400E

Unable to generate PassTicket. Verify that the secured signon (PassTicket) function and application ID is configured properly by referring to Using PassTickets in the guide for your security provider

Reason:

Unable to generate PassTicket.

Action:

Verify that the secured signon (PassTicket) function and application ID is configured properly by referring to Using PassTickets in the guide for your security provider

ZWEAS401E

Token is not provided

Reason:

There was no JWT token provided for the generation of the PassTicket

Action:

Ensure that you are passing JWT token for PassTicker generation

ZWEAS404E

Gateway service is unavailable

Reason:

Gateway service does not respond.

Action:

Ensure that the Gateway service is up and that the path to the gateway service is properly set.

ZWEAS417E

The application name was not found

Reason:

The application id provided for the generation of the PassTicket was not recognized by the security provider

Action:

Ensure that the security provider recognized the application id.

ZWEAS130E

Invalid token provided

Reason:

The JWT token is not valid

Action:

Provide a valid token.

ZWEAS500E

There was no path to the trust store.

Reason:

The Zaas Client configuration does not contain the path to the trust store

Action:

Ensure that the configuration contains the trustStorePath and that it points to valid trust store.

ZWEAS501E

There was no path to the key store.

Reason:

The Zaas Client configuration does not contain the path to the key store

Action:

Ensure that the configuration contains the keyStorePath and that it points to valid key store.

ZWEAS502E

The configuration provided for SSL is invalid.

Reason:

The type of the keystore, truststore or the included keys/certs aren't considered valid

Action:

Ensure that the combination of the configuration is cryptographically valid.

ZWEAS503E

The SSL configuration contained invalid path.

Reason:

There was an invalid path to either trust store or keystore

Action:

Ensure that both provided paths are resolved to valid trust store and valid key store

ZWEAS504E

Internal server error while generating PassTicket: %s

Reason:

Unable to generate PassTicket.

Action:

Supply a valid user and application name, and check that corresponding permissions have been set up.

Discovery service messages

ZWEAD400E

Cannot notify Gateway on '%s' about new instance '%s'

Reason:

The Discovery Service tried to notify the Gateway about an instance update, but the REST call failed. The purpose of this call is to update the Gateway caches. The Gateway might be down or a network problem occurred.

Action:

Ensure that there are no network issues and that the Gateway was not restarted. If the problem reoccurs, contact Broadcom support.

ZWEAD401E

Cannot notify Gateway on '%s' about cancelled registration

Reason:

The Discovery Service tried to notify the Gateway about service un-registration, but the REST call failed. The purpose of this call is to update the Gateway caches. The Gateway might be down or a network problem occurred.

Action:

Ensure that there are no network issues and that the Gateway was not restarted. If the problem reoccurs, contact Broadcom support.

ZWEAD700W

Static API definition directory '%s' is not a directory or does not exist

Reason:

One of the specified static API definition directories does not exist or is not a directory.

Action:

Review the static API definition directories and their setup. The static definition directories are specified as a launch parameter to a Discovery service jar. The property key is: `apiml.discovery.staticApiDefinitionsDirectories`

ZWEAD701E

Error loading static API definition file '%s'

Reason:

A problem occurred while reading (IO operation) of a specific static API definition file.

Action:

Ensure that the file data is not corrupted or incorrectly encoded.

ZWEAD702W

Unable to process static API definition data: '%s' - '%s'

Reason:

A problem occurred while parsing a static API definition file.

Action:

Review the mentioned static API definition file for errors. Refer to the specific log message to determine the exact cause of the problem:

- ServiceId is not defined in the file '%s'. The instance will not be created. Make sure to specify the ServiceId.
- The `instanceBaseUrls` parameter of %s is not defined. The instance will not be created. Make sure to specify the `InstanceBaseUrl` property.
- The API Catalog UI tile ID %s is invalid. The service %s will not have an API Catalog UI tile. Specify the correct catalog title ID.
- One of the instanceBaseUrl of %s is not defined. The instance will not be created. Make sure to specify the InstanceBaseUrl property.
- The URL %s does not contain a hostname. The instance of %s will not be created. The specified URL is malformed. Make sure to specify valid URL.
- The URL %s does not contain a port number. The instance of %s will not be created.
- The specified URL is missing a port number. Make sure to specify a valid URL.
- The URL %s is malformed. The instance of %s will not be created: The Specified URL is malformed. Make sure to specify a valid URL.
- The hostname of URL %s is unknown. The instance of %s will not be created: The specified hostname of the URL is invalid. Make sure to specify a valid hostname.
- Invalid protocol. The specified protocol of the URL is invalid. Make sure to specify valid protocol.
- Additional service metadata of %s in processing file %s could not be created: %s

ZWEAD703E

A problem occurred during reading the static API definition directory: '%s'

Reason:

There are three possible causes of this error:

- The specified static API definition folder is empty.
- The definition does not denote a directory.
- An I/O error occurred while attempting to read the static API definition directory.

Action:

Review the static API definition directory definition and its contents on the storage. The static definition directories are specified as a parameter to launch a Discovery Service jar. The property key is:

`apiml.discovery.staticApiDefinitionsDirectories`

ZWEAD704E

Gateway Service is not available so it cannot be notified about changes in Discovery Service

Reason:

Gateway Service is probably mis-configured or failed to start from another reason.

Action:

Review the log of Gateway Service and its configuration.

Gateway service messages

ZWEAG111E

The service has encountered a situation it doesn't know how to handle. Please contact support for further assistance. More details are available in the log under the provided message instance ID

Reason:

Action:

ZWEAG501E

The connection is not secure.

Reason:

AT-TLS is not properly configured.

Action:

Review AT-TLS documentation and make sure your configuration is correct for this service.

ZWEAG701E

Service '%s' does not allow encoded characters in the request path: '%s'.

Reason:

The request that was issued to the Gateway contains an encoded character in the URL path. The service that the request was addressing does not allow this pattern.

Action:

Contact the system administrator and request enablement of encoded characters in the service.

ZWEAG702E

Gateway does not allow encoded slashes in request: '%s'.

Reason:

The request that was issued to the Gateway contains an encoded slash in the URL path. Gateway configuration does not allow this encoding in the URL.

Action:

Contact the system administrator and request enablement of encoded slashes in the Gateway.

ZWEAG717E

The service id provided is invalid: '%s'

Reason:

The provided id is not valid under conformance criteria.

Action:

Verify the conformance criteria, provide valid service id.

ZWEAG718E

Cannot retrieve metadata: '%s'

Reason:

Metadata aren't accessible

Action:

Verify that the metadata are accessible and not empty

ZWEAG719I

The service is not conformant: %s

Reason:

The provided service does not satisfy the conformance criteria and is therefore not valid.

Action:

Verify the conformance criteria.

ZWEAG101E

Authentication method '%s' is not supported for URL '%s'

Reason:

The HTTP request method is not supported by the URL.

Action:

Use the correct HTTP request method supported by the URL.

ZWEAG105E

Authentication is required for URL '%s'

Reason:

Authentication is required.

Action:

Provide valid authentication.

ZWEAG167E

No client certificate provided in the request

Reason:

The X509 client certificate was not provided with the request

Action:

Configure your client to provide valid certificate.

ZWEAM400E

Error initializing SSL Context: '%s'

Reason:

An error occurred while initializing the SSL Context.

Action:

Refer to the specific message to identify the exact problem. Possible causes include:

- Incorrect security algorithm
- The keystore is invalid or corrupted
- The certificate is invalid or corrupted

ZWEAT403E

The user is not authorized to the target resource: %s

Reason:

The service has accepted the authentication of the user but the user does not have access rights to the resource.

Action:

Contact your security administrator to give you access.

ZWEAG510E

Request to the resource ended with unexpected status code.

Reason:

The service did not respond properly.

Action:

Verify that the target service is healthy.

ZWESG100W

Cannot receive information about services on API Gateway with apimlId '%s' because: %s

Reason:

Cannot connect to the Gateway service.

Action:

Make sure that the external Gateway service is running and the truststore of the both Gateways contain the corresponding certificate.

ZWESG101E

An internal exception occurred in ZAAS service %s.

Reason:

ZAAS cannot process authentication required to finish the request.

Action:

Make sure that the ZAAS is configured well and check all security requirements.

ZWESG429E

Request was denied access.

Reason:

Connections limit exceeded.

Action:

Wait for the number of active connections to decrease before retrying your request.

API Catalog messages

ZWEAC100W

Could not retrieve information about service %s from the Discovery Service. Requested URL: %s. Response received: status code: %s, body: %s

Reason:

The response from The Discovery Service about the registered service instances returned an error or empty body.

Action:

Make sure the Discovery Service and requested service are up and running. If the HTTP response error code refers to a security issue, make sure that security configuration is correct.

ZWEAC101E

Could not parse service info from discovery -- %s

Reason:

The response from the Discovery Service about the registered instances could not be parsed to extract applications.

Action:

Run debug mode and look at the Discovery Service potential issues while creating a response. If the Discovery Service does not indicate any error, create an issue.

ZWEAC102E

Could not retrieve containers. Status: %s

Reason:

One or more containers could not be retrieved.

Action:

Check the status of the message for more information and the health of the Discovery Service.

ZWEAC103E

API Documentation not retrieved, %s

Reason:

API documentation was not found.

Action:

Make sure the service documentation is configured correctly.

ZWEAC104E

Could not retrieve container statuses, %s

Reason:

The status of one or more containers could not be retrieved.

Action:

Check the status of the message for more information and the health of the Discovery Service.

ZWEAC105W

API Documentation not retrieved for service '%s' due to communication error, %s

Reason:

Unable to fetch API documentation.

Action:

Make sure the service documentation url or server transport encoding is configured correctly.

ZWEAC106E

Could not retrieve service. Status: %s

Reason:

Service could not be retrieved.

Action:

Check the status of the message for more information and the health of the Discovery Service.

ZWEAC700E

Failed to update cache with discovered services: '%s'

Reason:

Cache could not be updated.

Action:

Check the status of the Discovery Service.

ZWEAC701W

API Catalog Instance not retrieved from Discovery service

Reason:

An error occurred while fetching containers information.

Action:

The jar file is not packaged correctly. Please submit an issue.

ZWEAC702E

An unexpected exception occurred when trying to retrieve an API Catalog instance from the Discovery Service: %s

Reason:

An unexpected error occurred during API Catalog initialization. The API Catalog was trying to locate an instance of itself in the Discovery Service.

Action:

Review the specific message for more information. Verify if the Discovery Service and service registration work as expected.

ZWEAC703E

Failed to initialize API Catalog with discovered services

Reason:

The API Catalog could not initialize running services after several retries.

Action:

Ensure services are started and discovered properly.

ZWEAC704E

ApiDoc retrieval problem for '%s' service. %s

Reason:

ApiDoc for service could not be retrieved.

Action:

Verify that the service provides a valid ApiDoc.

ZWEAC705W

The home page url for service %s was not transformed. %s

Reason:

The home page url for service was not transformed. The original url will be used.

Action:

Refer to the specific printed message. Possible causes include:

- The Gateway was not found. The Transform service cannot perform the request. Wait for the Gateway to be discovered.
- The URI is not valid. Ensure the service is providing a valid URL.
- Not able to select a route for the URL of the specific service. The original URL is used. If necessary, check the routing metadata of the service.
- The path of the service URL is not valid. Ensure the service is providing the correct path.

ZWEAC706E

Service not located, %s

Reason:

The service could not be found.

Action:

Check if the service is up and registered. If it is not registered, review the onboarding guide to ensure that all steps were completed.

ZWEAC707E

Static API refresh failed, caused by exception: %s

Reason:

The Static API refresh could not be performed because of exception.

Action:

Check the specific exception for troubleshooting.

ZWEAC708E

The API base path for service %s was not retrieved. %s

Reason:

The API base path for service was not retrieved. An empty path will be used.

Action:

Refer to the specific printed message. Possible causes include:

- The URI is not valid. Ensure the service is providing a valid URL.
- Not able to select a route for the URL of the specific service. The original URL is used. If necessary, check the routing metadata of the service.
- The path of the service URL is not valid. Ensure the service is providing the correct path.

ZWEAC709E

Static definition generation failed, caused by exception: %s

Reason:

The Static definition generation could not be performed because of exception.

Action:

Check the specific exception for troubleshooting.

Version: v3.2.x LTS

Troubleshooting Zowe Application Framework

The following topics contain information that can help you troubleshoot problems when you encounter unexpected behavior installing and using Zowe™ Application Framework which includes the Zowe Desktop.

Most of the solutions below identify issues by referring to the Zowe logs. To identify and resolve issues, you should be familiar with their names and locations.

The Zowe Application Framework manages issues in GitHub. When you troubleshoot a problem, you can check whether a GitHub issue (open or closed) that covers the problem already exists. For a list of issues, see the zlux repo.

Desktop apps fail to load

Symptom:

When you open apps in the Zowe desktop, a page is displayed with the message `The plugin failed to load`.

Solution:

This problem may occur due to file encoding. If this occurs in a Zowe extension, verify it is correctly encoded.

NODEJSAPP disables immediately

Symptom:

You receive the message `CEE5207E The signal SIGABRT was received in stderr`.

Solution:

You might have reached the limit for shared message queues on your LPAR. When Node.js applications are terminated by a SIGKILL signal, shared message queues might not be deallocated. For more information, see the **If the NODEJSAPP disables immediately** section in the Troubleshooting Node.js applications topic on IBM Knowledge Center.

Cannot log in to the Zowe Desktop

Symptom:

When you attempt to log in to the Zowe Desktop, you receive the following error message that is displayed beneath the **Username** and **Password** fields.

The Zowe desktop attempts to authenticate the credentials using the types that have been configured, by default the three above of `["saf","apiml","zss"]`. If Zowe has been configured with the `components.app-sever.enabled=true` and `components.gateway.enabled=false`, then the message will just include the types `["saf","zss"]`.

Solution:

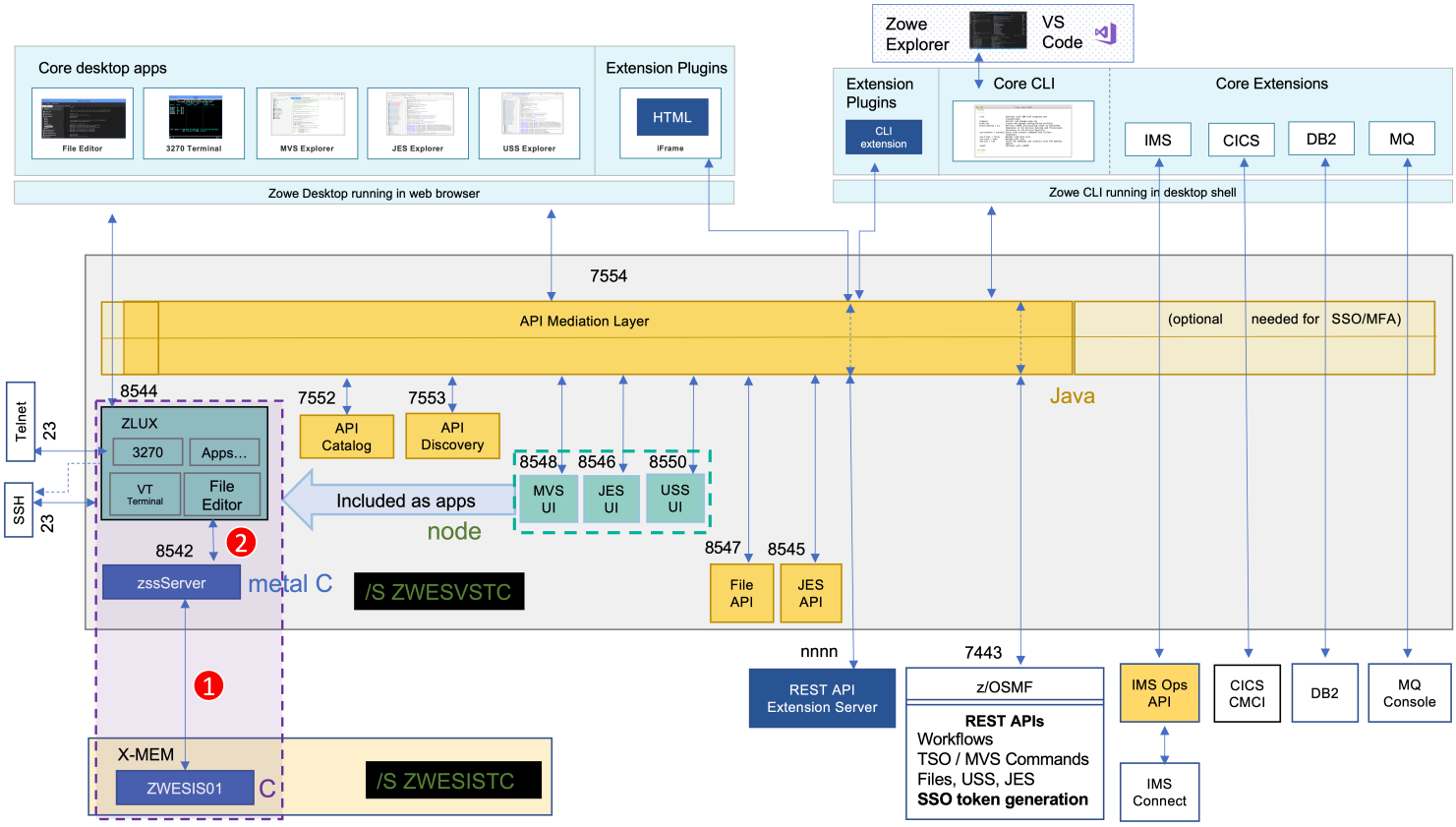
This can be due to network disruption, a server not running, certificate issues, incorrect password, or a locked account. If the reason for failure isn't known, you should gather information to contact support

Below are some additional, possible reasons for the failure:

For the Zowe Desktop to work, the node server that runs under the ZWESLSTC started task must be able to make cross memory calls to the ZWESIS01 load module running under the ZWESISTC started task. If this communication fails, you see the authentication error.

There are three known problems that might cause this error. The Zowe architecture diagram shows the following connections. One of these three connections likely failed.

1. The zssServer connection to the `ZWESISTC` started task using cross memory communication. If this fails, see zssServer unable to communicate with ZIS. The architecture diagram below has been annotated with a (1) to show this connection.
2. The Zowe Desktop Application Framework server connection to the zssServer across the default port 7557. If this fails, see Application Framework unable to communicate with zssServer. The architecture diagram below has been annotated with a (2) to show this connection.
3. The Zowe Desktop Application Framework server cannot connect to API Mediation Layer for authentication. If this fails, see Application Framework unable to communicate with API Mediation Layer.



ZSS server unable to communicate with ZIS

- Open the log file `zowe.logDirectory/zssServer-yyyy-mm-dd-hh-ss.log`. This file is created each time ZWESLSTC is started and only the last five files are kept.
- Look for the message that starts with `ZIS status`.
  - If the communication works, the message includes `Ok`. For example:

If the communication works, the problem is likely that the Application Framework server is unable to communicate to the zssServer. For more information, see Application Framework unable to communicate with zssServer.

- If the communication is not working, the message includes `Failure`. For example:

  or

  or

  or

  In this case, check that the ZWESISTC started task is running. If not, start it with the MVS command `/S ZWESISTC`

- If the problem cannot be easily fixed (such as the ZWESISTC task not running), then it is likely that the ZIS server is not running. To check whether the server is running, check the started task `ZWESISTC` log for any errors.

- If the ZIS server `ZWESISTC` started task is running, check that the program name of the cross memory procedure matches between the `ZWESISTC` PROCLIB member and the `zowe.yaml` file used to launch Zowe.

  By default the proc value is `ZWESIS_STD`, and if a new name is chosen then both files need to be updated for the handshake to be successful.

  The line in the `ZWESISTC` proclib that defines the server name that ZIS will use is

  This example in `zowe.yaml` specifies the cross memory server name that the zssServer will try to attach to

- If this is the first time you set up Zowe, it is possible that the ZIS server configuration did not complete successfully. To set up and configure the ZIS server, follow steps as described in the topic Installing and configuring the Zowe ZIS server (ZWESISTC). Once `ZWESISTC` is started, if problems persist, check its log to ensure it has been able to correctly locate its load module ZWESIS01 as well as the parmlib ZWESIP00.

- If there is an authorization problem, the message might include `Permission Denied`. For example:

  Check that the user ID of the ZWESLSTC started task is authorized to access the load module. Only authorized code can call ZWESIS01 because it is an APF-authorized load module.

  Note: If you are using RACF security manager, a common reason for seeing `Permission Denied` is that the user running the started task ZWESLSTC (typically ZWESVUSR) does not have READ access to the FACILITY class ZWES.IS.

If the message includes the following text, the configuration of the Application Framework server may be incomplete:

If you are using AT/TLS, then the `components.app-server.agent.http.attls=true` statement might be missing from the server configuration file. For more information, see Configuring Zowe App Server for HTTPS communication with ZSS.

Application Framework unable to communicate with zssServer

Follow these steps:

- Open the log file `zowe.logDirectory/appServer-yyyy-mm-dd-hh-ss.log`. This file is created each time ZWESLSTC is started and only the last five files are kept.
- Look for the message that starts with `GetAddrInfoReqWrap.onlookup` and the log messages below.

  These messages show that the host name `localhost` cannot be reached between the Zowe desktop server and the zssServer because `localhost` has not been mapped to an IP address.
- Map localhost to port 127.0.0.1.

  Create an entry in the file `/etc/hosts` that contains the line
- Restart the `ZWESLSTC` address space.

Slow performance of the VT terminal on SSH

Symptom:

When you try to use VT terminal on the Zowe Desktop to connect to the UNIX System Services through SSH, the VT terminal on node v12 slows down. Then, the connection fails because the connecting process can run into the 3-minute limit.

Solution:

To solve this issue, use Telnet through port 1023 to connect to the UNIX System Services.

Application Framework unable to communicate with API Mediation Layer

Follow these steps:

- Verify whether API Mediation Layer is started or not. If it is started, you can see a service status page with all green check marks by visiting `https://<your-zowe-host>:<gateway-port>`. If there are any red cross marks, follow the instructions in Troubleshooting API ML to identify and solve the issue.
- You may need to wait a little longer to allow API Mediation Layer Gateway to complete the environment test.

Server startup problem ret=1115

Symptom: When ZWESLSTC is restarted, the following message is returned in the output of the ZSS server log file, `zowe.logDirectory/zssServer-yyyy-mm-dd-hh-ss.log`:

Solution: This message means that some other process is already listening on port 7542, either at address 127.0.0.1 (localhost) or at 0.0.0.0 (all addresses). This prevents the ZSS server from starting.

One possibility is that a previously running ZSS server did not shut down correctly, and either the operating system has not released the socket after the ZSS server shut down, or the ZSS server is still running.

Server error EACCESS on z/os

Symptoms: When you see messages like this in the server logs:

It is a sign that a permission error is stopping Zowe servers from completing the action of binding to a TCP Port for listening for client connections. This can manifest in the servers being inaccessible.

Network permissions control varies by OS, to resolve this we don't have a tip for users of containers, but for z/os, IBM has a guide on access control, for more details check Port Statement

Also, there is a very important part troubleshooting step just for Zowe. When you are setting a PORT statement, you can assign rules by jobname. When FACILITY resource `BPX.JOBNAME` is granted for the zowe STC user (recommended!) then each server of zowe will have a different jobname. It will not be "ZWESLSTC" or "ZWESLSTC" as it would be when that resource is not granted. They'll instead be other names that start with "ZWE".

Note: So, for a troubleshooting tip on the server error EACCESS on z/os, note that not only should an administrator check their PORT statements, they should probably set their jobname in the port statements to `ZWE` since it will catch all zowe components regardless of whether or not `BPX.JOBNAME` is granted.

Application plug-in not in Zowe Desktop

Symptom:
An application plug-in is not appearing in the Zowe Desktop.

Solution:
To check whether the plug-in loaded successfully, enter the following URL in a browser to display all successfully loaded Zowe plug-ins:

`https://my.mainframe.com:7556/plugins?type=application`

You can also search the node server logs for the plug-in identifier, for example `org.zowe.sample.app`. If the plug-in loaded successfully, you will find the following message:

If the plug-in did not load successfully, you will find the following message:

If the identifier is not in the logs, make sure the plug-in's locator file is in the `/zlux-app-server/deploy/instance/ZLUX/plugins/` directory. The plug-in locator is a `.json` file, usually with same name as the identifier, for example `org.zowe.sampleapp.json`. Open the file and make sure that the path that is defined with the `pluginLocation` attribute is correct. If the path is relative, make sure it is relative to the `zlux-app-server/bin` directory.

For more information on loading plug-ins to the Desktop, see Adding Your App to the Desktop.

Error: You must specify MVD_DESKTOP_DIR in your environment

Symptom:

A plug-in that is built in your local environment using `npm run start` or `npm run build` failed with an error message about a missing `MVD_DESKTOP_DIR` environment variable.

Solution:
Add the Zowe Desktop directory path to the `MVD_DESKTOP_DIR` environment variable. To specify the path, run the following commands in your Windows console or Linux bash shell:

- Windows
- Mac Os/Linux

Error: Exception thrown when reading SAF keyring {ZWED0148E}

Symptom: The error message indicates that Zowe's local certificate authority (local CA) `ZoweCert`, the certificate `jwtsecret`, or the Zowe certificate `localhost` does not exist in the Zowe keyring. ZWED0148E contains the following messages.

Solution:

Zowe's local CA certificate has its default name `ZoweCert`, and the Zowe Desktop hardcodes this certificate in the configuration scripts.

If you are using your own trusted CA certificate in the keyring and the name is different from the default one, this error will occur. To resolve the issue, you must match the names in the Zowe configuration. For more information, see Configuring certificates overview.

If you are using Zowe's local CA certificate but it still reports **ZWED0148E**, you may find the following message in the same log.

In this case, you must make sure that the label names exactly match the names in TSO when looking up the keyring you own. Any difference in spaces, capitalization, or other places will cause the error.

Warning: Problem making eureka request { Error: connect ECONNREFUSED }

Symptom: The Zowe started task `ZWESLSTC` log contains error messages reporting problems connecting

Solution:
You can ignore these messages. These messages are timing-related where different Eureka servers come up, try to connect to each other, and warn that the endpoint they are trying to perform a handshake with is not available. When all of the Eurka services have started, these errors will stop being logged.

Warning: Zowe extensions access to ZSS security endpoints fail

Symptom:

Zowe extensions fail when accessing the ZSS APIs such as the `security-mgmt/classes/default-class/profiles` endpoint. The following error is written to the log.

Solution:

Access to the ZSS endpoints are protected. To access the ZSS endpoints, the user must have `READ` access on the `OMVSAPPL` resource in the `APPL` class.

To fix this permit access, issue the following TSO command, where `userID` is the started task ID of the requesting process. The vendor documentation describes which userID to use which might be `ZWESVUSR`.

Fail when launching MVS, USS, and JES Explorers

Symptoms:

An error occurs when launching specific Zowe Desktop application plug-ins:

- MVS Explorer throws the following error:
  `Fetch for Datasets failed`
- USS Explorer throws the following error:
  `Fetch children failed for <USS directory>`
- JES Explorer fails to load and displays an infinite loop.

Solution:

One possible cause of these errors in when SAF is the authentication provider. Check to verify that z/OSMF is set as the authentication provider:
`components.gateway.apiml.security.auth.provider: zosmf`

Version: v3.2.x LTS

Gathering information to troubleshoot Zowe Application Framework

If you need to contact a support group for Zowe, they will likely need a variety of information from you to help you. This page details a list of items you should gather to the best of your ability to provide to your support group. You may also find this list useful for independent troubleshooting.

Basic information

Please review the list of information needed for general server support.

Javascript console output

When the web UI such as the Zowe Desktop or Apps inside it have an issue, the root problem may originate from either server-side or browser-side behavior. In addition to the server logs, the browser logs should be gathered. They can be accessed by opening a browser's web developer toolkit. Most browsers allow this via pressing F12.

Read more about it here.

Version: v3.2.x LTS

Raising a Zowe Application Framework issue on GitHub

When necessary, you can raise GitHub issues against the Zowe™ zlux core repository here. This issue tracker is for the Desktop, the apps, and the app-server component. It is suggested that you use the template that best matches what you want to talk about.

If you need to open an issue about configmgr, ZSS, or ZIS you should instead open a ticket at the zss repository here

If you have a general server install & configuration issue, you should instead open a ticket in the community repository here

Version: v3.2.x LTS

Enabling tracing

If you need to provide support with tracing information about the App Framework or a particular part of it, or need to debug a program you are developing that uses the App Framework, you can enable a variety of tracing within the Zowe YAML configuration file.

If you are looking for basic troubleshooting and support, please see Gathering Information for Support or Troubleshooting.

Basic debugging

Within the Zowe YAML file, the value `components.app-server.debug` can be set to `true` to turn on several debug loggers.

This does not turn on every type of debugging but provides a basic set for debugging for the App Server.

Enabling `components.app-server.debug` is equivalent to setting:

Advanced debugging for App Server

The Zowe YAML file section `components.app-server.logLevels` controls the verbosity for every logger within the server.

This includes core loggers, prefixed with `_zsf`, as well as plug-in loggers.

A list of core loggers and their purpose is defined within the App Server schema Loggers, plug-in loggers, and log levels (such as 5 for highest debugging, or 2 for default) are defined in detail in the Logging document.

Attributes within `components.app-server.logLevels` can be exact names of loggers, or can be pattern matching of multiple loggers.

For example, to enable minimum debug verbosity of the auth logger of the server core ("_zsf.auth"), and to enable maximum verbosity logging of all plug-ins made by company foo ("com.foo"), you could set the YAML configuration as:

Advanced debugging for ZSS

The Zowe YAML file section `components.zss.logLevels` controls the verbosity for every logger within the server.

This includes core loggers, prefixed with `_zss`.

A list of core loggers and their purpose is defined within the ZSS schema.

Unlike the App Server, the `components.zss.logLevels` section cannot take pattern matching for attribute names. The attribute names must exactly match the name of a logger.

Version: v3.2.x LTS

App-server Return Codes

If the app-server abnormally ends with a return code, this may originate from the app-server itself or from the programs involved in starting the server. Return codes from the startup process are documented here, while the app-server specific codes are listed below.

Return code	Explanation
2	Generic cause, check logs for more information.
3	Insufficient authentication configuration. The server found no authentication plugins, or all of the plugins found failed to load, or no plugins were found for the specific default auth type requested, or the entire auth configuration was missing. More specific error messages will be found in the logs.
4	The server encountered an error when reading the PFX file requested in the HTTPS configuration. ZWED0070W in the logs will explain the error in more detail.
5	The server could not establish networking for one of several possible reasons, and a ZWED error message in the logs will explain the error in more detail.
7	The configuration requested loading a z/OS keyring when not running on z/OS. The error ZWED0145E is also logged.

Version: v3.2.x LTS

App-server Error Message Codes

The following error message codes may appear on the app-server log. Use the following message code references and the corresponding reasons and actions to help troubleshoot issues.

App-server informational messages

ZWED0020I

Registering at *discoveryUrl*

Reason:

The app-server is registering its existence to the API ML discovery server, because `components.app-server.node.mediationLayer.enabled=true` is set in the zowe configuration.

Action:

No action required.

ZWED0021I

Eureka Client Registered from *ipAddress*. Available at *discoveryUrl*.

Reason:

The registration attempt from ZWED0020I has succeeded. The server is known to the API ML discovery server from the address *ipAddress*.

Action:

No action required.

ZWED0022I

Fork worker *workerId*

Reason:

A new app-server worker process is starting. Workers are redundant execution contexts of the server and increase throughput and latency of requests when the server has a lot of concurrent client requests. Workers are started and stopped according to current server load and the minimum and maximum worker limits defined in environment variables ZLUX_MIN_WORKERS and ZLUX_MAX_WORKERS.

Action:

No action required.

ZWED0023I

Restart worker *workerId*

Reason:

An existing app-server worker process has exited with a status code that indicates it should be restarted rather than permenantly stopped.

Action:

Review the preceeding log messages as worker restart may be due to a caught error.

ZWED0024I

Keys=*workerIds*

Reason:

The server lists the worker IDs right before all workers are about to be reloaded.

Action:

No action required.

ZWED0025I

Killing worker pid=*processId*

Reason:

The server just issued the SIGTERM unix signal to the worker with the process ID listed. This is an expected action when reloading all workers of the server.

Action:

No action required.

ZWED0026I

Fork *quantity* workers.

Reason:

The server is starting up *quantity* new workers. Workers are redundant execution contexts of the server and increase throughput and latency of requests when the server has a lot of concurrent client requests. This message appears at startup and the *quantity* is determined by the environment variables ZLUX_MIN_WORKERS and ZLUX_MAX_WORKERS.

Action:

No action required.

ZWED0027I

Close worker *workerId*

Reason:

The server is removing an existing worker due to lack of recent client activity. Workers are added and removed according to average load of the server. Workers are redundant execution contexts of the server and increase throughput and latency of requests when the server has a lot of concurrent client requests. Workers may be removed down to the minimum count as defined by the environment variable ZLUX_MIN_WORKERS.

Action:

No action required.

ZWED0028I

Master *processId* is running.

Reason:

The server has started up and is printing its unix process ID in case the user needs to know for analysis or troubleshooting.

Action:

No action required.

ZWED0029I

Worker *workerId* pid *processId*

Reason:

A worker has started and is listing its ID and unix process ID in case the user needs to know for analysis or troubleshooting.

Action:

No action required.

ZWED0031I

Server is ready at *ipAddress*, Plugins successfully loaded: *percentage*% (*successful*/*total*)

Reason:

The server is ready to accept client requests. It can be found at the *ipAddress* listed, and you can tell if it has loaded all plugins successfully by the *percentage* listed.

Action:

If the percentage is less than expected, review the log for messages with IDs ZWED0159W or ZWED0027W. Those messages will tell you which plugins failed, and you can search for their plugin ID within the log to find out the reason they failed to load.

ZWED0033I

The http port given to the APIML is: *tcpPort* The https port given to the APIML is: *tcpPort* The zlux-apiml config are: *jsonConfig*

Reason:

The server lists the properties that will be used to connect to the APIML Discovery server to help with troubleshooting.

Action:

No action required.

ZWED0036I

Plugin *pluginId* will serve static files from *filePath*

Reason:

The plugin *pluginId* was loaded which has a webContent section defined in its pluginDefinition.json file. The server will serve the read-only content from the *filePath*.

Action:

No action required.

ZWED0037I

pluginId: found proxied service *serviceName*

Reason:

When the server was loading the plugin *pluginId*, it found that the plugin contains a service named *serviceName* of type "service".

Action:

No action required.

ZWED0038I

pluginId: importing service *sourceServiceName* from *sourcePluginId* as *serviceName*

Reason:

When the server was loading the plugin *pluginId*, it found that the plugin contains a service named *serviceName* of type "import". It then resolved the import to the service *sourceServiceName* from plugin *sourcePluginId*.

Action:

No action required.

ZWED0039I

pluginId: found router *serviceName*

Reason:

When the server was loading the plugin *pluginId*, it found that the plugin contains a service named *serviceName* of type "router".

Action:

No action required.

ZWED0040I

pluginId: found legacy node service *serviceName*

Reason:

When the server was loading the plugin *pluginId*, it found that the plugin contains a service named *serviceName* of type "nodeService".

Action:

This type of service is deprecated and may not work on a future version of Zowe, so you should consider getting an upgraded version of the plugin that instead uses a service of an undeprecated type.

ZWED0041I

pluginId: found external service *serviceName*

Reason:

When the server was loading the plugin *pluginId*, it found that the plugin contains a service named *serviceName* of type "external".

Action:

No action required.

ZWED0042I

pluginId: found *serviceType* service *serviceName*

Reason:

When the server was loading the plugin *pluginId*, it found that the plugin contains a service named *serviceName* of type "*serviceType*".

Action:

No action required.

ZWED0043I

Plugin *pluginId* is not requested skipping without error

Reason:

When the server was loading the "nodeAuthentication" type plugin *pluginId*, it determined that the plugin only handles security actions for a category that was not requested by the server configuration or any plugins. The plugin was skipped because it was not required.

Action:

No action required unless you need the plugin to be used. If you need the plugin, you can set an authentication category it implements as the default by configuration property `components.app-server.dataserviceAuthentication.defaultAuthentication`, or within a plugin's security configuration.

ZWED0044I

Processing plugin reference *filePath*...

Reason:

The server is checking if the plugin definition file *filePath* exists and will attempt to load it.

Action:

No action required.

ZWED0045I

Reading plugins dir *pluginsDirectory*

Reason:

The server is scanning the directory *pluginsDirectory* as specified by the server configuration property `components.app-server.pluginsDir` so that it can locate each plugin in the instance.

Action:

No action required.

ZWED0046I

Adding dynamic plugin *pluginIdentifier*

Reason:

The server has added the plugin with *pluginIdentifier* to its bootstrapped list of plugins. It also emits a `pluginAdded` event.

Action:

No action required. If you need it, you may check the list of plugins on the Desktop to see if the plugin was added successfully.

ZWED0047I

Reason:

A child process from *path* has received data of *data* - usually done interally by ProcessManager.

Action:

No action required.

ZWED0048I

[Path= *path*] exited, code: *code*

Reason:

A process from *path* has exited with a return *code*.

Action:

No action required.

ZWED0049I

Stopping managers

Reason:

Begins ending all child processes.

Action:

No action required.

ZWED0050I

Server shutting down, received signal=*signal*

Reason:

Tells server to shutdown after receiving *signal* by ending all child processes and then performing cleanup.

Action:

No action required.

ZWED0052I

Deleting plugin due to request, id *pluginIdentifier*, path *path*

Reason:

Notifies that the server is removing a plugin with *pluginIdentifier* located in *path*.

Action:

No action required. Optionally, you could verify that the plugin was deleted using following options:

- doing a GET call to the list of the plugins, OR
- viewing the status code of the REST request if plugin was deleted by the network request.

ZWED0053I

Setting up *type* proxy (*pluginIdentifier*:*serviceName*) to destination=*destination*

Reason:

Making an external proxy of *type* (HTTP or HTTPS) for *pluginIdentifier*:*serviceName* at the *destination*.

Action:

No action required.

ZWED0054I

Installing root service at *url*

Reason:

Attempting to install new root service at *url*.

Action:

No action required.

ZWED0055I

Installing root service proxy at *url*

Reason:

Attempting to install new root service proxy at *url*.

Action:

No action required.

ZWED0056I

pluginIdentifier: installing websocket service

Reason:

Attempting to install new websocket service for *pluginIdentifier*.

Action:

No action required.

ZWED0059I

Found connection info for *pluginIdentifier*:*service=info*

Reason:

Connection info for *pluginIdentifier*:*service* was found as *info*.

Action:

No action required.

ZWED0062I

pluginIdentifier: installing router at *url*

Reason:

For *pluginIdentifier*, the server is installing new router at *url*.

Action:

No action required.

ZWED0064I

pluginIdentifier: installing import *sourcePlugin*:*name* at *url*

Reason:

For *pluginIdentifier*, the server is instaling import from *sourcePlugin* with *name* at *url*.

Action:

No action required.

ZWED0066I

pluginIdentifier: serving static files at *url*

Reason:

For *pluginIdentifier*, the server is serving static files and assets at *url*.

Action:

No action required.

ZWED0067I

pluginIdentifier: serving library files at *url*

Reason:

For *pluginIdentifier*, the server is serving libary files at *url*.

Action:

No action required.

ZWED0070I

User=*user* (*pluginId*): Session *authCapability* successful. Plugin response: *httpResponse*

Reason:

An authentication plugin ran successfully and received a valid HTTP response.

Action:

No action required.

ZWED0072I

Using Certificate: *stringArray*

Reason:

The app server has successfully loaded a certificate and added it to the certificates array.

Action:

No action required.

ZWED0086I

tomcatPID closed, code=*returnCode*

Reason:

A running tomcat process with PID *tomcatPID* was cloesd.

Action:

Refer to return code.

ZWED0087I

tomcatPID exited, code=*returnCode*

Reason:

A running tomcat process with PID *tomcatPID* was exited.

Action:

Refer to return code.

ZWED0090I

tomcatPID closed, code=*returnCode*

Reason:

A running tomcat process with PID *tomcatPID* was cloesd.

Action:

Refer to return code.

ZWED0091I

tomcatPID exited, code=*returnCode*

Reason:

A running tomcat process with PID *tomcatPID* was exited.

Action:

Refer to return code.

ZWED0092I

Tomcat Manager ID=*manager id* stopping

Reason:

It specifies that Apache Tomcat Host Manager is stopping *manager id*.

Action:

No action required.

ZWED0093I

Tomcat Manager ID=*manager id* cleanup successful

Reason:

It specifies that Apache Tomcat Host Manager successfully cleaned up the *manager id*.

Action:

No action required.

ZWED0094I

Extracted war to *destination path*

Reason:

It specifies that it extracted the WAR directory successfully to the *destination path*.

Action:

No action required.

ZWED0095I

Making junction from *extracted war* to *appbase*

Reason:

A junction link is a sort of subset or a variation of a symbolic link. It creates a junction link between *extracted war* directory to *appbase* directory.

Action:

No action required.

ZWED0096I

Making symlink from *extracted war* to *appbase*

Reason:

It creates a symbolic link between *extracted war* directory to *appbase* directory.

Action:

No action required.

ZWED0109I

Registering App (ID=*plugin identifier*) with App Server

Reason: The registration attempt from ZWED0109I has succeeded. Before the server starts, it registers all the *plugin identifier* with the App server and installs them.

Action:

No action required.

ZWED0110I

App *plugin identifier* installed to *appdir* and registered with App Server

Reason:

App *plugin identifier* installed to *appdir* and registered with App Server successfully.

Action:

No action required.

ZWED0111I

Authentication plugin *plugin identifier* added to category *authentication category*

Reason:

Auth plugin *plugin identifier* is being registered as a part of *authentication category*.

Action:

No action required.

ZWED0112I

Auth enabled=false. Auth passthrough.

Reason:

This message alerts you whenever an authentication handler is requested but the dataservice has authentication disabled via configuration. This is not the default behavior of Zowe but a user may have configured it for a dataservice or a plugin may have shipped with this configuration.

Action:

Review dataservice configuration to determine if this is intentional and desired. Some dataservices do not require authentication, while others should have it.

ZWED0114I

Adding plugin remotely

Reason:

A new plugin is detected and is being added.

Action:

No action required.

ZWED0115I

Skip child processes spawning on worker *workerId childProcessPath*

Reason: The process listed as childProcessPath was not spawned under the specified worker because it was listed as being a process that should only be started once. Some child processes should be started per-worker for redundancy, while others that need exclusive access to a resource such as a network port are specified with the property *childProcess.once*, and are skipped on all but one worker. The other workers print this message to indicate this behavior.

Action:

No action required.

ZWED0116I

The LOCATIONS are *serverModuleLocation* and *clientModuleLocation*

Reason:

The server has set the location *serverModuleLocation* and *clientModuleLocation*.

Action:

No action required.

ZWED0117I

The fileLocation is *lib*

Reason:

Location of files will be in *lib* directory.

Action:

No action required.

ZWED0118I

The NODE_PATH is *NODE_PATH* from environment variable.

Reason: The server recognizes the location of Node as *NODE_PATH* from environment variable.

Action:

No action required.

ZWED0119I

Plugin *plugin identifier* will serve library data from directory *dir location*

Reason:

For plugins with type 'library', plugin *plugin identifier* has been registered and will be serving library data from *dir location*

Action:

No action required.

ZWED0120I

Auth plugin *plugin identifier*: loading auth handler module *app server*

Reason: An auth category was requested as the default in the server configuration, or requested by a particular plugin, and because the auth plugin pluginId handles this category, it is being loaded by the app-server.

Action:

No action required.

ZWED0124I

Plugin *plugin identifier* at path=*plugin location* loaded.

Reason: All the *plugin identifier* will be loaded at plugins directory at *path*. Plugins will be available in *plugin location*.

Action:

No action required.

ZWED0125I

Plugin *plugin identifier* not loaded

Reason: A plugin object was not returned in the *makePlugin()* call of the app-server, and therefore the app-server did not load this plugin. The plugin will not be available in the server.

Action:

Check the log for references to *pluginId* to see other messages that indicate the cause

ZWED0129I

(*HTTP or HTTPS*) Listening on *ip address:port*

Reason: *type* (HTTP or HTTPS) Listening on ip address:port.

Action:

No action required.

ZWED0130I

(*HTTP or HTTPS*) About to start listening on *app-server port*

Reason: About to start listening on *app-server port*.

Action:

No action required.

ZWED0154I

Following link: *dependency*: *dependency importer*

Reason:

Following the link formed by the *dependency* and the *dependency importer* in the graph.

Action:

No action required.

ZWED0158I

*** pluginsSorted:

Reason:

The graph with the sorted plugins.

Action:

No action required.

ZWED0159E

*** rejects:

Reason:

Removing the plugins with the broken dependencies from the graph.

Action:

No action required.

ZWED0160I

Dep.valid:

Reason:

Checking if the dependency is valid.

Action:

No action required.

ZWED0205I

User=*user* (*pluginId*): User logout

Reason:

This message prints when the *user* logs out of the Zowe Desktop. Logout is being handled by the *pluginId* plugin.

Action:

If logout was intentional, message can be safely ignored. If logout was unintentional, keep in mind the Desktop logs out after inactivity. Incorrect logout behavior can be troubleshooted with the authentication plugin.

ZWED0211I

The number of processors is: *count*

Reason:

Lists the *count* of CPU cores on the system hosting the App server.

Action:

No action required.

ZWED0212I

Environmental variable ZLUX_MIN_WORKERS was not a valid number therefore *count* will be used as the minimum workers

Reason:

ZLUX_MIN_WORKERS environment variable is not valid, so the minimum number of workers as part of the cluster will be *count*

Action:

By default, the App server runs in a cluster. You can specify minimum number of cluster workers.

ZWED0213I

Environmental variable ZLUX_MAX_WORKERS was not a valid number therefore *count* will be used as the maximum workers.

Reason:

ZLUX_MAX_WORKERS environment variable is not valid, so the maximum number of workers as part of the cluster will be *count*.

Action:

By default, the App server runs in a cluster. You can specify maximum number of cluster workers.

ZWED0214I

Read *directory*: found plugin id = *identifier*, type = *type*

Reason:

Reading in *directory*, found a plugin with *identifier* of *type*

Action:

No action required.

ZWED0287I

JarMgr with id=*id* invoked to startup with config=*object*

Reason:

JarManager *id* has been started with the configuration *object*

Action:

No action required.

ZWED0290I

Plugin (*pluginId*) loaded. Version: *pluginVersion*. Successful: *overallSuccess*% (*pluginsLoaded*/*pluginsTotal*) Attempted: *pluginsAttempted*% (*attemptedCount*/*pluginsTotal*)

Reason:

Plugin with *pluginId* loaded, with version *pluginVersion*. The server attempted to load a total of *pluginsTotal* with *pluginsLoaded* plugins already successfully loaded.

Action:

No action Required.

ZWED0292I

Plugin *identifier* loaded. Version: *pluginVersion*.

Reason:

Plugin *identifier* loaded successfully and the plugin version for the same is *pluginVersion*.

Action:

No action Required.

ZWED0294I

Successfully loaded *recognizers length* recognizers for *appId* into config

Reason:

Successfully loaded *recognizers length* for *appId* into config at path workspace/app-server/ZLUX/pluginStorage/org.zowe.zlux.ng2desktop/.

Action:

No action Required.

ZWED0295I

Successfully loaded *actions length* actions for *appId* into config

Reason:

Successfully loaded *actions length* for *appId* into config at path workspace/app-server/ZLUX/pluginStorage/org.zowe.zlux.ng2desktop/.

Action:

No action required.

ZWED0299I

Loading remote iframe app *plugin_identifier* located at *remoteUrl*.

Reason:

Loading remote iframe app *plugin_identifier* which is located at *remoteUrl*.

Action:

No action Required.

ZWED0300I

APIML Storage configured

Reason:

caching service/APML storage is configured

Action:

No action Required.

ZWED0301I

Found *pre-existing recognizers*/*pre-existing actions* in config for *appID*.

Reason:

Get *pre-existing recognizers*/*pre-existing actions* in config, if any for *appID*.

Action:

No action Required.

ZWED0302I

HA mode is enabled/disabled.

Reason:

High Availability mode is enabled/disabled.

Action:

No action Required.

App-server warning messages

ZWED0004W

Tomcat for ID=*id* not starting, no services succeeded loading

Reason:

A tomcat instance required for loading a set of java dataservices could not start, so none of the associated dataservices will be available either.

Action:

Review prior logs to determine the reason the tomcat server is not starting, and address the problem before restarting Zowe in order to access the missing dataservices.

ZWED0006W

RBAC is disabled in the configuration. All authenticated users will have access to all services. Enable RBAC in the configuration to control users' access to individual services.

Reason:

RBAC can be used to permit and reject access to each URL of the app-server individually according to security rules such as those from SAF resources. Enabling RBAC is beneficial but requires configuration first so this message is often seen.

Action:

If you wish to learn more about RBAC and enable it, read Application Framework Advanced Configuration

ZWED0007W

Dataservice authentication definition is not present in server configuration file, or malformed. Correct the configuration file before restarting the server.

Reason:

The `components.app-server.dataserviceAuthentication` configuration section is missing or invalid, so the server cannot continue until it is fixed. Authentication plugins for dataservices are described here

Action:

Correct your zowe configuration for this section according to the app-server schema

ZWED0008W

Error loading auth plugin *pluginIdentifier*: *error*

Reason:

The plugin could not be loaded due to an error. This plugin may be required for the server to continue, but if it is non-essential then the server will continue to run without the ability to perform authentication against that particular plugin.

Action:

Review the error to determine the way to fix the plugin before restarting Zowe.

ZWED0013W

Initializing was not complete for worker *workerId*

Reason:

A cluster mode worker exited before it fully initialized. Another worker will be started soon to attempt again.

Action:

If this continues to happen, you should contact support.

ZWED0014W

Error adding plugin: *error*

Reason:

A dynamic plugin, or a plugin added post-startup was unable to be added to the server. The server continues to run, but this plugin was not added.

Action:

Check the *error* and lines above in the log to determine the reason for the failure.

ZWED0015W

Error reloading workers: *error*

Reason:

The server was attempting to reload all workers, probably to complete a configuration change. An error occurred instead so some of the workers may not have been reloaded and could contain the old configuration.

Action:

If you were doing a configuration change, you should try again or restart the server if the error persists. You can check the *error* to see the reason for the issue.

ZWED0016W

Error setting override: *error*

Reason:

The server attempted to load a new configuration, but failed when writing the configuration update to a file.

Action:

Check the *error* to see the possible cause for the failure. Retry this operation but if the issue persists you should restart the server.

ZWED0017W

Duplicate plugin identifier *pluginId* found.

Reason:

A plugin was trying to be added to the server but it wasn't possible because another plugin with the same ID was already running within the server.

Action:

Plugin upgrades cannot be done through the add plugin operation. Instead, the server should be stopped to perform this upgrade.

ZWED0018W

Could not initialize Java manager. Java services from Apps will not be able to load *stackTrace*

Reason:

The Java manager is used to run Java services bundled into plugins. It could not start, so the server cannot load any Java services. Plugins that have Java services may fail to load, but the server will still run with the remaining plugins.

Action:

Check the *stackTrace* output to determine the reason the Java manager could not run.

ZWED0019W

Exception when setting log level for ID=*logId*. E: *stackTrace*

Reason:

Log levels listed in the configuration file are set during startup. For some reason, the level for *logId* could not be set, but the server will continue to run with that logger set to default verbosity.

Action:

Check the *stackTrace* to determine the reason why *logId* could not be set. Potentially the log id was an invalid name, or the log level was an invalid number.

ZWED0020W

Could not spawn *childProcess*: *errorMessage*

Reason:

The child process that was requested to run when the server started up could not run for some reason. *childProcess* lists the parameters requested to start the process.

Action:

Check the *errorMessage* to determine the reason of failure, and also verify that the information in *childProcess* is valid.

ZWED0021W

Missing one or more parameters required to run. The server requires either HTTP or HTTPS. HTTP Port given: *httpPort*. HTTPS Port given: *httpsPort* HTTPS requires either a PFX file or Key & Certificate files. Given PFX: *pfx* Given Key: *key* Given Certificate: *certificate* config was: *configuration* All but host server and config file parameters should be defined within the config file in JSON format.

Reason:

The server could not start because the configuration was not valid. When the server's HTTPS section is specified, *httpsPort* must be a valid TCP port number and you must have a key and certificate. If the HTTPS section is not specified, the HTTP section must be specified and *httpPort* must be a valid TCP port number.

Action:

Review the *configuration* to see if there are corrections to be made before restarting the server.

ZWED0027W

Plugin (*pluginId*) loading failed. Version: *versionNumber*. Message: "*errorMessage*" Successful: *percentSuccess*% (*pluginsLoaded*/*pluginsTotal*) Attempted: *percentAttempted*% (*pluginsAttempted*/*pluginsTotal*)

Reason:

An error prevented the plugin *pluginId* from loading. Other plugins will still be attempted to be loaded, until *percentAttempted* reaches 100%. The server will run if all auth plugins needed have successfully loaded.

Action:

Review *errorMessage* to see if there is something you can do to fix the error. You may need to contact the plugin developer to find a solution. If you do not need this plugin, it is OK to continue.

ZWED0028W

Encountered parse exception while reading *filename*

Reason:

The server cannot read the JSON file *filename*. This might be a configuration file or a plugin file. In either case, the server may not be able to run or may run with less plugins than desired.

Action:

Review the file listed in *filename*. Check if it is in the right encoding for your platform. Tagging the file according to its encoding is recommended for z/OS. Also check if the file is valid JSON. The file may have a missing or extra comma, or missing quotes or brackets.

ZWED0029W

Authentication plugin was found which was not requested in the server configuration file's dataserviceAuthentication object. Skipping load of this plugin

Reason:

The server will attempt to load every plugin given to it in the plugins directory. Authentication plugins are only needed if a plugin requests them or it implements the default authentication category. Because the server did not find a user of this plugin, it was not loaded.

Action:

No action is needed unless you believe that this plugin needed to be loaded. If so, check for plugins that require it to determine if there is missing or incorrect auth configuration.

ZWED0030W

location points to an invalid plugin definition, skipping

Reason:

The file specified at *location* is not valid according to the pluginDefinition schema, so it cannot be loaded. The server will still start without the plugin if possible.

Action:

Correct the pluginDefinition.json file of the plugin to load the plugin on next server restart, or remove the plugin if not needed.

ZWED0032W

Failed to load *filename*

Reason:

The plugin definition located at *filename* could not be read, so the plugin that referred to this cannot be loaded. The server may still run without the plugin if possible.

Action:

Check if the file exists and is readable to the user that is running the server. Also check that the file is in the right encoding for the OS the app-server is running on. On z/OS, it is recommended to have the file encoding tagged.

ZWED0033W

Could not initialize plugin *pluginId*: *error*

Reason:

The plugin *pluginId* could not be loaded. This may be due to unsatisfied imports, where an import requested a version of something that was not available, or an entire plugin was not available. The server will still attempt to load if this plugin was not needed.

Action:

Check the *error* message to determine the cause of error for correction.

ZWED0034W

Skipping install of plugin due to existing plugin with same id=*identifier*

Reason:

The plugin could not be loaded due to a plugin that is already loaded containing the same *identifier* ID. Plugin IDs are unique, so the first plugin with that ID that is seen is the one that is loaded.

Action:

Check to see if you have 2 extensions that contain plugins with the same ID. Alternatively, an extension may have updated to have its name change without its ID changing, causing a duplicate to appear. You may need to clean up your extensions or the contents of the pluginsDir directory.

ZWED0035W

Error thrown when installing plugin=*identifier*: *error*

Reason:

The plugin with id *identifier* could not be added to the server because of an error that occurred. The server will still attempt to run without the plugin if possible.

Action:

Check the *error* message to see the reason for the error, and correct it before restarting the server in order to try loading the plugin again.

ZWED0036W

Uncaught exception found. Error: *stackTrace*

Reason:

The server encountered an unexpected error. If cluster mode is running, this will result in the worker crashing but the cluster starting a new worker to replace it. The client that initiated the request will need to retry the operation though other clients should not experience disruption.

If cluster mode is not running, the process will end but the launcher will restart it. In this case, state may be lost unless the caching service was also being used.

Action:

The *stackTrace* should be sent to developers so that the issue can be fixed.

ZWED0037W

Ending server process due to uncaught exception.

Reason:

The server is stopping after encountering ZWED00036W.

Action:

The information within ZWED0036W should be sent to developers so that the issue can be fixed.

ZWED0038W

Reason:

A child process with path *childProcessConfig.path* encountered an error with receiving *data*.

Action:

Action depends on context of what *data* is. May be useful in debugging an issue with internal ProcessManager.

ZWED0039W

Exception at server cleanup function: *stack*

Reason:

An exception occurred when ending process, during the cleanup phase.

Action:

No action is needed, but *stack* can be sent to developers if server processes are failing to end.

ZWED0040W

Callservice: Service call to %s:%s%s failed.

Reason:

An HTTP request to *host* with *port* at *path* failed.

Action:

Check the subsequent error message to see why it failed or Network log, if request originated from the browser.

ZWED0041W

[Proxy URL: *urlPrefix*] Exception caught. Message=*message*

Reason:

For *urlPrefix* proxy, an exception was caught with content *message*

Action:

No action needed usually, but message may be needed for debugging

ZWED0042W

Stack trace follows *stack*

Reason:

For the exception from ZWED0041W, a *stack* trace is printed

Action:

No action needed usually, but stack may be needed for debugging

ZWED0043W

[Proxy URL: *urlPrefix*] proxyWS error: *error*

Reason:

Proxy worker encountered an *error*

Action:

No action needed usually except, debugging of the error.

ZWED0044W

[Proxy URL: *urlPrefix*] WS error: *error*

Reason:

Worker encountered an *error*

Action:

No action needed usually except, debugging of the error.

ZWED0045W

Failed to reach the auth services host for address *host*:*port*

Reason:

Client encountered error when trying to connect to an agent *host*:*port*

Action:

This usually means your agent (for example: ZSS) is unreachable or your configuration is pointing to an incorrect agent

ZWED0046W

The auth services host system was not specified at startup, and defaulted to 127.0.0.1. Verify that the auth services server is running, or specify at startup the remote host and port to connect to. See documentation for details.

Reason:

Client encountered an error when trying to connect to the agent from ZWED0045W

Action:

See ZWED0045W

ZWED0048W

Invalid Swagger from file for service (*plugin identifier*:*service name*)

Reason:

N/A

Action:

Check validity of Swagger file

ZWED0049W"

error message stack

Reason:

Prints the *error message* and *stack* from ZWED0048W

Action:

See ZWED0048W

ZWED0051W

Failed to parse translation file *path*. File skipped

Reason:

Failed to parse the file *path* as a valid translation file, most likely because it's not valid JSON

Action:

Check if the translation file is valid JSON and matches the structure of core translation files (i.e. Sample Apps)

ZWED0052W

Error when reading file=*path*. Error=*message*

Reason:

Failed to read certificates or keys *path* with a returned *message*

Action:

Review content of *message* and correct

ZWED0053W

Event handler failed: *error*

Reason:

An asynchronous event listener handler failed

Action:

This isn't part of normal operation, if it causes issue, *error* and any relevant context should be sent to developers

ZWED0054W

Skipping invalid listener address=*hostname*

Reason:

hostname was deemed invalid when attempting a DNS lookup to find IP address

Action:

Compare with your configuration to see where the invalid *hostname* is being picked up

ZWED0055W

Skipping invalid listener address=*hostname*

Reason:

hostname is not a valid string

Action:

Compare with your configuration to see where the invalid *hostname* is being referenced

ZWED0056W

Couldn't process *address* as IP

Reason:

The *address* was not pointing a valid IP address by the ipaddr utility

Action:

Compare with your configuration to see where the invalid *address* is being referenced

ZWED0057W

Loopback calls: localhost equivalent address not found in the list *listenerAddresses*. Using first address *address*; Verify firewall will allow this.

Reason:

Unable to find a localhost equivalent from the *listenerAddresses* list so the server considers the first address in the loop by default.

Action:

Verify if this is the intended configuration (edit/define components.app-server.node.https.ipAddresses) or check Zowe documentation.

ZWED0058W

Log location for logger '*identifier*:*serviceDefinitionName*' is undefined

Reason:

Log location isn't being specified for this dataservice.

Action:

Check dataservice plugin definition to see if log location is being specified.

ZWED0059W

Failed to add the plugin: *errorMessage*

Reason:

Using the /plugins API to add a plugin, has failed

Action:

Review *errorMessage* for explanation

ZWED0060W

errorMessage

Reason:

Invalid JSON

Action:

Review *errorMessage*

ZWED0061W

Callservice: Service call failed.

Reason:

A network request to this service failed.

Action:

Check Network log and review the error.

ZWED0062W

[Service URL: *url*] Exception caught. Message=*errorMessage*

Reason:

An error occurred calling *url* with reason *errorMessage*

Action:

Review correctness of *url* and review *errorMessage*

ZWED0063W

Stack trace follows *stackTrace*

Reason:

This exception originates from the web socket and the stack trace message handles the generated exception. The stack trace for an exception helps in understanding the error and what went wrong with the code.

Action:

No action needed unless user is experiencing an interruption in the server service, then send the stack to developers.

ZWED0064W

plugin.identifier: Invalid method *method*

Reason:

It will throw the warning if *method* is invalid (different from these methods: get|post|put|delete|ws)

Action:

Review the warning message and use correct method.

ZWED0065W

Library plugin *plugin.identifier* is missing libraryVersion attribute for hosting files. Skipping file hosting.

Reason:

Library plugin's plugin definition is missing the library version attribute.

Action:

Add the correct library version in the plugin definition.

ZWED0066W

pluginID: getCapabilities() is not a function

Reason:

The handler for plugin *pluginID* does not have a getCapabilities() method

Action:

No action required. If your desired authentication plugin isn't successfully authenticating a login, please send the log and any relevant info to the developers.

ZWED0068W

Failed to set proxy authorizations. Error=*errorMessage*

Reason:

Failed to add proxy authorization with reason *errorMessage*.

Action:

No action required. If your desired authentication plugin isn't successfully authenticating a login, please send the log and any relevant info to the developers.

ZWED0069W

Returning null for cipher array because input had non-string:

Reason:

Returns null for cipher array if an array element is not a string type.

Action:

Please verify, if any custom cyphers present, that all cyphers are of type string.

ZWED0070W

Error when reading PFX. The server cannot continue. Error=*errorMessage*

Reason:

If we get an error while reading *config.https.pfx* file then the server cannot continue and throws *errorMessage*.

Action:

No action is needed, but the *errorMessage* may be needed to debug

ZWED0071W

Unexpected error on server *ipAddress*:*port*. E=*errorMessage*. Stack trace follows. *stack*

Reason:

When we get an unexpected (anything except EACCES, EADDRINUSE, ENOTFOUND, EADDRNOTAVAIL) error in the web server for *ipAddress*:*port*.

Action:

No action needed unless user is experiencing an interruption in server, then send error message and stack to developers

ZWED0072W

Could not stop manager due to error *errorMessage*

Reason:

If the server manager is unable to stop due to any reason it will throw an exception with an *errorMessage*.

Action:

If the Java manager (handles Jar and War) is unable to stop all servers, send *errorMessage* to developers

ZWED0073W

No server returned for group=*group*

Reason:

If No server was found in this War *group* then it will throw this warning message.

Action:

No action is required

ZWED0074W

Unknown default behavior=*defaultBehavior*

Reason:

The default grouping behaviour in the config for this War is not of type 'microservice' or 'appserver'

Action:

No action is needed, but the warning may be needed to debug

ZWED0075W

Services in plugin=*plugin* war grouping skipped. Plugin missing or already grouped

Reason:

Server was not created for *plugin* War grouping, because it was already made or plugin is missing.

Action:

No action is needed

ZWED0076W

Skipping invalid plugin group=*plugins*

Reason:

If *plugins* is not an array and the size is less than zero, then it will log a warning message.

Action:

Make sure *plugins* should be an array of size greater than zero.

ZWED0077W

Could not extract war for service=*key-value*, error=*errorMessage*

Reason:

If the service with the *key-value* pair is unable to extract the war file then it throws the *errorMessage*

Action:

Check if the war file exists and configured correctly.

ZWED0078W

Could not access files to determine status for service=*key-value*, error=*errorMessage*

Reason:

If we are unable to get the status of war extracted or not, then it throws *errorMessage* in catch block.

Action:

Check if the war file exists.

ZWED0079W

Cannot add servlet for service=*key-value*, error=*errorMessage*

Reason:

If unable to add servlet for service *key-value*, then it logs a warning *errorMessage*.

Action:

No action is needed, but the warning may be needed to debug this War

ZWED0080W

Cannot add servlet for service=*key-value*

Reason:

When we are not able to get the directory to add servlet for service *key-value*.

Action:

Check if your directory exists and is valid.

ZWED0081W

Could not start Tomcat, error=*errorMessage*

Reason:

Tomcat manager is unable to start Tomcat with the Java option, due to an incorrect configuration with `components.app-server.node.https.port`, `components.app-server.node.https.key`, or `components.app-server.node.https.certificate`.

Action:

Verify configuration with `components.app-server.node.https.port`, `components.app-server.node.https.key`, or `components.app-server.node.https.certificate` is valid or not.

ZWED0082W

Tomcat PID=*pid*: stderr=*error*

Reason:

A Tomcat process with Tomcat *pid* encountered an *error* (stderr).

Action:

Action depends on what *error* is and may be useful to debug.

ZWED0083W

Tomcat could not start. Closing. code=*code*

Reason:

If the Tomcat manager is unable to start itself, then it closes with *code*.

Action:

Review the message and if app server service is interrupted, send the message along with the log to support for troubleshooting.

ZWED0084W

Tomcat could not start. Exiting. code=*code*

Reason:

If the Tomcat manager is unable to start itself, then it exits with *code*.

Action:

Review the message and if app server service is interrupted, send the message along with the log to support for troubleshooting.

ZWED0085W

Tomcat PID=*pid* Error when stopping, error=*errorMessage*

Reason:

If Tomcat manager is unable to stop the Tomcat process on Windows, then it logs *errorMessage*.

Action:

Review the *errorMessage* and see if there is something you can do to fix the error

ZWED0086W

Could not stop Tomcat, error=*errorMessage*

Reason:

If Tomcat manager is unable to stop the Tomcat process on Unix, then it logs *errorMessage*.

Action:

Review the *errorMessage* and if app server service is interrupted, send the message along with the log to support for troubleshooting.

ZWED0087W

Tomcat PID=*pid*: stderr=*error*

Reason:

While stopping Tomcat, Tomcat process with Tomcat *pid* encountered an *error* (stderr).

Action:

Review the *error* and if app server service is interrupted, send the message along with the log to support for troubleshooting..

ZWED0146W

Could not stat destination or temp folder *path*. Error=*ErrorMsg*

Reason:

Server was unable to use 'stat' command on folder *path* and threw *ErrorMsg*.

Action:

No action is needed usually, however, need to debug the *ErrorMsg*.

ZWED0148W

App extracted but not registered to App Server due to write fail. Error=*errorMessage*

Reason:

App extracted successfully but not registered to App Server due to write fail. Error=*errorMessage*.

Action:

Go through the *errorMessage* and undestand what to debug.

ZWED0149W

Could not find pluginDefinition.json file in App (dir=*AppDir*). Error=*ErrorMsg*

Reason:

Throws *ErrorMsg* when its not able to find the pluginDefinition.json file in *AppDir* location.

Action:

Check if pluginDefinition.json exists in *AppDir*.

ZWED0150W

identifier library path *location* does not exist.

Reason:

Server throws warning when library plugin *identifier* does not exist at path *location*.

Action:

Check if the library plugin exists in the path *location*.

ZWED0151W

unhandledRejection *error*

Reason:

When process experiences an unhandledRejection.

Action:

No action is needed usually, however, need to debug the *ErrorMsg*.

ZWED0152W

Error at call sessionStore. *APIMethodname*: *Error Object*

Reason:

There is a problem calling a sessionStore *APIMethodname*.

Action:

No action is needed usually, however, need to debug the *ErrorMsg*.

ZWED0153W

WARNING: CLI Argument missing name or has unsupported type=*type*

Reason:

The server throws a warning when the CLI argument is missing a name, or has an unsupported type (supported types: 1 - *flag*, 2 - *value*, 3 - *json*).

Action:

Check any missing argument or unsupported argument.

ZWED0154W

WARNING: Unrecognized command: *args*

Reason:

Throws warning when *args* is unrecognized.

Action:

Check the command once again or check if the specified command is interpreted as intended.

ZWED0155W

ErrorMsg

Reason:

Server throws 500 code with *ErrorMsg*.

Action:

Go through the *ErrorMsg* for context on what to debug.

ZWED0156W

1 function initLoggerMessages - ERROR - *Error*

Reason:

Attempt to get log message for a language a user may have specified, has failed with *Error*.

Action:

Go through the *Error* for details on what to debug.

ZWED0157W

2 function initLoggerMessages - ERROR - *Error*.

Reason:

Attempt to get log message for English has failed with *Error*.

Action:

Go through the *Error* for details on what to debug.

ZWED0158W

ErrorMsg

Reason:

Server throws 500 code with *ErrorMsg*.

Action:

Go through the *ErrorMsg* for details on what to debug.

ZWED0159W

Plugin (*PluginIdentifier*) loading failed. Message: "*errorMessage*" Successful: *pluginsLoaded*% (*pluginsLoaded*/*eventCount*) Attempted: *pluginCount*% (*pluginCount*/*eventCount*)

Reason:

Plugin with *pluginId* loaded failed with *errorMessage*. The server attempted to load a total of *pluginCount* with *pluginsLoaded* plugins already successfully loaded.

Action:

Review *errorMessage* to see if there is something you can do to fix the error. You may need to contact the plugin developer to find a solution. If you do not need this plugin, it is OK to continue.

ZWED0166W

Error updating the storage: *Error*

Reason:

Throws warning *Error* when it faced error while updating the storage.

Action:

Contact support if *Error* is not clear.

ZWED0167W

Error adding to the storage: *errorMessage*

Reason:

Throws *errorMessage* while adding to the storage.

Action:

If app server service is interrupted, go through the *errorMessage* for details on what to debug or contact support if *errorMessage* is not clear.

ZWED0168W

Unable to retrieve storage value from cluster *Error*

Reason:

Throws warning *Error* when it is unable to retrieve storage value from cluster.

Action:

By default, the timeout for cluster method calls is 1000ms which should cause no issues. If service is interrupted, contact support and provide *Error*.

ZWED0169W

Error deleting the storage with id: *deleteStorageByKey Error*

Reason:

when server tries deleting storage by key *deleteStorageByKey*.

Action:

Contact support if *Error* is not clear.

ZWED0170W

Plugin (*PluginIdentifier*) loading failed. Version: *PluginVersion*. Message: "*Error*"

Reason:

Plugin *PluginIdentifier* with version *PluginVersion* has failed to load with an *Error*.

Action:

Review *Error* to see if there is something you can do to fix the error. You may need to contact the plugin developer to find a solution. If you do not need this plugin, it is OK to continue.

ZWED0171W

Rejected undefined referrer for url=*originalUrl*, ip=*ip*

Reason:

Throws 403 Forbidden when App server fails to honor a network request due to failed referrer check.

Action:

Double check the address. A possible reason for a 403 error is a misstyped *originalUrl* or *ip* or because loopback routing is not configured in the App server.

ZWED0172W

Rejected bad referrer=*referrerHeaderValue* for url=*accessedUrl*, ip=*clientIp*

Reason:

The client from *clientIp* tried to access *accessedUrl* but due to having a referrer header value that didn't seem to originate from this server, a security violation was caused and the attempt to access the URL was rejected.

Action:

Review the values to determine if this was a valid attempt to access the server or not. If this access seems suspicious, then the server was correct in rejecting the access. However, if the access attempt seemed legitimate, then this points to the referrer configuration needing revision. You can customize which referrer header values are permitted using the environment variable ZWE_REFERRER_HOSTS and it should be set to match the external hostnames of the system the app-server is running on.

ZWED0173W

Unable to decode P12 certificate (different password than keystore?). Attempting to use empty string as password. Decode error: *error*.

Reason:

The server tried to load the p12 file provided for the server certificate or certificate authorities, but encountered *error*. The server may not be accessible as a result of invalid TLS configuration.

Action:

Check the value of zowe.certificate.keystore.password and zowe.certificate.truststore.password, or the environment variable KEYSTORE_PASSWORD to see if they are valid for the p12 file provided, and adjust the configuration if needed.

ZWED0174W

componentName could not verify (*operatingSystem*) as a supported platform to install (*pluginId*). Proceeding anyway...

Reason:

The plugin *pluginId* has a dependency which can only run on certain operating systems, and *operatingSystem* is not on the list, but because the operating system is not explicitly forbidden, the server will attempt to load the plugin anyway. This may fail, but the server may continue to run without the plugin if possible.

Action:

Review the plugin dependencies as seen in the plugin's pluginDefinition.json file to see if your Zowe configuration or the plugin can be changed in order to match the requirements. Consult the plugin developer if you believe the plugin was able to run fine on the operating system, so they can explicitly add support in the future.

ZWED0175W

componentName could not verify (*systemArchitecture*) as a supported architecture to install (*pluginId*). Proceeding anyway...

Reason:

The plugin *pluginId* has a dependency which can only run on certain system architectures, and *systemArchitecture* is not on the list, but because the system architecture is not explicitly forbidden, the server will attempt to load the plugin anyway. This may fail, but the server may continue to run without the plugin if possible.

Action:

Review the plugin dependencies as seen in the plugin's pluginDefinition.json file to see if your Zowe configuration or the plugin can be changed in order to match the requirements. Consult the plugin developer if you believe the plugin was able to run fine on the system architecture, so they can explicitly add support in the future.

ZWED0177W

Unable to load *actionOrRecognizer* for '*pluginId*' into config

Reason:

The plugin *pluginId* has an action or recognizer within its package and the plugin install process was trying to copy that into the workspace so it can be used, but encountered an error that prevented this.

Action:

Contact support if the reason cannot be determined.

ZWED0178W

Skipping authentication plugin *pluginId* because it's not HA compatible

Reason:

The server is setup for running in high availability (HA) mode which requires that plugins that have state, in particular authentication plugins, must be HA-compatible or else errors will occur. Therefore, the server skips over loading of this plugin nbecause its pluginDefinition.json did not state it was HA compatible.

Action:

Either the plugin must be updated to support and state its support for HA, or it must be removed, or HA mode disabled. To make a plugin support HA, the conformance program should be reviewed. When HA mode is supported, the plugin can be marked as compatible by setting capabilities.haCompatible=true within its initialization.

ZWED0179W

Unable to retrieve the list of certificate authorities from the keyring=*keyringName* owner=*username* Error: *error*

Reason:

The server could not automatically determine the certificate authorities (CA) from the z/OS keyring listed. This may cause the server to be unable to verify certificate chains from other servers or clients causing other errors later.

Action:

Review the error to resolve it and contact support if needed. It's also possible as a workaround to explicitly state the CAs within the keyring that you would like to load, rather than relying upon the server's attempt to automatically find all CAs within the keyring.

App-server error messages

ZWED0001E

Error: *error*

Reason:

The server is running in cluster mode and the cluster manager has encountered an unexpected error.

Action:

Review the error to resolve it, and contact support if needed.

ZWED0002E

Could not stop language manager for types=*languageNames*

Reason:

A plugin had a service that needed a language manager to run. During shutdown, the language manager could not be stopped.

Action:

The language manager may continue to run after the app-server shuts down. Review the logs to determine the location of the language manager and try to stop the manager manually.

ZWED0003E

The screen displays the following error message:

Loopback configuration not valid, *loopbackConfiguration* Loopback calls will fail!

Reason:

The administrative network configuration does not make a loopback network address available to the app-server. The app-server requires a loopback network address to communicate with itself, but the address is unavailable.

Action:

There are two ways to solve this problem: Option 1 Enable the administrative network configuration to make a loopback network address available to the app-server. For example, enable the administrative network configuration to provide 127.x.x.x to the app-server, where 127.x.x.x is the IP that denotes the loopback network address. The IP address must be 127.x.x.x

Option 2 In the YAML configuration file, set a value for the `components.app-server.node.loopbackAddress` property that denotes the IP that you want to use.

> **NOTE**
>
> If the network administrator associates a loopback network address with the app servers, then do not mention the loopback network address in the YAML configuration file. Verify whether your network's configuration in the YAML configuration file is correct. If the alarm still displays, contact your network administrator.

ZWED0004E

Could not listen on address *ip*:*port*. It is already in use by another process.

Reason:

The server tried to start using the ip and port values shown which were from the zowe configuration. When trying to connect to this address, the server recieved an error telling it that the address was already in use.

Action:

Check the system's network port status to see what program could be using this address, and either stop that program or change the zowe configuration to use a different address before restarting zowe.

ZWED0005E

Could not listen on address *ip*:*port*. Invalid IP for this system.

Reason:

When the app-server was binding to the address shown, it recieved the error EADDRNOTAVAIL or ENOTFOUND. In either case, the app-server was not able to bind to the address and so it will not run until the problem is solved.

Action:

Review the address and check if it is valid or if there is some lack of permissions that might explain why these errors were received by the server.

ZWED0006E

Usage: --inputApp | -i INPUTAPP --pluginsDir | -p PLUGINSDIR --zluxConfig | -c ZLUXCONFIGPATH [--verbose | -v]

Reason:

This message appearas when you attempt app installation but have not provided enough of the mandatory arguments for the program to run. It is printing out what options are valid so that you can retry with different options.

Action:

Retry the operation after modifying the input arguments to be valid against the list shown. Or, if you are trying to do app installation, you should use `zwe components install` instead whenever possible.

ZWED0007E

serviceName invalid version *version*

Reason:

The service mentioned was trying to be loaded by the server but failed validation due to the version number not being a a valid semver string. This service and therefore plugin will be skipped during loading.

Action:

Contact the developers so that they can revise the pluginDefinition.json of the plugin where the service is located to be semver-compatible. Details on semver version can be found at semver.org

ZWED0008E

localServiceName: invalid version range *serviceName*: *versionRange*

Reason:

When the *serviceName* was trying to be imported into a plugin as *localServiceName*, the version range of acceptable versions for the service to be imported was not valid. Due to this, the import cannot be resolved and the plugin will be skipped in loading.

Action:

Contact the developers of the plugin this error occurred in as the pluginDefinition.json needs to be revised to have the version range given for this import service be a valid semver range string.

ZWED0009E

localServiceName: invalid version range *versionRange*

Reason:

When the a service was trying to be imported into a plugin as *localServiceName*, the version range of acceptable versions for the service to be imported was not valid. Due to this, the import cannot be resolved and the plugin will be skipped in loading.

Action:

Contact the developers of the plugin this error occurred in as the pluginDefinition.json needs to be revised to have the version range given for this import service be a valid semver range string.

ZWED0010E

No file name for data service

Reason:

When the server was trying to load a service for a plugn, it couldn't identify the filename where the service is located within the plugin, so the service and therefore plugin have been skipped during loading.

Action:

Contact the plugin developer to fix that the service within the pluginDefinition.json is missing the "fileName" or "filename" property which must describe the path to the dataservice entry file, relative to the plugin's lib directory.

ZWED0011E

Plugin *pluginId* has web content but no web directory under *location*

Reason:

The plugin definition of *pluginId* stated that the plugin has web content to serve such as HTML files, but the required 'web' folder was missing, so the plugin cannot be loaded.

Action:

Check that the web folder within this plugin exists or not. If it does exist, then the server may not have had permission to read it. Otherwise, if it doesn't exist, try to reinstall the plugin in case it is corrupt. Or, contact the developers to fix the lack of web directory.

ZWED0012E

pluginId::*serviceName* Required local service missing: *localService*

Reason:

The service *serviceName* could not be loaded because of an unsatisfied version requirement upon another service. This causes the plugin *pluginId* to be skipped during loading.

Action:

Review the plugin's definition to see why the version match could not be made. Either a required plugin is missing, or the pluginDefinition.json will need to be revised by the developer of the plugin to fix the version check failure.

ZWED0013E

pluginId::*serviceName* Could not find a version to satisfy local dependency *serviceName*@*requiredVersion*

Reason:

The service *serviceName* could not be loaded because of an unsatisfied version requirement upon another service. This causes the plugin *pluginId* to be skipped during loading.

Action:

Review the plugin's definition to see why the version match could not be made. Either a required plugin is missing, or the pluginDefinition.json will need to be revised by the developer of the plugin to fix the version check failure.

ZWED0014E

Plugin *pluginId* invalid

Reason:

The plugin could not be loaded because the plugin definition was not valid in some way. There are fields that every plugin must define, such as type. Then, depending on type, there are more fields a plugin can and cannot have. When the server went to load the plugin, it found that the definition was not correct versus the requirements, so the loading of this plugin was skipped.

Action:

Contact the developers of this plugin so that they can fix the plugin to adhere to the plugin schema

ZWED0015E

No plugin directory found at *pluginLocation*

Reason:

The server finds plugins by reading JSON files within the "plugins" folder of its workspace directory. When it checked the JSON of this particular plugin, the JSON stated the plugin could be found at a folder *pluginLocation* which either does not exist or could not be read by the server.

Action:

Check that the location shown exists. If it does exist, then there is some permission problem preventing the server from reading it. If it does not exist, determine whether this plugin is desired but has the wrong location, or if this plugin is not desired and should be removed. Contact support so they can assist in fixing the plugin location problem.

ZWED0016E

No pluginDefinition.json found at *pluginLocation*

Reason:

The server finds plugins by reading JSON files within the "plugins" folder of its workspace directory. When it checked the JSON of this particular plugin, it stated the plugin was located in a folder which the server determined did not contain the pluginDefinition.json file that every plugin requires. Due to this missing file, the loading of this plugin was skipped.

Action:

Check that a pluginDefinition.json exists at the location specified. If it does, then the server is missing permissions necessary to read the file. If the file does not exist, review if there is a problem with the plugin itself that should be resolved by contacting the plugin developers. If the plugin exists with a pluginDefinition.json file at a different location than the error suggests, contact Zowe support to resolve the location problem.

ZWED0017E

Identifier doesn't match one found in pluginDefinition: *pluginIdentifier*

Reason:

The identifier found in the plugin reference doesn't match the one specified in the pluginDefinition.json

Action:

Check if identifier found is the same one as intended (typo perhaps?). If not, delete the plugin identifier JSON (found in instance/workspace/app-server/plugins) and restart Zowe. If issue isn't resolved, increase app server debugging and send logs to the app developer

ZWED0018E

No plugin type found, skipping

Reason:

The plugin definition for the plugin has no 'pluginType' property set

Action:

Contact app developers if you need plugin to be loaded and working

ZWED0019E

Plugin already registered

Reason:

A plugin with this identifier has already been registered to the map of plugins

Action:

Check if you have multiple components sharing the same, or different versions, of the same plugin. This is not allowed

ZWED0020E

"*pluginIdentifier*: pluginType *type* is unknown

Reason:

The plugin *pluginIdentifier* has in its plugin definition an invalid plugin *type*

Action:

Accepted plugin types found in the schema (https://github.com/zowe/zlux-app-server/blob/v2.x/staging/schemas/plugindefinition-schema.json#L47)

ZWED0021E

pluginPath is missing

Reason:

App server tried to process the plugin reference from path *pluginPath*

Action:

Check if *pluginPath* is a real path or the App server (started task user of Zowe) has the permission to read it

ZWED0022E

Module not found *moduleName*

Reason:

App server, during a cluster/worker method call, tried to require a module *moduleName* it couldn't find

Action:

Contact the plugin developer if plugin returns this error.

ZWED0023E

Method not implemented *methodName*

Reason:

App server, during a cluster/worker method call, tried to act on a method that isn't valid.

Action:

Contact the plugin developer if plugin returns this error.

ZWED0024E

Object not exported *exportName*

Reason:

App server, during a cluster/worker method call, tried and failed to export a module object.

Action:

Contact the plugin developer if plugin returns this error.

ZWED0025E

.authenticate() missing

Reason:

Authentication plugin (which plugin includes looking at nearby log messages) is missing the .authenticate() method.

Action:

Contact the plugin developer if plugin is essential for authenticaiton.

ZWED0026E

Circular dependency: *pluginIdentifier*

Reason:

The App server encountered a circular dependency for plugin *pluginIdentifier* (meaning it contains a dependency that imports itself).

Action:

Contact the plugin developer for troubleshooting help. This is a packaging issue.

ZWED0027E

Circular dependency: *pluginIdentifier*

Reason:

The App server encountered a circular dependency for plugin *pluginIdentifier* (meaning it contains a dependency that imports itself).

Action:

Contact the plugin developer for troubleshooting help. This is a packaging issue.

ZWED0028E

Config invalid

Reason:

The App server attempted to validate and process the server configuration and there was an issue.

Action:

Please consult the App server schema components.app-server.node section (https://github.com/zowe/zlux-app-server/blob/v2.x/staging/schemas/app-server-config.json#L9). You may also instead have a syntax issue. For a free, offline YAML validator, check out RedHat's VSCode YAML Extension

ZWED0038E

JavaManager given port range beyond limits

Reason:

The Java manager was given a port outside the valid port range (0 < 65535).

Action:

Please check your configuration to see if any ports are out of bounds.

ZWED0039E

JavaManager not given any ports with which to run servers.

Reason:

Configuration does not contain ports for Java manager to try to run the servers.

Action:

Please check your configuration to see if any ports are missing.

ZWED0040E

Unknown java war grouping default=*grouping*

Reason:

For this war, an unknown grouping default *grouping* was encountered (types: 'microservice' or 'appserver' allowed).

Action:

Contact the plugin developer for troubleshooting.

ZWED0041E

Could not find port to use for configuration, at config position=*portIndex*.

Reason:

The server was trying to determine a network port to use for a Java dataservice, but no available ports could be found, so the server cannot load that service.

Action:

Check your Zowe configuration to see if you have enough or any ports specified for the app-server to use when assigning ports to Java dataservices.

ZWED0042E

Could not find runtime to satisfy group: *javaRuntime*

Reason:

When trying to run a group of Java dataservices under a common java runtime, the *javaRuntime* couldn't be found, so the dataservices cannot be run.

Action:

Check the configuration for this group of Java services to see if *javaRuntime* is a good value, and resolve the Java issue before restarting the server.

ZWED0043E

Unknown java app server type=*javaRuntimeTime* specified in config. Cannot continue with java loading.

Reason:

The app-server can only handle Java dataservices if they run under certain types of Java server runtimes. The type chosen was not one of the types supported, so the server cannot continue with the loading.

Action:

Check if the version of the plugin you are using is compatible with the version of Zowe you are using. Check if you can change the "type" of java server to one that the app-server does work with, such as "tomcat".

ZWED0044E

Java runtimes not specified, and no JAVA_HOME set

Reason:

The app-server cannot run the java dataservices because it doesn't know how to start any Java with the configuration specified.

Action:

Either define the environment variable JAVA_HOME to point to a valid Java runtime home, or specify a Java runtime within the app-server configuration as `components.app-server.languages.java.runtimes`. For more information, see the server schema https://github.com/zowe/zlux-app-server/blob/v2.x/master/schemas/app-server-config.json

ZWED0045E

Java app server not defined in config

Reason:

A dataservice was configured to run from a WAR file but the configuration section `components.app-server.languages.java.war.javaAppServer` was missing, so the app-server could not run the dataservice.

Action:

Define the missing configuration section according to the app-server schema https://github.com/zowe/zlux-app-server/blob/v2.x/master/schemas/app-server-config.json or remove it and the plugin that required it.

ZWED0046E

JavaManager not given either war or jar configuration options, nothing to do

Reason:

A java dataservice was requested but the `components.app-server.languages.java` configuration section of Zowe was missing either a `war` or `jar` subsection. Since one of the two is needed, the server could not continue with loading the java dataservices.

Action:

Review the app-server schema https://github.com/zowe/zlux-app-server/blob/v2.x/master/schemas/app-server-config.json and your Zowe configuration file to identify and correct the missing properties within `components.app-server`.

ZWED0047E

Proxy (*pluginid*:*servicename*) setup failed. Host & Port for proxy destination are required but were missing. For information on how to configure a proxy service, see the Zowe wiki on dataservices (https://github.com/zowe/zlux/wiki/ZLUX-Dataservices)

Reason:

A proxy was requested by the service *pluginid*:*servicename* but the service configuration or pluginDefinition did not specify what the proxy destination was, so the server is skipping the loading of that plugin.

Action:

Review the plugin's configuration or contact the developer of that plugin to correct the proxy configuration.

ZWED0049E

Can't specify error metadata

Reason:

When a dataservice called the utility function makeErrorObject, it did not supply context of the `_objectType` and `_metaDataVersion`, which are required and caused the function to throw its own error about the lack of information.

Action:

Contact the developer of the plugin which caused this error.

ZWED0050E

Root service *serviceName* not found

Reason:

A dataservice tried to call a "root", or non-plugin service of the app-server or app-server's agent, and this root service *serviceName* was not found on the server, so the request failed.

Action:

Verify that your version of Zowe works with the plugins that you have installed, and contact the developer of the plugin which tried to call this missing root service.

ZWED0051E

Could not resolve service URL. Plugin=*pluginId*, service=*serviceName*

Reason:

A dataservice *serviceName* handled by a language manager could not be used because the URL in which to access this dataservice from its language manager could not be determined.

Action:

Check the logs to see if there was trouble installing the service or plugin, and contact the developers of *pluginId* for more support.

ZWED0052E

Could not load service *pluginId*:*serviceName* due to unknown type=*serviceType*

Reason:

The service from the plugin shown could not be loaded because the plugin declared the service to be of some type that the app-server does not handle.

Action:

Check to see if the version of Zowe you are using works with the version of the plugin you are using. Plugins must have dataservices only of types seen within the pluginDefinition schema https://github.com/zowe/zlux-app-server/blob/v2.x/staging/schemas/plugindefinition-schema.json

ZWED0053E

Import *sourcePluginId*:*sourceServiceName* can't be satisfied

Reason:

A plugin trying to load a dataservice from *sourcePluginId*:*sourceServiceName* couldn't load that service, therefore the requesting plugin will fail to load.

Action:

Confirm that the source plugin and service exist. Check the logs to see if there was something that caused the source service to fail loading. Contact the developers of either source or target plugin for more assistance if the cause is not clear.

ZWED0111E

SEVERE: Exception occurred trying to generate object from input: *error*

Reason:

The server could not parse its input configuration due to the error shown, so the server cannot start.

Action:

Review the error to determine the cause, or contact support if the cause is unclear.

ZWED0112E

The server found no plugin implementing the specified default authentication type of *type*.

Reason:

The value of `components.app-server.dataserviceAuthentication.defaultAuthentication` within the server configuration specified a type of authentication that some authentication plugin must implement in order for the server to run. Because no plugin that successfully loaded declared that it implemented this type, the server found no implementation and could not continue.

Action:

Review if any plugin you have implements the given type. If the type is incorrect, revise the configuration to choose a type that does exist in your system. If the type is correct, check if you are missing a required plugin.

ZWED0113E

The server found no authentication types. Verify that the server configuration file defines server authentication.

Reason:

The server was unable to find any authentication plugins where at least one is required to run.

Action:

Review the list of plugins that are being used and see if any authentication plugins you needed have failed to load, and review their error messages.

ZWED0114E

The server found no plugin implementing the specified default authentication type of *type*.

Reason:

The value of `components.app-server.dataserviceAuthentication.defaultAuthentication` within the server configuration specified a type of authentication that some authentication plugin must implement in order for the server to run. Because no plugin that successfully loaded declared that it implemented this type, the server found no implementation and could not continue.

Action:

Review if any plugin you have implements the given type. If the type is incorrect, revise the configuration to choose a type that does exist in your system. If the type is correct, check if you are missing a required plugin.

ZWED0115E

Unable to retrieve storage object from cluster. This is probably due to a timeout. You may change the default of '*storageTimeout*' ms by setting 'node.cluster.storageTimeout' within the config.

Reason:

The app-server was running in cluster mode and a service attempted to get content from the cluster storage but this failed. Because storage could not be read, its possible the service that requested the storage will have further errors.

Action:

If there was a network disruption or performance issue, a timeout could have occurred. Review the rest of the logs to see if there are other messages to explain the failure. You can attempt to avoid timeout-related failures by editing the configuration parameter `components.app-server.node.cluster.storageTimeout`.

ZWED0145E

Cannot load SAF keyring content outside of z/OS

Reason:

The Zowe configuration of `zowe.certificate` or `components.app-server.node.https` specifies SAF keyrings as locations to find keystore and truststore data. SAF keyrings only exist on z/OS, and the server detected it was not running on z/OS so it cannot continue.

Action:

Modify the configuration to use a different keystore type, or migrate the server to z/OS.

ZWED0146E

SAF keyring data had no attribute "*attribute*". Attributes=*attributeKeys*

Reason:

Within the list of *attributeKeys*, *attribute* could not be found.

Action:

Check the keystore configuration of the server such as in `zowe.certificate` or `components.app-server.node.https` to see if it is valid for Zowe. The SAF keyring Zowe was configured to use may be missing a key and certificate pair, or certificate authorities keychain. For more suggestions on configuring keyrings for Zowe, review the install guide

ZWED0147E

SAF keyring data was not found for "*keyName*"

Reason:

The server tried to read the SAF keyring specified within the Zowe configuration, but ran into an error where the server received no data instead.

Action:

Review the logs to see if a reason for the error is shown. Verify that the Zowe configuration points to a valid keyring that the Zowe server user has permissions to read.

ZWED0148E

Exception thrown when reading SAF keyring, e=*error*

Reason:

The SAF keyring which the app-server was configured to use could not be read due to an error. The server likely will not start or will be unable to do any network activity until this error is resolved.

Action:

Review the error message to determine the cause. Often, the error messages will originate from a system service where the documentation can be found here https://www.ibm.com/docs/en/zos/2.5.0?topic=library-return-reason-codes

ZWED0149E

SAF keyring reference missing userId "*user*", keyringName "*name*", or label "*label*"

Reason:

The server configuration specified that the app-server should load keystore and truststore content from a SAF keyring, but the syntax in the configuration was incorrect, because *user*, *name*, or *label* were not usable by the server.

Action:

Check the `zowe.certificate` or `components.app-server.node.https` sections of Zowe configuration to see if there are entries that start with `safkeyring://` and verify that they are in the format of `safkeyring://USERNAME:RINGNAME&LABEL`. Older versions of zowe will require that there be 4 slashes, such as `safkeyring:////`. The `&LABEL` suffix is only needed for specifying certificate authorities and should be omitted in other sections, for example it is only needed within

`zowe.certificate.pem.certificateAuthorities` or `components.app-server.node.https.certificateAuthorities`. For more suggestions on configuring keyrings for Zowe, review the install guide

ZWED0150E

Cannot load SAF keyring due to missing keyring_js library

Reason:

The Zowe configuration specified that the app-server should load keystore and truststore information from a SAF keyring, which requires the nodejs library keyring_js. This library is defined within the package.json of zlux-server-framework and ships with Zowe installs, but could not be loaded for some reason and therefore the server could not load keyrings and will either stop or have issues with network communication.

Action:

Use the command `zwe support` to verify if the Zowe install has all files expected, as this message indicates the keyring_js library is missing and reinstalling Zowe may be required.

ZWED0151E

Env var *variableName* not found

Reason:

The server was loading plugins. It determines the location of each plugin via a plugin pointer file. The plugin referenced in the logs, it's location is dynamically determined by an environment variable *variableName*. Because the variable did not resolve to a value, the plugin could not be found and could not be loaded.

Action:

Review the documentation for the plugin that failed to load, check what the value of the variable should be, and contact support for that plugin if needed.

ZWED0152E

Unable to locate server config instance location and INSTANCE_DIR environment variable does not exist.

Reason:

While installing a plugin, the server could not determine the location of the configuration dataservice's "instance" folder. Due to this, the plugin could not be completely installed.

Action:

Correct the error before reinstalling the plugin. This error could happen due to an incorrect value for `components.app-server.instanceDir` and normally defaults to `{{ zowe.workspaceDirectory }}/app-server`.

ZWED0153E

(*operatingSystemName*) is not a supported platform for *componentName*. Skipping (*pluginid*)... Supported: *requiredOperatingSystem*

Reason:

The Zowe host operating system *operatingSystemName* is not supported by the component *componentName*. Supported platforms are defined in the component's pluginDefinition.json.

Action:

Refer to *componentName* pluginDefinition.json for supported platforms. The installation of Zowe may also be moved to a supported platform. Lastly, contact the author of the component, or a system administrator.

ZWED0154E

(*architectureName*) is not a supported architecture for *componentName*. Skipping (*pluginid*)... Supported: *requiredArchitecture*

Reason:

The Zowe host architecture is not supported by *componentName*. Supported architectures are defined in the component's pluginDefintion.json.

Action:

Refer to *componentName* pluginDefinition.json for supported architectures. The installation of Zowe may also be moved to a supported architecture. Lastly, contact the author of the component, or a system administrator.

ZWED0155E

(*url*) is not a supported endpoint for *componentName*. Skipping (*pluginid*)... Supported: *urls*

Reason:

The endpoint *url* does not match any required endpoints of *componentName*. Supported endpoints may be viewd in the component's pluginDefinition.json.

Action:

Refer to *componentName* pluginDefinition.json for supported endpoints. Optionally, remove *url* from the required endpoints in pluginDefinition.json. Lastly, contact the author of the component, or a system administrator.

ZWED0156E

Could not register default plugins into app-server.

Reason:

org.zowe.zlux.json is missing from app-server plugin directory. This error will cause the process to exit.

Action:

Verify integrity of Zowe installation, or contact system administrator. Please refer to https://docs.zowe.org/stable/appendix/zwe_server_command_reference/zwe/support/zwe-support for collecting Zowe runtime information.

ZWED0157E

Could not register default plugin *pluginid* into app-server.

Reason:

Could not register default plugin *pluginid* into app-server due to plugin upgrade failure.

Action:

Verify integrity of plugin files, or contact system administrator. Please refer to https://docs.zowe.org/stable/appendix/zwe_server_command_reference/zwe/support/zwe-support for collecting Zowe runtime information.

ZWED0158E

Could not listen on address *ipAddress*:*port*. Insufficient permissions to perform port bind.

Reason:

Server could not bind to port due to an EACCES error. User lacks privilege to perform port bind. This error will cause the process to exit.

Action:

Contact system administrator.

Version: v3.2.x LTS

ZSS Error Message Codes

The following error message codes may appear on ZSS log. Use the following message code references and the corresponding reasons and actions to help troubleshoot issues.

ZSS informational messages

ZWES1007I

webContent was not found in plugin definition for '%s'

Reason:

The `webContent` was not found in plugin definition for `<plugin-ID>`.

Action:

No action required.

ZWES1008I

libraryVersion was not found in plugin definition for '%s'

Reason:

The `libraryVersion` was not found in plugin definition for `<plugin-ID>`.

Action:

No action required.

ZWES1010I

Plugin ID and/or location was not found in '%s'

Reason:

The plugin ID and/or location was not found in `<path>`.

Action:

No action required.

ZWES1013I

ZSS Server has started. Version '%s' '%s'

Reason:

ZSS Server has started. Version is `<zowe-version>` `<addressing-mode>`.

`<addressing-mode>` is either `31-bit` or `64-bit`.

Action:

No action required.

ZWES1014I

ZIS status - '%s' (name='%.16s', cmsRC='%d', description='%s', clientVersion='%d')

Reason:

The message shows status of the connection to Privileged Server: ZIS status - `<OK or Failure>` (name=`<Privileged Server Name>`, cmsRC=`<RC>`, description=`<description>`, clientVersion=`<version>`)

Action:

if Status is `OK` then no action required. If Status is `Failure` check the `<description>` of reported `<RC>`. In the cases listed below check that the ZWESISTC started task is running. If not, start it with the TSO command `/S ZWESISTC`:

- cmsRC=`12`, description=`'Global area address is NULL'`
- cmsRC=`30`, description=`'Server is not running'`
- cmsRC=`39`, description=`'Cross-memory server abended'`
- cmsRC=`47`, description=`'ZVT is NULL'`
- cmsRC=`64`, description=`'PC is unavailable'`

ZWES1035I

ZSS Server settings: Address='%s', port='%d', protocol='%s'

Reason:

Server is starting using Address=`<IP address>`, port=`<port>`, protocol=`http` or `https`

Action:

No action required.

ZWES1038I

Server timeouts file '%s' either not found or invalid JSON. ZSS sessions will use the default length of one hour.

Reason:

The server timeouts file `<path>` either was not found or is invalid JSON. ZSS sessions uses the default length of one hour.

Action:

No action required.

ZWES1039I

Installing '%s' service...

Reason:

`<Service>` is about to install.

Action:

No action required.

ZWES1061I

TLS settings: keyring '%s', label '%s', password '%s', stash '%s'

Reason:

ZSS uses TLS settings: keyring `<keyring>` or `<p12-file>`, label `<cert-label>`, password `"*****"` or `(no password)`, stash `<stash-file>` or `(no stash)`.

Action:

No action required.

ZWES1063I

Caching Service settings: gateway host '%s', port %d

Reason:

Caching Service settings are gateway host `<Gateway-host>`, port `<Gateway-port>`. HA mode is enabled.

Action:

No action required.

ZWES1064I

Caching Service not configured

Reason:

Caching Service not configured. HA mode is disabled.

Action:

No action required.

ZWES1100I

Product Registration is enabled.

Reason:

Product Registration is enabled.

Action:

No action required.

ZWES1101I

Product Registration is disabled.

Reason:

Product Registration is disabled.

Action:

No action required.

ZWES1102I

Product Registration successful.

Reason:

Product Registration successful.

Action:

No action required.

ZWES1600I

JWT will be configured using JWK URL '%s'

Reason:

JWT will be configured using JSON Web Key(JWK) at URL `<url>`.

Action:

No action required.

ZWES1601I

Server is ready to accept JWT `with`(or `without`) fallback to legacy tokens

Reason:

Server is ready to accept JWT `with` or `without` fallback to legacy tokens.

Action:

No action required.

ZSS error messages

ZWES1001E

Log level '%d' is incorrect.

Reason:

The logging level `<log-level>` is incorrect.

Action:

Verify the `<log-level>` is in range `0..5`.

ZWES1002E

Error in timeouts file: Could not parse config file as a JSON object.

Reason:

There is an error in timeouts file: could not parse config file as a JSON object.

Action:

Verify the timeouts file is a valid JSON.

ZWES1006E

Error while parsing plugin definition file '%s': '%s'.

Reason:

An error occurred while parsing `<plugin-definition-file>`: `<error-details>`.

Action:

If you are a plugin developer check `<error-details>` and fix the error by editing `<plugin-definition-file>`, otherwise, report the error to the plugin vendor.

ZWES1011E

Error while parsing: '%s'

Reason:

There is an error while parsing: `<json-statement>`.

Action:

Review the `<json-statement>` and correct it.

ZWES1016E

Cannot validate file permission, path is not defined.

Reason:

Cannot validate the file permission, path is not defined.

ZWES1017E

Could not get file info on config path='%s': Ret='%d', res='%d'

Reason:

Could not get the file information on config path=`<path>`: Ret=`<return-code>`, res=`<reason-code>`

Action:

Contact support.

ZWES1020E

Skipping validation of file permissions: Disabled during compilation, using file '%s'.

Reason:

Skipping validation of file permissions: disabled during compilation, using the file `<file>`.

Action:

Contact support.

ZWES1021E

Cannot validate file permissions: Path is not defined.

Reason:

Cannot validate the file permissions: path is not defined.

ZWES1022E

Cannot validate file permissions: Path is for a directory and not a file.

Reason:

Cannot validate the file permissions. Given path is a directory path only without a file.

ZWES1034E

Server startup problem: Address '%s' not valid.

Reason:

IP address nor hostname is not valid.

Action:

Use valid IP address or hostname, e.g. `0.0.0.0`.

ZWES1036E

Server startup problem: Ret='%d', res='0x%x'

Reason:

Server has failed to start.

Action:

If the next message is `ZWES1037E` then refer ZWES1037E. Otherwise, examine the reason code with `bpxmtext` command, e.g. use `bpxmtext 744c7247` if you got `res='0x744c7247'`

ZWES1037E

This is usually because the server port '%d' is occupied. Is ZSS running twice?

Reason:

ZSS port number is already occupied.

Action:

Check if another ZSS instance is already running, or chose another free port number and restart Zowe.

ZWES1065E

Failed to configure https server, check agent https settings

Reason:

Failed to configure https server.

Action:

Check agent https settings.

ZWES1500E

Failed to generate PassTicket - userId='%s', applId='%s', %s

Reason:

Failed to generate the PassTicket for userId=`<user-id>`, applId=`<application-name>`, `<error-text>`.

Action:

Review your security product to determine that it meets all passTickets requirements.

ZSS warning messages

ZWES1000W

Privileged server name not provided, falling back to default.

Reason:

Privileged server name not defined in configuration file.

Action:

If your privileged server name is `ZWESIS_STD` then no action required. Otherwise set `components.zss.crossMemoryServerName` property in configuration to the correct name.

ZWES1004W

Expected plugin ID '%s', instead received '%s'

Reason:

Expected plugin ID is `<plugin-ID>`, but it was received `<wrong-plugin-ID>`.

Action:

Verify the plugin JSON definition.

ZWES1005W

Plugin ID was not found in '%s'

Reason:

`pluginId` property wasn't found in `<path-to-pluginDefinition.json>` file. The plugin skipped.

Action:

If you are a plugin developer add the `pluginId` property to the `<path-to-pluginDefinition.json>` file. Otherwise, contact the plugin vendor.

ZWES1009W

Plugin ID '%s' is NULL and cannot be loaded.

Reason:

The plugin with `<plugin-ID>` was not succesfully created and cannot be loaded.

Action:

Verify the plugin JSON definition.

ZWES1012W

Could not open pluginsDir '%s': Ret='%d', res='0x%x'

Reason:

Could not open `<pluginsDir>`: Ret=`<return-code>`, res=`<reason-code>`

Action:

Check that `<pluginsDir>` exists and allows reading. Examine the reason code with `bpxmtext` command for additional information.

ZWES1060W

Failed to init TLS environment, rc=%d(%s)

Reason:

Failed to initialized TLS environment GSKit return code `<rc>`(`<description>`)

Action:

Ensure that the ZSS certificate is configured correctly. Check GSKit return code and description for additional information.

ZWES1103W

Product Registration failed, RC = %d

Reason:

Failed to register ZSS.

Action:

Examine the return code at [https://www.ibm.com/docs/en/zos/2.2.0?topic=requeststatus-return-codes] and correct the error.

ZWES1200W

Could not %s file '%s': Ret='%d', res='%d'

Reason:

Could not `<action>` file `<file>`, return code is `<return-code>`, resason code is `<reason-code>`.

`<action>` specifies for which file operation a problem was detected.

Action:

No action required.

ZWES1201W

Could not %s file '%s': Ret='%d', res='%d'

Reason:

Unixfile REST Service could not `<action>` file `<filename>`: Ret=`<return-code>`, res=`<reason-code>`

Action:

Action depends on return/reason code. For additional information examine the reason code with the `bpxmtext` command.

ZWES1202W

Transfer type has not been set.

Reason:

The transfer type was not set.

Action:

No action required.

ZWES1103W

Could not get metadata for file '%s': Ret='%d', res='%d'

Reason:

Unixfile REST Service could not get metadata for file `<filename>`: Ret=`<return-code>`, res=`<reason-code>`

Action:

Action depends on return/reason code. For additional information examine the reason code with `bpxmtext` command.

ZWES1200W

Could not %s file '%s': Ret='%d', res='%d'

Reason:

Could not `<action>` file `<file>`, return code is `<return-code>`, resason code is `<reason-code>`.

`<action>` specifies for which file operation a problem was detected.

Action:

No action required.

ZWES1202W

Transfer type has not been set.

Reason:

The transfer type was not set.

Action:

No action required.

ZWES1400W

Non standard class provided for '%s' '%s', ending request...

Reason:

Non standard class was provided for `<HTTP-setting>` `<HTTP-method>`, the request was ended.

ZWES1401W

Profile not provided for profiles GET, ending request...

Reason:

The profile not provided for profiles GET, the request was ended.

ZWES1402W

Profile name required for '%s' '%s'

Reason:

The profile name is required for `<HTTP-setting>` `<HTTP-method>`

ZWES1403W

User ID required for user POST/PUT

Reason:

The user ID is required for user POST or PUT.

ZWES1404W

Body not provided for user POST/PUT, ending request...

Reason:

The body was not provided for user POST or PUT, the request was ended.

ZWES1406W

Unknown access type '%d' provided for user POST/PUT, ending request...

Reason:

Unknown access type `<access-type>` provided for user POST or PUT, the request was ended.

ZWES1407W

Access list can only be retrieved in bulk, ending request...

Reason:

The access list can only be retrieved in bulk, the request was ended.

ZWES1408W

Access list buffer with size '%u' not allocated, ending request...

Reason:

The access list buffer with size `<size>` was not allocated, the request was ended.

ZWES1409W

Access list size out of range '%u', ending request...

Reason:

The size of access list is out of range `<number>`, the request was ended.

ZWES1410W

Access list entry name required for access list DELETE

Reason:

The access list entry name is required for access list `DELETE`.

ZWES1411W

Class-mgmt query string is invalid, ending request...

Reason:

`Class-mgmt`` query string is invalid, the request was ended.

ZWES1412W

Group name required for '%s' '%s'

Reason:

The group name required for `<HTTP-setting>` `<HTTP-method>`.

ZWES1413W

Body not provided for group POST, ending request...

Reason:

The body was not provided for group `POST`, the request was ended.

ZWES1414W

Superior not provided for group POST, ending request...

Reason:

Superior not provided for group `POST`, the request was ended.

ZWES1415W

Bad superior group provided for group POST, ending request...

Reason:

Bad superior group was provided for group `POST`, the request was ended.

ZWES1416W

Access type not provided for user POST/PUT, ending request...

Reason:

The access type was not provided for user `POST` or `PUT`, the request was ended.

ZWES1417W

Unknown access type, use [USE, CREATE, CONNECT, JOIN]

Reason:

Unknown access type, use `USE`, `CREATE`, `CONNECT` or `JOIN`.

ZWES1418W

Access list will be re-allocated with capacity '%u'

Reason:

The access list will be re-allocated with capacity `<size>`.

Action:

No action required.

ZWES1419W

Group-mgmt query string is invalid, ending request...

Reason:

`<Group-mgmt>` query string is invalid and the requested was ended.

ZWES1602W

JWK is in unrecognized format

Reason:

JSON Web Key(JWK) is in unrecognized format.

Action:

Report an issue at [https://github.com/zowe/zlux/issues]

ZWES1603W

Failed to construct public key using JWK

Reason:

JSON Web Key(JWK) has invalid public key info.

Action:

Report an issue at [https://github.com/zowe/zlux/issues]

ZWES1604W

JWK: failed to init HTTP context, ensure that APIML and TLS settings are correct

Reason:

Failed to init HTTP context for requesting JSON Web Key(JWK).

Action:

Check the zowe keystore configuration and specification of it within the zowe server config.

ZWES1605W

Server will not accept JWT

Reason:

ZSS Server will not accept JWT.

Action:

No action required.

ZWES1606W

Failed to get JWK - %s, retry in %d seconds

Reason:

Failed to get JWK - `<reason>`, retry in `<n>` seconds. ZSS Server was unable to get JSON Web Key(JWK), it will try to repeat the attempt in `<n>` seconds.

Action:

- This message is repeated each `<n>` seconds. After a succesfull attempt, the message `ZWES1601I` is displayed and no action is required.
- If message `ZWES1601I` does not appear, but rather the message `ZWES1606W Failed to get JWK. rc=failed to init HTTP request (9), rsn=TLS error (17). Retry in 10 seconds`, consider the following:
  - TLSv1.3 recommends encryption `ChaCha20-Poly1305`. However, this encryption may be restricted by the `ICSF FIPS 140-2` policy. When ZSS requests `ChaCha20-Poly1305`, such request will fail.
  - Modify the `zowe.yaml` to use TLSv1.2 to avoid the problem with `ChaCha20-Poly1305`:

ZWES0054E

ZIS AUX Server started in wrong key 8

Reasons:

authPluginLib was missing in the `ZWESASTC` JCL and the `ZWESISTC` JCL.

Action:

When the Zowe STC userid has read access to the profile SAF `OMVSAPPL`, the `ZWESASTC` task will be able to successfully be started on an as-needed basis from `ZWESISTC`.

Version: v3.2.x LTS

ZIS Error Message Codes

The following codes can appear in either the ZIS SYSPRINT or JESMSGLG log, or both. Use the following message code references and the corresponding reasons and actions to help troubleshoot issues.

ZIS cross-memory server messages

ZWES0001I

ZSS Cross-Memory Server starting, version is *major.minor.patch+datestamp*

Reason:

The cross-memory server with the specified version is starting.

Action:

No action required.

ZWES0002I

Input parameters at *address*:

hex_dump

Reason:

The message shows a hex dump of the parameters passed in the started task JCL.

Action:

No action required.

ZWES0003I

Server name not provided, default value '*name*' will be used

Reason:

The user did not provide a server name.

Action:

The cross-memory server uses the indicated default value *name*. If needed, specify a server name either via the `NAME` parameter in the JCL or via the `ZWES.NAME` parameter in the PARMLIB member; the JCL parameter takes precedence.

ZWES0004I

Server name is '*name*'

Reason:

The message indicates this server's name.

Action:

No action required.

ZWES0005E

ZSS Cross-Memory server not created, RSN = *reason_code*

Reason:

The cross-memory server failed to create the cross-memory server's data structure.

Action:

The cross-memory server terminates. Contact support.

ZWES0006E

ZSS Cross-Memory server resource not allocated (*resource_name*)

Reason:

The cross-memory server failed to allocate storage for a resource.

Action:

The cross-memory server terminates. Contact support.

ZWES0007E

ZSS Cross-Memory server PARMLIB member suffix is incorrect - '*suffix*'

Reason:

The cross-memory's PARMLIB member suffix is invalid.

Action:

The cross-memory server terminates. Ensure that the suffix consists of two characters that are allowed in a member name.

ZWES0008E

ZSS Cross-Memory server configuration not read, member = '*member_name*', RC = *return_code_1* (*return_code_2*, *reason_code_2*)

Reason:

The cross-memory server failed to read the specified PARMLIB member.

Action:

The cross-memory server terminates. Review the error codes and contact support if you cannot resolve the issue.

Possible return codes and the corresponding actions:

return_code_1	*return_code_2*	*reason_code_2*	Action
RC_ZISPARM_MEMBER_NOT_FOUND(2)	N/A	N/A	Ensure the member exists
RC_ZISPARM_DDNAME_TOO_LONG(8)	N/A	N/A	Contact support
RC_ZISPARM_MEMBER_NAME_TOO_LONG(9)	N/A	N/A	Contact support
RC_ZISPARM_PARMLIB_ALLOC_FAILED(10)	Return code from `IEFPRMLB REQUEST=ALLOCATE`	Reason code from `IEFPRMLB REQUEST=ALLOCATE`	Review the IEFPMLB return and reason codes
RC_ZISPARM_READ_BUFFER_ALLOC_FAILED(11)	N/A	N/A	Contact support
RC_ZISPARM_PARMLIB_READ_FAILED(12)	Return code from `IEFPRMLB REQUEST=READMEMBER`	Reason code from `IEFPRMLB REQUEST=READMEMBER`	Review the IEFPMLB return and reason codes
RC_ZISPARM_PARMLIB_FREE_FAILED(13)	Return code from `IEFPRMLB REQUEST=FREE`	Reason code from `IEFPRMLB REQUEST=FREE`	Review the IEFPMLB return and reason codes
RC_ZISPARM_SLH_ALLOC_FAILED(16)	Start line number	End line number	Contact support
RC_ZISPARM_CONTINUATION_TOO_LONG(19)	Start line number	End line number	Review the lines and fix continuation

ZWES0009E

ZSS Cross-Memory server configuration not found, member = '*member_name*', RC = *return_code*

Reason:

The cross-memory server could not find the specified PARMLIB member.

Action:

The cross-memory server terminates. Ensure that the name is correct and the member is available.

ZWES0010E

ZSS Cross-Memory server configuration not loaded, RC = *return_code*, RSN = *reason_code*

Reason:

The cross-memory server failed to load the configuration.

Action:

The cross-memory server terminates. Contact support.

ZWES0011E

ZSS Cross-Memory server not started, RC = *return_code*

Reason:

The cross-memory server could not start.

Action:

The cross-memory server terminates. Review the messages preceding this message. If you cannot resolve the issue, contact support.

ZWES0012I

ZSS Cross-Memory Server terminated

Reason:

The cross-memory server fully terminated.

Action:

No action required.

ZWES0013E

ZSS Cross-Memory Server terminated due to an error, status = *status_code*

Reason:

The cross-memory server terminated due to an error.

Action:

The cross-memory server terminates. Review the messages preceding this message. If you cannot resolve the issue, contact support.

ZWES0014E

Fatal config error - *details*, RC = *return_code*

Reason:

A fatal error occurred during processing of the configuration.

Action:

The cross-memory server terminates. Review the messages preceding this message. If you cannot resolve the issue, contact support.

ZWES0015E

LPA *lpa_action* failed for module *module_name*, RC = *csvdylpa_return_code*, RSN = *csvdylpa_reason_code*

Reason:

The cross-memory server failed to perform the specified link pack area (LPA) action for a plug-in module.

Action:

The cross-memory server terminates. Review the provided CSVDYLPA return and reason codes (see "z/OS MVS Programming: Authorized Assembler Services Reference ALE-DYN") and contact support if you cannot resolve the issue.

ZWES0016I

Service '*plug-in_name*':'*service_name*' *version* has been added

Reason:

The cross-memory server successfully added the specified service.

Action:

No action required.

ZWES0017W

Plug-in '*plug-in_name*' failure - *details*

Reason:

One of the callbacks of a plug-in failed.

Action:

Depending on the stage, some of the plug-in functionality might be impacted. Contact support if you cannot resolve the issue.

ZWES0018W

Plug-in '*plug-in_name*' version *plug-in_version* doesn't match anchor version *anchor_version*, LPA module discarded

Reason:

The cross-memory server detected that a plug-in module was outdated; this usually happens when a plug-in gets updated.

Action:

The cross-memory server discards the old module and loads the latest version to the link pack area (LPA).

ZWES0019W

Parameter '*parameter_name*' has an invalid value

Reason:

The cross-memory server detected an invalid parameter.

Action:

The cross-memory server uses the default parameter. Fix the reported parameter and restart the cross-memory server.

ZWES0020E

ZSS Cross-Memory server PARMLIB member name not determined, RC = *return_code*

Reason:

The cross-memory server could not determine which PARMLIB member to use.

Action:

The cross-memory server terminates. Contact support.

ZWES0021E

ZSS Cross-Memory server module member name not determined, RC = *csvquery_return_code*

Reason:

The cross-memory server could not determine its module name.

Action:

The cross-memory server terminates. Review the provided CSVQUERY return code (see "z/OS MVS Programming: Assembler Services Reference ABE-HSP") and contact support if you cannot resolve the issue.

ZWES0098I

debug_message

Reason:

This is a debug message.

Action:

No action required.

ZWES0099I

hex_dump

Reason:

This is a debug hex dump.

Action:

No action required.

ZIS Auxiliary Server messages

ZWES0050I

ZIS AUX Server starting, version is *major.minor.patch+datestamp*

Reason:

The cross-memory auxiliary server with the specified version is starting.

Action:

No action required.

ZWES0051I

ZIS AUX Server terminated

Reason:

The cross-memory auxiliary server fully terminated.

Action:

No action required.

ZWES0052I

Input parameters at *address*:

Reason:

The message shows a dump of the parameters passed to this address space.

Action:

No action required.

ZWES0053E

Not APF-authorized (*testauth_status*)

Reason:

One or more data sets in the STEPLIB concatenation is not APF-authorized.

Action:

The cross-memory auxiliary server terminates. Ensure that all the STEPLIB data sets are APF-authorized.

ZWES0054E

ZIS AUX Server started in wrong key *key*

Reason:

The cross-memory auxiliary server detected that it was running in the wrong key.

Action:

The cross-memory auxiliary server terminates. Ensure that you have added the correct PPT-entry (see the documentation) for the ZIS AUX module.

ZWES0055E

ZIS AUX Server resource not allocated (*resource_name*)

Reason:

The cross-memory auxiliary server failed to allocate storage for a resource.

Action:

Depending on the location of the failure some functionality might be affected. Contact support.

ZWES0056E

RESMGR failed, RC = *return_code*, service RC = *resmgr_return_code*

Reason:

The cross-memory auxiliary server failed to install the task resource manager.

Action:

The cross-memory auxiliary server terminates. Review the RESMGR ADD service return code value in *resmgr_return_code* (see "z/OS MVS Programming: Authorized Assembler Services Reference LLA-SDU"). If you cannot

resolve the issue, contact support.

ZWES0057E

PC not established, RC = *return_code*, RSN = *reason_code*

Reason:

The cross-memory auxiliary server failed to set up the communication Program Call (PC) routine.

Action:

The cross-memory auxiliary server terminates. Contact support.

ZWES0058E

Communication area failure - *details*

Reason:

The cross-memory auxiliary server could not establish the communication area.

Action:

The cross-memory auxiliary server terminates. Review the details. If you cannot resolve the issue, contact support.

ZWES0059E

Address space extract RC = *return_code*, RSN = *reason_code*

Reason:

The cross-memory auxiliary server could not extract its address space parameters.

Action:

Contact support.

ZWES0060E

Fatal config error - *details*, RC = *return_code*

Reason:

A fatal error occurred when processing the configuration.

Action:

The cross-memory auxiliary server terminates. Review the details. If you cannot resolve the issue, contact support.

ZWES0061E

ZIS AUX Server configuration not read, member = '*member_name*', RC = *return_code_1* (*return_code_2*, *reason_code_2*)

Reason:

The cross-memory auxiliary server failed to read the specified PARMLIB member.

Action:

The cross-memory auxiliary server terminates. Review the error codes and contact support if you cannot resolve the issue.

Possible return codes and the corresponding actions:

return_code_1	***return_code_2***	***reason_code_2***	**Action**
RC_ZISPARM_MEMBER_NOT_FOUND(2)	N/A	N/A	Ensure the member exists
RC_ZISPARM_DDNAME_TOO_LONG(8)	N/A	N/A	Contact support
RC_ZISPARM_MEMBER_NAME_TOO_LONG(9)	N/A	N/A	Contact support
RC_ZISPARM_PARMLIB_ALLOC_FAILED(10)	Return code from `IEFPRMLB REQUEST=ALLOCATE`	Reason code from `IEFPRMLB REQUEST=ALLOCATE`	Review the IEFPMLB return and reason codes
RC_ZISPARM_READ_BUFFER_ALLOC_FAILED(11)	N/A	N/A	Contact support
RC_ZISPARM_PARMLIB_READ_FAILED(12)	Return code from `IEFPRMLB REQUEST=READMEMBER`	Reason code from `IEFPRMLB REQUEST=READMEMBER`	Review the IEFPMLB return and reason codes
RC_ZISPARM_PARMLIB_FREE_FAILED(13)	Return code from `IEFPRMLB REQUEST=FREE`	Reason code from `IEFPRMLB REQUEST=FREE`	Review the IEFPMLB return and reason codes
RC_ZISPARM_SLH_ALLOC_FAILED(16)	Start line number	End line number	Contact support
RC_ZISPARM_CONTINUATION_TOO_LONG(19)	Start line number	End line number	Review the lines and fix continuation

ZWES0062E

ZIS AUX Server configuration not found, member = '*member_name*', RC = *return_code*

Reason:

The cross-memory auxiliary server could not find the specified PARMLIB member.

Action:

The cross-memory auxiliary server terminates. Ensure that the name is correct and the member is available.

ZWES0063E

User module failure - *details*

Reason:

One of the callbacks of the user module failed.

Action:

Depending on the stage, some of the user module functionality might be impacted. Contact support if you cannot resolve the issue.

ZWES0064W

Unsafe function *function_name* failed, ABEND *abend_code-reason_code* (recovery RC = *recovery_return_code*)

Reason:

An abend occurred in one of the callbacks of the user module.

Action:

Depending on the stage, some of the user module functionality might be impacted. Contact support if you cannot resolve the issue.

ZWES0065W

Caller not released, RC = *return_code*

Reason:

A synchronization error occurred when communicating with the parent address space of this auxiliary address space.

Action:

Communication between the parent and auxiliary address spaces might be impacted. Contact support.

ZWES0066E

AUX host server ABEND *abend_code-reason_code* (recovery RC = *recovery_return_code*)

Reason:

An abend occurred in one of the components of the cross-memory auxiliary server.

Action:

The cross-memory auxiliary server terminates. Contact support.

ZWES0067E

Main loop unexpectedly terminated

Reason:

The cross-memory auxiliary server detected an incorrect state in the main loop.

Action:

The cross-memory auxiliary server terminates. Contact support.

ZWES0068W

Command too long (*length*)

Reason:

The provided modify command is too long.

Action:

The cross-memory auxiliary server ignores the command.

ZWES0069W

Command not tokenized

Reason:

The cross-memory auxiliary server failed to tokenize the provided modify command.

Action:

The cross-memory auxiliary server ignores the command. Review the messages preceding this message and contact support if you cannot resolve the issue.

ZWES0070I

Modify command '*command*' received

Reason:

The cross-memory auxiliary server received a modify command.

Action:

The cross-memory auxiliary server proceeds to handle the command.

ZWES0071I

Termination command received

Reason:

An operator issued the termination command and the cross-memory auxiliary server successfully received it.

Action:

The cross-memory auxiliary server starts the termination sequence.

ZWES0072I

Modify command '*command*' accepted

Reason:

The cross-memory auxiliary server accepted a modify command.

Action:

No action required.

ZWES0073I

Modify command '*command*' not recognized

Reason:

The cross-memory sever did not recognize a modify command.

Action:

The cross-memory auxiliary server ignores the command.

ZWES0074W

Modify command '*command*' rejected

Reason:

The cross-memory auxiliary server rejected the provided modify command because it was either incorrect or the server was not ready to process it.

Action:

The cross-memory auxiliary server ignores the command.

ZWES0075W

'*command*' expects *expected_arg_number* args, *provided_arg_number* provided, command ignored

Reason:

The modify command *command* was used with an incorrect number of arguments.

Action:

The cross-memory auxiliary server ignores the command.

ZWES0076W

Log component '*component*' not recognized, command ignored

Reason:

An operator passed an invalid log component in the LOG modify command.

Action:

The cross-memory auxiliary server ignores the command.

ZWES0077W

Log level '*level*' not recognized, command ignored

Reason:

An operator passed an invalid log level in the LOG modify command.

Action:

The cross-memory auxiliary server ignores the command.

ZWES0078I

response_text

Reason:

This message contains the response of a DISPLAY modify command.

Action:

No action required.

ZWES0079I

Response message - '*response_text*'

Reason:

This message contains the response of a modify command.

Action:

No action required.

ZWES0080I

Termination signal received (*signal*)

Reason:

The parent address space issued a termination signal and the cross-memory auxiliary server successfully received it.

Action:

The cross-memory auxiliary server starts the termination sequence.

ZWES0081E

Bad dub status *bpx4qdb_status* (*bpx4qdb_return_code*,*bpx4qdb_reason_code*), verify that the started task user has an OMVS segment

Reason:

The cross-memory auxiliary server detected an invalid dub status.

Action:

The cross-memory auxiliary server terminates. Ensure that the user under which the cross-memory auxiliary server's started task runs has an OMVS segment.

ZWES0082W

Legacy API has been detected, some functionality may be limited

Reason:

The cross-memory auxiliary server detected a legacy communication area.

Action:

Some functionality might not be available. Update the parent address space to use a more modern AUX API version.

Core cross-memory server messages

ZWES0100I

debug_message

Reason:

This is a debug message.

Action:

No action required.

ZWES0101I

hex_dump

Reason:

This is a debug hex dump.

Action:

No action required.

ZWES0102E

Initialization step '*step_name*' failed, RC = *return_code*

Reason:

A cross-memory server's initialization step failed. The initialization process stops.

Action:

The cross-memory server terminates. Review the messages preceding this message. If you cannot resolve the issue, contact support.

ZWES0103I

Initialization step '*step_name*' successfully completed

Reason:

A cross-memory server's initialization step completed successfully.

Action:

No action required.

ZWES0104I

About to start console task

Reason:

The cross-memory server is starting the console listener task which handles operator commands.

Action:

No action required.

ZWES0105I

Core server initialization started

Reason:

The cross-memory server is starting initialization.

Action:

No action required.

ZWES0106E

Core server initialization failed, RC = *return_code*

Reason:

The initialization process failed.

Action:

The cross-memory server terminates. Review the messages preceding this message. If you cannot resolve the issue, contact support.

ZWES0107I

Cold start initiated

Reason:

An operator started the server with the cold start option.

Action:

The cross-memory server discards its global resources and performs a clean start.

ZWES0108W

Global resources clean up RC = *return_code*

Reason:

The global resource clean-up process failed.

Action:

The cross-memory server continues running. Review *return_code* and contact support if needed.

Possible return codes:

return_code	Action
RC_CMS_GLOBAL_AREA_NULL(12)	Ignore if you have not run this ZIS after IPL
RC_CMS_ZVT_NULL(47)	Ignore if you have not run any ZIS after IPL
RC_CMS_ZVTE_CHAIN_LOOP(66)	Contact support
RC_CMS_ZVTE_CHAIN_NOT_LOCKED(67)	Contact support
RC_CMS_ZVTE_CHAIN_NOT_RELEASED(68)	Contact support

ZWES0109I

Core server ready

Reason:

The cross-memory server initialized and it is ready to accept program calls.

Action:

No action required.

ZWES0110E

Main loop unexpectedly terminated

Reason:

The cross-memory server detected an incorrect state in the main loop.

Action:

The cross-memory server terminates. Contact support.

ZWES0111I

Main loop terminated

Reason:

The main loop of this cross-memory server successfully terminated upon shutdown.

Action:

No action required.

ZWES0112E

Termination step '*step_name*' failed, RC = *return_code*

Reason:

A cross-memory server's termination step failed.

Action:

The termination process continues. Review the messages preceding this message. If you cannot resolve the issue, contact support.

ZWES0113I

Termination step '*step_name*' successfully completed

Reason:

A cross-memory server's termination step completed successfully.

Action:

No action required.

ZWES0114I

Core server stopped

Reason:

The cross-memory server successfully stopped.

Action:

No action required.

ZWES0115E

Core server stopped with an error, status = *status_code*

Reason:

The cross-memory server stopped with a non-zero status.

Action:

Review the messages preceding this message. Contact support if you cannot resolve the issue.

ZWES0116E

Core server is abnormally terminating

Reason:

An abend occurred in this cross-memory server.

Action:

Review any messages and errors preceding this message and contact support if you cannot resolve the issue.

ZWES0117E

Not APF-authorized (*testauth_status*)

Reason:

One or more data sets in the STEPLIB concatenation is not APF-authorized.

Action:

The cross-memory server terminates. Ensure that all the STEPLIB data sets are APF-authorized.

ZWES0118E

Core server started in wrong key *key*

Reason:

The cross-memory server detected that it was running in the wrong key.

Action:

The cross-memory server terminates. Ensure that you have added the correct PPT-entry (see the documentation) for the main ZIS module.

ZWES0200I

modify_commands

Reason:

This message lists the modify commands supported by this cross-memory server (not including the plug-ins).

Action:

No action required.

ZWES0201E

Service ID *service_id* is out of range

Reason:

The cross-memory server detected an invalid service ID.

Action:

The cross-memory server terminates. Contact support.

ZWES0202E

A duplicate server is running

Reason:

A cross-memory server with the same server name is already running.

Action:

The cross-memory server terminates. Specify a different server name in the cross-memory server's JCL or the PARMLIB member.

ZWES0203E

Server not locked, ISGENQ RC = *return_code*, RSN = *reason_code*

Reason:

An internal synchronization error occurred.

Action:

The cross-memory server terminates. Contact support.

ZWES0204E

Global area address in NULL

Reason:

The global anchor of this cross-memory server is zero.

Action:

The cross-memory server terminates. Contact support.

ZWES0205E

Relocation failed for *service_id* (*function_address* not in [*module_start_address*, *module_end_address*])

Reason:

An error occurred during the relocation of one of the services in the server module.

Action:

The cross-memory server terminates. Contact support.

ZWES0206E

parameter_name (*parameter_address*) has invalid eyecatcher

Reason:

The print or dump service received a request with an invalid eyecatcher.

Action:

The service ignores the request. Correct the parameter list if your application initiated the request, otherwise contact support.

ZWES0207E

resource_name (*resource_size*) not allocated

Reason:

The cross-memory server failed to allocate storage for a resource.

Action:

Depending on the location of the failure some functionality might be affected. Contact support.

ZWES0208E

Module not loaded into LPA, RC = *csvdylpa_return_code*, RSN = *csvdylpa_reason_code*

Reason:

The cross-memory server failed to add its main module to the link pack area (LPA).

Action:

The cross-memory server terminates. Review the provided CSVDYLPA return and reason codes (see "z/OS MVS Programming: Authorized Assembler Services Reference ALE-DYN") and contact support if you cannot resolve the issue.

ZWES0209E

Module not deleted from LPA, RC = *csvdylpa_return_code*, RSN = *csvdylpa_reason_code*

Reason:

The cross-memory server failed to delete its main module from the link pack area (LPA).

Action:

The cross-memory server terminates with a non-zero status. Review the provided CSVDYLPA return and reason codes (see "z/OS MVS Programming: Authorized Assembler Services Reference ALE-DYN") and contact support if you cannot resolve the issue.

ZWES0210W

No valid LPMEA in global area

Reason:

The cross-memory server detected an invalid LPMEA area for its main module.

Action:

The cross-memory server continues running. If the error occurred in the development mode ignore it, otherwise contact support.

ZWES0211E

Name/Token delete failed, RC = *ieantdl_return_code*

Reason:

The cross-memory server failed to delete the cross-memory server's global area's name/token.

Action:

The cross-memory server terminates with a non-zero status. Review the provided IEANTDL return code (see "z/OS MVS Programming: Assembler Services Reference IAR-XCT") and contact support if you cannot resolve the issue.

ZWES0212E

RACROUTE LIST failed (*saf_return_code*, *racf_return_code*, *racf_reason_code*)

Reason:

The cross-memory server failed to perform RACROUTE LIST on the FACILITY class.

Action:

The cross-memory server terminates. The message contains the SAF return code, RACF return and reason codes (see "z/OS Security Server RACROUTE Macro Reference"); review the codes. If you cannot resolve the issue, contact support.

ZWES0213E

ZVT not populated, RC = *return_code*

Reason:

The cross-memory server failed to populate the Zowe vector table.

Action:

The cross-memory server terminates. Contact support.

ZWES0214E

Global area not set, RC = *return_code*

Reason:

The cross-memory server could not set the cross-memory server's global area.

Action:

The cross-memory server terminates. Contact support.

ZWES0215E

Global area not retrieved, RC = *return_code*

Reason:

The cross-memory server could not retrieve the cross-memory server's global area.

Action:

The cross-memory server terminates. Contact support.

ZWES0216E

PC-*type* not set, step = *step_name* (*return_code reason_code*)

Reason:

The cross-memory server failed to set up a Program Call (PC) routine.

Action:

Contact support.

ZWES0217E

Too many tokens in command

Reason:

The provided modify command has too many tokens.

Action:

The cross-memory server ignores the command.

ZWES0218E

Command too long (*command_length*)

Reason:

The provided modify command is too long.

Action:

The cross-memory server ignores the command.

ZWES0219E

Command not tokenized

Reason:

The cross-memory server failed to tokenize the provided modify command.

Action:

The cross-memory server ignores the command. Review the messages preceding this message and contact support if you cannot resolve the issue.

ZWES0220I

Modify *command_verb* command received

Reason:

The cross-memory server received a modify command with verb *command_verb*.

Action:

The cross-memory server proceeds to handle the command.

ZWES0221I

Modify *command_verb* command accepted

Reason:

The cross-memory server accepted a modify command with verb *command_verb*.

Action:

No action required.

ZWES0222I

response_text

Reason:

This message contains the response of a successful modify command.

Action:

No action required.

ZWES0223I

Termination command received

Reason:

An operator issued the termination command and the cross-memory server successfully received it.

Action:

The cross-memory server starts the termination sequence.

ZWES0224W

command_verb expects *expected_arg_number* args, *provided_arg_number* provided, command ignored

Reason:

A modify command with verb *command_verb* was used with an incorrect number of arguments.

Action:

The cross-memory server ignores the command.

ZWES0225W

Log component '*component_name*' not recognized, command ignored

Reason:

An operator passed an invalid log component in the LOG modify command.

Action:

The cross-memory server ignores the command.

ZWES0226W

Log level '*level*' not recognized, command ignored

Reason:

An operator passed an invalid log level in the LOG modify command.

Action:

The cross-memory server ignores the command.

ZWES0227W

Modify *command_verb* command not recognized

Reason:

The cross-memory server did not recognize a modify command with verb *command_verb*.

Action:

The cross-memory server ignores the command.

ZWES0228W

Empty modify command received, command ignored

Reason:

The cross-memory server received an empty modify command.

Action:

The cross-memory server ignores the command.

ZWES0229W

Server not ready for command *command_verb*

Reason:

The cross-memory server is being either initialized or terminated and isn't ready to accept the provided modify command.

Action:

The cross-memory server ignores the command. Re-issue the command later.

ZWES0230W

Display option '*option_name*' not recognized, command ignored

Reason:

The cross-memory server did not recognize a DISPLAY modify command.

Action:

The cross-memory server ignores the command.

ZWES0231E

RESMGR version *resource_manager_version* not locked, ISGENQ RC = *return_code*, RSN = *reason_code*

Reason:

The cross-memory's address space resource manager serialization failed (lock not acquired)

Action:

The cross-memory server terminates. Contact support.

ZWES0232E

RESMGR version *resource_manager_version* not released, ISGENQ RC = *return_code*, RSN = *reason_code*

Reason:

The cross-memory's address space resource manager serialization failed (lock not released).

Action:

The cross-memory server continues running. Contact support.

ZWES0233E

RESMGR ECSA storage not allocated, size = *requested_size*

Reason:

The cross-memory server could not obtain common storage for the cross-memory server's address space resource manager.

Action:

The cross-memory server terminates. Ensure that there is no shortage of the extended common service area (ECSA) storage on your system. If you cannot resolve the issue, contact support.

ZWES0234E

RESMGR NAME/TOKEN not created, RC = *ieantcr_return_code*

Reason:

The cross-memory server failed to create the resource manager name/token pair.

Action:

The cross-memory server terminates. Review the provided IEANTCR return code (see "z/OS MVS Programming: Assembler Services Reference IAR-XCT") and contact support if you cannot resolve the issue.

ZWES0235E

RESMGR NAME/TOKEN not retrieved, RC = *ieantrt_return_code*

Reason:

The cross-memory server failed to retrieve the resource manager name/token pair.

Action:

The cross-memory server terminates. Review the provided IEANTRT return and reason (see "z/OS MVS Programming: Assembler Services Reference IAR-XCT") codes and contact support if you cannot resolve the issue.

ZWES0236E

RESMGR not added for ASID = *hex_asid_number*, RC = *return_code*, manager RC = *resmgr_return_code*

Reason:

The cross-memory server could not add the resource manager.

Action:

The cross-memory server terminates. Review the RESMGR ADD service return code value in *resmgr_return_code* (see "z/OS MVS Programming: Authorized Assembler Services Reference LLA-SDU"). If you cannot resolve the issue, contact support.

ZWES0237E

RESMGR not removed for ASID = *hex_asid_number*, RC = *return_code*, manager RC = *resmgr_return_code*

Reason:

The cross-memory server could not delete the resource manager.

Action:

The cross-memory server terminates with a non-zero status. Review the RESMGR DELETE service return code in *resmgr_return_code* (see "z/OS MVS Programming: Authorized Assembler Services Reference LLA-SDU"). If you cannot resolve the issue, contact support.

ZWES0238E

rname_value RNAME not created, *failure_reason*

Reason:

The cross-memory server failed to create an RNAME.

Action:

The cross-memory server terminates. Contact support.

ZWES0239E

nametoken_name NAME (NT) not created, *failure_reason*

Reason:

The cross-memory server failed to create a name-token name.

Action:

The cross-memory server terminates. Contact support.

ZWES0240W

Discarding outdated LPA module at *module_address* (*current_module_timestamp - new_module_timestamp*)

Reason:

The cross-memory server detected that the current link pack area (LPA) module was outdated; this usually happens when the cross-memory server gets updated.

Action:

The cross-memory server discards the old module and loads the latest version to LPA.

ZWES0241E

Service with ID *service_id* not relocated, *function_address* not in range [*module_start_address*, *module_end_address*]

Reason:

An error occurred during the relocation of a cross-memory service.

Action:

The cross-memory server terminates. Contact support.

ZWES0242W

Modify *command_verb* command rejected

Reason:

The cross-memory server rejected the provided modify command because it was either incorrect or the server was not ready to process it.

Action:

The cross-memory server ignores the command.

ZWES0243W

Server busy, modify commands are rejected

Reason:

An operator issued too many commands in a short period and the cross-memory server was not able to process the provided modify command.

Action:

The cross-memory server ignores the command.

ZWES0244E

Resource '*resource_name*' not created, RC = *return_code*

Reason:

The cross-memory server failed to create an internal resource.

Action:

Depending on the location either the cross-memory server terminates or some functionality is impacted. Contact support.

ZWES0245E

ABEND *abend_code-reason_code* averted in step '*step_name*' (recovery RC = *recovery_return_code*)

Reason:

An abend occurred in a component of the cross-memory server.

Action:

Depending on the location either the cross-memory server terminates or some functionality is impacted. Contact support.

ZWES0246E

Service entry *service_id* is occupied

Reason:

The cross-memory server made an attempt to install a cross-memory service in an already occupied slot.

Action:

The cross-memory server terminates. Contact support.

ZWES0247W

Development mode is enabled

Reason:

The user enabled one or more of the development modes.

Action:

Ensure it was done intentionally, otherwise disable any development mode.

ZWES0248W

Address space is not reusable, start with REUSASID=YES to prevent an ASID shortage

Reason:

An operator started the cross-memory server's address space as a non-reusable address space.

Action:

Use RESUASID=YES when starting the cross-memory server, otherwise starting it without that parameter can cause an address space identifier (ASID) shortage.

ZWES0249E

Module *module_name* is loaded from common storage, ensure *module_name* is valid in the STEPLIB

Reason:

The cross-memory server detected that its module was located in common storage.

Action:

The cross-memory server terminates. Ensure that the module is in a STEPLIB data set.

ZWES0250E

Bad dub status *bpx4qdb_status* (*bpx4qdb_return_code*,*bpx4qdb_reason_code*), verify that the started task user has an OMVS segment

Reason:

The cross-memory server detected an invalid dub status.

Action:

The cross-memory server terminates. Ensure that the user under which the cross-memory server's started task runs has an OMVS segment.

ZWES0251I

Look-up routine anchor has been created at *address*

Reason:

The cross-memory server created a cross-memory server look-up routine anchor.

Action:

No action required.

ZWES0252I

Look-up routine anchor at *address* has been reused

Reason:

The cross-memory server found and reused an existing look-up routine anchor.

Action:

No action required.

ZWES0253I

Look-up routine anchor at *address* has been deleted

Reason:

The cross-memory server deleted a look-up routine anchor.

Action:

No action required.

ZWES0254W

Look-up routine anchor at *address* has been discarded due to *reason*:

Reason:

The cross-memory server discarded a look-up routine anchor.

Action:

The cross-memory server creates a new anchor. Review the reason and contact support if the reason is not one of the following:

- Incompatible version
- Insufficient size
- Outdated look-up routine

ZWES0255E

Look-up routine anchor has not been created

Reason:

The cross-memory server could not create a look-up routine anchor.

Action:

The cross-memory server terminates. Ensure there is no shortage of the extended common service area (ECSA) storage on your system. Contact support if you cannot resolve the issue.

ZWES0256I

Look-up routine anchor at *address* has been explicitly discarded

Reason:

The user forced the cross-memory server to discard the current look-up routine anchor via a parameter.

Action:

No action required.

ZWES0257W

Look-up routine anchor discard RC = *return_code*

Reason:

The cross-memory server could not discard the current look-up routine anchor.

Action:

The cross-memory server continues running. Review *return_code* and contact support if needed.

Possible return codes:

return_code	Action
RC_CMS_ZVT_NULL(47)	Ignore if you have not run any ZIS after IPL

ZIS Dynamic Linkage Base plug-in messages

ZWES0700I

ZIS Dynamic Base plug-in starting, version *major.minor.patch+datestamp*, stub version *stub_version*

Reason:

The dynamic linkage base plug-in with the specified plug-in and stub versions is starting.

Action:

No action required.

ZWES0701I

ZIS Dynamic Base plug-in successfully started

Reason:

The dynamic linkage base plug-in successfully started.

Action:

No action required.

ZWES0702E

ZIS Dynamic Base plug-in startup failed, status = *status_code*

Reason:

The dynamic linkage base plug-in failed to start.

Action:

The dynamic linkage functionality will not be available. Review the messages preceding this message and contact support if you cannot resolve the issue.

ZWES0703E

ZIS Dynamic Base plug-in init error - *details*

Reason:

The dynamic linkage base plug-in failed during initialization.

Action:

The dynamic linkage functionality will not be available. Review the details and contact support if you cannot resolve the issue.

ZWES0704I

ZIS Dynamic Base plug-in terminating

Reason:

The plug-in is terminating.

Action:

No action required.

ZWES0705I

ZIS Dynamic Base plug-in successfully terminated

Reason:

The plug-in successfully terminated.

Action:

No action required.

ZWES0706E

ZIS Dynamic Base plug-in terminated with error

Reason:

The dynamic linkage base plug-in terminated with errors.

Action:

Review the details and contact support if you cannot resolve the issue.

ZWES0707I

response_text

Reason:

This message contains a response from a modify command of the dynamic linkage base plug-in.

Action:

No action required.

ZWES0708I

Stub vector has been created at *address*

Reason:

The dynamic linkage base plug-in created a new stub vector at the specified address.

Action:

No action required.

ZWES0710I

Stub vector at *address* has been reused

Reason:

The dynamic linkage base plug-in reused the stub vector at the specified address.

Action:

No action required.

ZWES0711I

Stub vector at *address* has been deleted

Reason:

The dynamic linkage base plug-in deleted the stub vector at the specified address.

Action:

No action required.

ZWES0712W

Stub vector at *address* is discarded due to *reason*:

Reason:

The dynamic linkage base plug-in discarded an existing stub vector because it was invalid.

Action:

The dynamic linkage base plug-in creates a new vector. Review the reason and contact support if the reason is not one of the following:

- Incompatible version
- Insufficient size

ZWES0713W

ZIS Dynamic base plug-in development mode is enabled

Reason:

The user enabled the development mode.

Action:

Ensure it was done intentionally, otherwise disable any development mode.

ZWES0714E

Bad cross-memory server version: expected [*min_major*.*min_minor*.*min_patch*, *max_major*.*max_minor*.*max_patch*), found *current_major*.*current_minor*.*current_patch*

Reason:

The dynamic linkage base plug-in detected that it was running in an unsupported cross-memory server.

Action:

The dynamic linkage functionality will not be available. Use a supported version of the cross-memory server.

Version: v3.2.x LTS

Troubleshooting Zowe Launcher

The following topics contain information that can help you troubleshoot problems when you encounter unexpected behavior using Zowe™ Launcher.

Issues and development of the Zowe Launcher is managed in GitHub. When you troubleshoot a problem, you can check whether a GitHub issue (open or closed) that covers the problem already exists. For a list of issues, see the launcher repo.

Error Message Codes

Enable Zowe Launcher Debug Mode

Use debug mode to display additional debug messages for Zowe Launcher.

Important: We highly recommend that you enable debug mode only when you want to troubleshoot issues. Disable debug mode when you are not troubleshooting. Running Zowe Launcher in debug mode can adversely affect its performance and consume a large amount of spool space.

Follow these steps:

1. Open the PROCLIB member `ZWESLSTC`.
2. Find `STDENV DD` in-stream data.
3. Add a new line `ZLDEBUG=ON`.

By default, debug mode is disabled, in which `ZLDEBUG` is set to `OFF`. To disable debug mode, remove this line or set `ZLDEBUG` to `OFF`.

4. Restart `ZWESLSTC` Started Task.

> **TIP**
>
> `_CEE_ENVFILE_COMMENT` sets the comment character. See the following example, in which the last two lines of in-stream data are commented (not in effect):

Version: v3.2.x LTS

Error Message Codes

The following error message codes may appear on Zowe Launcher SYSPRINT. Use the following message code references and the corresponding reasons and actions to help troubleshoot issues.

Zowe Launcher informational messages

ZWEL0001I

component %s started

Reason:

The component `<component-name>` was started.

Action:

No action required.

ZWEL0002I

component %s stopped

Reason:

The component `<component-name>` was stopped.

Action:

No action required.

ZWEL0003I

new component initialized %s, restart_cnt=%d, min_uptime=%d seconds, share_as=%s

Reason:

The component `<component-name>` was initialized.

- `restart_cnt` - The number of attempts to restart the component in case of failure
- `min_uptime` - The minimum uptime that the component can be considered as successfully started
- `share_as` - One of the following values: `<yes|no|must>`. The value indicates whether child processes of the component start in the same address space. For details, see _BPX_SHAREAS in the IBM documentation.

Action:

No action required.

ZWEL0004I

component %s(%d) terminated, status = %d

Reason:

The component `<component-name>`(`<process-id>`) terminated with the status `<code>`.

Action:

No action required.

ZWEL0005I

next attempt to restart component %s in %d seconds

Reason:

Next attempt to restart component `<component-name>` in `<n>` seconds.

Action:

No action required. The component `<component-name>` will be restarted in `<n>` seconds.

ZWEL0006I

starting components

Reason:

Starting the components.

Action:

No action required.

ZWEL0007I

components started

Reason:

The components are started.

Action:

No action required.

ZWEL0008I

stopping components

Reason:

Stopping the components.

Action:

No action required.

ZWEL0009I

components stopped

Reason:

The components are stopped.

Action:

No action required.

ZWEL0010I

launcher has the following components:

Reason:

The launcher has the following components.

Action:

No action required.

ZWEL0011I

name = %16.16s, PID = %d

Reason:

Name = `<component-name>`, PID = `<process-id>`.

Action:

No action required.

ZWEL0012I

starting console listener

Reason:

Starting the console listener.

Action:

No action required.

ZWEL0013I

command '%s' received

Reason:

The command `<command>` was received.

Action:

No action required.

ZWEL0014I

termination command received

Reason:

The termination command was received.

Action:

No action required.

ZWEL0015I

console listener stopped

Reason:

The console listener was stopped.

Action:

No action required.

ZWEL0016I

start component list: '%s'

Reason:

Start the component list `<component-list>`

Action:

No action required.

ZWEL0017I

ROOT_DIR is '%s'

Reason:

The ROOT_DIR (`zowe.runtimeDirectory`) is `<zowe-runtime-directory>`

Action:

No action required.

ZWEL0018I

Zowe instance prepared successfully

Reason:

Zowe instance prepared successfully.

Action:

No action required.

ZWEL0019I

Zowe Launcher stopping

Reason:

Zowe Launcher is stopping.

Action:

No action required.

ZWEL0021I

Zowe Launcher starting

Reason:

Zowe Launcher is starting.

Action:

No action required.

ZWEL0022I

Zowe Launcher stopped

Reason:

Zowe Launcher was stopped.

Action:

No action required.

ZWEL0023I

Zowe YAML config file is '%s'

Reason:

Zowe YAML config file is `<path-to-zowe-yaml>`.

Action:

No action required.

ZWEL0024I

HA_INSTANCE_ID is '%s'

Reason:

The HA_INSTANCE_ID name is `<ha-instance-name>`.

Action:

No action required.

ZWEL0025I

restart_intervals for component '%s'= %s

Reason:

Restart intervals for component `<component-name>` = `<restart-intervals>.` Restart intervals is defined in `zowe.launcher.restartIntervals`.

Action:

No action required.

ZWEL0058I

WORKSPACE_DIR is '%s'

Reason:

The WORKSPACE_DIR (`zowe.workspaceDirectory`) is `<path-to-workspace-dir>`.

Action:

No action required.

ZWEL0069I

Configuration is valid

Reason:

The configuration is valid.

Action:

No action required.

Zowe Launcher error messages

ZWEL0026E

%s env variable not found

Reason:

The environmental variable `<variable-name>` was not found.

Action:

In launcher's STC, under `DD` statement `STDENV`, review the `<variable-name>`.

ZWEL0027E

%s env variable too large

Reason:

`<variable-name>` environmental variable is too large.

Action:

In launcher's STC, under `DD` statement `STDENV`, review the `<variable-name>`.

ZWEL0028E

failed to get component list

Reason:

Failed to get the component list.

Action:

Review the components defined in the configuration (identified by message `ZWEL0023I`).

ZWEL0029E

start component list is empty

Reason:

Start component list is empty.

Action:

Review the components defined in the configuration (identified by message `ZWEL0023I`).

ZWEL0030E

failed to prepare Zowe instance

Reason:

Failed to prepare the zowe instance.

Action:

Check previous messages in the Zowe Launcher `SYSPRINT` to find the reason and correct it.

ZWEL0031E

failed to setup signal handlers

Reason:

Failed to setup signal handlers.

Action:

Contact Support.

ZWEL0032E

failed to find %s='%s', check if the dir exists

Reason:

Failed to find `<dir-type>`=`<dir-path>`, check if the directory exists.

Action:

Verify `<dir-type>` is correctly defined in configuration (identified by message `ZWEL0023I`).

ZWEL0033E

failed to get ROOT_DIR dir

Reason:

Failed to get ROOT_DIR (`zowe.runtimeDirectory`).

Action:

Review `zowe.runtimeDirectory` defined in configuration (identified by message `ZWEL0023I`).

ZWEL0034E

ROOT_DIR is empty string

Reason:

ROOT_DIR (`zowe.runtimeDirectory`) is empty string.

Action:

Review `zowe.runtimeDirectory` defined in configuration (identified by message `ZWEL0023I`).

ZWEL0035E

invalid command line arguments, provide HA_INSTANCE_ID as a first argument

Reason:

Invalid command line arguments, provide `<HA_INSTANCE_ID>` as a first argument.

Action:

Review the command and provide `<HA_INSTANCE_ID>` as a first argument.

ZWEL0036E

failed to initialize launcher context

Reason:

Failed to initialize launcher context.

Action:

Contact support.

ZWEL0037E

max component number reached, ignoring the rest

Reason:

Maximal number of components reached, ignoring the rest.

Action:

Review the components defined in configuration (identified by message `ZWEL0023I`).

ZWEL0038E

failed to restart component %s, max retries reached

Reason:

The component `<component-name>` terminates, and the start limit of the launcher has been reached, thereby preventing component restart.

Action:

Review the logs to determine the cause of component terminations. When the problem has been corrected, restart the main Zowe task or restart the component manually, to continue using the component. For more information on restarting Zowe or individual components, see Starting and stopping Zowe.

ZWEL0039E

cannot start component %s - already running

Reason:

Cannot start the component `<component-name>` because it is already running.

Action:

No action required.

ZWEL0040E

failed to start component %s

Reason:

Failed to start the component `<component-name>`.

Action:

Review the component defined in configuration (identified by message `ZWEL0023I`).

ZWEL0041E

bad value supplied, command ignored

Reason:

Bad value for the command supplied, such command is ignored.

Action:

Review the command.

ZWEL0042E

command not recognized

Reason:

Command not recognized.

Action:

Review the command.

ZWEL0043E

failed to start console thread

Reason:

Failed to start the console thread.

Action:

Contact support.

ZWEL0044E

failed to stop console thread

Reason:

Failed to stop the console thread.

Action:

Contact support.

ZWEL0045E

error converting zowe.yaml file - %s

Reason:

Error converting zowe.yaml file - `<path-to-zowe-yaml>`.

Action:

Contact support.

ZWEL0046E

error reading zowe.yaml file - %s

Reason:

There is an error while reading zowe.yaml file - `<path-to-zowe.yaml>`

Action:

Contact support.

ZWEL0047E

failed to parse zowe.yaml - %s

Reason:

Failed to parse the zowe.yaml - `<path-to-zowe-yaml>`.

Action:

Verify that the YAML has no syntax errors.

ZWEL0048E

failed to open zowe.yaml - %s: %s

Reason:

Failed to open zowe.yaml - `<path-to-zowe-yaml>`:?

Action:

Verify if the YAML provided exists and the user running Zowe has permission to read it.

ZWEL0049E

failed to restart component %s

Reason:

Failed to restart the component `<component-name>`.

Action:

Contact support.

ZWEL0050E

cannot read output from comp %s(%d) - %s

Reason:

Cannot read the output from component `<component-name>` (`<process-id>`) - `<error-text>`

Action:

Contact support.

ZWEL0055E

failed to create file for stdin(%s) - %s

Reason:

Failed to create the file for stdin(`<file>`) - `<error-text>`.

Action:

Contact support.

ZWEL0056E

failed to open file for stdin(%s) - %s

Reason:

Failed to open the file for stdin(`<file>`) - `<error-text>`.

Action:

Contact support.

ZWEL0057E

failed to create workspace dir '%s'

Reason:

Failed to create the workspace directory `<path-to-workspace-dir>`.

Action:

Verify that the directory is valid and the Zowe user has permission to create it.

ZWEL0059E

failed to get WORKSPACE_DIR dir

Reason:

Failed to get the WORKSPACE_DIR (`zowe.workspaceDirectory`) directory.

Action:

Contact support.

ZWEL0060E

WORKSPACE_DIR is empty string

Reason:

The WORKSPACE_DIR (`zowe.workspaceDirectory`) is empty string.

Action:

Correct the Zowe YAML to define the `zowe.workspaceDirectory` value.

ZWEL0061E

failed to find %s='%s', check if the file exists

Reason:

Failed to find ?=?, check if the file exists.

Action:

Contact support.

ZWEL0062E

failed to create dir '%s' - %s

Reason:

Failed to create the directory `<directory>` - `<error-text>`.

Action:

Review the error text to determine the action to take.

ZWEL0064E

failed to run command %s - %s

Reason:

Failed to run the command `<command>` - `<error-text>`.

Action:

Review the error text to determine the action to take.

ZWEL0065E

error reading output from command '%s' - %s

Reason:

There is an error reading the output from command `<command>` - `<error-text>`

Action:

Review the error text to determine the action to take.

ZWEL0067E

PARMLIB() entries must all have the same member name

Reason:

PARMLIB() entries must all have the same member name.

Action:

Review the member names are identical for all PARMLIB() entries.

ZWEL0068E

PARMLIB() entries must have a member name

Reason:

PARMLIB() entries must have a member name.

Action:

Review the dataset name contains the member name in PARMLIB entry.

ZWEL0070E

Configuration has validity exceptions:

Reason:

Configuration has validity exceptions.

Action:

Review the exceptions and correct the configuration.

ZWEL0071E

Internal failure during validation, please contact support

Reason:

Internal failure during validation, please contact support.

Action:

Contact support.

ZWEL0072E

Launcher could not load configurations

Reason:

Launcher could not load the configurations.

Action:

Review the configuration entries.

ZWEL0073E

Launcher could not load schemas, status=%d

Reason:

Launcher could not load schemas, status=`<return-code>`

Action:

For the `status=5`, locate the `zowe.runtimeDirectory` in the configuration.

Check the `zowe.runtimeDirectory/schemas` contains four `.json` files shown below:

On occasion the error occurs because the `zowe.runtimeDirectory` is pointing to a valid directory, but one which doesn't contain a valid Zowe runtime environment is one of the first failures during a Zowe launch.

ZWEL0074E

Log context was not created

Reason:

The logging context was not created.

Action:

Contact support.

Zowe Launcher warning messages

ZWEL0051W

failed to read zowe.yaml, launcher will use default settings

Reason:

Failed to read zowe.yaml, launcher will use default settings.

Action:

Contact support.

ZWEL0052W

not all components started

Reason:

Not all components were started.

Action:

No action required.

ZWEL0053W

not all components stopped gracefully

Reason:

Not all components were stopped gracefully.

Action:

No action required.

ZWEL0054W

component %s not found

Reason:

The component `<component-name>` was not found.

Action:

No action required.

ZWEL0063W

Component %s(%d) will be terminated using SIGKILL

Reason:

Component `<component-name>`(`<process-id>`) will be terminated using `SIGKILL`.

Action:

No action required.

ZWEL0066W

command '%s' ended with code %d

Reason:

The command `<command>` ended with return code `<return-code>`.

Action:

No action required.

Version: v3.2.x LTS

Troubleshooting Zowe CLI

When there is a problem

If Zowe™ CLI is experiencing a problem, there are steps you can take to find a potential solution.

Applicable environments

These instructions apply to Zowe CLI installed on Windows, Mac OS X, and Linux systems as a standalone installation via a Zowe download or an NPM registry.

Reaching out for support

1. Is there already a GitHub issue (open or closed) that covers the problem? Check CLI Issues.
2. Review the current list of Known Zowe CLI issues in documentation. Also try searching using the Zowe Docs **Search** bar.

Resolving the problem

Collect the following information to help diagnose the issue:

- Zowe CLI version installed.
  - Issue the Zowe CLI command to get the version number.
- List of plug-ins installed and their version numbers.
  - Issue the Zowe CLI plug-ins command to get the version number(s).
- Node.js and NPM versions installed.
  - Issue the Node.js and npm commands to get the version numbers.
- List of environment variables in use.

For instructions on using commands to collect this information, see Gathering information to troubleshoot Zowe CLI or Using individual commands for troubleshooting.

The following information is also useful to collect:

- If you are experiencing HTTP errors, see z/OSMF troubleshooting for information to collect.
- Is the CLI part of another Node application, such as VSCode, or is it a general installation?
- Which queue managers are you trying to administer, and on what systems are they located?
- Are the relevant API endpoints online and valid?

Version: v3.2.x LTS

Gathering information to troubleshoot Zowe CLI

An important step in troubleshooting is confirming that your local environment is set up correctly. There are several Zowe CLI commands you can use to view the conditions for the following system settings:

- Configurations
- Supported components
- Command property values

These commands offer differing levels of information for analysis. Review this list to understand the outputs they provide and how to apply them for troubleshooting.

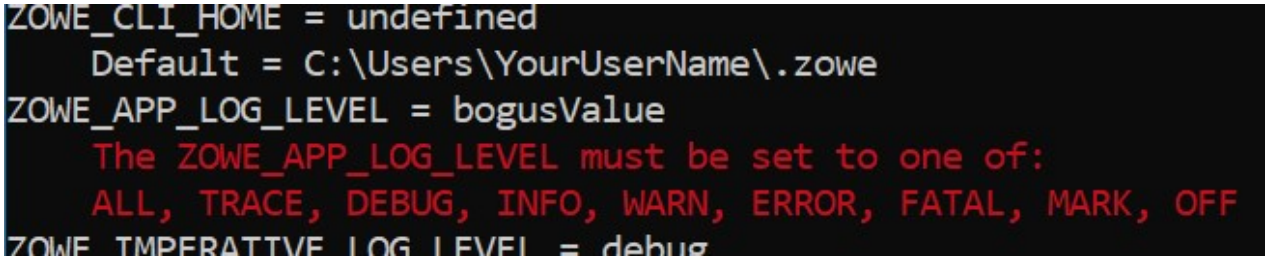
Generating a working environment report

Issue the following command:

The output provides a granular view of key areas in the working environment on your terminal, including the following settings:

- Node.js version, operating system path, environment variables
- NPM information
- Zowe CLI version, profile names
- Installed plug-ins and their versions

This detailed report helps provide insights as you troubleshoot. If it finds a problem with a setting, the report displays a warning message.



Alternatively, the output can be saved as a text file that can be attached to an issue submitted to the Zowe CLI issues list. Before filing an issue, confirm that it has not already been submitted.

Finding configuration file properties and locations

Issue the following command:

The output provides a brief overview with the following information:

- Configuration file locations

- Profile names and types
- Profile type defaults
- All property values (host, port, etc.)

This overview outlines configuration property values and where they are specified.

Finding configuration file locations

Issue the following command:

The output provides a list of configuration files that affect your Zowe commands in the directory from which this command is issued.

Finding property values used by a Zowe command

Add the `--show-inputs-only` option to any Zowe command.

For example, if you want to check the command to list a data set, add the option to the following command:

The output provides the property values that are used by the specified command, which can help the user identify properties that might be incorrect.

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Using individual commands for Zowe CLI troubleshooting

Follow these instructions to gather specific pieces of information to help troubleshoot Zowe™ CLI issues.

Identify the currently installed CLI version

Issue the following command:

The exact Zowe CLI version may vary depending upon if the `@latest`, `@zowe-v1-lts`, `@zowe-v2-lts`, or `@zowe-v3-lts` version is installed.

Display the version of your globally-installed Zowe CLI through the following NPM command:

More information regarding versioning conventions for Zowe CLI and plug-ins is located in Zowe CLI Releases.

Identify the currently installed versions of plug-ins

Issue the following command:

The output includes the plug-in version number and registry information.

Environment variables

The following settings are configurable with environment variables:

Log levels

Environment variables are available to specify logging level and the CLI home directory.

> **WARNING**
> Setting the log level to `TRACE` or `ALL` might result in sensitive data being logged. For example, command line arguments will be logged when `TRACE` is set.

For more information about logging and environment variables, see Setting CLI log levels.

CLI daemon mode

By default, the CLI daemon mode binary creates or reuses a file in the user's home directory each time a Zowe CLI command runs. In some cases, this behavior might be undesirable. One example of this would be when the home directory resides on a network drive and has poor file performance. In this case, changing the file location would improve performance time.

For information about how to change the location that the daemon uses, see Setting CLI daemon mode properties.

Home directory

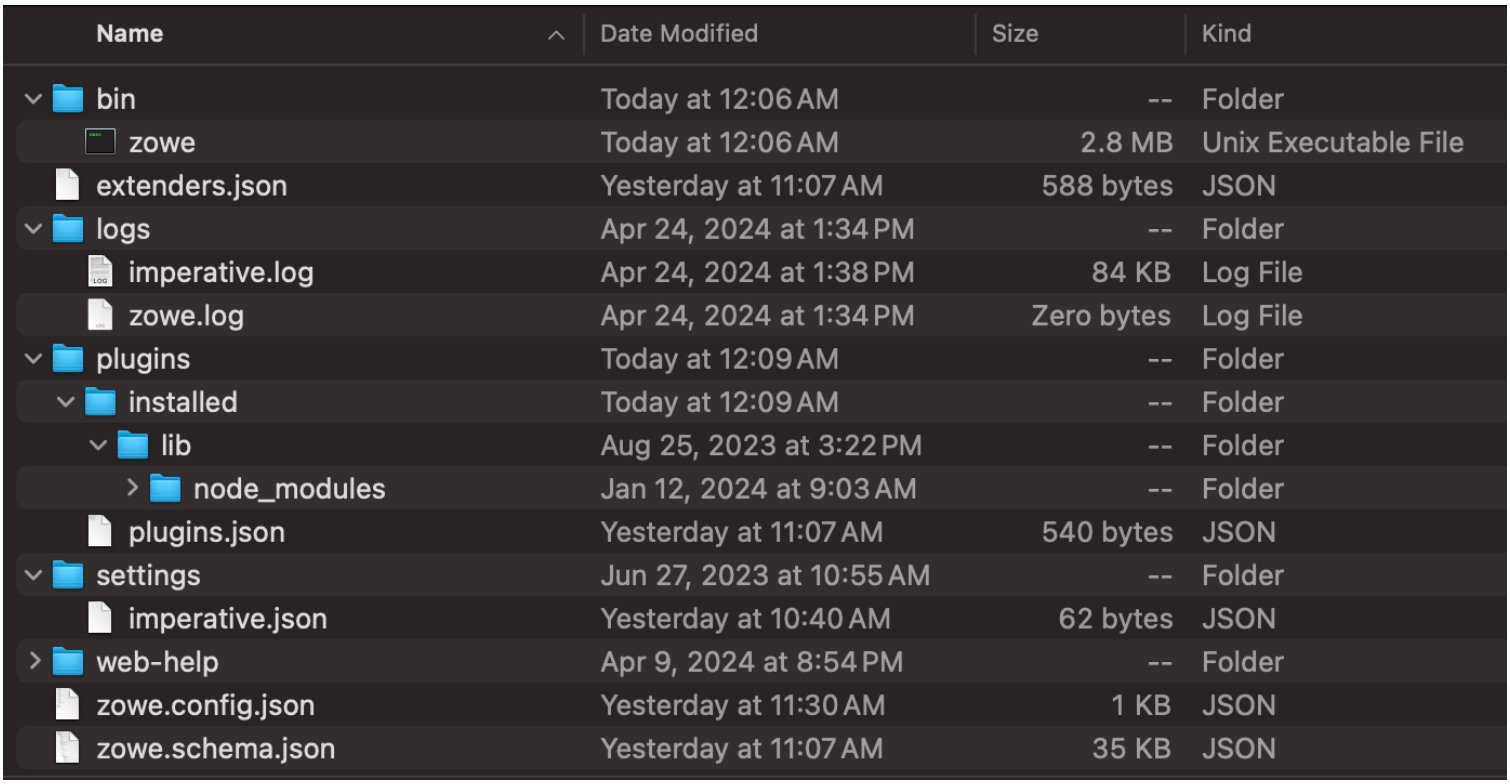
You can set the location on your computer for the Zowe CLI home directory, which contains log files, profiles, and plug-ins for the product.

The default `.zowe` folder is created when you issue your first Zowe CLI command. If you change the location of the folder, you must reinstall plug-ins and recreate or move profiles and log files that you want to retain. In some cases, you might want to maintain a different set of profiles in multiple folders, then switch between them using the environment variable.

For information about setting an environment variable for the Zowe CLI home directory, see Setting the CLI home directory.

The values for these variables can be **echo**ed.

Home directory structure



Location and types of logs

Zowe client logs are located in the `~/.zowe/logs` directory:

- **Imperative CLI Framework log**, `imperative.log`
  - Generally contains installation and configuration information
- **Zowe CLI log**, `zowe.log`
  - Contains information about interaction between the CLI and the server endpoints

Analyze these logs for any information relevant to your issue.

Node.js and npm

Zowe CLI is compatible with the currently supported Node.js LTS versions. For an up-to-date list of supported LTS versions, see Node.js.org.

To gather the Node.js and npm versions installed on your computer, issue the following commands:

npm configuration

If you are having trouble installing Zowe CLI from an npm registry, gather your npm configuration to help identify issues with registry settings, global install paths, proxy settings, etc.:

npm log files

In case of errors, npm creates log files in the `npm_cache\_logs` location. To get the `npm_cache` location for a specific OS:

By default, npm keeps only 10 log files, but sometimes more are needed. To increase the log count:

- This command increases the log count to 50, so that more log files will be stored on the system. Now you can run tests multiple times and not lose the log files. The logs can be passed to Support for analysis.

By default, log files are created only when an npm command fails. To see what is executed, increase the log level of npm:

- With this change, you can see all actions taken by npm on the stdout. If the command is successful, it still does not generate a log file.
- The available log levels are:
  - `silent`
  - `error`
  - `warn`
  - `notice`
  - `http`
  - `timing`
  - `info`
  - `verbose`
  - `silly`
  - `notice`
- Alternatively, pass `--loglevel verbose` on the command line. This only works with npm related commands. By setting log level in the config, it also works when you issue some `zowe` commands that use npm (for example, `zowe plugins install @zowe/cics`).

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Using cURL to troubleshoot Zowe CLI

When a REST API call fails on Zowe CLI, you can use cURL to troubleshoot.

Run a command with cURL and compare its output with what is returned using Zowe CLI. This can help pinpoint whether the problem lies with z/OSMF or Zowe CLI, depending on which command returns an API error.

Installing cURL

cURL is installed by default on Windows 10 V1803 and later, macOS, and most Linux distributions.

If the cURL command is missing from your system, you can download it from the cURL Releases and Downloads page.

Understanding cURL commands

A cURL command using the `https` protocol follows the basic syntax `curl <URL>`.

Add cURL options to establish communication between Zowe CLI and z/OSMF, as in the following example command:

> **NOTE**
>
> Some terminals might require single quotes rather than double quotes.

`--location`

Use `--location` to allow the server to redirect to a different URL, if needed.

When the server attempts to redirect and `--location` is not included in the command, the server responds with a 3XX status code.

`--request <API method>`

Use `--request` to identify the API method (such as `POST`, `GET`, `PUT`, `DELETE`). Not necessary when the API method is `GET`.

- `<API method>`

  Specifies the API method used in the request.

`"https://<host>:<port>/<API>"`

Indicates the protocol and URL.

- `<host>`

  Specifies the host name where the z/OSMF services are running.

- `<port>`

Specifies the REST port number. If not specified, defaults to 443 for HTTPS.

- `<API>`

  Specifies the API endpoint used in the request.

`--header "X-CSRF-ZOSMF-HEADER;"`

Required to establish communication with z/OSMF. Specifies that the client is sending a cross-site request to the REST interface.

- `;`

  Indicates that the header has no value. (Not all headers require a value.)

  To pass an additional header with a value, use a colon to separate the key and value. For example: `--header "X-IBM-Data-Type: binary"`.

`--insecure`

Use `--insecure` with a trusted server that does not require verification before a data transfer.

For example, this bypasses SSL certificate verification for servers with self-signed certificates.

`--user "<ID>:<PASSWORD>"`

Required and displays as plain text. Also possible to use an environment variable.

- `<ID>`

  Specifies the z/OSMF user identification.

- `<PASSWORD>`

  Specifies the user password for z/OSMF.

> **NOTE**
>
> To be prompted for a password instead of displaying it in plain text, omit the password from the command and enter `--user "<ID>"`.

Comparing commands

To troubleshoot, run a Zowe API request with Zowe CLI and cURL commands, then compare responses.

When both responses include the same error, that may indicate there could be a problem with z/OSMF.

If an API call fails with the Zowe CLI command but not cURL, this can mean the problem lies with Zowe CLI.

The following APIs illustrate some common examples of comparing commands that you can use to troubleshoot with cURL.

z/OSMF Info API

The `z/OSMF Info` API uses a `GET` request to obtain basic information from z/OSMF, such as the version, available services, and other details.

Submitting the cURL command:

Run the following example command using your information:

A successful cURL response follows the format below:

Submitting the Zowe CLI command:

Run the following example command using your information:

A successful Zowe CLI response follows the format below:

z/OSMF Files API

The `z/OSMF Files` API uses a `PUT` request to upload a file to a data set via z/OSMF.

Submitting the cURL command:

Run the following example command using your information:

A successful cURL response is empty without any error messages.

Submitting the Zowe CLI command:

Run the following example command using your information:

A successful Zowe CLI response follows the format below:

z/OSMF Jobs API

The `z/OSMF Jobs` API uses a `PUT` request to submit a job from a data set via z/OSMF.

Submitting the cURL command:

Run the following example command using your information:

A successful cURL response folllows the format below:

Submitting the Zowe CLI command:

Run the following example command using your information:

A successful Zowe CLI response follows the format below:

Version: v3.2.x LTS

z/OSMF troubleshooting

The core command groups use the z/OSMF REST APIs, which can experience any number of problems.

If you encounter HTTP 500 errors with the CLI, consider gathering the following information:

- The IZU* (IZUSVR and IZUANG) joblogs (z/OSMF server)
- z/OSMF USS logs (default location: /global/zosmf/data/logs, but may change depending on installation)

If you encounter HTTP 401 errors with the CLI, consider gathering the following information:

- Any security violations for the TSO user in SYSLOG

Alternate methods

At times, it may be beneficial to test z/OSMF outside of the CLI. You can use the CLI tool `curl` or a REST tool such as "Postman" to isolate areas where the problem might be occurring (CLI configuration, server-side, etc.).

Example `curl` command to `GET /zosmf/info`:

Version: v3.2.x LTS

Troubleshooting Zowe CLI credentials

Secure credentials

Authentication mechanisms

You can troubleshoot a failed log-in to a mainframe service by reviewing the authentication mechanisms used by Zowe CLI.

Zowe CLI accepts various methods, or mechanisms, of authentication when communicating with the mainframe, and the method that the CLI ultimately follows is based on the service it is communicating with.

However, some services can accept multiple methods of authentication. When multiple methods are provided (in a configuration profile or command) for a service, the CLI follows an *order of precedence* to determine which method to apply.

To find the authentication methods used for different services and their order of precedence, see the table in Authentication mechanisms.

PEM certificate files

PEM certificate files are used by Zowe CLI to authenticate to the API Mediation Layer. To be accepted, these certificate files must first be recorded in the service's keyring/trust-store on the mainframe before they are used by Zowe CLI.

Some users choose to secure PEM certificates by placing them in a password protected container, such as a PGP file, a ZIP file, or a password protected PKCS12 file (or a PFX file). However, Zowe CLI does not currently support any certificate files that require a password for use.

> **NOTE**
>
> These client certificate files are different from the certificates generated or imported during Zowe server configuration. For more information, see Using Certificates.

To log into the API Mediation Layer with a PEM certificate file, refer to this workaround.

Symptom:

When using a password protected certificate to log in to API ML, an error message displays.

Sample message:

Solution:

Create a new PEM certificate file with no password requirement to log in to API ML.

Version: v3.2.x LTS

Known Zowe CLI issues

The following topics contain information that can help you troubleshoot problems when you encounter unexpected behavior installing and using Zowe™ CLI.

Zowe commands fail with secure credential errors

Valid on Windows, macOS, and Linux

Symptoms:

After you install Zowe CLI, and the installation appears to complete successfully, Zowe commands that load the secure credential store return error messages. For example, the following commands return error messages:

- `zowe config init`
- `zowe config secure`
- Most Zowe commands that access your mainframe environment

This behavior occurs under the following conditions:

- npm version 8.11.0 or 8.12.0 is running on your computer.
- The computer on which you installed Zowe CLI cannot access the Internet or it has limited access to the Internet. Your site does not allow connections to https://github.com/.
- You installed Zowe CLI from a local package or from an NPM public online registry

Solution:

1. Define the `npm_config_global` environment variable. Issue the command that corresponds with your operating system:
    - Windows Command Prompt: `set npm_config_global=true`
    - Windows PowerShell: `$env:npm_config_global="true"`
    - macOS/Linux Bash: `export npm_config_global=true`
2. Install or reinstall Zowe CLI using your preferred installation method.
3. After the Zowe CLI installation completes, reset the `npm_config_global` environment variable. Issue the command that corresponds with your operating system:
    - Windows Command Prompt: `set npm_config_global=`
    - Windows PowerShell: `$env:npm_config_global=""`
    - macOS/Linux Bash: `export npm_config_global=`
4. Continue configuring Zowe CLI. Or, reissue a Zowe command that returned an error message. You should no longer get an error message.

Chain commands fail in a batch script

Valid on Windows

Symptom: When invoking Zowe CLI in a batch script (`.bat` or `.cmd` file), subsequent commands in the script do not run.

Solution:

To prevent the Zowe executable from taking control and stopping the execution of the script it is called from, add `call` in front of each Zowe CLI command.

In the example below, the script never prints "hello" to the terminal:

To fix this, add `call` before the Zowe CLI command.

For multiple Zowe CLI commands, see the following example:

Command not found message displays when issuing `npm install` commands

Valid on all supported platforms

Symptom:

When you issue NPM commands to install the CLI, the message *command not found* displays. The message indicates that Node.js and NPM are not installed on your computer, or that PATH does not contain the correct path to the NodeJS folder.

Solution:

To correct this behavior, verify the following:

- Node.js and NPM are installed.
- PATH contains the correct path to the NodeJS folder.

For more information, see System requirements for Zowe CLI.

EACCESS error when issuing `npm install` command

Valid on Windows, Mac, or Linux

Symptom:

An `EACCESS` error is returned when you issue the `npm install -g` command to install a package from Zowe.org or npm.

Solution:

To resolve the issue, follow the steps described in Resolving EACCESS permissions errors when installing packages globally in the npm documentation.

Installation fails on Oracle Linux 6

Valid on Oracle Linux 6

Symptom:

You receive error messages when you attempt to install the product on an Oracle Linux 6 operating system.

Solution:

Install the product on Oracle Linux 7 or another Linux or Windows OS. Zowe CLI is not compatible with Oracle Linux 6.

Node.js commands do not respond as expected

Valid on Windows or Linux

Symptom:

You attempt to issue node.js commands and you do not receive the expected output.

Solution:

There might be a program that is named *node* on your path. The Node.js installer automatically adds a program that is named *node* to your path. When there are pre-existing programs that are named *node* on your computer, the program that appears first in the path is used. To correct this behavior, change the order of the programs in the path so that Node.js appears first.

`npm install -g` command fails due to an EPERM error

Valid on Windows

Symptom:

This behavior is due to a problem with Node Package Manager (npm). There is an open issue on the npm GitHub repository to fix the defect.

Solution:

If you encounter this problem, some users report that repeatedly attempting to install Zowe CLI yields success. Some users also report success using the following workarounds:

- Issue the `npm cache clean` command.
- Uninstall and reinstall Zowe CLI. For instructions, see the Zowe CLI installation checklist.
- Add the `--no-optional` flag to the end of the `npm install` command.

Paths converting in Git Bash

Valid on Windows

Symptom:

When issuing a command with an absolute directory path that begins with a forward slash, Git Bash converts it into an invalid path that does not exist.

If a command includes a path similar to the following example:

Git Bash can erroneously convert the root directory to a drive letter, as in the example below:

> **NOTE**
>
> Depending on the root directory, the Git Bash conversion can add other directories it assumes to be included in the path.

Solutions:

- Replace the single slash in front of a path with double slashes (//). This stops Git Bash from remapping the path.

  To avoid conversion in the example above, edit the path in the following manner:

- Set the environment variable `MSYS_NO_PATHCONV` to `1` in one of the following ways:
  - Use the export command.

    While running commands in a terminal, run the export command once during that terminal session. If writing a script, run the command once at the top of the script.

    The export command is included in the following example:

  - Set the environment variable in your `~/.bashrc` file to define it permanently.

The better option depends on particular circumstances. Using double forward slashes is a good choice when defining system-wide environment variables could cause problems with other applications. On the other hand, the environment variable helps avoid rewriting paths on every CLI command that uses them.

`Sudo` syntax required to complete some installations

Valid on Linux and macOS

Symptom:

The installation fails on Linux or macOS.

Solution:

Depending on how you configured Node.js on Linux or macOS, you might need to add the prefix `sudo` before the `npm install -g` command or the `npm uninstall -g` command. This step gives Node.js write access to the installation directory.

Missing data set search results with `--mainframe-search` option

Valid on Windows, Mac, or Linux

Symptom:

When the `zowe zos-files search data-sets` command is issued with the `--mainframe-search` option, results can omit data sets that are in binary format.

Solution:

Issue the `zowe files search ds` command without the `--mainframe-search` option. This returns results that include data sets in binary format.

Error message with PowerShell scripts

Valid on Windows

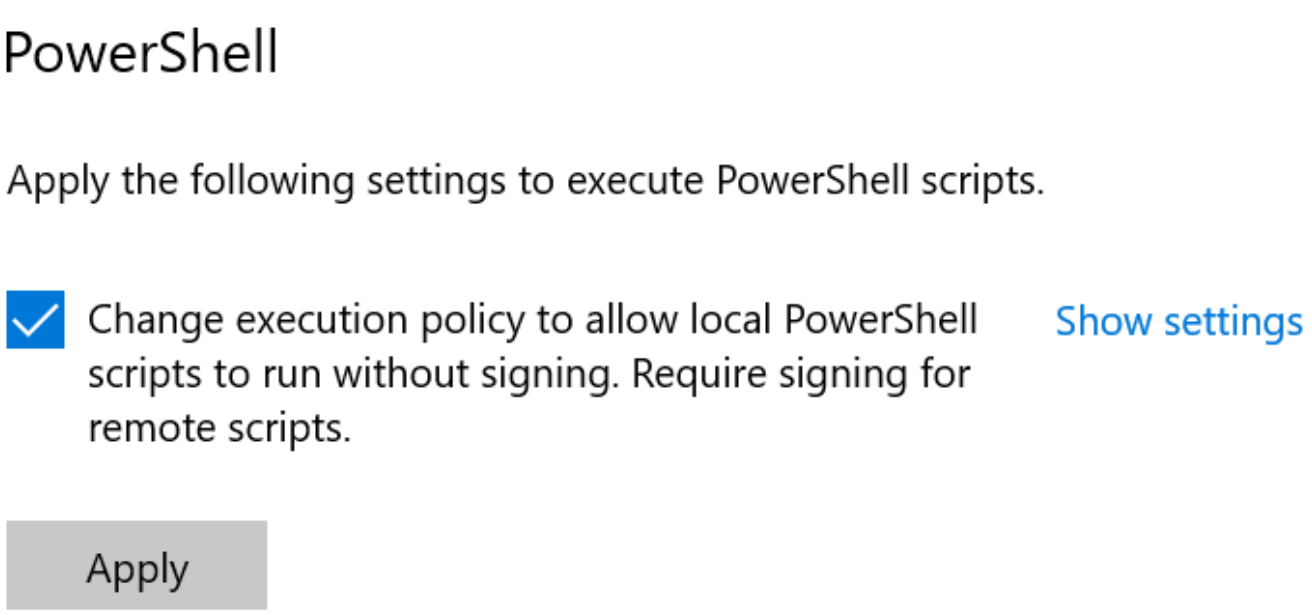
Symptom:

PowerShell users on Windows can encounter an error when they try to run Zowe CLI with certain execution policies in place.

Example of an error message:

Solutions:

- Update developer settings in Windows to enable running local scripts without signing:



- Run PowerShell as an administrator and use the `Set-ExecutionPolicy` command to change the execution policy to a less-restrictive setting, for example: `Set-ExecutionPolicy RemoteSigned -scope CurrentUser`.

Version: v3.2.x LTS

Raising a CLI issue on GitHub

When necessary, raise a GitHub issue in the Zowe™ CLI repository. It is suggested that you use either the bug or enhancement template.

Raising a bug report

Please provide as much of the information listed on Troubleshooting CLI as is reasonable. Anyone working on the issue might need to request this and other information if it is not supplied initially. A description of the error and how it can be reproduced is the most important information.

Raising an enhancement report

Enhancement reports are just as important to the Zowe project as bug reports. Enhancement reports should be clear and detailed requirements for a potential enhancement.

Version: v3.2.x LTS

Troubleshooting Zowe CLI plug-ins

When there is a problem

If a plug-in for Zowe™ CLI is experiencing a problem, there are steps you can take to find a potential solution.

Error codes

For help with error codes from a back-end vendor, refer to the vendor's help documentation.

Reaching out for support

1. Is there already a GitHub issue (open or closed) that covers the problem? Check the following repositories:

   - IBM CICS Plug-in issues
   - IBM Db2 Database Plug-in issues
   - IBM MQ Plug-in issues
   - IBM z/OS FTP Plug-in issues

   If there is no issue on the problem, file an issue in the repository for the respective plug-in so the dev team can review it.

2. Try searching for the issue using the Zowe Docs **Search** bar.

3. Use the Zowe CLI Slack channel to reach the Zowe CLI community for assistance.

Version: v3.2.x LTS

IBM Db2 Database Plug-in troubleshooting

Incompatible glibc version

The `ibm_db` dependency, which utilizes pre-built drivers to access DB2 and downloads those drivers at install time, pulls down drivers with a pre-requisite on the GNU C library (glibc) version 2.32.

Due to potential incompatibility issues, users on some Linux distributions might encounter an error while attempting to install any version of the DB2 Plug-in. Known distributions affected include Ubuntu 20, Debian 11, CentOS 8, and Red Hat Enterprise Linux 8.

If you are using any of these distributions of Linux, a workaround is required.

Symptom:

Solution:

Use one of the following workarounds:

For Zowe v3 LTS DB2 Plug-in versions 6.1.0 and above, run the following command before installing the DB2 Plug-in:

For Zowe v2 LTS, and Zowe v3 LTS DB2 Plug-in versions prior to 6.1.0, run the following command before installing the DB2 Plug-in:

ODBC driver install failure

As part of the IBM Db2 Database Plug-in installation, the ODBC driver is automatically installed. The driver is required to connect to Db2, but installation can fail due to security restrictions.

When the ODBC driver installation fails, Zowe CLI displays an error message. To resolve the error, the user can manually download and install the driver.

Symptom:

The ODBC driver installation fails when installing the IBM Db2 Database Plug-in.

The ODBC driver installation can fail due to several factors, displaying the following error when the `zowe plugins install` command is issued:

To identify the cause of the error and get more details to troubleshoot, run the following command:

The response includes an error message, which could specify a timeout or unpacking error.

Timeout error

Network restrictions can prevent the ODBC driver from downloading, resulting in a timeout error:

Solution:

Download the ODBC driver manually by following the instructions in Downloading the ODBC driver.

Unpacking error

If the driver downloads successfully, security settings can still prompt an unpacking error.

In the following example, the ODBC driver is downloaded manually and the environment variable `IBM_DB_INSTALLER_URL` is set to the local path to the ODBC driver.

Solution:

To fix a failed extraction:

1. Manually extract the ODBC driver binaries from the `build.zip` file which is bundled with the ibm_db package. The `build.zip` archive can also be downloaded from GitHub.
2. Open the `build/Release` folder and copy the binary for your Node version (for example, `odbc_bindings.node.18.18.2` if you have Node 18) into the Db2 plug-in folder (`C:\Users\username\.zowe\plugins\installed\node_modules\@zowe\db2-for-zowe-cli\node_modules\ibm_db\build\Release`).
3. Rename the file to `odbc_bindings.node`. This is the name used by the Db2 plug-in.

   You successfully extracted the ODBC driver.

> **NOTE**
>
> The preceding steps extract the driver binary to fix a broken installation of the IBM Db2 Database Plug-in. When installing a new version of the plug-in, perform the workaround again to fix a failed extraction.

Version: v3.2.x LTS

Troubleshooting Zowe Explorer

As a Zowe Explorer user, you may encounter problems when using Visual Studio Code extension functions. Review Zowe Explorer known issues and troubleshooting solutions here.

Before reaching out for support

1. Is there already a GitHub issue (open or closed) that covers the problem? Check Zowe Explorer Issues.
2. Review the current list of Known issues in documentation. Also, try searching using the Zowe Docs search bar (keyboard shortcut `ctrl` + `k`).
3. Collect the following information to help diagnose the issue:
    - The Zowe Explorer and Visual Studio Code versions installed
        - See Checking your Zowe version release number for information.
    - Node.js and NPM versions installed
    - Your operating system
    - Zowe Logs, which usually can be found in `C:\Users\userID\.vscode\extensions\zowe.vscode-extension-for-zowe-X.Y.Z\logs`

        > **NOTE**
        >
        > In some cases, this path can differ. On operating systems such Linux or Mac, the default path is `~/.vscode/extensions/zowe.vscode-extension-for-zowe-X.Y.Z/logs`. In a non-standard installation of Visual Studio Code, extensions could be stored under a different directory.

Use the Slack channel to reach the Zowe Explorer community for assistance.

Connection issues with Zowe Explorer

If you are using Zowe Explorer at a site that uses an Internet proxy but cannot connect to a mainframe, ensure that the **Proxy Support** setting in Visual Studio Code is properly configured. Your system administrator can provide information on which option works best for your network environment.

Note that Zowe Explorer cannot bypass this setting as it would circumvent the VS Code setting applied to all other extensions.

To access the **Proxy Support** setting in VS Code:

1. Open VS Code and select the **Manage** icon on the **Side Bar**.
2. Select the **Settings** option from the context menu.
3. In the Settings view, open the **Application** menu and select **Proxy**.
4. Find the **Proxy Support** drop-down menu and select the appropriate option.

In addition, VS Code allows users and administrators to configure proxy options on launch. See Network Connections in Visual Studio Code for more information on proxy server support.

System administrators can also add IP addresses, IP ranges, or DNS hostnames for each system inaccessible by proxy to the `NO_PROXY` environment variable. VS Code uses this variable for outgoing requests.

Resolving invalid profiles

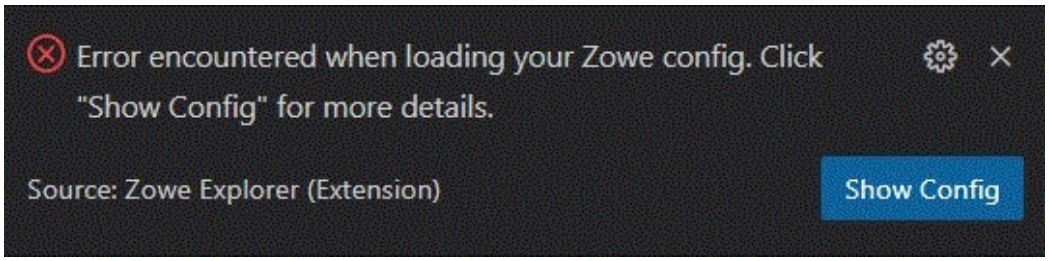
A problem with a configuration file can make Zowe Explorer unable to read your configurations.

Zowe Explorer displays an error message advising it cannot read the configuration file when a Zowe V3 configuration file fails to load.

Possible problems in the file could include a syntax error, or an invalid keyword or symbol.

To fix the configuration file causing the error:

1. Click the **Show Config** button in the message window.

   This opens the file in an **Editor** tab.

2. Modify the file as needed and save the changes.

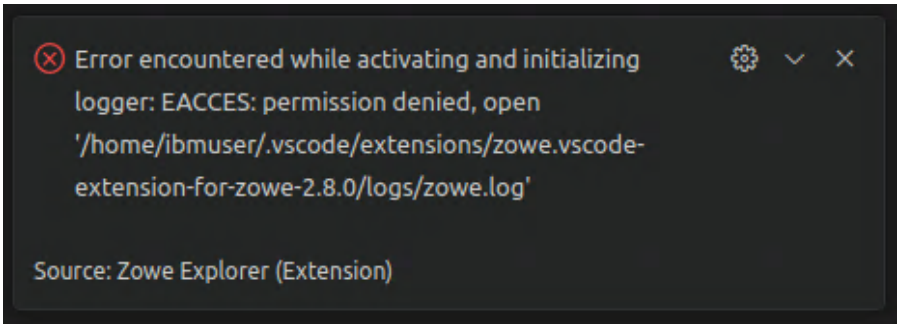
3. Reload Visual Studio Code to confirm that Zowe Explorer can read the updated file.

Missing write access to VS Code `extensions` folder

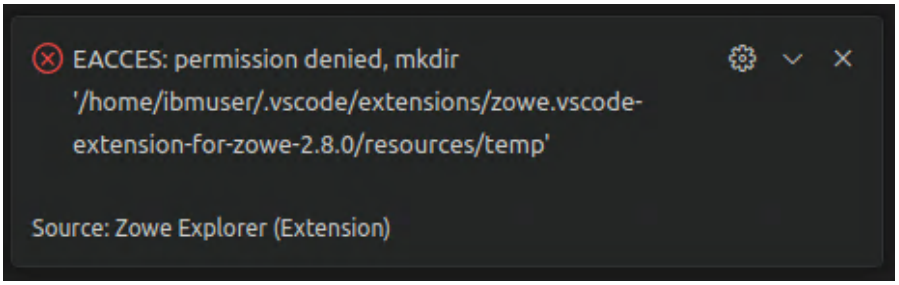
In some environments, the path for VS Code extensions (typically `~/.vscode/extensions`) can be read-only. This can happen when an environment has developers sharing a common read-only extensions folder that is managed by an admin with write access.

In these cases, Zowe Explorer fails to activate because it cannot write to the `logs` and `temp` folders in the extension path. When Zowe Explorer launches, an `EACCES: permission denied` error displays. See the following examples.

`logs` folder write access error:



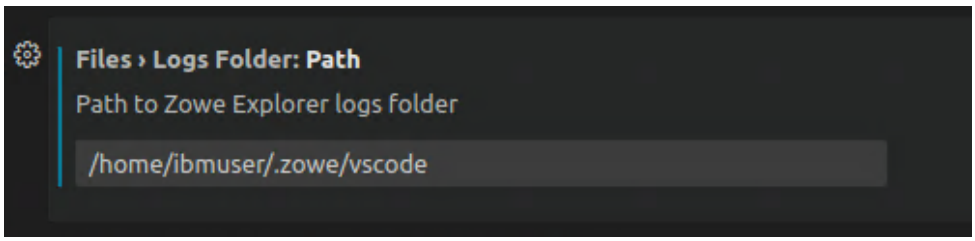
`temp` folder write access error:



To avoid this, change the `logs` and `temp` folder locations:

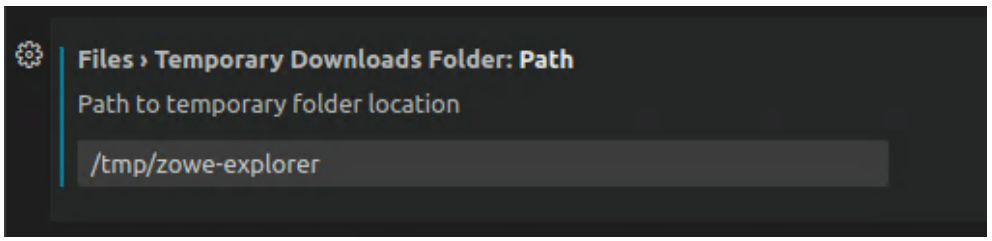
1. In VS Code, select the **File menu**, select **Preferences**, and click on **Settings**.
2. In either the **User** or **Workspace** tab, click on the **Extensions** option to open the menu.
3. Select **Zowe Explorer**.
4. Enter the new path in the **Logs Folder** or **Temporary Downloads Folder** fields. For examples:

   `logs` folder setting:

   - Log files include information about Zowe Explorer and the connections it makes to the mainframe. These files can be used for troubleshooting and to analyze errors.

   `temp` folder setting:

- Temporary files are local copies of data sets or USS files downloaded from the mainframe to edit in VS Code. These files last until VS Code closes and all changes have been uploaded to the mainframe.

After a new path is entered, Zowe Explorer writes logs and temporary files using the corresponding path.

Version: v3.2.x LTS

Known Zowe Explorer issues

The following topics contain information that can help you troubleshoot problems when you encounter unexpected behavior when using Zowe Explorer.

Bidirectional languages

Files written in languages primarily read from right to left (Arabic, Hebrew, many Asian languages) can include portions of text that are written and read left to right, such as numbers.

These bidirectional (BiDi) languages are not currently supported in Visual Studio Code. See Issue #86667 for more information.

As a result, VS Code extensions like Zowe Explorer, Zowe Explorer CICS Extension, and Zowe Explorer FTP Extension are not able to support BiDi languages in files.

Client certificate support

Some Zowe Explorer users prefer to use certificates to access the API Mediation Layer. This can be the case in sites that use credentials such as passwords and multifactor authentication, which might only be valid for a short period of time. On the other hand, certificates can be valid for much longer.

Zowe Explorer does not support authenticating to API ML using client certificates. However, it is possible to use Zowe CLI to authenticate to API ML using client certificates and receive a token that Zowe Explorer can use for API ML access.

To use a client certificate to generate an API ML token:

1. Open a command line window and issue the following command:

   - `<APIML Host>`

     Specifies the API ML host.

   - `<APIML Port>`

     Specifies the API ML port.

   - `<PEM Public Certificate Path>`

     Specifies the path for the PEM public certificate.

   - `<PEM Private Certificate Path>`

     Specifies the path to the PEM private certificate.

   Zowe CLI procures a security token from API ML and adds that token to the base profile in the applicable configuration file.

2. Open Zowe Explorer, or reload it if already open.

Zowe Explorer can access the API ML token in the base profile for authentication.

> **NOTE**
>
> If you have multiple types of configuration files and base profiles, see How configuration files and profiles work together to learn which configuration and profile would be used to store the API ML token.

Data Set creation error

Symptom:

Data set creation fails.

Sample message:

Error running command zowe.createDataset: z/OSMF REST API Error: http(s) request error event called Error: self signed certificate in certificate chain. This is likely caused by the extension that contributes zowe.createDataset.

Solution:

Set the value of the Reject-Unauthorized parameter to `false`. Use the profile edit function to change profile's parameters.

Opening binary files error

Symptom:

When opening a binary file, an error message appears.

Sample messages:

Solution:

There is no solution or workaround at this time.

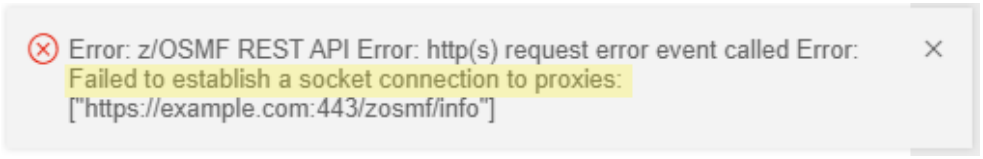
Visual Studio Code mainframe connection error

Symptom:

When performing an action that requires a mainframe connection (such as searching for data sets), you get a proxy error.

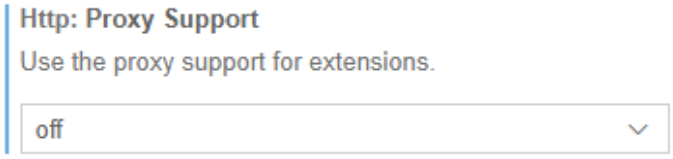
Sample message:

"z/OSMF REST API Error" that includes the message `Failed to establish a socket connection to proxies`, as in the following image:



Solution:

In VS Code settings, search for `proxy` and change the http.proxySupport setting to `off`, as in the following image:



Version: v3.2.x LTS

Known Zowe Explorer limitations

Data set pagination and descending sort for PDS members

Limitation

Zowe Explorer v3.2.0 and higher implements server-side pagination by default when displaying lists of data sets and Partitioned Data Set (PDS) members. This feature divides large lists into separate, more manageable pages.

When sorting PDS members in descending order, members are first paginated alphabetically. Your specified descending sort is then applied to the members *within* each page. Consequently, you might need to navigate through multiple pages (using **Next page**/**Previous page**) to locate a specific member.

> **NOTE**
>
> This behavior primarily affects profile types that support listing ranges of PDS members, such as z/OSMF and z/FTP.

Workarounds

To mitigate this behavior:

- **Disable Data Set List Pagination**

  Set the **Zowe > Ds > Paginate: Max Items Per Page** user setting to `0`. This disables the pagination feature for data set and PDS member lists, loading all items at once. This approach might impact performance for very large PDSs.

- **Refine Member Search Pattern**

  Use a more specific member pattern when searching. This can limit the number of members returned, potentially reducing the need to navigate across multiple pages.

Mismatched credentials when using Zowe Explorer and Zowe CLI

Limitation

Mismatching credentials can potentially lock you out from using Zowe CLI and Zowe Explorer in Visual Studio Code with either Windows Subsystem for Linux (WSL) or Remote Secure Shell (SSH).

WSL allows developers to run a Linux environment on Windows without the need for a separate virtual machine or dual booting. When using Zowe Explorer with WSL, two parallel processes take place: VS Code runs on the Windows operating system, while code execution and tooling happen within the Linux environment.

With Remote SSH, the network protocol provides users with a secure connection to a remote computer. When using this protocol with Zowe Explorer, you can securely connect to a remote machine or a remote development environment.

Both WSL and Remote SSH provide more tools for mainframe developers, but they also have limitations when it comes to credentials.

Authentication information used in Zowe Explorer — such as usernames and passwords, SSH keys, and API Mediation Layer tokens — resides on the developer's local machine, provided the developer is not connected to a remote environment through VS Code. If you are connected to a remote environment through VS Code, your secure credentials are stored on the remote system.

Using the VS Code integrated terminal with virtual machines does not include access to the credentials stored by Zowe Explorer in the local machine. Zowe CLI, for example, is not able to retrieve credentials saved on a developer's PC when accessing the mainframe. Instead, Zowe CLI attempts to use any credentials stored in the virtual machine.

This can lead to confusion and inconsistencies when authenticating and accessing resources.

Workaround

It is crucial to ensure that credentials are carefully managed between the local machine and the remote server to maintain proper authentication.

To avoid any potential issues (such as being locked out) caused by credential mismatch or discrepancies, credentials in both local and virtual/remote machines must match.

Version: v3.2.x LTS

Raising a Zowe Explorer issue on GitHub

When necessary, raise a GitHub issue in the Zowe Explorer for Visual Studio Code repository. It is suggested that you use either the bug or feature request.

Raising a bug report

Please provide as much of the information listed on Troubleshooting Zowe Explorer as is reasonable. Anyone working on the issue might need to request this and other information if it is not supplied initially. A description of the error and how it can be reproduced is the most important information.

Submitting a feature request

Feature requests are just as important to the Zowe project as bug reports. Feature requests should contain clearly formulated ideas that can improve user experience.

Version: v3.2.x LTS

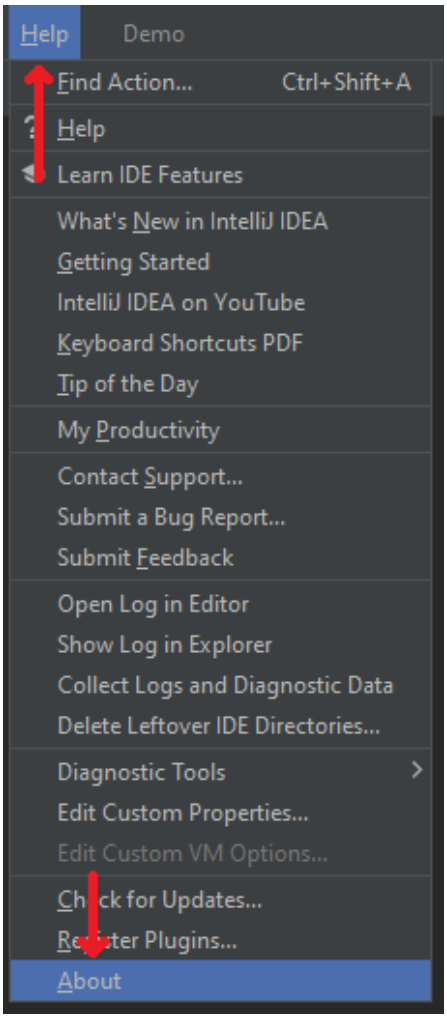
Troubleshooting Zowe Explorer plug-in for IntelliJ IDEA

As a Zowe Explorer plug-in for IntelliJ IDEA user, you may encounter problems both with the plug-in and the IntelliJ IDEA platform. Our support is open for any type of issues, related to this client-side component. See the next sections as an example of how to react on these problems.

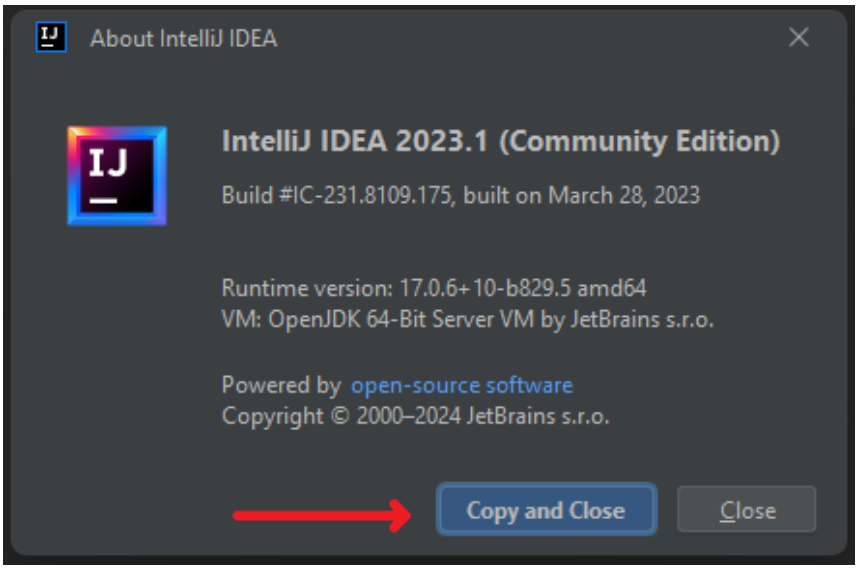
Troubleshooting IntelliJ IDEA platform issues

Sometimes there could be inconveniences in how your IDE works. Before trying to fix any problem:

1. Go to **Help** > **About**



2. Click **Copy and Close** button and save this information somewhere for later



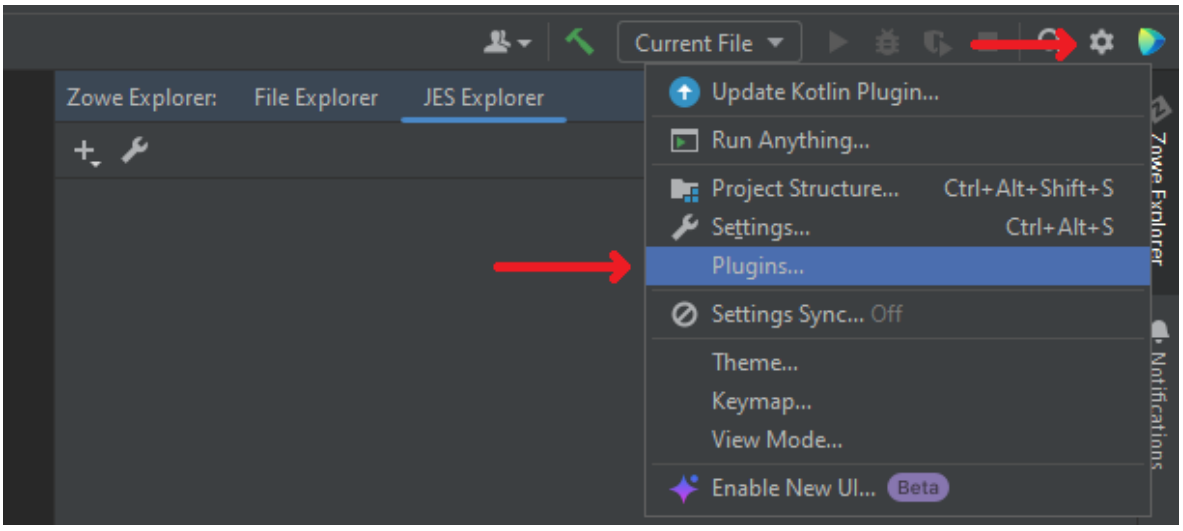
After that, there are a few steps that could be possibly done to fix the issue:

- **If the issue details are clear and IDE says, which component it is** - copy all the related information and send it to the component's developer
- **If the issue is unclear** - try to reload IDE / your computer. If the problem persists, try to reinstall the IDE or install the newest one supported LTS version of the IDE you are using
- **Ask for help or search for the related issue** - there is an issue tracker, related to the IntelliJ IDEA issues. Try to find something related or create a new one

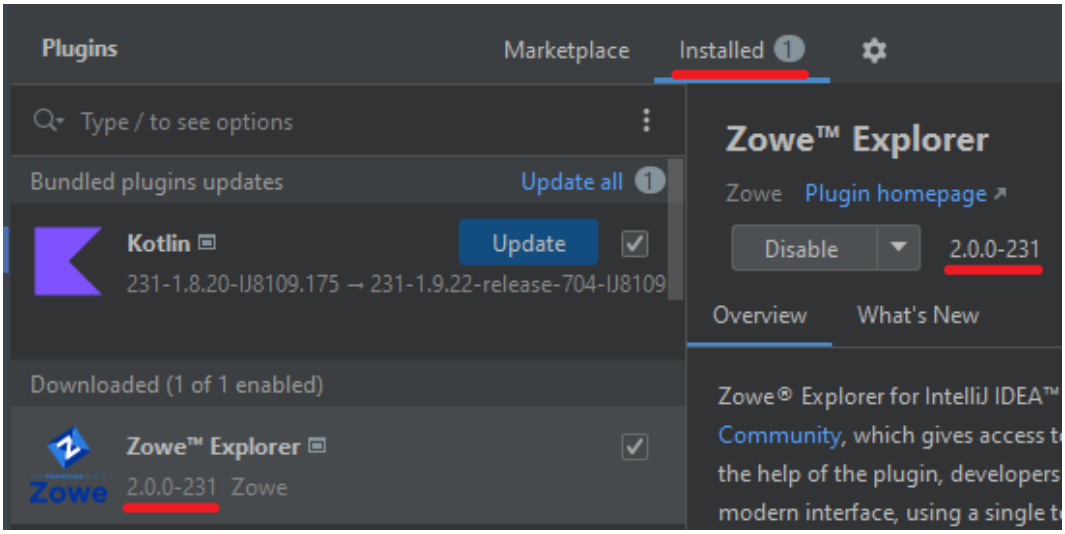
Troubleshooting the plug-in

If you have an issue with the plug-in:

1. Click the **gear** button, select **Plugins...**



2. Go to **Installed** tab, locate the plug-in, save **the exact version number**



After these actions, you have some options to try:

- **If the problem occurs for the plug-in in editor** - try to close the file you are editing, refresh the path and open it again
- **If the problem occurs with displaying a mask or a filter** - try to hit refresh on a working set or try to recreate a connection and a working set
- **If the problem occurs for some other issues related to Files Explorer or JES Explorer** - try to recreate a new connection, and a new working set for it
- **If the problem occurs for TSO Console** - try to reopen the session, try to recreate a session entirely
- **Other non-related issues, e.g. if the problem occurs for encoding or permissions or "Internal IDE error" notification appears constantly** - copy all the necessary information about the IDE you use and the plug-in's version, create a new issue listing all the necessary information (like the steps to recreate the issue) as well as the versions, or search for the related issue in the repository and put a thumb-up for it, so we know that it should have a higher priority

If you want a direct consulting, don't hesitate to visit our Slack channel and leave a message. Our team is always willing to help with any issues related to the platform or the plug-in, no matter the size of an issue or a question.

Version: v3.2.x LTS

Troubleshooting Zowe Chat

As a Zowe Chat user, you might encounter some issues with how Zowe Chat works. This section lists some solutions to help you.

Check the chatServer.log

When you run into some errors, you can check the server log which can be found in `$ZOWE_CHAT_HOME/log/chatServer.log`.

Note: You need to set `rejectUnauthorized` to `false` in `chatServer.yaml` to access the log.

Raising a Zowe Chat issue on GitHub

When necessary, you can reach out for troubleshooting support via GitHub. You can raise GitHub issues against the Zowe Chat repository. You could either use it for a bug report or feature request.

Contacting support via Slack

You can also reach out for support through the Zowe Chat Slack channel.

Version: v3.2.x LTS

Contributing to Zowe

You are welcome to contribute to Zowe in many forms and help make this project better! We want to make it as easy as possible for you to become a Zowe contributor. This topic outlines the different ways that you can get involved and provides some of the resources that are available to help you get started. All feedback is welcome.

- Report bugs and enhancements
- Fix issues
- Send a Pull Request
- Report security issues
- Contribution guidelines
- Promote Zowe
- Helpful resources

Report bugs and enhancements

- Report bugs: Download and try one of the latest Zowe builds. Report any bugs you find by creating a Zowe bug report in GitHub.
- Report enhancements: Got an idea for a feature? Or something you're already using could be improved? Post an enhancement request in GitHub!
- Upvote enhancements and bugs: You can show us that an issue matters to you by applying the thumbs-up emoji for a specific issue. See this link to view the list of issues sorted by the most upvotes. This information is taken into account when planning the upcoming PI.

If you have an issue that is specific to a sub-project or community team, feel free to submit an issue against a specific repo.

Fix issues

- There are many issues and bugs with the label `Good first issue` in the Zowe GitHub repositories to help you get familiar with the contribution process. Check out the following list of GitHub repos to make your contribution!

  - Zowe sub-projects repositories
  - Zowe operations squads repositories

  When you decide to work on an issue, check the comments on that issue to ensure that it's not taken by anyone. If nobody is working on it, comment on that issue to let others know that you want to work on it to avoid duplicate work. The squad can assign that issue to you and provide guidance as well.

- You can also reach out to the Zowe squads on Slack to check with the squads if there is any good starter issue that you can work on.

Send a Pull Request

All code in Zowe aligns with the established licensing and copyright notice guidelines.

Before submitting a Pull Request, review the general Zowe Pull Request Guidelines and make sure that you provide the information that is required in the Pull Request template in that specific repo.

All Zowe commits need to be signed by using the Developer's Certificate of Origin 1.1 (DCO), which is the same mechanism that the Linux® Kernel and many other communities use to manage code contributions. You need to add a `Signed-off-by` line as a part of the commit message. Here is an example `Signed-off-by` line, which indicates that the submitter accepts the DCO:

```
Signed-off-by: John Doe <john.doe@hisdomain.com>
```

You can find more information about DCO signoff in the zac repo.

Report security issues

Please direct all security issues to `zowe-security@lists.openmainframeproject.org`. A member of the security team will reply to acknowledge receipt of the vulnerability and coordinate remediation with the affected project.

Contribution guidelines

Check out the contribution guidelines for different components and squads to learn how to participate.

- Zowe CLI
- Zowe API Mediation Layer
- Zowe Application Framework
- Zowe Explorer
- Zowe Client SDKs
- Zowe Explorer plug-in for IntelliJ IDEA
- Zowe Docs

Promote Zowe

- Contribute a blog about Zowe. Read the Zowe blog guidelines to get started.
- Present Zowe on conferences and social channels

Helpful resources

- General code guidelines
- UI guidelines
- Zowe learning resources

Version: v3.2.x LTS

Code categories

The Zowe™ codebase consists of a few key areas, with both unique and shared guidelines that define how to write new code. A few such areas are:

- Server Core
- Server Security
- Microservices
- Zowe Desktop Applications
- Zowe Application Framework
- Zowe CLI and CLI Plug-ins
- Imperative CLI Framework

Programming languages

For each area of the codebase, there are established and favored programming languages. Each repository in Github identifies the primary language used. Some of the basic skills needed to contribute to the project include:

- **CLI** - Node.js, TypeScript
- **Desktop UI** - Node.js, JavaScript
- **APIs** - C, Assembler, Java, Spring
- **API Mediation Layer** - Java, Spring, JavaScript

> **NOTE**
>
> JavaScript is not recommended and should be avoided in favor of Typescript to utilize typing.

Component-specific guidelines and tutorials

This "Code Guidelines" section provides high-level best practices. Each component may have more specific contribution guidelines. Look for a CONTRIBUTING.md file in the component's GitHub repository for specific details.

To learn more about how to develop Zowe applications and plug-ins or extending Zowe with APIs, see Extending.

Version: v3.2.x LTS

General code style guidelines

All code written in the languages described in Code categories should adhere to the following guidelines to facilitate collaboration and understanding.

Note: Uncertainties, unimplemented but known future action-items, and odd/specific constants should all be accompanied with a short comment to make others aware of the reasoning that went into the code.

Whitespaces

Do not use tabs for whitespace. Use 2 spaces per tab instead.

Naming Conventions

Self-documenting code reduces the need for extended code comments. It is encouraged to use names as long as necessary to describe what is occurring.

Functions and methods

Methods should be named as verbs (for example, `get` or `set`), while Objects/Classes should be nouns.

Objects and functions should be CamelCase. Methods on Objects should be dromedaryCase.

Variables

Constants should be CAPITALIZED_AND_UNDERSCORED for clarity, while variables can remain dromedaryCase.

Avoid non-descriptive variable names such as single letters (except for iteration in loops such as i or j) and variable names that have been arbitrarily shortened (Don't strip vowels; long variable names are OK).

Version: v3.2.x LTS

Pull requests guidelines

The Zowe™ source code is stored in GitHub repositories under the Zowe GitHub project. You contribute to the project through Pull Requests in GitHub.

Each pull request is made against a repository that has assigned "maintainers". Pull requests cannot be merged without the approval of at least one maintainer, who will review Pull Requests to ensure that they meet the following criteria:

- The code in the pull request must adhere to the General Code Style Guidelines.
- The code must compile/transpile (where applicable) and pass a smoke-test such that the code is not known to break the current state of Zowe.
- The pull request must describe the purpose and implementation to the extent that the maintainer understands what is being accomplished. Some pull requests need less details than others.
- The pull request must state how to test this change, if applicable, such that the maintainer or a QA team can check correctness. The explanation may simply be to run included test code.
- If a pull request depends upon a pull request from the same/another repository that is pending, this must be stated such that maintainers know in which order to merge open pull requests.

Version: v3.2.x LTS

Documentation Guidelines

Documentation of Zowe™ comes in various forms depending on the subject being detailed. In general, consider how you can help end users and contributors through external documentation, in-product help, error messages, etc... and open an issue in zowe/docs-site if you need assistance.

Contributing to external documentation

The external documentation for the Zowe project, Zowe Docs, is completely open-source. See How to contribute for more information about contributing to the documentation.

Consider: Release Notes, Install/Config/User Guides, Developer Tutorials, etc...

Component Categories

Provide the following documentation depending on the component that you contribute to:

Server Core

Principles of operation and end-user guides (configuration, troubleshooting) should be documented on Zowe Docs site. Code documentation follows language-specific formats.

Server Security

Principles of operation and end-user guides (configuration, troubleshooting) should be documented on Zowe Docs site. Code documentation follows language-specific formats.

Microservices

Microservices implement a web API, and therefore must be documented for understanding and testing. These web APIs must be accompanied with documentation in the Swagger (https://swagger.io/) format. These documents must be Swagger 2.0, `.yaml` extension files. Zowe Application Framework plug-ins that implement microservices should store these files within the `/doc/swagger` folder.

Zowe Desktop Applications

Zowe Desktop applications should include documentation that explains how to use them, such that this documentation can integrate with a Zowe Desktop documentation reader. This is not strictly API documentation, but rather user guides that can display within the Desktop GUI. The preferred documentation format is a `.md` extension file that exists in the `/doc/guide` folder of an App.

Web Framework

Principles of operation and end-user guides (configuration, troubleshooting) should be documented on Zowe Docs site. Code documentation follows language-specific formats.

CLI Plugins

Provide a readme.md file for developers (overview, build, test) as well as end-user documentation for your plug-in on Zowe Docs site.

For more information, see the CLI documentation contribution guidelines.

Core CLI Imperative CLI Framework

Contributions that affect end users of the CLI should be documented on Zowe Docs site.

Contributions that affect the underlying Imperative CLI Framework should be documented in the GitHub Wiki for future developers using the framework.

Code documentation follows language-specific formats.

Programming Languages

Each of the common languages in Zowe have code-documentation-generation tools, each with their own in-code comment style requirements to adhere to in order to generate readable API references. Objects and functions of interest should be commented in accordance to the language-specific tools to result in output that serves as the first point of documentation for APIs.

Typescript

When writing TypeScript code, comment objects and functions in compliance with JSDoc. If you are writing in an area of the codebase that does not yet have a definition file for JSDoc, define a configuration file that can be used for future documentation of that code.

Java

When writing Java code, comment objects and functions in the Javadoc format.

C

When writing C code, comment functions and structures in compliance with Doxygen.

Version: v3.2.x LTS

UI Guidelines

Introduction

This style guide is the visual language that represents Zowe™. It is a living document that will be updated based on the needs of our users and software requirements.

Clear

Our users rely on our software to help them be efficient in their work. The interfaces and experiences that we design should be clear so that there is never confusion about where to click or how to take the next step. Users should always feel confident in their actions.

Consistent

Users should be able to look at Zowe software products and know that they are in a family. Each software product is different, but should use similar patterns, icons, and interactions. If a user switches to a new product within Zowe, it should feel familiar.

Smart

Our users are intelligent, and they need smart software. Zowe design patterns should always compliment the user’s intelligence and reflect the user’s complex work environment. Designs should align with the Zowe design language by putting the human needs of the user first.

Version: v3.2.x LTS

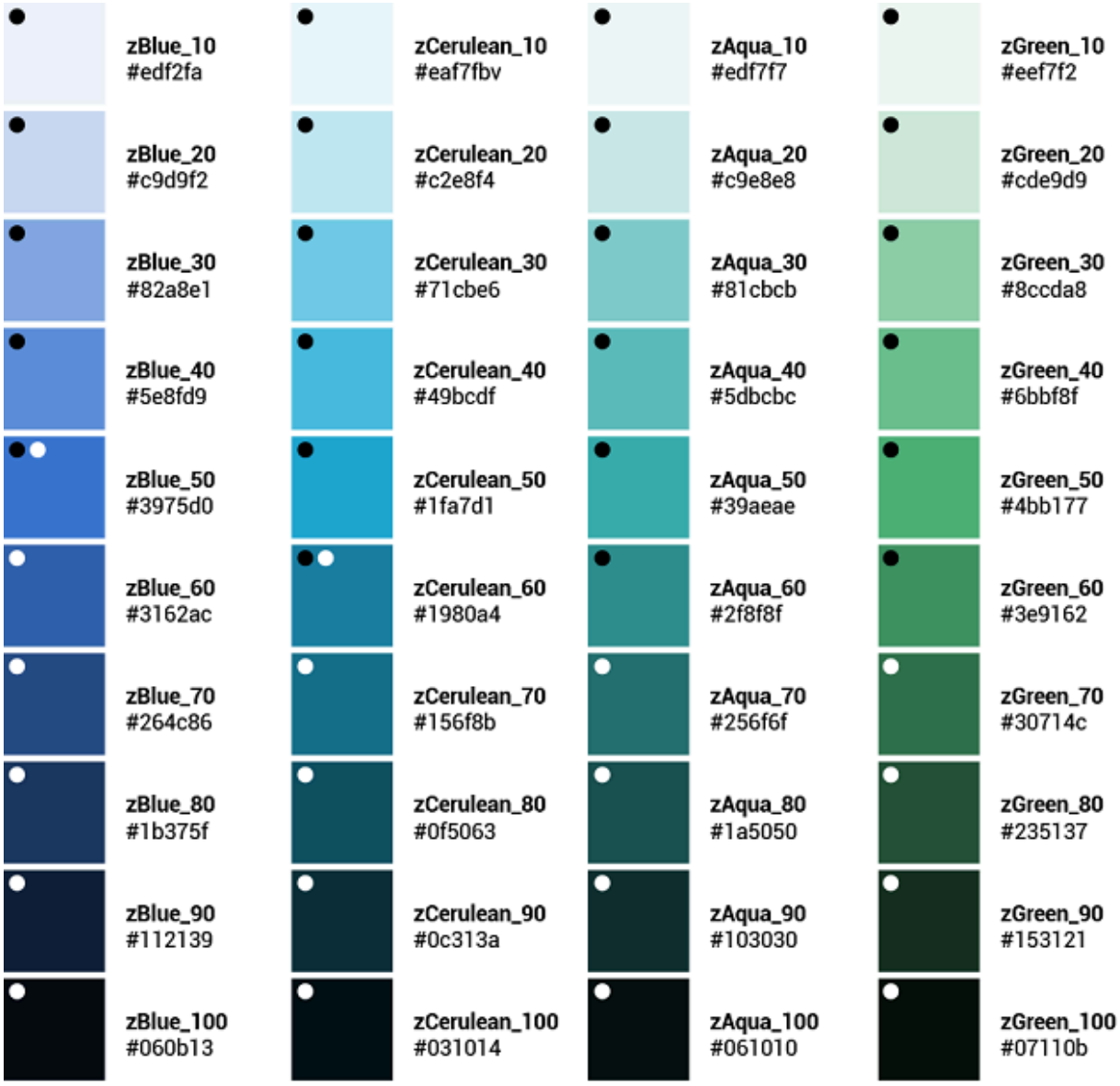
Colors

Color brings a design to life. Color is versatile; it's used to express emotion and tone, as well as place emphasis and create associations. Color should always be used in meaningful and intentional ways to create patterns and visual cues.

Color palette

The Zowe™ color palette is designed and implemented in a theme-able manner. The universal color variables are determined by common roles and usage; it is not based singularly on a color value (i.e. unique hex code). The same color value might be assigned to multiple variables in a theme's palette when the values have distinctly different roles.

A universal variable can also have multiple associated roles when the color is consistently used across those roles. This allows for uniform color application across themes, while giving each theme the freedom to express its own individuality at a more detailed level.


zBlue_10
#edf2fa
zCerulean_10
#eaf7fbv
zAqua_10
#edf7f7
zGreen_10
#eef7f2
zBlue_20
#c9d9f2
zCerulean_20
#c2e8f4
zAqua_20
#c9e8e8
zGreen_20
#cde9d9
zBlue_30
#82a8e1
zCerulean_30
#71cbe6
zAqua_30
#81cbcb
zGreen_30
#8ccda8
zBlue_40
#5e8fd9
zCerulean_40
#49bcdf
zAqua_40
#5dbcbc
zGreen_40
#6bbf8f
zBlue_50
#3975d0
zCerulean_50
#1fa7d1
zAqua_50
#39aeae
zGreen_50
#4bb177
zBlue_60
#3162ac
zCerulean_60
#1980a4
zAqua_60
#2f8f8f
zGreen_60
#3e9162
zBlue_70
#264c86
zCerulean_70
#156f8b
zAqua_70
#256f6f
zGreen_70
#30714c
zBlue_80
#1b375f
zCerulean_80
#0f5063
zAqua_80
#1a5050
zGreen_80
#235137
zBlue_90
#112139
zCerulean_90
#0c313a
zAqua_90
#103030
zGreen_90
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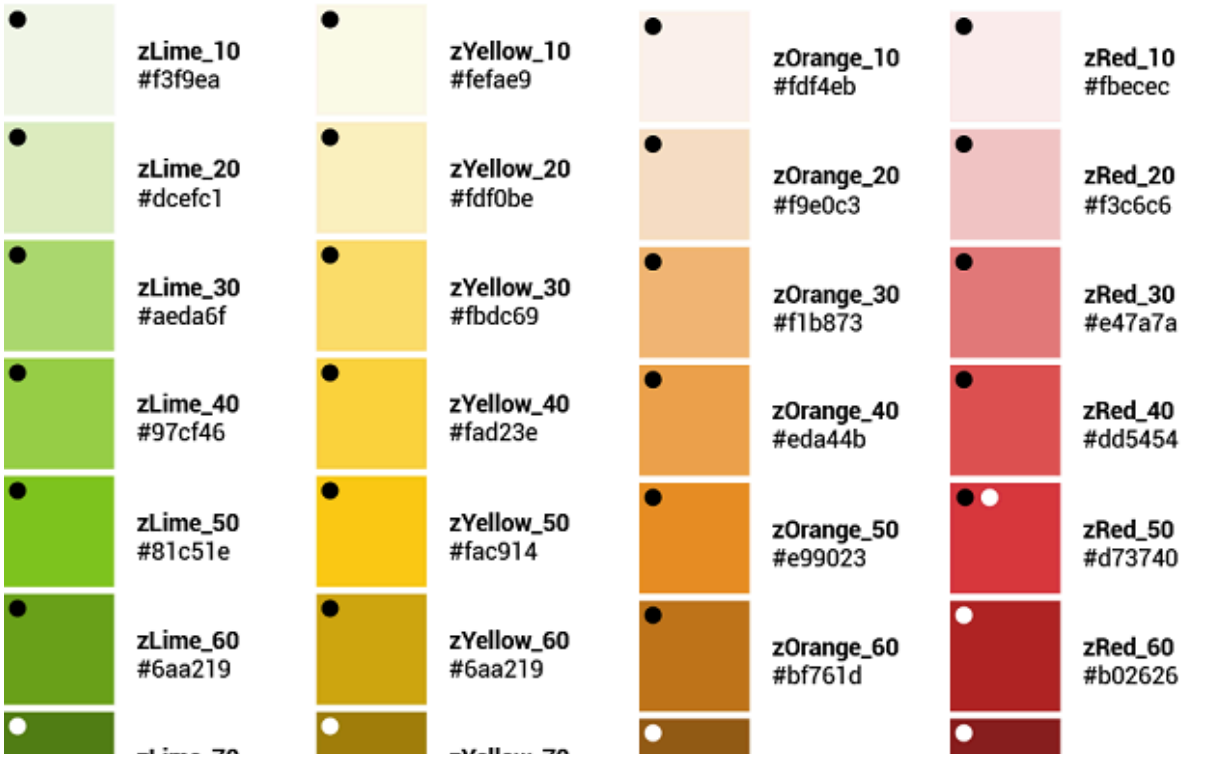
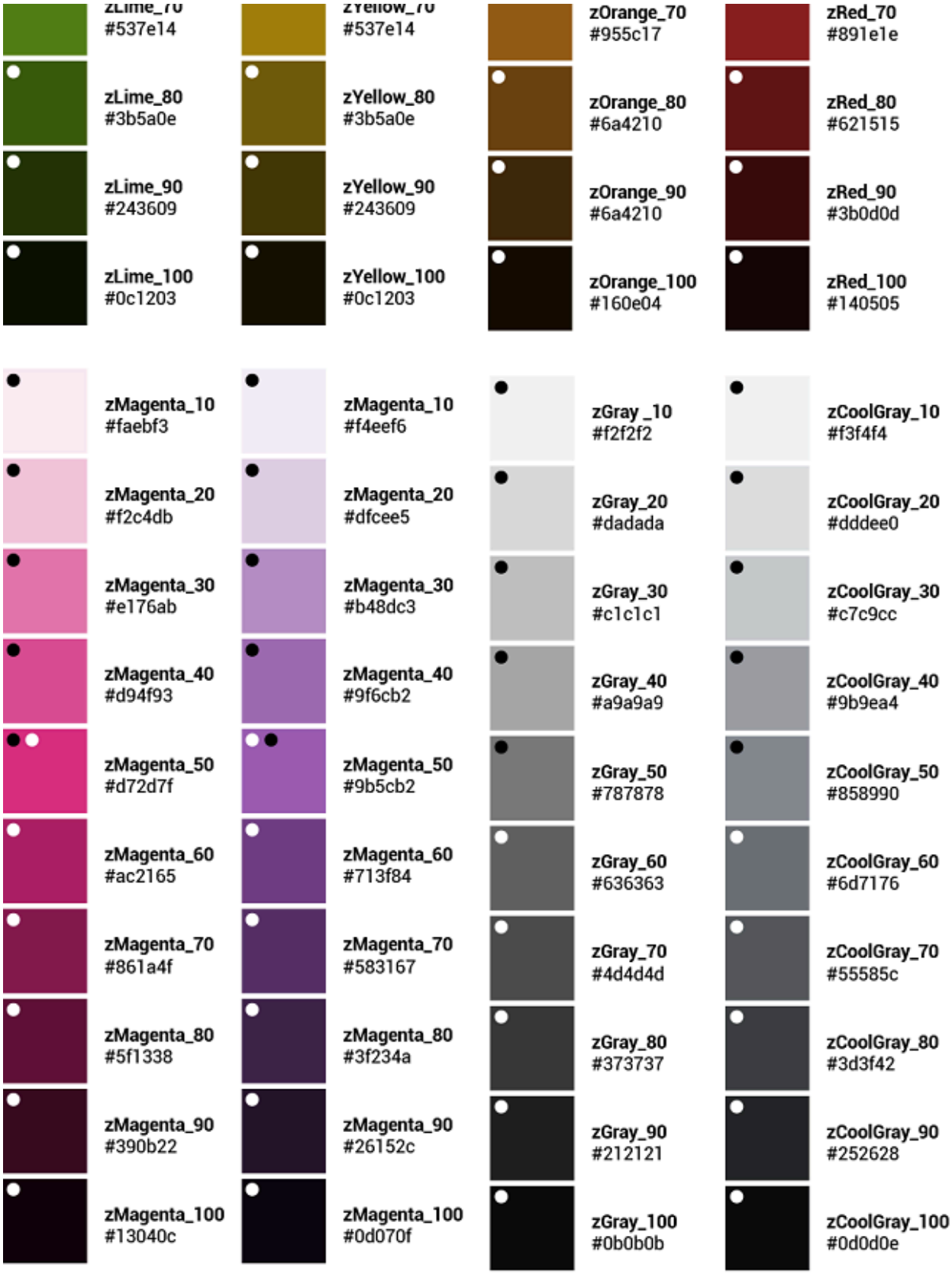
zCerulean_100
#031014
zAqua_100
#061010
zGreen_100
#07110b


zLime_10
#f3f9ea
zYellow_10
#fefae9
zOrange_10
#fdf4eb
zRed_10
#fbecec
zLime_20
#dcefc1
zYellow_20
#fdf0be
zOrange_20
#f9e0c3
zRed_20
#f3c6c6
zLime_30
#aeda6f
zYellow_30
#fbdc69
zOrange_30
#f1b873
zRed_30
#e47a7a
zLime_40
#97cf46
zYellow_40
#fad23e
zOrange_40
#eda44b
zRed_40
#dd5454
zLime_50
#81c51e
zYellow_50
#fac914
zOrange_50
#e99023
zRed_50
#d73740
zLime_60
#6aa219
zYellow_60
#6aa219
zOrange_60
#bf761d
zRed_60
#b02626



○ AA font color compliant

● AA font color compliant

Light theme

Primary / Secondary Colors

zBlue_60
#3162ac

zCoolGray_60
#6d7176

Support Colors

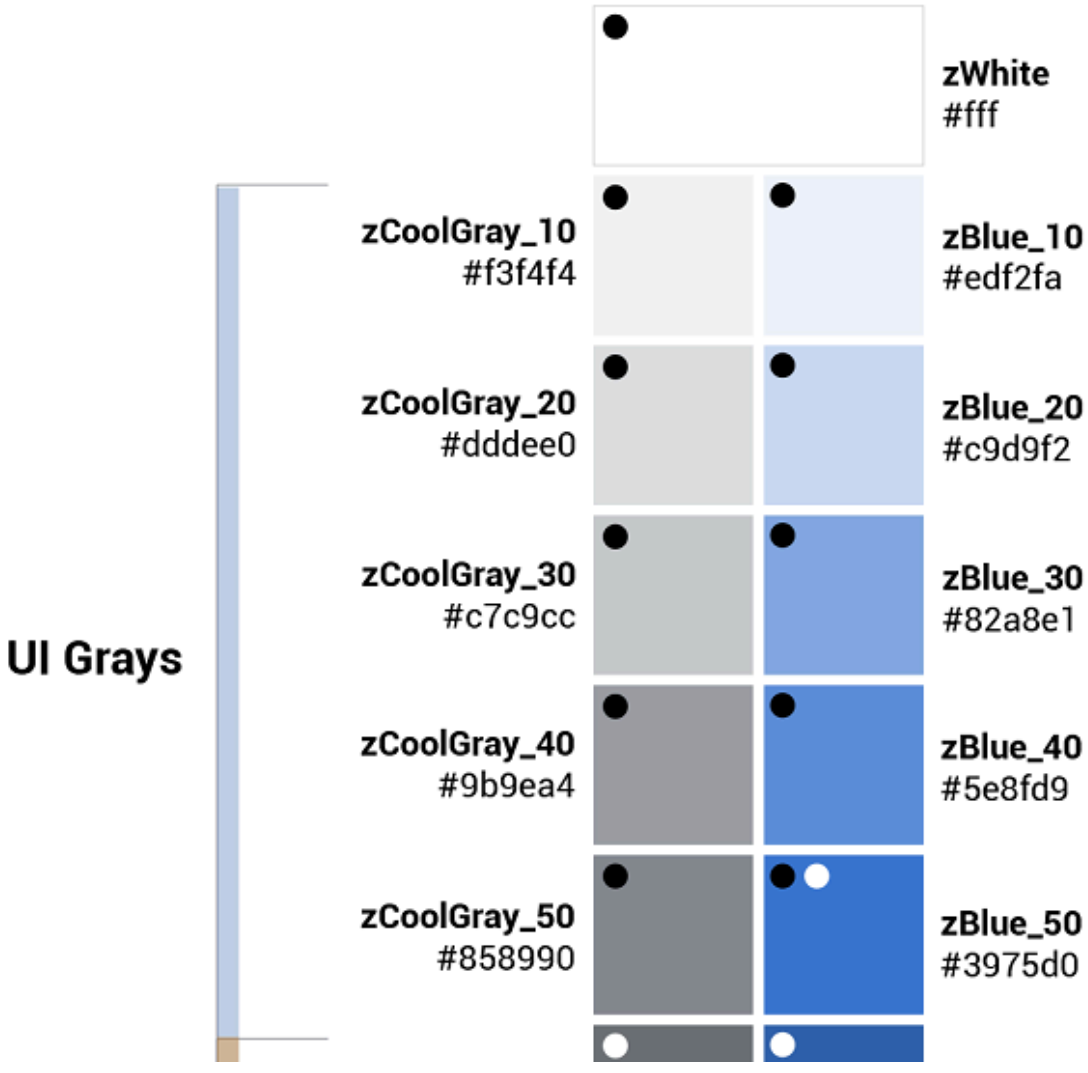
zSupport_01
#e0182d

zSupport_02
#e99023

zSupport_02
#97cf46

zSupport_02
#3b77d1

UI Colors



zWhite
#fff

UI Grays

zCoolGray_10
#f3f4f4

zBlue_10
#edf2fa

zCoolGray_20
#dddee0

zBlue_20
#c9d9f2

zCoolGray_30
#c7c9cc

zBlue_30
#82a8e1

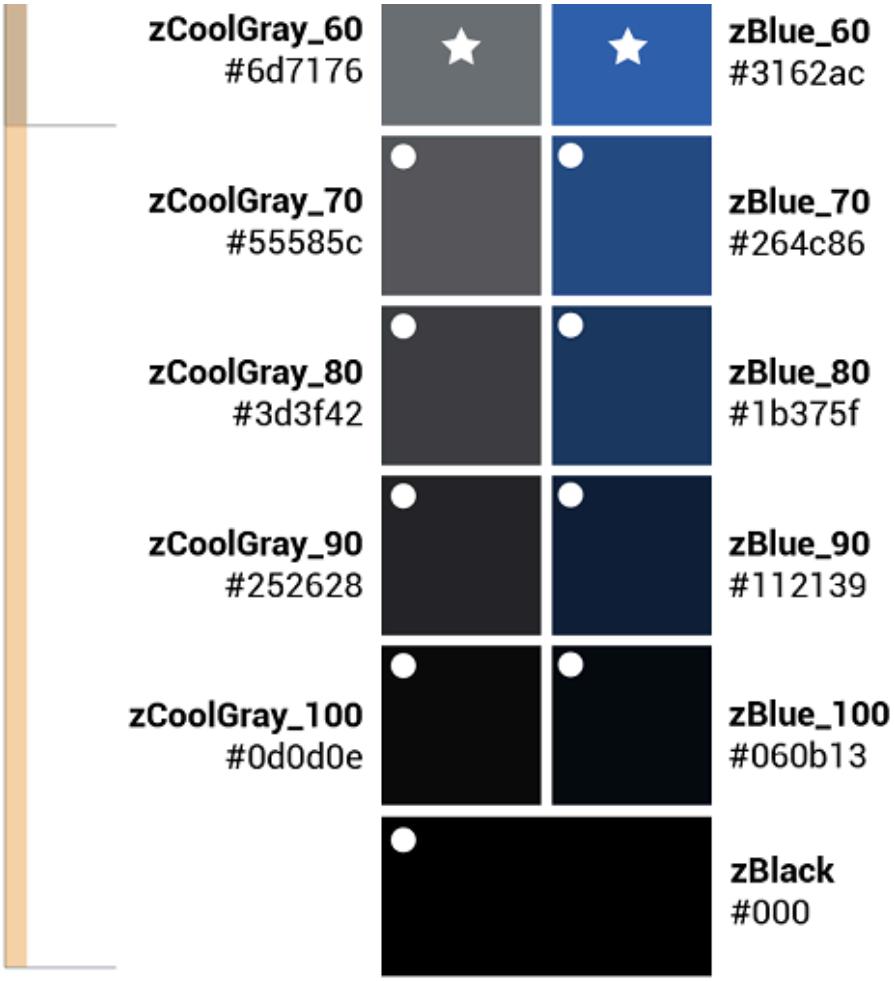
zCoolGray_40
#9b9ea4

zBlue_40
#5e8fd9

zCoolGray_50
#858990

zBlue_50
#3975d0

Font Colors



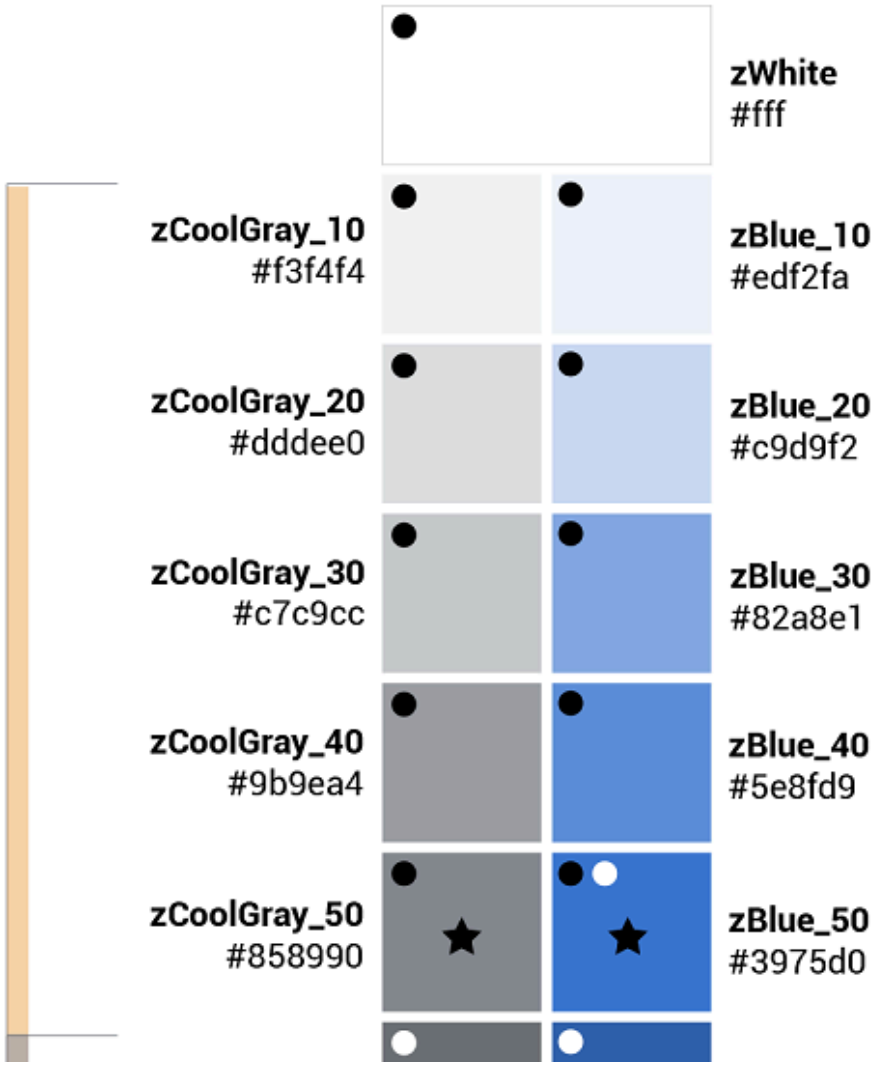
Dark theme

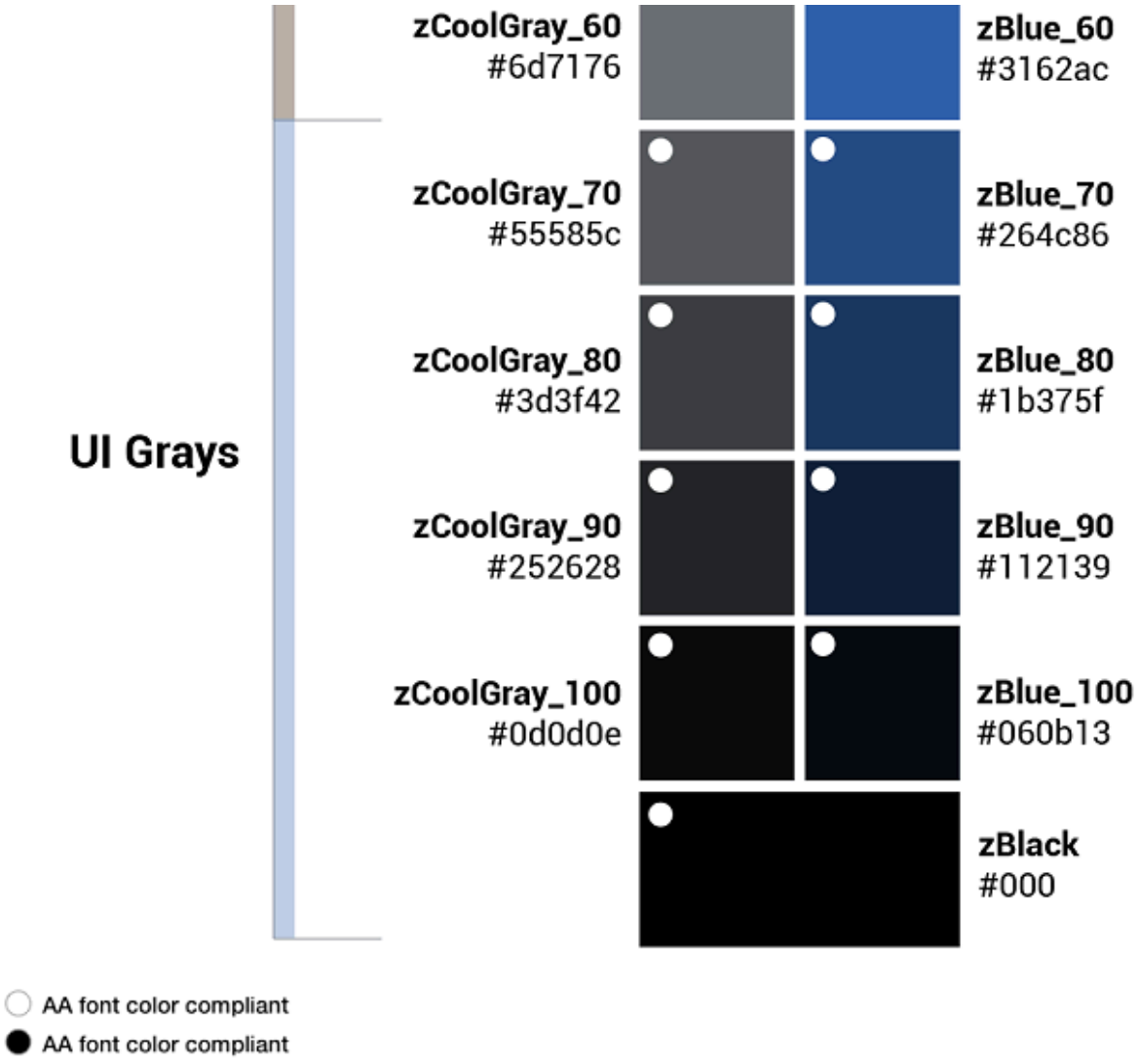
Primary / Secondary Colors

Support Colors

UI Colors

Font Colors





Color contrast | WCAG AA standards

- Type colors

  All type color combinations on Zowe must pass WCAG AA standards of 4.5:1 for normal text and 3:1 for large text. For larger text, if the font weight is light (300) or normal (400) the text should be no smaller than 24px. If the font weight is Semi-Bold (600) then the large text should be no smaller than 19px.

- Body Text (4.5:1)
- Large Text (3:1): at least 24px / 19px semi-bold

WCAG guidelines: https://www.w3.org/WAI/standards-guidelines/wcag/

Contrast Checker Tool: https://webaim.org/resources/contrastchecker/

Version: v3.2.x LTS

Typography

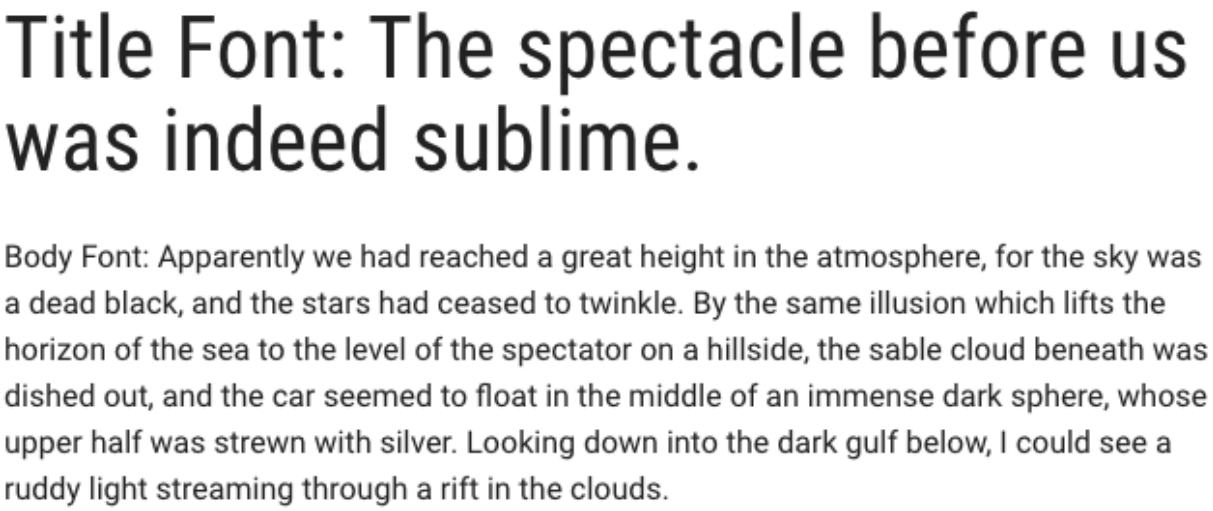
Typography is used to create clear hierarchies, useful organizations, and purposeful alignments that guide users through the product and experience. It is the core structure of any well designed interface.

Typeface

Title typeface: Roboto Condensed

Body typeface: Roboto

Sample:



Font weight

Font weight is an important typographic style that can add emphasis and is used to differentiate content hierarchy. Font weight and size pairings must be carefully balanced. A bold weight will always have more emphasis than a lighter weight font of the same size. However, a lighter weight font can rank hierarchically higher than a bold font if the lighter weight type size is significantly larger than the bold.

Roboto font family provides a wide range of weights. However, only SemiBold, Regular, Light should be used for product design.

- Font-weight: 300 / Light

  Light

  Should only be used at sizes greater than or equal to 18px / 1.125rem

- Font-weight: 400 / Normal

Regular

- Font-weight: 500 / Semi-bold

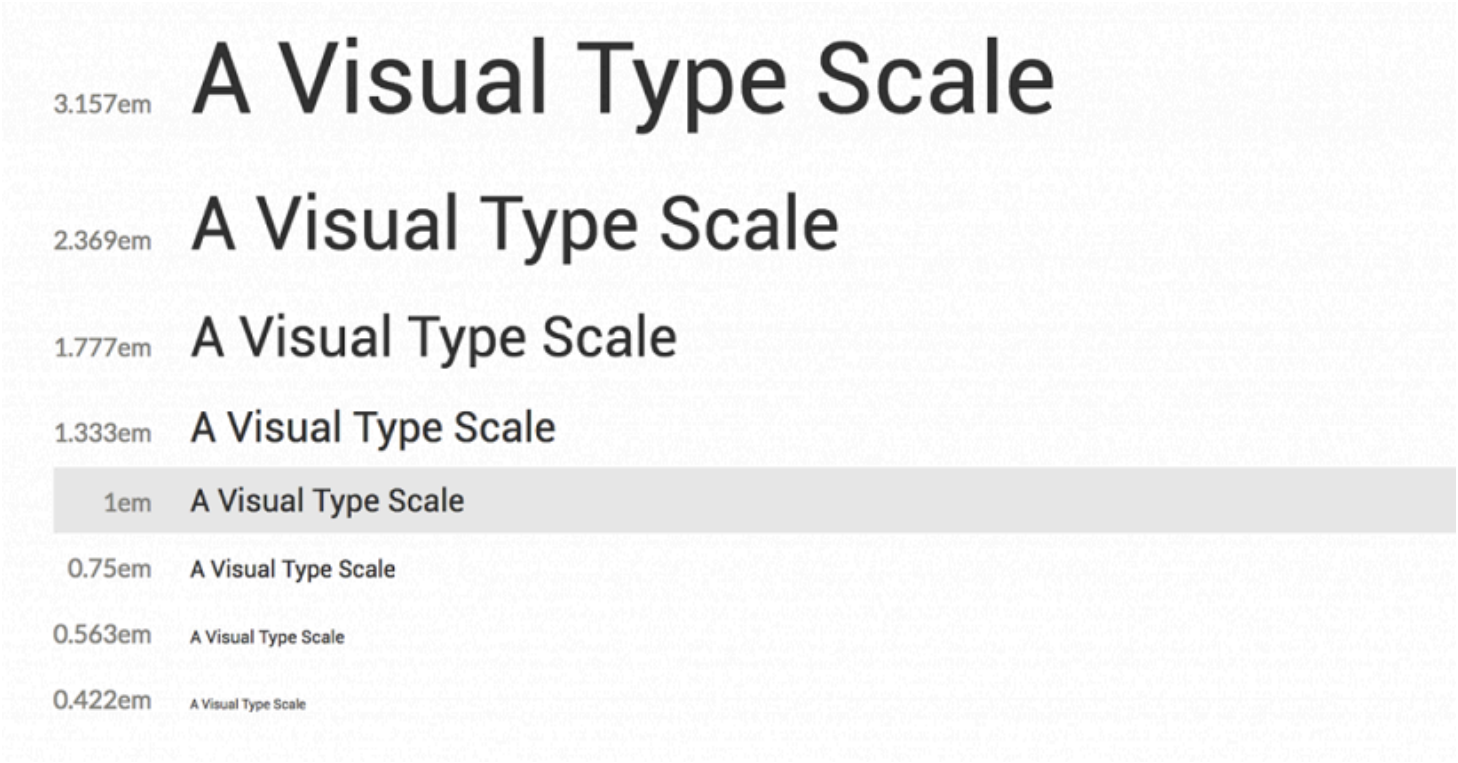
Semi-Bold

Body copy

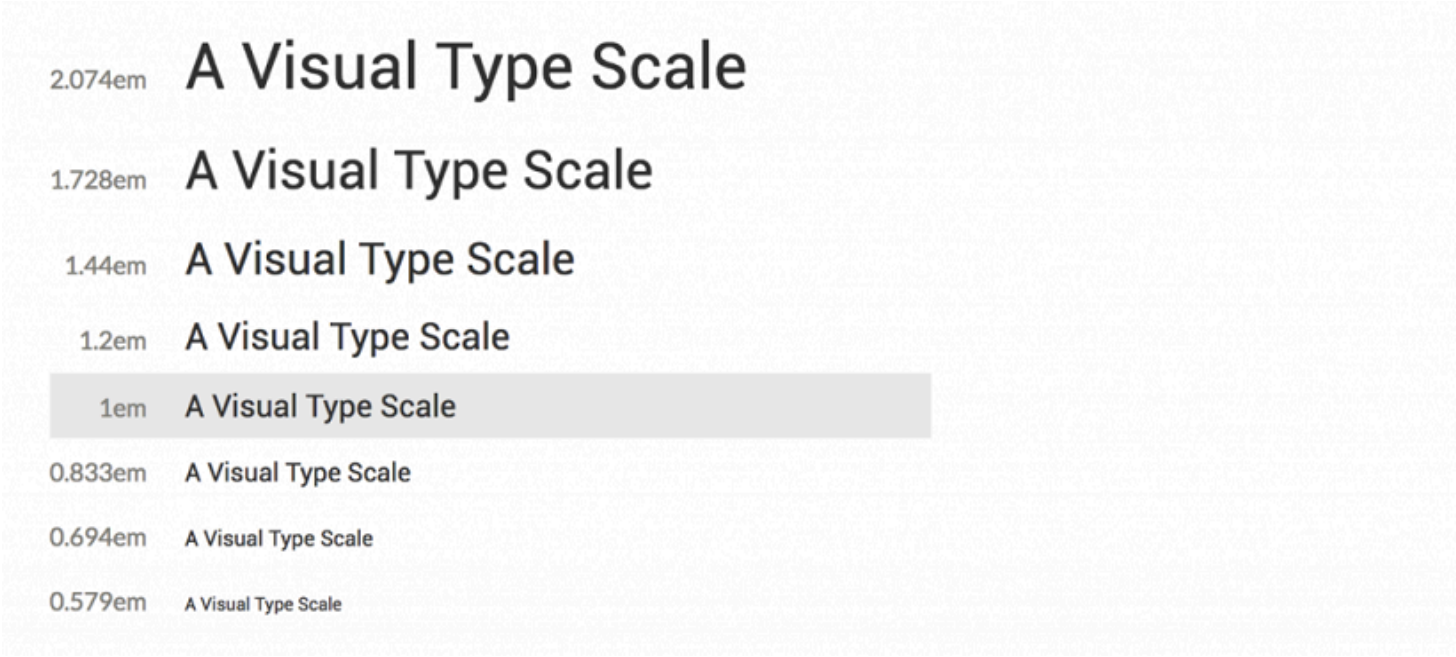
We recommended that you use two sizes for body copy. The first size is UI specific. To maximize screen real estate we chose a smaller 14px / 0.875rem body copy size for the standard UI console. However, for areas that have prolonged reading, such as Documentation, we use a larger body copy size of 16px / 1rem to enhance readability.

Line scale

- 1.333 Perfect Fourth-type scale - desktop



- 1.2 Minor Third type-scale - mobile



Line-height

Line-height, traditionally known as leading, is one of several factors that directly contribute to readability and pacing of copy. Line-heights are based on the size of the font itself. Ideal line-heights for standard copy have a ratio of 1:1.5 (typesize : line-height). For example, a type at 16px / 1rem would have a line-height of 1.5rem / 24px (16 x 1.5). The exception to this rule are headings, which need less spacing and therefore have a line-height ratio of 1:1.25.

Embed font

To embed your selected fonts into a web page, copy the following code into the `<head>` of your HTML document:

Import font

Specify in CSS

Use the following CSS rules to specify these families:

Version: v3.2.x LTS

Grid

Grid systems are used for creating page layouts through a series of rows and columns that house your content. Zowe™ uses a responsive, mobile-first, fluid grid system that appropriately scales up to 12 columns as the device or view port size increases.

12 column grid

A 12 column grid is recommended. 12 is a well-distributed division that provides a good range of widths to assign to content. It is dividable by 2, 3, 4 and 6, which allows flexibility. Many frameworks, such as Bootstrap and Pure, use a 12 column grid by default. Other grid systems like a 5 column grid can reduce flexibility, balance, and consistency.

Gutters

Columns create gutters (gaps between column content) through padding. For devices with a screen width greater than 768px, the column padding is 20px. For devices with a screen width less than 768px, the column padding is 10px.

Screen width ≥ 768px = 20px gutters

Screen width 768px = 10px gutters

Columns

Zowe designs should be limited to 12 columns. If designers feel that they need fewer columns in their grid, they can specify the number of 12 available columns they wish to span.

This can translate to percentages of the twelve columns. Using this method, a designer can create a folded, less granular grid. For example, if your component spans three equal columns, that is equal to 25% of twelve columns.

Column count: 12

Margins

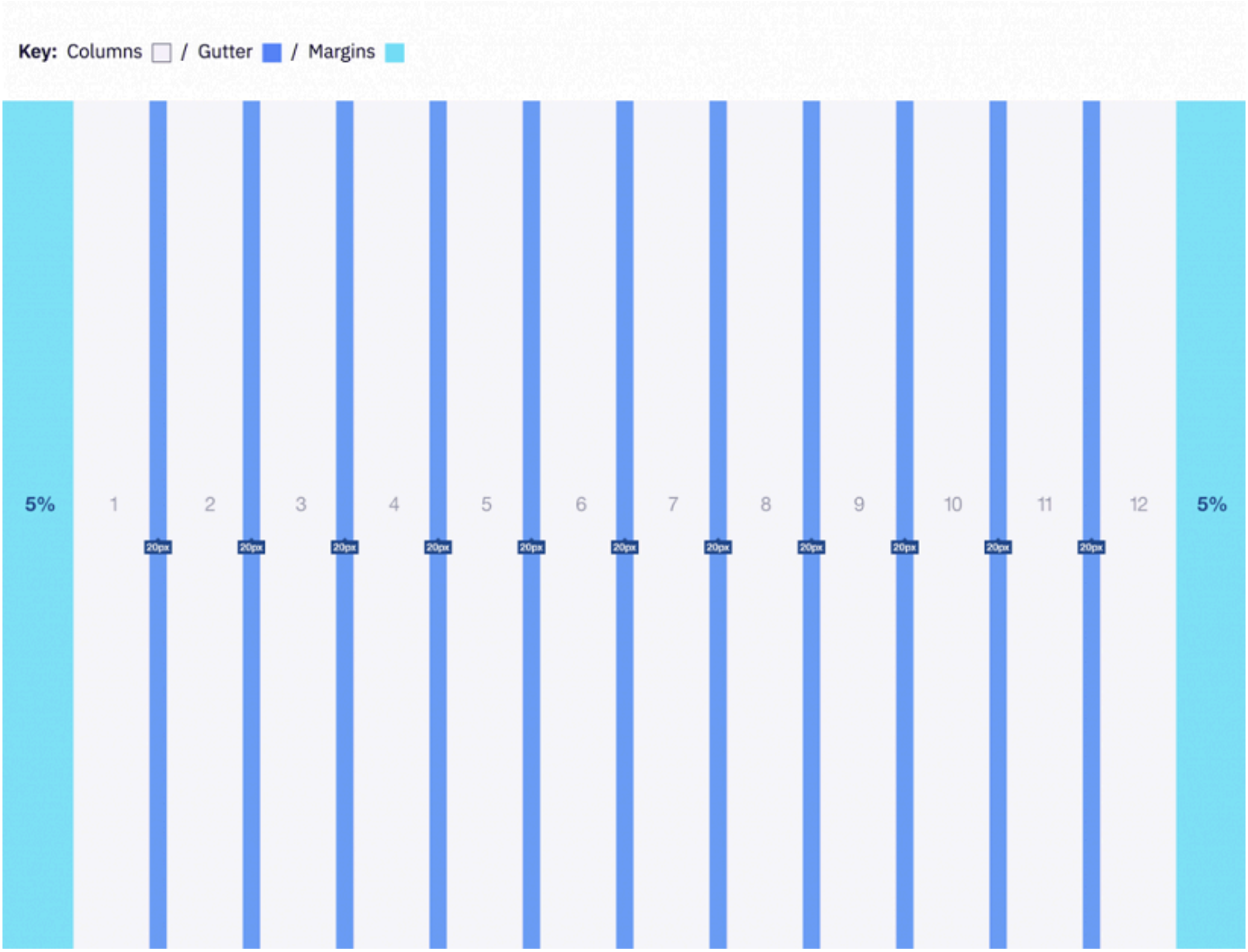
The 12 column grid does not have a maximum width. It has a width of 100%, with built in margins that create padding between column count and the edges of the viewport.

In devices with a screen width greater than 768px, the margins are **5%** on the left, and **5%** on the right.

In devices with a screen width less than 768px, the margins are **3%** on the left, and **3%** on the right.

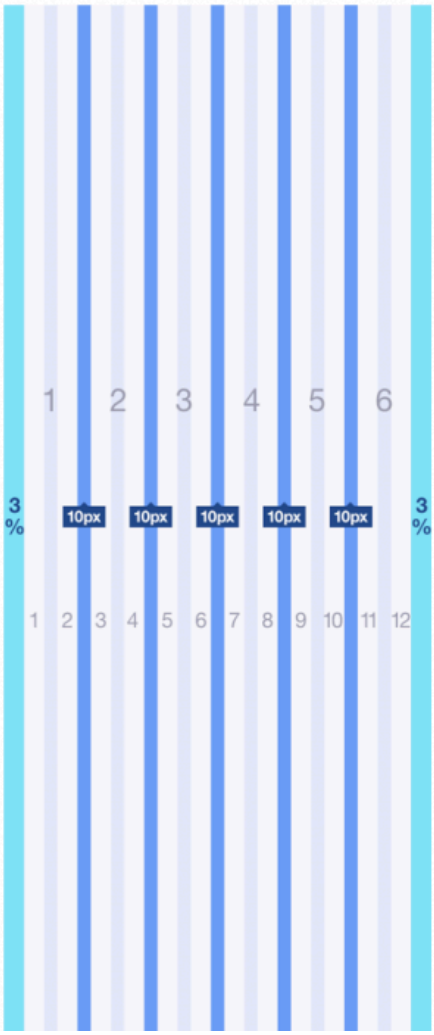
Example: Screen Width > 768px

5% left = 38px (rounded to nearest whole pixel) 5% right = 38px (rounded to nearest whole pixel) 12 columns + gutters = 768px - 38px - 38px = 692px (rounded to nearest whole pixel)



Example: Screen Width 320px

3% left = 10px (rounded to nearest whole pixel) 3% right = 10px (rounded to nearest whole pixel) 12 columns + gutters = 320px - 10px - 10px = 300px (rounded to nearest whole pixel)


1
2
3
4
5
6
3 %
10px
10px
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10px
10px
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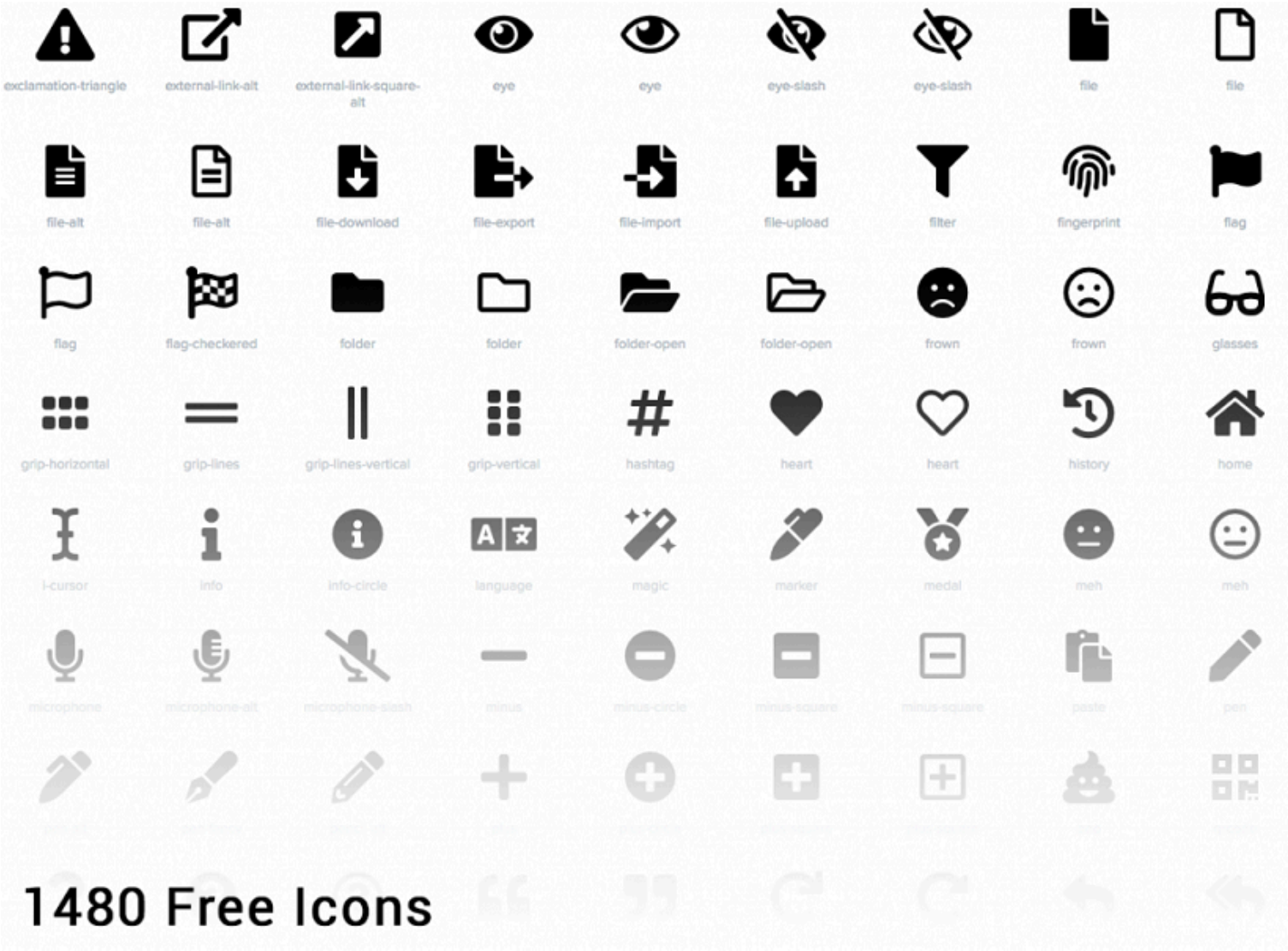
10
11
12

Version: v3.2.x LTS

Iconography

Icons are key component for a successful UI design because they are a visual way to help add meaning to elements.

Font Awesome is a robust icon library that allows for an easy addition to any web project. Scalable vector icons that can instantly be customized — size, color, drop shadow, and anything that can be done with the power of CSS.



- **One Font, Hundreds of Icons** – In a single collection, Font Awesome is a pictographic language of web-related actions.
- **No JavaScript Required** – Fewer compatibility concerns because Font Awesome doesn't require JavaScript.
- **Infinite Scalability** – Scalable vector graphics means every icon looks awesome at any size.
- **Free, as in Speech** – Font Awesome is completely free for commercial use. Check out the license.
- **CSS Control** – Easily style icon color, size, shadow, and anything that's possible with CSS.
- **Perfect on Retina Displays** – Font Awesome icons are vectors, which mean they're gorgeous on high-resolution displays.
- **Plays Well with Others** – Originally designed for Bootstrap, Font Awesome works great with all frameworks.
- **Desktop Friendly** – To use on the desktop or for a complete set of vectors, check out the cheatsheet.

- **Accessibility-minded** – Font Awesome loves screen readers and helps make your icons accessible on the web.

To learn more or download the library go to www.fontawesome.com

Version: v3.2.x LTS

Application icon

General rules

Embrace simplicity. Use a simple, unique shape or element that represents the essence of the application. Avoid excessive details and redundant shading.

Use the Zowe™ color palette. Avoid using a monochromatic palette for your icons. Use the Zowe color palette to ensure that the icons have a consistent look.

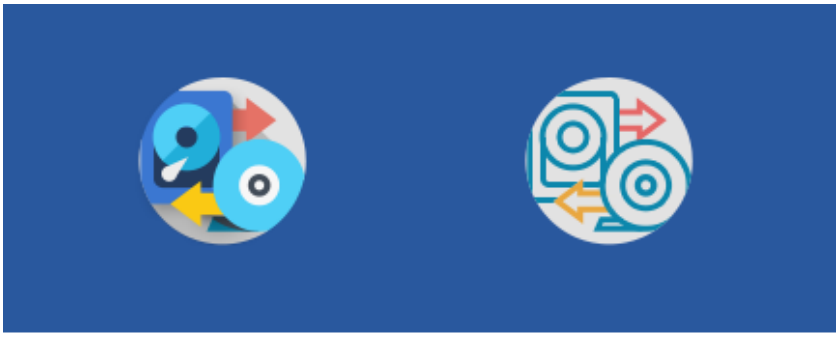
Use unique shapes and design elements. Avoid using single commonly used design elements, such as the gear, document, or folder. These elements can reduce recognizability. Do not use photos and screenshots. Keep icons simple and abstract.

Avoid labels and text. Short, commonly used abbreviations are acceptable, if necessary. Remember that all icons have center-aligned labels beneath them.

Use brand identity. If your Zowe application has a brand identity element such as a logo, you can use it. Remember to include the copyright symbol.

Shape, size, and composition

Use a flat design style. Flat design focuses on open space, bright colors, and flat graphics or illustrations. Our minimalistic design approach puts the emphasis on usability.

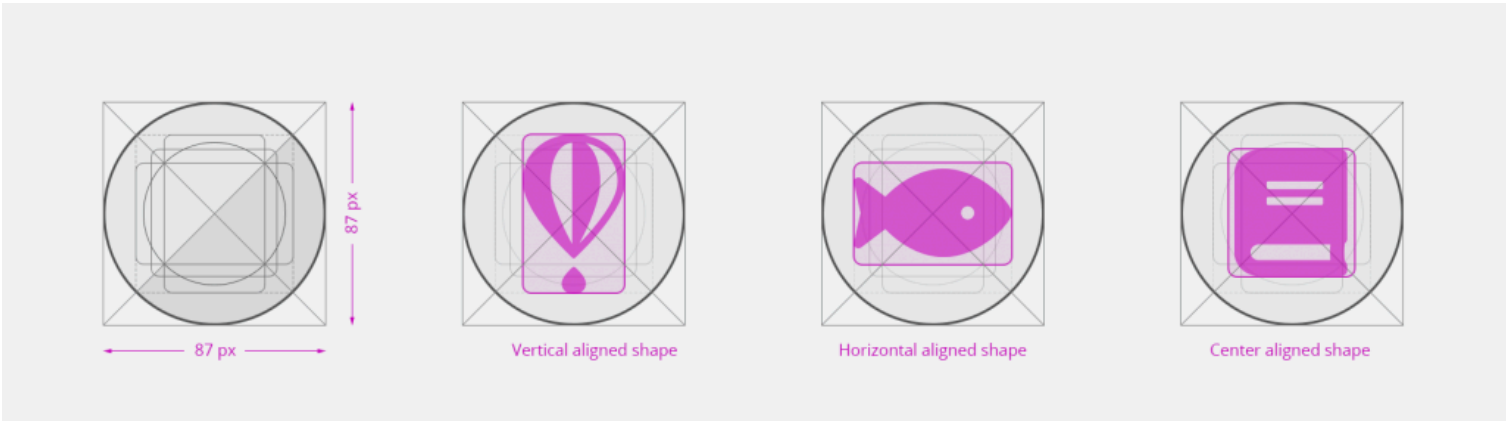


A flat icon has clean, crisp edges and a flat dimensional layout.

Use solid fill shapes. Most Zowe App icons have solid fill shapes, which are more readable on dark backgrounds.

Use the circle shape for the background application icons. Set the outer corners to 100% opacity. Create an image file that is 87x87 pixels, and save the file in PNG format.

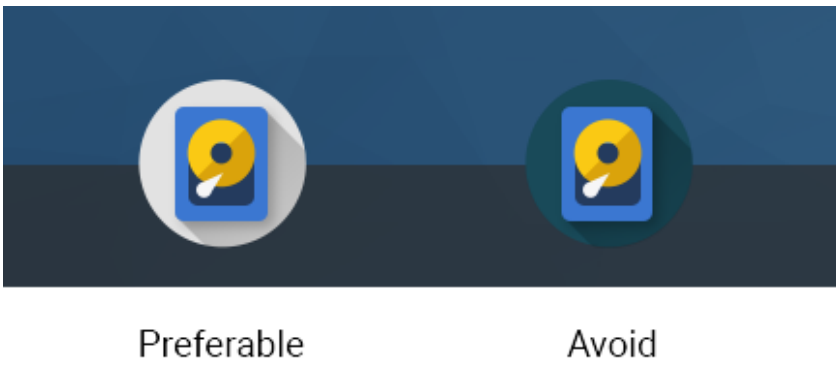
Maintain consistent visual proportions.



Colors and shades

Verify the contrast

Verify that the background color of the icon provides enough contrast against the desktop.



Use the Zowe palette

To ensure that your app icons are clear and consistent, use the Zowe color palette. If you need to use well-established brand identity elements, you can use the colors that are associated with the brand.

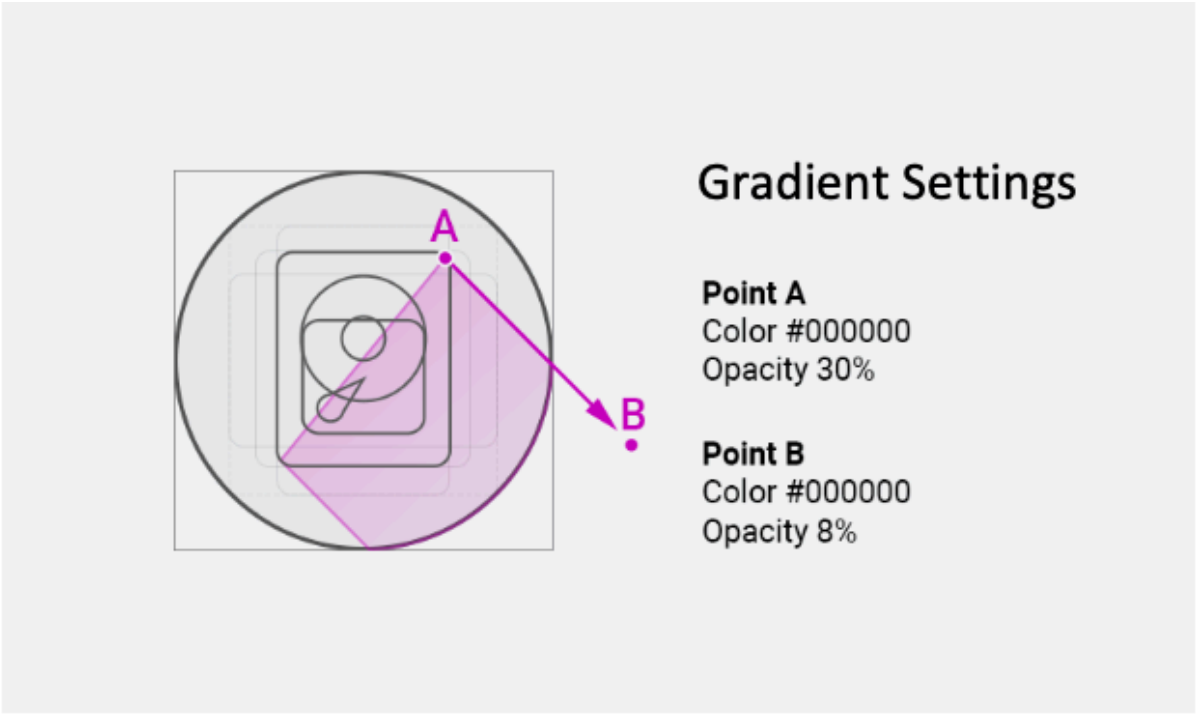
Layer Shadows

Use smooth shadows to represent that some elements are on different layers and should be visually separated. Avoid using too many layers because they can overcomplicate the icon.

Use the long shadow for consistency.

Although the long shadow effect does not have any semantic meaning, it adds focus to the main icon shape and identifies the central,most meaningful element.

Use the gradient shadow settings shown in the following image, or use a flat non-gradient shadow with 20% opacity and #000000 color.



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Contributing to Zowe Documentation

You are welcome to contribute to the Zowe™ documentation repository. Anyone can open an issue about documentation, or contribute a change with a pull request (PR) to the zowe/docs-site GitHub repository.

Before You Get Started

Before contributing a documentation change to the repository, you should be familiar with:

- Git and GitHub: To learn about git and GitHub, refer to the Github Guides.
- Slack: The Zowe Documentation team communicates using the Slack application. To learn about Slack, refer to the Slack Help Center. The Zowe team is part of the Open Mainframe Project channel.
- Markdown Language: The Zowe documentation is written in Markdown language. To learn about Markdown, refer to The Markdown Guide.

Contributions to Zowe documentation are reviewed before being committed to the repository. Commits needs to have Developer Certificate of Origin (DCO). Committing changes to the Zowe repository requires additional access rights. See https://github.com/zowe/community/blob/master/COMMITTERS.md. Also see Participating in Zowe Documentation for more details about roles and permissions.

Getting started checklist

If you are ready to get started contributing to the Zowe Documentation repository:

- Verify that you are familiar with the concepts in Before You Get Started.
- Familiarize yourself with the Zowe documentation repository.
- Contact the Doc Squad in Slack to verify that you can open a pull request and review changes.
- Open an issue for Zowe documentation if you find a problem.
- Read the documentation style guide.

The Zowe documentation repository

The Zowe documentation is managed in a GitHub repository.

- Review the site's overall organization and structure
- Review the help files related to your planned changes or addition

Sending a GitHub Pull Request

You can provide suggested edits to any documentation page by using the **Edit this page** link on top of each page. After you make the changes, you submit updates in a pull request for the Zowe documentation team to review and merge.

Follow these steps:

1. Click **Edit this page** on the page that you want to update.

2. Make the changes to the file.
3. Scroll to the end of the page and enter a brief description about your change.
4. Optional: Enter an extended description.
5. Select **Propose file change**.
6. Select **Create pull request**.

Opening an issue for Zowe documentation

You can request the documentation to be improved or clarified, report an error, or submit suggestions and ideas by opening an issue in GitHub for the Zowe documentation team to address. The team tracks the issues and works to address your feedback.

Follow these steps:

1. Click the **Open doc issue** link at the top of the page.
2. Enter the details of the issue.
3. Click **Submit new issue**.

Documentation style guide

This section gives writing style guidelines for the Zowe documentation.

Headings and titles

Use sentence-style capitalization for headings

Capitalize only the initial letter of the first word in the text and other words that require capitalization, such as proper nouns. Examples of proper nouns include the names of specific people, places, companies, languages, protocols, and products.

Example: Verifying that your system meets the software requirements.

For tasks and procedures, use gerunds for headings

Example:

- Building an API response
- Setting the active build configuration

For conceptual and reference information, use noun phrases for headings

Example:

- Query language
- Platform and application integration

Use headline-style capitalization for only these items

Titles of books, CDs, videos, and stand-alone information units.

Example:

- Installation and User's Guide
- Quick Start Guides or discrete sets of product documentation

Technical elements

Variables

Style:

- Italic when used outside of code examples,

  Example: *myHost*

- If wrap using angle brackets `<>` within code examples, italic font is not supported.

  Example:

  - put <pax-file-name>.pax
  - Where *pax-file-name* is a variable that indicates the full name of the PAX file you download. For example, zoe-0.8.1.pax.

Message text and prompts to the user

Style: Put messages in quotation marks.

Example: "The file does not exist."

Code and code examples

Style: Monospace

Example: `java -version`

Command names, and names of macros, programs, and utilities that you can type as commands

Style: Monospace

Example: Use the `BROWSE` command.

Interface controls

Categories: check boxes, containers, fields, folders, icons, items inside list boxes, labels (such as **Note:**), links, list boxes, menu choices, menu names, multicolumn lists, property sheets, push buttons, radio buttons, spin buttons, and Tabs

Style: Bold

Example: From the **Language** menu, click the language that you want to use. The default selection is **English**.

Directory names

Style: Monospace

Example: Move the `install.exe` file into the `newuser` directory.

File names, file extensions, and script names

Style: Monospace

Example:

- Run the `install.exe` file.
- Extract all the data from the `.zip` file.

Search or query terms

Style: Monospace

Example: In the Search field, enter `Zowe`.

Citations that are not links

Categories: Chapter titles and section titles, entries within a blog, references to industry standards, and topic titles in IBM Knowledge Center

Style: Double quotation marks

Example:

- See the "Measuring the true performance of a cloud" entry in the blog.
- For installation information, see "Installing the product".

Tone

Use simple present tense rather than future or past tense, as much as possible

Example:

✔️ The API returns a promise.

❌ The API will return a promise.

Use simple past tense if past tense is needed

Example:

✔️ The limit was exceeded.

❌ The limit has been exceeded.

Use active voice as much as possible

Example:

✔️ In the Limits window, specify the minimum and maximum values.

❌ The Limits window is used to specify the minimum and maximum values.

Exceptions: Passive voice is acceptable when any of these conditions are true:

- The system performs the action.
- It is more appropriate to focus on the receiver of the action.
- You want to avoid blaming the user for an error, such as in an error message.
- The information is clearer in passive voice.

  Example:

  ✔️ The file was deleted.

  ❌ You deleted the file.

Using second person such as "you" instead of first person such as "we" and "our"

In most cases, use second person ("you") to speak directly to the reader.

End sentences with prepositions selectively

Use a preposition at the end of a sentence to avoid an awkward or stilted construction.

Example:

✔️ Click the item that you want to search for.

❌ Click the item for which you want to search.

Avoid anthropomorphism

Focus technical information on users and their actions, not on a product and its actions.

Example:

✔️ User focus: On the Replicator page, you can synchronize your local database with replica databases.

❌ Product focus: The Replicator page lets you synchronize your local database with replica databases.

Avoid complex sentences that overuse punctuation such as commas and semicolons.

Release notes

Release notes should be written in a consistent style that is easy to read and provides relevant information to users.

To help ensure these best practices are followed, see CHANGELOG and release notes formatting and Writing style for release notes entries.

Word usage and punctuation

Admonitions

Use the admonitions syntax provided by Docusaurus.

> **NOTE**
>
> Some **content** with *Markdown* `syntax`. Check this link.

> **TIP**
>
> Some **content** with *Markdown* `syntax`. Check this link.

> **INFO**
>
> Some **content** with *Markdown* `syntax`. Check this link.

> **WARNING**
>
> Some **content** with *Markdown* `syntax`. Check this link.

> **DANGER**
>
> Some **content** with *Markdown* `syntax`. Check this link.

Use of "following"

For whatever list or steps we are introducing, the word "following" should precede a noun.

Examples:

- Before a procedure, use "Follow these steps:"
- The `<component_name>` supports the following use cases:
- Before you install Zowe, review the following prerequisite installation tasks:

Avoid ending the sentence with "following".

Examples:

✔️ Complete the following tasks.

❌ Complete the following.

Use a consistent style for referring to version numbers

When talking about a specific version, capitalize the first letter of Version.

Examples:

✔️ Java Version 8.1 or Java V8.1

❌ Java version 8.1, Java 8.1, or Java v8.1

When just talking about version, use "version" in lower case.

Example: Use the latest version of Java.

Avoid "may"

Use "can" to indicate ability, or use "might" to indicate possibility.

Examples:

- Indicating ability:

  ✔️ You can use the command line interface to update your application."

  ❌ "You may use the command line interface to update your application."

- Indicating possibility:

  ✔️ "You might need more advanced features when you are integrating with another application. "

  ❌ "You may need more advanced features when you are integrating with another application."

Use "issue" when you want to say "run"/"enter" a command

Example: At a command prompt, issue the following command:

Use of slashes

Avoid spaces when using a slash in between words.

Examples:

- Indicating or (on/off), and or (document/file), per (millions of instructions/second):

  ✔️ Save the document/file in your desktop folder.

  ❌ Save the document / file in your desktop folder.

Punctuation in lists

Use punctuation (periods, commas) in bulleted and numbered lists when appropriate. Do not use conjunctions (and, or) to separate list items.

Use periods for list items when the items are complete sentences, or the introductory text is a sentence fragment and each item completes the sentence

Examples:

✔️ You can obtain IBM SDK for Node.js - z/OS for free in one of the following ways:

- Order the SMP/E edition through your IBM representative if that is your standard way to order IBM software.
- Order the SMP/E edition through IBM Shopz with optional paid support available.
- Download PAX file format at ibm.com/products/sdk-nodejs-compiler-zos. IBM defect Support is not available for this format.

❌ Through customization, you can change attributes such as:

- Enabling or disabling components so you only run what you need

- Changing the network ports Zowe runs on to suit your environment
- Customizing the behavior of a component, such as turning on optional features or logging

Use periods for list items when the items are complete sentences, or the introductory text is a sentence fragment and each item completes the sentence

Examples:

✔️ You can obtain IBM SDK for Node.js - z/OS for free in one of the following ways:

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- Download PAX file format at ibm.com/products/sdk-nodejs-compiler-zos. IBM defect Support is not available for this format.

❌ Through customization, you can change attributes such as:

- Enabling or disabling components so you only run what you need
- Changing the network ports Zowe runs on to suit your environment
- Customizing the behavior of a component, such as turning on optional features or logging

Do not use punctuation or conjunctions (and, or) in bullet lists when the list items are not complete sentences, when the bullet item has three or fewer words, or when the bullet items are UI labels, headings, strings, or similar

Examples:

✔️ The z/OSMF configuration process occurs in three stages, and in the following order:

- Security setup
- Configuration
- Server initialization

❌ The Zowe runtime, which consists of a number of components including:

- Zowe Application Framework.
- Zowe API Mediation Layer.
- Z Secure Services (ZSS).

Do not use conjunctions (and, or) in bullet lists

Examples:

✔️ Integrated development environments:

- VS Code 1.53.2+
- Eclipse Che
- Red Hat CodeReady Workspaces

- Theia 1.18+

❌ Before continuing with the installation, you should be familiar with the following topics:

- Zowe's hardware and software requirements, and
- The `zwe` utility used for installing, configuring, and managing Zowe, and
- The configuration file used for Zowe, `zowe.yaml`.

Punctuation in numbered lists

Abbreviations

Do not use an abbreviation as a noun unless the sentence makes sense when you substitute the spelled-out form of the term

Examples:

✔️ The tutorials are available as PDF files.

❌ The tutorials are available as PDFs. [portable document formats]

Do not use abbreviations as verbs

Examples:

✔️ You can use the FTP command to send the files to the server.

❌ You can FTP the files to the server.

Do not use Latin abbreviations

Use their English equivalents instead. Latin abbreviations are sometimes misunderstood.

Latin	English equivalent
e.g.	for example
etc.	and so on. When you list a clear sequence of elements such as "1, 2, 3, and so on" and "Monday, Tuesday, Wednesday, and so on." Otherwise, rewrite the sentence to replace "etc." with something more descriptive such as "and other output."
i.e.	that is

Spell out the full name and its abbreviation when the word appears for the first time. Use abbreviations in the texts that follow

Example: Mainframe Virtual Desktop (MVD)

Structure and format

Add "More information" to link to useful resources or related topics at the end of topics where necessary.

Word usage

The following table alphabetically lists the common used words and their usage guidelines.

Do	Don't
API ML (where appropriate)	The API ML
application	app
data set	dataset (unless used in syntax)
Capitalize "Server" when it's part of the product name	
file name	filename (unless it's a property written as one word)
Java	java
keyboard shortcut	hotkey
IBM z/OS Management Facility (z/OSMF) z/OSMF	zosmf (unless used in syntax)
ID	id
PAX	pax
personal computer PC server	machine
later	higher Do not use to describe versions of software or fix packs.
macOS	MacOS
Node.js	node.js Nodejs
plug-in	plugin
REXX	Rexx
UNIX System Services z/OS UNIX System Services	USS
zLUX	ZLUX zLux

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Zowe CLI command reference guide

View detailed documentation on commands, actions, and options in Zowe CLI. You can read an interactive online version, download a PDF document, or download a ZIP file containing the HTML for the online version.

This reference documentation is organized to contain the web help for Zowe CLI, CLI plug-ins maintained by Zowe, and Zowe V3 LTS-conformant third-party CLI plug-ins. As third-party plug-ins are approved under the Zowe V3 LTS Conformance Program and contribute their web help to Zowe, we update the documentation accordingly.

To view the web help for V2 conformant plug-ins, click the version drop-menu on the top right corner of this page and click the link to any previous v2.xx.x version of this page.

- Browse the interactive online version
- Download the CLI reference guide in PDF format
- Download the CLI reference guide in ZIP format

Version: v3.2.x LTS

Zowe YAML server configuration file reference

Zowe v3 uses a YAML configuration file for server installation, configuration, and runtime. This file is usually referred to as the Zowe configuration YAML file or the `zowe.yaml` file. YAML is a human-friendly data serialization language for all programming languages. To learn more about YAML specifications, see https://yaml.org/. For a free, offline YAML validator to help validate your syntax, download the Red Hat's VS Code YAML extension.

Content within the YAML file is documented by and validated against schema files which are shipped within Zowe and extended by Zowe extensions. For details on the schema technology and where to find the schema files within our source code, see Using the Configuration Manager.

> **NOTE**
>
> In the following sections, we refer to configuration keys by using the concatenation of key names and dots. For example, if you want to update the configuration key `zowe.certificate.keystore.type` with the value `PKCS12`, you should set the value for this entry in the `zowe.yaml`:

High-level overview of YAML configuration file

The YAML configuration file has few high-level sections:

- **zowe**
  Defines global configurations specific to Zowe, including default values.
- **java**
  Defines Java configurations used by Zowe components.
- **node**
  Defines node.js configurations used by Zowe components.
- **zOSMF**
  Tells Zowe your z/OSMF configurations.
- **components**
  Defines detailed configurations for each Zowe component or extension. Each component or extension may have a key entry under this section. For example, `components.gateway` is the configuration for the API Mediation Layer Gateway service.
- **haInstances**
  Defines customized configurations for each High Availability (HA) instance. You should predefine all Zowe HA instances you want to start within your Sysplex.

Extract sharable configuration out of zowe.yaml

The Zowe YAML configuration file supports splitting into several files or PARMLIB members. This can help simplify grouping configuration changes by type or owner. For details, see Splitting configuration into multiple storage types.

Creating portable references

The Zowe YAML configuration file has template logic for relating one value to another, a system environment variable or symbol, and the possibility to add conditional behavior. This template logic can help to make your configuration portable between systems that need slightly different behavior while retaining the same configuration file. For details, see Configuration templates in the article *Zowe Configuration Manager*.

Configuration override - defaults.yaml

Values for global configuration and components are defined in the `defaults.yaml` file. This file is always merged with current `configs` when `configmgr` is used.

For example, if you decide to remove the `zowe.job` section by commenting or deleting, the `zowe.job` section reappears after merging with the defaults.

Example of initial user config:

Example of modified user config - `zowe.job` commented out:

Example of merged result:

> **NOTE**
>
> To disable a component which is defined enabled in `defaults.yaml`, ensure that you have a definition of that component in your config, and change `enabled: true` to `enabled: false`. Deleting or commenting out a component does not disable the component.

Configuration override - inside zowe.yaml

In the `zowe.yaml`, you can define default values which can be overridden in more granular level configurations. This can happen in several ways:

- The component can override the default certificate configuration. For the specific entry of certification configuration that is not overridden, the configuration falls back to default configurations.

Example:

In this example, the App Server usees the certificate alias `app-server` instead of `localhost` from the same keystore defined in `zowe.certificate.keystore.file`. Note that the service uses the same truststore defined in `zowe.certificate.truststore.file`.

- Zowe high availability (HA) instance component configuration `haInstances.<ha-instance>.components.<component>` can override global level component configurations `components.<component>`. Any configuration in the `components.<component>` level can be overridden in the `haInstances.<ha-instance>.components.<component>` level.

Example:

In this example configuration, the App Server on `lpar2a` HA instance will not be started. On `lpar2b` HA instance, it will be started but on port 28544.

YAML configurations - certificate

In Zowe YAML configuration, the certificate definition shares the same format which can be used in several configuration entries. For example, `zowe.certificate`, `components.<component>.certificate`, and `haInstances.<ha-instance>.components.<component>.certificate`. The certificate definition may include the following entries:

- **keystore.type**
  Specifies the type of the keystore. If you are using keystore, this value usually should be `PKCS12`. If you are using keyring, this value should be `JCERACFKS`.
- **keystore.file**
  Specifies the path of the keystore file. If you are using keyring, this should look like `safkeyring://<keyring-owner>/<keyring-name>`. For example, `safkeyring://ZWESVUSR/ZoweKeyring`.
- **keystore.password**
  Specifies the password of the keystore.
- **keystore.alias**
  Represents the alias name of the certificate stored in keystore. If you are using keyring, this is the certificate label connected to the keyring.
- **truststore.type**
  Specifies the type of the truststore file. If you are using keystore, this value usually should be `PKCS12`. If you are using keyring, this value should be `JCERACFKS`.
- **truststore.file**
  Specifies the path to the truststore file. If you are using keyring, this should look like `safkeyring://<keyring-owner>/<keyring-name>`, and usually will be the same value of `keystore.file`.
- **truststore.password**
  Specifies the password of the truststore.
- **pem.key**
  Specifies the private key file in PEM format. This can be used by applications that do not support either PKCS12 keystore format or z/OS keyring.
- **pem.certificate**
  Specifies the public key file in PEM format. This can be used by applications that do not support either PKCS12 keystore format or a z/OS keyring.
- **pem.certificateAuthorities**
  Specifies certificate authorities in PEM format. This can be used by applications that do not support either PKCS12 keystore format or a z/OS keyring.

YAML configurations - zowe

The high-level configuration `zowe` supports these definitions:

Directories

- **zowe.runtimeDirectory**
  Specifies the runtime directory where Zowe is installed.
- **zowe.logDirectory**
  Some Zowe components write logs to file system. This parameter specifies which directory should be used to store log files.
- **zowe.workspaceDirectory**
  Specifies components where they can write temporary runtime files.

- **zowe.extensionDirectory**
  Specifies the location of the runtime of all your extensions.

Zowe Job

- **zowe.job.name**
  Specifies the Zowe job name for the ZWESLSTC started task.
- **zowe.job.prefix**
  Specifies the Zowe address space prefix for Zowe components.

Domain and port to access Zowe

- **zowe.externalDomains**
  Specifies a list of external domains to be used by the Zowe instance. This configuration is an array of domain name strings. In Sysplex deployment, this value is the DVIPA domain name defined in Sysplex Distributor. For example,

In Kubernetes deployment, this value is the domain name you will use to access your Zowe running in a Kubernetes cluster.

- **zowe.externalPort**
  Specifies the port that is to be exposed to external Zowe users. By default, this value is set based on Zowe APIML Gateway port. In Sysplex deployment, this is the DVIPA port defined in Sysplex Distributor. For more information, see Configure Sysplex Distributor. In Kubernetes deployment, this value is the Gateway Service port to be exposed externally.

Extra environment variables

- **zowe.environments**
  Defines extra environment variables to customize the Zowe runtime. This configuration is a list of key / value pairs.
  Example:

> **NOTE**
>
> Variables defined here are global to all Zowe components, on all HA instances.
>
> An example use case is to override system-wide environment variables for the Zowe runtime, such as the directory to use for temporary files.

Certificate

- **zowe.certificate**
  Specifies the northbound certificate facing Zowe users.
- **zowe.verifyCertificates** Specifies how Zowe is to validate the certificates used by components or external service(s) like z/OSMF.
  Possible values:
  - `STRICT`: This is the default value. Zowe validates if the certificate is trusted in Zowe's trust store and if the certificate Command Name and Subject Alternative Name (SAN) is validated. This is recommended for the best security.
  - `NONSTRICT`: Zowe validates if the certificate is trusted in Zowe's trust store. In this mode, Zowe does not validate certificate Common Name and Subject Alternative Name (SAN). This option does not have the highest security

level but allows you to try out Zowe when you do not have permission to fix the certificate used by external services like z/OSMF.
    - `DISABLED`: This value disables certificate validation completely. This is **NOT** recommended for security purpose.

Launcher and launch scripts

Launcher is the program behind the `ZWESLSTC` started task.

- **zowe.launcher**
  The launcher section defines defaults about how the Zowe launcher acts on components.
- **zowe.launcher.restartIntervals**
  An array of positive integers that defines how many times a component attempts to be restarted if it fails, and how much time to wait in seconds for that restart to succeed before retrying.
- **zowe.launcher.minUptime**
  Specifies the minimum amount of time a Zowe component should be running in order to be declared as started successfully.
- **zowe.launcher.shareAs**
  Specifies if the launcher should start components in the same address space. See documentation for _BPX_SHAREAS for details.
- **zowe.launchScript.logLevel**
  Set to `debug` or `trace` to enable different levels of debug messages from Zowe launch scripts. This setting may help troubleshoot issues during Zowe start.

Setup

Zowe YAML configuration uses the `zowe.setup` section to instruct how Zowe should be installed and configured. This section is optional for Zowe runtime and only applies to `zwe install` and `zwe init` commands.

- **zowe.setup.dataset.prefix**
  Specifies where the `SZWEAUTH` data set is installed.
- **zowe.setup.dataset.parmlib**
  Specifies the user custom parameter library. The Zowe server command may generate sample PARMLIB members and stores in this library.
- **zowe.setup.dataset.jcllib**
  Specifies the custom JCL library. The Zowe server command may generate sample JCLs and put into this data set.
- **zowe.setup.dataset.authLoadlib**
  Specifies the user custom APF LOADLIB. This field is optional. If this parameter is defined, members of `SZWEAUTH` are copied over to this data set to be APF authorized. If this parameter is not defined, `SZWEAUTH` from `zowe.setup.dataset.prefix` is APF authorized.
- **zowe.setup.dataset.authPluginLib**
  Specifies the user custom APF PLUGINLIB. Zowe ZIS plug-ins can be installed into this load library. This loadlib requires APF authorize.
- **zowe.setup.security.product**
  Speficies the security product. Can be `RACF`, `ACF2`, or `TSS`. This configuration is optional. The default value is `RACF`.
- **zowe.setup.security.groups.admin**
  Specifies the group for Zowe administrators. This configuration is optional. The default value is `ZWEADMIN`.
- **zowe.setup.security.groups.stc**
  Specifies the group for Zowe started tasks. This configuration is optional. The default value is `ZWEADMIN`.

- **zowe.setup.security.groups.sysProg**
  Speficies the system programmer user ID/group. This configuration is optional. The default value is `ZWEADMIN`.
- **zowe.setup.security.users.zowe**
  Specifies the userid for Zowe started task. This configuration is optional. The default value is `ZWESVUSR`.
- **zowe.setup.security.users.zis**
  Specifies the userid for ZIS started task. This configuration is optional. The default value is `ZWESIUSR`.
- **zowe.setup.security.stcs.zowe**
  Specifies the Zowe started task name. This configuration is optional. The default value is `ZWESLSTC`.
- **zowe.setup.security.stcs.zis**
  Specifies the ZIS started task name. This configuration is optional. The default value is `ZWESISTC`.
- **zowe.setup.security.stcs.aux**
  Specifies ZIS AUX started task name. This configuration is optional. The default value is `ZWESASTC`.
- **zowe.setup.certificate.type**
  Specifies the type of certificate. Valid values are `PKCS1` (USS keystore) or `JCERACFKS` (z/OS keyring).
- **zowe.setup.certificate.dname**
  Specifies the distinguished name of the certificate. You can define `caCommonName`, `commonName`, `orgUnit`, `org`, `locality`, `state`, and / or `country`. These configurations are optional.
- **zowe.setup.certificate.validity**
  Specifies the validity days of the certificate. This is optional.
- **zowe.setup.certificate.san**
  Specifies the `Subject Alternative Name`(s) of the certificate if they are different from `zowe.externalDomains`. Note that for `JCERACFKS` type, with limitation of RACDCERT command, this should contain exact one hostname (domain) and one IP address.
- **zowe.setup.certificate.importCertificateAuthorities**
  Specifies the list of certificate authorities to be imported to the Zowe `PKCS12` keystore or `JCERACFKS` keyring. Note that for JCERACFKS, only a maximum 2 CAs are supported. For `PKCS12` certificates, ensure this value is the USS files in PEM format. For `JCERACFKS` certificates, ensure this value represents certificate labels on the z/OS system.

For `PKCS12` certificate users

- **zowe.setup.certificate.pkcs12.directory**
  Specifies the directory where the PKCS12 keystore and truststore are stored. This value is required if `zowe.setup.certificate.type` is `PKCS12`.
- **zowe.setup.certificate.pkcs12.lock**
  Specifies a boolean configuration to indicate if the PKCS12 keystore directory is to be locked only for Zowe runtime user and group. The default value is `true`.
- **name**, **password**, **caAlias**, and **caPassword**
  Under `zowe.setup.certificate.pkcs12`, these parameters
  customize the keystore and truststore. These configurations are optional, but it is recommended to update the values from default values.
- **zowe.setup.certificate.pkcs12.import.keystore**
  Specifiy this parameter if you already acquired certificates from another CA, stored them in PKCS12 format, and want to import into Zowe PKCS12 keystore.
- **zowe.setup.certificate.pkcs12.import.password**
  Specifies the password for keystore defined in `zowe.setup.certificate.pkcs12.import.keystore`.

- **zowe.setup.certificate.pkcs12.import.alias**
  Specifies the original certificate alias defined in `zowe.setup.certificate.pkcs12.import.keystore`. After import, the certificate is saved as an alias specified in `zowe.setup.certificate.pkcs12.name`.

For `JCERACFKS` certificate (z/OS keyring) users

- **zowe.setup.certificate.keyring.owner**
  Specifies the keyring owner. It's optional and default value is `zowe.setup.security.users.zowe`. If it's also not defined, the default value is `ZWESVUSR`.

- **zowe.setup.certificate.keyring.name**
  Specifies the keyring name to be created on z/OS. This is required if `zowe.setup.certificate.type` is `JCERACFKS`.

- **label** and **caLabel**
  Specify these parameters under `zowe.setup.certificate.keyring` to let Zowe generate a new certificate.
  The default value of `label` is `localhost`. The default value of `caLabel` is `localca`.

- To import a certificate stored in an MVS data set into Zowe keyring, use the following parameters:

  - **zowe.setup.certificate.keyring.connect.dsName**
    This value is required to inform Zowe about the data set where the certificate stored.
  - **zowe.setup.certificate.keyring.connect.passwor**
    Specifies the password when importing the certificate.
  - **zowe.setup.certificate.keyring.label**
    Specifies the label of the certificate to be imported.

- To connect an existing certificate into a Zowe keyring apply the following parameters:

  - **zowe.setup.certificate.keyring.connect.user**
    This parameter is required and specifies the owner of an existing certificate. This field can have the value of `SITE`.
  - **zowe.setup.certificate.keyring.connect.label**
    This parameter is required and specifies the label of an existing certificate.

- If `zowe.verifyCertificates` is not `DISABLED`, and z/OSMF host (`zOSMF.host`) is provided, Zowe attempts to trust the z/OSMF certificate.

  - **For RACF**
    If the CA of the z/OSMF is not in the Zowe truststore, you can define it using `zowe.setup.certificate.keyring.zOSMF.user` and label `zowe.setup.certificate.keyring.zOSMF.ca`

    Example:

  - **For ACF2 or TSS (Top Secret)**
    `zowe.setup.certificate.keyring.zOSMF.ca` is required to indicate the label of the z/OSMF root certificate authority.

- **zowe.setup.vsam.mode**
  Indicates if VSAM utilizes Record Level Sharing (RLS) services. Valid values are `RLS` or `NONRLS`.

- **zowe.setup.vsam.volume**
  Indicates the name of volume. This field is required if VSAM mode is `NONRLS`.

- **zowe.setup.vsam.storageClass**
  Indicates the name of RLS storage class. This field is required if VSAM mode is `RLS`.

YAML configurations - java

The high-level configuration `java` supports these definitions:

- **home**
  Specifies the path to the Java runtime directory.

YAML configurations - node

The high-level configuration `node` supports these definitions:

- **home**
  Specifies the path to the Node.js runtime directory.

> **TIP**
> Ensure the value of `node.home` in the `zowe.yaml` is visible to the Zowe STC users, and contains `bin/node`.
> **Example:**
>
> This value is valid only when the path `/usrlppSysplex/nodejs/node-v18.18.2/bin/node` exists. If you observe output of `node:...FSUM7351 not found`, check that the value contains `bin/node`.

YAML configurations - zOSMF

The high-level configuration `zOSMF` supports the following definitions:

- **zOSMF.host**
  Specifies the hostname of your z/OSMF instance.
- **zOSMF.port**
  Specifies the port of your z/OSMF instance.
- **zOSMF.applId**
  Specifies the application ID of your z/OSMF instance.

YAML configurations - components

All Zowe components and extensions can have a dedicated section under the `components` high-level configuration.

In this section, *component* represents any Zowe components or extension. For all components and extensions, the following parameters are the common definitions:

- **components.*component*.enabled**
  Specifies if the component should be started in this Zowe instance, thereby providing control over each component instead of a group.

- **components.*component*.certificate**
  Allows for customization for a component to use a different certificate from default values. This section follows the same format defined in YAML configurations - certificate. If this parameter is not customized, the component uses certificates defined in `zowe.certificate`.
- **components.*component*.launcher**
  Specifies if a specific component has a launcher section which overrides the overall Zowe Launcher default defined in `zowe.launcher`.

Configure component gateway

These configurations can be used under the `components.gateway` section:

- **port**
  Specifies the port which the Gateway should start on. This value must be a valid port number.
- **debug**
  Specifies the enablement of debug mode for the Gateway.
- **apiml.connectionTimeout** Specifies the value in milliseconds which corresponds to the period in which API ML should establish a single, non-managed connection with the service. If omitted, the default value specified in the API ML Gateway service configuration is used.
- **apiml.connection.idleConnectionTimeoutSeconds**
  Specifies how long the connection to southbound remains open without communication. The default value is 5 seconds. The unit is in seconds.
- **apiml.health.protected**
  Specifies if the health check endpoint is accessible with or without authentication.
- **apiml.gateway.timeoutMillis**
  Specifies the timeout for the connection to the services in milliseconds.
- **apiml.security.x509.enabled**
  Specifies if client certificate authentication functionality through ZSS is enabled. Set this parameter to `true` to enable the client certificate authentication functionality through ZSS.
- **apiml.security.x509.externalMapperUrl**
  Specifies the URL where the Gateway can query the mapping of client certificates.
- **apiml.security.auth.jwt.customAuthHeader**
  Provides a valid JWT for the southbound service in the custom header. A valid value is any valid name for an HTTP header.
- **apiml.security.auth.passticket.customAuthHeader**
  Provides PassTickets for the southbound service in the custom header. A valid value is any valid name for an HTTP header.
- **apiml.security.auth.passticket.customUserHeader**
  Provides User Info when a PassTicket is provided in the custom header. A valid value is any valid name for an HTTP header.
- **apiml.security.auth.provider**
  Specifies the authentication provider used by the API Gateway. Valid options are `saf` or `zosmf`.
- **apiml.security.auth.zosmf.serviceId**
  Allows customization of the service id in case `zosmf` is specified as an authentication provider. The default value is `ibmzosmf`
- **apiml.security.auth.zosmf.jwtAutoconfiguration**
  Customizes the behavior of the Gateway with respect to how JWTs are produced. Valid options are `jwt` and `ltpa`.

`jwt` is the default option. `ltpa` allows API ML to produce JWTs instead of the z/OSMF service. `jwt` is the default and recommended option.

- **apiml.security.authorization.endpoint.url**
  Specifies the URL to the authorization endpoint. This endpoint informs the Gateway if a user has a particular permission on SAF profile, such as permission to the `APIML.SERVICES` profile of the `ZOWE` class.
- **apiml.security.personalAccessToken.enabled**
  Specifies if Personal Access Tokens are enabled. The default value is `false`.
- **apiml.security.useInternalMapper**
  This property is a global feature toggle. Set the value to `true` to enable the Internal Mapper. The default value is `true`.
- **apiml.security.oidc.enabled**
  Specifies the global feature toggle. Set the value to `true` to enable OIDC authentication functionality.
- **apiml.security.oidc.registry**
  Specifies the SAF registry used to group identities recognized as having an OIDC identity mapping. The registry name is the string used during the creation of the mapping between distributed and mainframe user identities. For more information, see ESM configuration prerequisites.
- **apiml.security.oidc.jwks.uri**
  Specifies the URI obtained from the authorization server's metadata where the Gateway queries for the JWK used to sign and verify the access tokens. A valid value is any valid URI.
- **apiml.security.oidc.jwks.refreshInternalHours**
  Specifies the frequency in hours to refresh the JWK keys from the OIDC provider. Defaults to one hour.
- **apiml.security.oidc.identityMapperUser**
  (Optional) If the userId is different from the default Zowe runtime userId (`ZWESVUSR`), specify the `identityMapperUser` userId to configure API ML access to the external user identity mapper.

> **NOTE**
>
> User authorization is required to use the `IRR.RUSERMAP` resource within the `FACILITY` class. The default value is `ZWESVUSR`. Permissions are set up during installation with the `ZWESECUR` JCL or workflow. To authenticate to the mapping API, a JWT is sent with the request. The token represents the user that is configured with this property.

- **apiml.security.oidc.identityMapperUrl**
  Specifies the URL where the Gateway can query the mapping of the distributed user ID to the mainframe user ID. This property informs the Gateway about the location of this API. ZSS is the default API provider in Zowe. Note that if you are using Zowe release 2.14 or a later version, we recommend you use the API ML internal mapper. To provide your own API to perform the mapping, it is necessary to customize this value.

  The following URL is the default value for Zowe and ZSS:

- **apiml.security.ssl.verifySslCertificatesOfServices**
  Specifies if API ML is used to verify certificates of services in strict mode. Setting to `true` enables `strict` mode where API ML validates if the certificate is trusted in the truststore, and also if the certificate Common Name or Subject Alternate Name (SAN) matches the service hostname.

- **apiml.security.ssl.nonStrictVerifySslCertificatesOfServices**
  Specifies if API ML is used to verify certificates of services in non-strict mode. Setting the value to `true` enables the `non-strict` mode where API ML validates if the certificate is trusted in the truststore, but ignores the certificate

Common Name or Subject Alternate Name (SAN) check. Zowe ignores this configuration when `strict` mode is enabled with `apiml.security.ssl.verifySslCertificatesOfServices`.

- **apiml.service.allowEncodedSlashes**
  Specifies if the Gateway allows encoded characters to be part of URL requests redirected through the Gateway. Set to `true` to allow encoded characters to be part of URL requests.

- **apiml.service.corsEnabled**
  Specifies if CORS are enabled in the API Gateway for Gateway routes `gateway/api/v1/**`. Set to `true` to enable CORS.

- **server.maxConnectionsPerRoute**
  Specifies the maximum connections for each service.

- **server.maxTotalConnections**
  Specifies the total connections for all services registered under API Mediation Layer.

- **server.ssl.enabled**
  Specifies if TLS is used

- **server.webSocket.maxIdleTimeout**
  This timeout handles how long the Websocket connection remains open if there is no communication happening over the open connection. The default is one hour (3600000 milliseconds).

- **server.webSocket.connectTimeout**
  This timeout limits how long the API Gateway waits until it drops connection if the Gateway cannot reach the target server. The default is 45 seconds (45000 milliseconds).

- **server.webSocket.asyncWriteTimeout**
  This timeout handles how long before the server fails with an unsuccessful response when trying to write a message to the Websocket connection. The default is 60 seconds (60000 milliseconds).

- **server.webSocket.requestBufferSize**
  This property handles the maximum request size allowed in the WebSocket handshake requests. The default is 8K.

Configure component discovery

These configurations can be applied to the `components.discovery` section:

- **port**
  Specifies the port which discovery is to be started on. This value may be a valid port number or an offset from the Gateway component's port. To define an offset enter `"+{offset}"` or `"-{offset}"` as a string. The offset must start with `+` or `-`.

- **debug**
  Specifies the enablement of debug mode for the Discovery Service.

- **apiml.health.protected**
  Specifies if the health check endpoint is accessible with or without authentication.

- **apiml.security.ssl.verifySslCertificatesOfServices**
  Specifies if API ML is to verify certificates of services in `strict` mode. Set to `true` to enable `strict` mode where API

ML validates both trust in the certificate in the turststore, and also if the certificate Common Name or Subject Alternate Name (SAN) matches the service hostname.

- **apiml.security.ssl.nonStrictVerifySslCertificatesOfServices**
  Specifies if API ML is to verify certificates of services in `non-strict` mode. Set to `true` to enable the `non-strict` mode where API ML validates if the certificate is trusted in the truststore, but ignores the certificate Common Name or Subject Alternate Name (SAN) check. Zowe ignores this configuration if `strict` mode is enabled with `apiml.security.ssl.verifySslCertificatesOfServices`.

- **alternativeStaticApiDefinitionsDirectories**
  Specifies the alternative directories of static definitions. A valid value is the list of directories separated by commas.

- **apiml.server.maxTotalConnections**
  Specifies the total number of connections for all services registered under API Mediation Layer.

- **apiml.discovery.serviceIdPrefixReplacer**
  Modifies the service ID of a service instance before it registers to API Mediation Layer. Use this parameter to ensure compatibility of services that use a non-conformant organization prefix with v2, based on Zowe v2 conformance.

- **server.ssl.enabled**
  Specifies if TLS is used. The default value is `true`.

Configure component api-catalog

The following configurations can be used under the `components.api-catalog` section:

- **port**
  Specifies the port which API Catalog is to be started on.
- **debug**
  Specifies the enablement of debug mode for the API Catalog. This value is equivalent to the `APIML_DEBUG_MODE_ENABLED` variable but with a higher granular level.
- **apiml.health.protected**
  Specifies if the health check endpoint is accessible with or without authentication. The default value is `true`.
- **apiml.security.authorization.provider**
  Specifies the provider used for the SAF resource check.
- **apiml.security.authorization.endpoint.url**
  Specifies the base path of endpoint's URL (`{base path}/{userId}/{class}/{entity}/{level}`).
- **apiml.catalog.customStyle.logo**
  Specifies the location of the logo that replaces the default Zowe logo in the API Catalog header. Supported image formats are: `svg`, `png` and `jpg/jpeg`.
- **apiml.catalog.customStyle.fontFamily**
  Specifies the font family to use across the API Catalog.
- **apiml.catalog.customStyle.backgroundColor**
  Specifies the HTML color of the main background across the API Catalog.
- **apiml.catalog.customStyle.titlesColor`**
  Specifies the title color.
- **`apiml.catalog.customStyle.headerColor**
  Specifies the HTML color of the header element in the API Catalog home page.

- **apiml.catalog.customStyle.textColor**
  Specifies the HTML color of the main text across the API Catalog
- **apiml.catalog.customStyle.docLink**
  Specifies a custom link to be displayed in the header. Use this property to refer to applicable documentation. The format is `<link_name>|<link_url>`.

Configure component Caching Service

These configurations can be used under the `components.caching-service` section:

- **port**
  Specifies the port which Caching Service should be started on. This may be defined as a valid port number or as an offset from the Gateway component's port. To define an offset enter `"+{offset}"` or `"-{offset}"` as a string. The offset must start with `+` or `-`.
- **debug**
  Specifies if debug mode is enabled for the Caching Service.
- **storage.mode**
  Sets the storage type used to persist data in the Caching Service. The valid values are `infinispan`, and `redis`.
- **storage.size**
  Specifies the number of records before eviction strategies start evicting.
- **storage.evictionStrategy**
  Specifies eviction strategy to be used when the storage size is achieved. The valid values are `reject`, and `removeOldest`.
- **storage.vsam.name**
  Specifies the data set name of the Caching service VSAM data set.
- **storage.infinispan.initialHosts**
  This property specifies the list of cluster nodes (members). In case of multiple instances, the value for each Caching Service instance can be either a list of all the members, separated by a comma, or just the replica. The format is `${haInstance.hostname}[${components.caching-service.storage.infinispan.jgroups.port}]`.
- **storage.infinispan.persistence.dataLocation**
  The path where the Soft-Index store keeps its data files for the Infinispan Soft-Index Cache Store. The default value is `data`. If you run the Caching Service in Highly Available mode and the instances use the same filesystem, you have to specify a different value of the `CACHING_STORAGE_INFINISPAN_PERSISTENCE_DATALOCATION` property for each instance. For more information, see the Soft-Index File Store.
- **storage.infinispan.jgroups.port**
  Specifies the port number used by Infinispan to synchronise data among caching-service instances.
- **storage.redis.masterNodeUri**
  Specifies the URI used to connect to the Redis master instance in the form `username:password@host:port`.
- **storage.redis.timeout**
  Specifies the timeout second to Redis. Defaults to 60 seconds.
- **storage.redis.sentinel.masterInstance**
  Specifies the Redis master instance ID used by the Redis Sentinel instances.
- **storage.redis.sentinel.nodes**
  Specifies the array of URIs used to connect to a Redis Sentinel instances in the form `username:password@host:port`.
- **storage.redis.ssl.enabled**
  Specifies the boolean flag indicating if Redis is being used with SSL/TLS support. Defaults to `true`.

- **storage.redis.ssl.keystore**
  Specifies the keystore file used to store the private key.
- **storage.redis.ssl.keystorePassword**
  Specifies the password used to unlock the keystore.
- **storage.redis.ssl.truststore**
  Specifies the truststore file used to keep other parties public keys and certificates.
- **storage.redis.ssl.truststorePassword**
  Specifies the password used to unlock the truststore.
- **apiml.security.ssl.verifySslCertificatesOfServices**
  Specifies if API ML is to verify certificates of services in strict mode. Set to `true` to enable `strict` mode where API ML validates both if the certificate is trusted in truststore, and also if the certificate Common Name or Subject Alternate Name (SAN) match the service hostname.
- **apiml.security.ssl.nonStrictVerifySslCertificatesOfServices**
  Specifies if API ML is to verify certificates of services in non-strict mode. Set to `true` to enable `non-strict` mode where API ML validates if the certificate is trusted in truststore, but ignores the certificate Common Name or Subject Alternate Name (SAN) check. Zowe ignores this configuration if strict mode is enabled with `apiml.security.ssl.verifySslCertificatesOfServices`.

Configure component app-server

The following configurations can be used under the `components.app-server` section:

- **port**
  Specifies the port which App Server is to be started on. This value may be defined as a valid port number or as an offset from the Gateway component's port. To define an offset enter `"+{offset}"` or `"-{offset}"` as a string. The offset must start with `+` or `-`.

Configure component zss

The following configurations can be used under the `components.zss` section:

- **port**
  Specifies the port which ZSS is to be started on. This value may be defined as a valid port number or as an offset from the Gateway component's port. To define an offset enter `"+{offset}"` or `"-{offset}"` as a string. The offset must start with `+` or `-`.

Configure external extension

You can define a `components.<extension-id>` section and use common component configuration entries.

For example, enable `my-extension`:

YAML configurations - haInstances

All Zowe high availability instances should have a dedicated section under the `haInstances` high-level configuration.

In this section, *ha-instance* represents any Zowe high availability instance ID.

> **NOTE**

> Each *ha-instance* must be unique. The identification of an *ha-instance* is based on the name in lowercase format.

For all high availability instances, these are the common definitions.

- **haInstances.*ha-instance*.hostname**
  Specifies the host name where you want to start this instance. This value could be the host name of one LPAR in your Sysplex.
- **haInstances.*ha-instance*.sysname**
  Specifies the system name of the LPAR where the instance is running. Zowe uses the `ROUTE` command to send JES2 start or stop command to this HA instance.
- **haInstances.*ha-instance*.components.*component***
  This optional settings allows you to override component configurations for this high availability instance. See Configuration override - defaults.yaml for more details.

Auto-generated environment variables

Each line of Zowe YAML configuration has a matching environment variable during runtime. This variable is converted based on a pre-defined pattern:

- All configurations under `zowe`, `components`, `haInstances` are converted to a variable with the name with the following conditions:
  - prefixed with `ZWE_`
  - any non-alphabetic-numeric characters are converted to underscore (`_`)
  - no double underscores (`__`)
- Calculated configurations of `haInstance`, which is a portion of `haInstances.<current-ha-instance>` are converted the same way.
- Calculated configurations of `configs`, which is a portion of `haInstances.<current-ha-instance>.components.<current-component>` are converted the same way.
- All other configuration entries are converted to a variable with a name with the following conditions:
  - all upper cases
  - any non-alphabetic-numeric characters are converted to underscore (`_`)
  - no double underscores (`__`)

Examples:

- `ZWE_zowe_runtimeDirectory` is parent directory where `zwe` server command is located.
- `ZWE_zowe_workspaceDirectory` is the path of the user customized workspace directory.
- `ZWE_zowe_setup_dataset_prefix` is the high-level qualifier where Zowe MVS data sets are installed.
- `ZWE_zowe_setup_dataset_parmlib` is the data set configured to store customized version of parameter library members.
- `ZWE_zowe_setup_dataset_authPluginLib` is the data set configured to store APF authorized ZIS plug-ins load library.
- `ZWE_zowe_setup_security_users_zowe` is the name of Zowe runtime user.
- `ZWE_configs_port` is your component port number you can use in your start script. It points to the value of `haInstances.<current-ha-instance>.components.<your-component>.port`, or fall back to `components.<my-component>.port`, or fall back to `configs.port` defined in your component manifest.

Troubleshooting your YAML with the Red Hat VS Code extension

After you download the Red Hat VSCode extension for YAML, YAML validation for your files is turned on by default. Syntax mistakes are highlighted in red. To parse sensitive information, we highly recommend leaving the data gathering option disabled. To customize your settings, click the "Extensions" category in VS Code left-hand side workspace, scroll down to YAML Language Support by Red Hat, click the gear icon, and select "Extension Settings".

Version: v3.2.x LTS

ZWE Server Command Reference

`zwe` is the management utility for Zowe server components.

It is a Unix command that is installed via a download of the Zowe server components.

When installed, you can find it within the zowe runtime directory's "bin" subdirectory.

This command can be accessed directly from that location, or you can save that location to your Unix PATH environment variable so that it's accessible at all times just by typing `zwe`.

`zwe` has several useful features, and more are added often.

Using the `zwe` command

With the `zwe` command you can:

- Install/initialize a Zowe instance
- Install/upgrade Zowe extensions
- Validate the configuration against a schema
- Diagnose a message
- Collect support information

Accessing `zwe` help

Every `zwe` subcommand, and the `zwe` command itself, has built-in help that is accessible by adding `--help` to the command.

To access the help content:

The built-in help goes over the following topics:

- What the current command does
- What subcommands exist
- What parameters exist
- Example uses of the current command

This `zwe` command reference includes the same content as the built-in help. In the sections that follow, you can find all `zwe` help information.

Version: v3.2.x LTS

zwe

zwe

zwe [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- certificate
- components
- config
- diagnose
- init
- install
- internal
- migrate
- sample
- start
- stop
- support
- version

Description

A command line utility helps you managing Zowe instance.

You can issue --help or -h to find information for all commands it supports.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.

Full name	Alias	Type	Required	Help message
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.

Error code	Exit code	Error message
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate keyring-jcl clean

zwe > certificate > keyring-jcl > clean

zwe certificate keyring-jcl clean [parameter [parameter]...]

Description

Remove Zowe keyring.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--dataset-prefix,--ds-prefix		string	yes	Dataset prefix where Zowe is installed.
--jcllib		string	yes	JCLLIB data set name where the JCL will be placed.
--security-dry-run		boolean	no	Whether to dry run security related setup.
--security-product		string	no	Security product. Can be a value of RACF, ACF2 or TSS.
--keyring-owner		string	yes	Owner of the keyring.
--keyring-name		string	yes	Name of the keyring.
--alias	-a	string	yes	Certificate alias name.
--ca-alias	-ca	string	yes	Certificate authority alias name.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.

Full name	Alias	Type	Required	Help message
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0176E	176	Failed to clean up Zowe keyring "%s".

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.

Error code	Exit code	Error message
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.

Error code	Exit code	Error message
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate keyring-jcl connect

zwe > certificate > keyring-jcl > connect

zwe certificate keyring-jcl connect [parameter [parameter]...]

Description

Connect existing certificate to Zowe keyring.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--dataset-prefix,--ds-prefix		string	yes	Dataset prefix where Zowe is installed.
--jcllib		string	yes	JCLLIB data set name where the JCL will be placed.
--security-dry-run		boolean	no	Whether to dry run security related setup.
--security-product		string	no	Security product. Can be a value of RACF, ACF2 or TSS.
--keyring-owner		string	yes	Owner of the keyring.
--keyring-name		string	yes	Name of the keyring.
--trust-cas		string	no	Labels of extra certificate authorities should be trusted, separated by comma (Maximum 2).
--connect-user		string	yes	Certificate owner. Can be `SITE` or a user ID.
--connect-label		string	yes	Certificate label to connect.
--trust-zosmf		boolean	no	Whether to trust z/OSMF CA.

Full name	Alias	Type	Required	Help message
--zosmf-ca		string	no	Labels of z/OSMF root certificate authorities. Specify `_auto_` to let Zowe to detect automatically. This works for RACF and TSS.
--zosmf-user		string	no	z/OSMF user name. This is used to automatically detect z/OSMF root certificate authorities.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0175E	175	Failed to connect existing certificate to Zowe keyring "%s".

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.

Error code	Exit code	Error message
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.

Error code	Exit code	Error message
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate keyring-jcl generate

zwe > certificate > keyring-jcl > generate

zwe certificate keyring-jcl generate [parameter [parameter]...]

Description

Generate new set of certificate in Zowe keyring.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--dataset-prefix,--ds-prefix		string	yes	Dataset prefix where Zowe is installed.
--jcllib		string	yes	JCLLIB data set name where the JCL will be placed.
--security-dry-run		boolean	no	Whether to dry run security related setup.
--security-product		string	no	Security product. Can be a value of RACF, ACF2 or TSS.
--keyring-owner		string	yes	Owner of the keyring.
--keyring-name		string	yes	Name of the keyring.
--domains	-d	string	yes	Domain and IP for the certificate separated by comma. (Please note RACDCERT is limited to only have one domain and one IP.)
--alias	-a	string	yes	Certificate alias name.
--ca-alias	-ca	string	yes	Certificate authority alias name.
--common-name	-cn	string	no	Common name of certificate and certificate authority.

Full name	Alias	Type	Required	Help message
--org-unit		string	no	Organization unit of certificate and certificate authority.
--org		string	no	Organization of certificate and certificate authority.
--locality		string	no	Locality of certificate and certificate authority.
--state		string	no	State of certificate and certificate authority.
--country		string	no	Country of certificate and certificate authority.
--validity		string	no	Validity days of certificate.
--trust-cas		string	no	Labels of extra certificate authorities should be trusted, separated by comma (Maximum 2).
--trust-zosmf		boolean	no	Whether to trust z/OSMF CA.
--zosmf-ca		string	no	Labels of z/OSMF root certificate authorities. Specify `_auto_` to let Zowe to detect automatically. This works for RACF and TSS.
--zosmf-user		string	no	z/OSMF user name. This is used to automatically detect z/OSMF root certificate authorities.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0174E	174	Failed to generate certificate in Zowe keyring "%s".

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.

Error code	Exit code	Error message
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate keyring-jcl import-ds

zwe > certificate > keyring-jcl > import-ds

zwe certificate keyring-jcl import-ds [parameter [parameter]...]

Description

Import certificate stored in MVS data set into Zowe keyring.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--dataset-prefix,--ds-prefix		string	yes	Dataset prefix where Zowe is installed.
--jcllib		string	yes	JCLLIB data set name where the JCL will be placed.
--security-dry-run		boolean	no	Whether to dry run security related setup.
--security-product		string	no	Security product. Can be a value of RACF, ACF2 or TSS.
--keyring-owner		string	yes	Owner of the keyring.
--keyring-name		string	yes	Name of the keyring.
--alias	-a	string	yes	Certificate alias name.
--trust-cas		string	no	Labels of extra certificate authorities should be trusted, separated by comma (Maximum 2).
--trust-zosmf		boolean	no	Whether to trust z/OSMF CA.
--zosmf-ca		string	no	Labels of z/OSMF root certificate authorities. Specify `_auto_` to let Zowe to detect automatically. This works for RACF and TSS.

Full name	Alias	Type	Required	Help message
--zosmf-user		string	no	z/OSMF user name. This is used to automatically detect z/OSMF root certificate authorities.
--import-ds-name		string	yes	Name of the data set holds certificate to import into keyring.
--import-ds-password		string	yes	Password of the data set holds certificate to import.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0173E	173	Failed to import certificate to Zowe keyring "%s".

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.

Error code	Exit code	Error message
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.

Error code	Exit code	Error message
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate keyring-jcl

zwe > certificate > keyring-jcl

zwe certificate keyring-jcl [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- clean
- connect
- generate
- import-ds

Description

Manage z/OS Keyring with JCL.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.

Error code	Exit code	Error message
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate pkcs12 create ca

zwe > certificate > pkcs12 > create > ca

zwe certificate pkcs12 create ca [parameter [parameter]...]

Description

Create a new PKCS12 format certificate authority.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.
--alias	-a	string	yes	Certificate authority alias name.
--password	-p	string	yes	Password of the certificate authority keystore.
--common-name	-cn	string	no	Common name of certificate authority.
--org-unit		string	no	Organization unit of certificate authority.
--org		string	no	Organization of certificate authority.
--locality		string	no	Locality of certificate authority.
--state		string	no	State of certificate authority.
--country		string	no	Country of certificate authority.
--validity		string	no	Validity days of certificate authority.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--keystore-dir	-d	string	yes	Keystore directory.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0300W		%s already exists. This %s will be overwritten.
ZWEL0158E	158	%s already exists.
ZWEL0168E	168	Failed to create certificate authority %s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.

Error code	Exit code	Error message
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).

Error code	Exit code	Error message
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate pkcs12 create cert

zwe > certificate > pkcs12 > create > cert

zwe certificate pkcs12 create cert [parameter [parameter]...]

Description

Create a new PKCS12 format certificate.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.
--keystore	-k	string	yes	PKCS12 keystore name.
--alias	-a	string	yes	Certificate alias name.
--password	-p	string	yes	Password of the certificate keystore.
--common-name	-cn	string	no	Common name of certificate.
--domains	-d	string	no	Domain list of certificate Subject Alternative Name (SAN).
--ca-alias		string	yes	Alias name of the certificate authority which is used to sign CSR.
--ca-password		string	yes	Password of the certificate authority keystore which is used to sign CSR.
--org-unit		string	no	Organization unit of certificate.
--org		string	no	Organization of certificate.

Full name	Alias	Type	Required	Help message
--locality		string	no	Locality of certificate.
--state		string	no	State of certificate.
--country		string	no	Country of certificate.
--validity		string	no	Validity days of certificate.
--key-usage		string	no	Key usage of certificate.
--extended-key-usage		string	no	Extended key usage of certificate.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--keystore-dir	-d	string	yes	Keystore directory.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0300W		%s already exists. This %s will be overwritten.
ZWEL0158E	158	%s already exists.
ZWEL0169E	169	Failed to create certificate "%s".

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.

Error code	Exit code	Error message
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate pkcs12 create

zwe > certificate > pkcs12 > create

zwe certificate pkcs12 create [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- ca
- cert

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--keystore-dir	-d	string	yes	Keystore directory.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate pkcs12 export

zwe > certificate > pkcs12 > export

zwe certificate pkcs12 export [parameter [parameter]...]

Description

Export PKCS12 keystore as PEM files.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--keystore	-f	string	yes	PKCS12 keystore file name.
--password	-p	string	yes	Password of the certificate keystore.
--private-keys		string	no	Private keys should also be exported.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0178E	178	Failed to export PKCS12 keystore %s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.

Error code	Exit code	Error message
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate pkcs12 import

zwe > certificate > pkcs12 > import

zwe certificate pkcs12 import [parameter [parameter]...]

Description

Import certificate and/or certificate authorities into PKCS12 keystore.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--keystore	-f	string	yes	Destination PKCS12 keystore file name.
--password	-p	string	yes	Password of the destination PKCS12 keystore.
--alias	-a	string	no	Alias in the destination PKCS12 keystore after imported. Required if --source-alias is specified.
--source-keystore	-sf	string	no	Source PKCS12 keystore file name.
--source-password	-sp	string	no	Password of the source PKCS12 keystore.
--source-alias	-sa	string	no	Private keys should also be exported.
--trust-cas		string	no	PEM files of extra certificate authorities should be trusted, separated by comma.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.

Full name	Alias	Type	Required	Help message
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0179E	179	Failed to import certificate (authorities) into keystore %s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.

Error code	Exit code	Error message
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.

Error code	Exit code	Error message
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate pkcs12 lock

zwe > certificate > pkcs12 > lock

zwe certificate pkcs12 lock [parameter [parameter]...]

Description

This command will lock the keystore directory to only be accessible by specified user group.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--keystore-dir	-d	string	yes	Keystore directory.
--user		string	yes	Owner of the keystore directory.
--group		string	yes	Group of the keystore directory.
--group-permission		string	no	Group permission. Can be `<empty>` for no permission, or `read`, `write`.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.

Full name	Alias	Type	Required	Help message
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0177E	177	Failed to lock keystore directory %s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.

Error code	Exit code	Error message
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.

Error code	Exit code	Error message
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate pkcs12 trust-service

zwe > certificate > pkcs12 > trust-service

zwe certificate pkcs12 trust-service [parameter [parameter]...]

Description

This command can detect and trust any service by importing the certificate into truststore.

NOTE: the service must be online and accessible.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--service-name	-n	string	yes	Service name.
--keystore-dir	-d	string	yes	Keystore directory.
--keystore	-k	string	yes	PKCS12 keystore name.
--password	-p	string	yes	Password of the certificate keystore.
--host		string	yes	Host name of the service.
--port		string	yes	Port of the service.
--alias	-a	string	yes	Certificate alias name for the imported the certificate.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.

Full name	Alias	Type	Required	Help message
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0300W		%s already exists. This %s will be overwritten.
ZWEL0170E	170	Failed to trust service "%s".

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.

Error code	Exit code	Error message
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.

Error code	Exit code	Error message
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate pkcs12

zwe > certificate > pkcs12

zwe certificate pkcs12 [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- create
- export
- import
- lock
- trust-service

Description

Manage PKCS12 format keystore and truststore.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.

Error code	Exit code	Error message
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate verify-service

zwe > certificate > verify-service

zwe certificate verify-service [parameter [parameter]...]

Description

This command can verify if the service certificate is valid by checking the certificate Common Name (CN) and Subject Alternate Name (SAN).

NOTE: the service must be online and accessible.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--host		string	yes	Host name of the service.
--port		string	yes	Port of the service.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0171E	171	Failed to verify certificate (CN and SAN) of service "%s".

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.

Error code	Exit code	Error message
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe certificate

zwe > certificate

zwe certificate [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- keyring-jcl
- pkcs12
- verify-service

Description

Set of commands to help you manage certificates.

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe components install extract

zwe > components > install > extract

zwe components install extract [parameter [parameter]...]

Description

Extract module package and lay down to target directory.

NOTE: this sub-command will be automatically executed by `zwe components install`, so usually you don't need to execute this manually.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--component-file,--component	-o	string	yes	Path to the component package or directory.
--auto-encoding	-e	string	no	If we want to automatically tagging the module files.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0139E	139	Failed to create directory %s.
ZWEL0153E	153	Cannot install Zowe component to system root directory.
ZWEL0154E	154	Temporary directory is empty.
ZWEL0155E	155	Component %s already exists in %s. If you meant to upgrade this component, run the command 'zwe components upgrade' instead.
ZWEL0167E	167	Cannot find component name from %s package manifest.
ZWEL0204E	204	Symlink creation failure, error=%s
ZWEL0313E	313	Cannot find component file %s.
ZWEL0318E	318	File extension invalid. Supported file extensions: .pax, .tar, .zip

Inherited from parent command

Error code	Exit code	Error message
ZWEL0156E	156	Component name is not initialized after extract step.
ZWEL0180E	180	Zowe extension directory (zowe.extensionDirectory) is not defined in Zowe YAML configuration file.
ZWEL0304E	304	Handler install failure, cannot continue.
ZWEL0305E	305	Could not find one of the components' directories.
ZWEL0314E	314	Cannot install with component=all. This option only exists for upgrade.
ZWEL0315E	315	Handler (-handler or zowe.extensionRegistry.defaultHandler) required but not specified.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.

Error code	Exit code	Error message
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.

Error code	Exit code	Error message
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe components install process-hook

zwe > components > install > process-hook

zwe components install process-hook [parameter [parameter]...]

Description

Process module install hook if exists.

NOTE: this sub-command will be automatically executed by `zwe components install`, so usually you don't need to execute this manually.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--component-name	-n	string	yes	Component name.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
ZWEL0156E	156	Component name is not initialized after extract step.
ZWEL0180E	180	Zowe extension directory (zowe.extensionDirectory) is not defined in Zowe YAML configuration file.
ZWEL0304E	304	Handler install failure, cannot continue.
ZWEL0305E	305	Could not find one of the components' directories.
ZWEL0314E	314	Cannot install with component=all. This option only exists for upgrade.
ZWEL0315E	315	Handler (-handler or zowe.extensionRegistry.defaultHandler) required but not specified.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.

Error code	Exit code	Error message
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe components install

zwe > components > install

zwe components install [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- extract
- process-hook

Description

Install a Zowe component, given a component archive, component directory, or component name. When a component name is given instead of a path, the installation will be performed against a Zowe package registry if one is configured. Archives can be in the .tar, .zip, or pax format where a component is at the root of the archive.

Components are the packaging standard of Zowe. Zowe has core Components, but extensions are also delivered as Components. You can read more about them here: https://docs.zowe.org/stable/extend/packaging-zos-extensions/

IMPORTANT NOTES, by default, this command will enable the component globally by modifying your YAML configuration. You can pass `--skip-enable` to disable this behavior.

Examples

Parameters only for this command

Full name	Alias	Type	Required	Help message
--component-file,--component	-o	string	yes	Either a path or component name. The path must be to a component package or directory. If a name is specified instead, install checks the zowe package registry.
--auto-encoding	-e	string	no	If we want to automatically tagging the module files.
--skip-enable		boolean	no	Install component without enabling it for use.
--registry	-r	string	no	Specifies the registry to searh within instead of the default. The registry must be compatible with the manager used.
--handler		string	no	Specifies the registry handler name used with the package registry, instead of the default. The handler must be compatible with the registry used.

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0156E	156	Component name is not initialized after extract step.
ZWEL0180E	180	Zowe extension directory (zowe.extensionDirectory) is not defined in Zowe YAML configuration file.
ZWEL0304E	304	Handler install failure, cannot continue.
ZWEL0305E	305	Could not find one of the components' directories.
ZWEL0314E	314	Cannot install with component=all. This option only exists for upgrade.
ZWEL0315E	315	Handler (-handler or zowe.extensionRegistry.defaultHandler) required but not specified.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.

Error code	Exit code	Error message
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.

Error code	Exit code	Error message
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe components disable

zwe > components > disable

zwe components disable [parameter [parameter]...]

Description

Disable a Zowe component.

IMPORTANT NOTES, this command will modify your YAML configuration.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--component-name,--component	-o	string	yes	Component name to be disabled.
--ha-instance	-i	string	no	Zowe high availability instance ID from zowe.yaml.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0152E	152	Cannot find component %s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.

Error code	Exit code	Error message
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe components enable

zwe > components > enable

zwe components enable [parameter [parameter]...]

Description

Enable a Zowe component.

IMPORTANT NOTES, this command will modify your YAML configuration.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--component-name,--component	-o	string	yes	Component name to be enabled.
--ha-instance	-i	string	no	Zowe high availability instance ID from zowe.yaml.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0152E	152	Cannot find component %s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.

Error code	Exit code	Error message
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe components search

zwe > components > search

zwe components search [parameter [parameter]...]

Description

Search for a Zowe component within a Zowe package registry.

This command requires you have a registry manager set up for zowe's use already, such as npm or conda.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--component-name,--component	-o	string	no	Component name to search for.
--component-id,--id	-d	string	no	Component id to search for.
--registry	-r	string	no	Specifies the registry to search within instead of the default. The registry must be compatible with the manager used.
--handler		string	no	Specifies the registry handler name used with the package registry, instead of the default. The handler must be compatible with the registry used.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.

Full name	Alias	Type	Required	Help message
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0310E	310	Component name (-name
ZWEL0311E	311	Handler (-handler,-h or zowe.extensionRegistry.defaultHandler) required but not specified.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.

Error code	Exit code	Error message
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.

Error code	Exit code	Error message
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe components uninstall

zwe > components > uninstall

zwe components uninstall [parameter [parameter]...]

Description

Uninstall a Zowe component, given its name.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--component-name,--component	-o	string	yes	The name of an installed component.
--registry	-r	string	no	Specifies the registry to search within instead of the default. The registry must be compatible with the manager used.
--handler		string	no	Specifies the registry handler name used with the package registry, instead of the default. The handler must be compatible with the registry used.
--dry-run	-d	boolean	no	Whether or not to perform the upgrade versus just checking if an upgrade is available

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.

Full name	Alias	Type	Required	Help message
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0306W	306	Component %s cannot be uninstalled, because it is not currently installed.
ZWEL0307E	307	Component %s cannot be uninstalled, because it is a core component. If you do not want to use it, disable it instead.
ZWEL0308W	308	Component directory %s could not be removed, rc=%s.
ZWEL0309W	309	Skipping removal of component %s because it is a core component.
ZWEL0312W	312	Component %s marked for removal but is not installed.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.

Error code	Exit code	Error message
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.

Error code	Exit code	Error message
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe components upgrade

zwe > components > upgrade

zwe components upgrade [parameter [parameter]...]

Description

Upgrade a Zowe component from a Zowe package registry when given a component name or "all" to upgrade all components. The upgrade will only be performed if a Zowe package registry is configured.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--component-file,--component	-o	string	yes	Either a path or component name. The path must be to a component package or directory. If a name is specified instead, install checks the zowe package registry.
--registry	-r	string	no	Specifies the registry to search within instead of the default. The registry must be compatible with the manager used.
--handler		string	no	Specifies the registry handler name used with the package registry, instead of the default. The handler must be compatible with the registry used.
--dry-run	-d	boolean	no	Whether or not to perform the upgrade versus just checking if an upgrade is available

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.

Full name	Alias	Type	Required	Help message
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0156E	156	Component name is not initialized after extract step.
ZWEL0180E	180	Zowe extension directory (zowe.extensionDirectory) is not defined in Zowe YAML configuration file.
ZWEL0304E	304	Handler install failure, cannot continue.
ZWEL0305E	305	Could not find one of the components' directories.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.

Error code	Exit code	Error message
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.

Error code	Exit code	Error message
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe components

zwe > components

zwe components [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- disable
- enable
- install
- search
- uninstall
- upgrade

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.

Error code	Exit code	Error message
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe config get

zwe > config > get

zwe config get [parameter [parameter]...]

Description

Return value of a configuration defined in YAML configuration. This command requires zowe.useConfigmgr=true or --configmgr to be used.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	Zowe high availability instance ID.
--path	-p	string	yes	Path of the configuration. For example, `components.gateway.port`.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0303E	303	Invalid config path syntax for %s. Get only supports single period delimiters between values.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.

Error code	Exit code	Error message
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe config validate

zwe > config > validate

zwe config validate [parameter [parameter]...]

Description

Runs schema validation upon given zowe yaml configuration files. This command can be used to prove that the zowe configuration is good before starting zowe. It requires that zowe.useConfigmgr=true or --configmgr are set. This command can optionally validate enabled components or all components, but otherwise would only validate the zowe core configuration.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--components		boolean	no	Turns on validation for enabled components.
--all		boolean	no	Turns on validation for all components, even disabled ones.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe config

zwe > config

zwe config [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- get
- validate

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.

Error code	Exit code	Error message
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.

Error code	Exit code	Error message
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe init apfauth

zwe > init > apfauth

zwe init apfauth [parameter [parameter]...]

Description

This command will APF authorize load library for you.

NOTE: You require proper permission to run APF authorize command.

These Zowe YAML configurations showing with sample values are used:

- `zowe.setup.dataset.prefix` shows where the `SZWEAUTH` data set is installed.
- `zowe.setup.dataset.authLoadlib` is the user custom APF LOADLIB. This field is optional. If it's not defined, `SZWEAUTH` from `zowe.setup.dataset.prefix` data set will be APF authorized.
- `zowe.setup.dataset.authPluginLib` is the user custom APF PLUGINLIB. You can install Zowe ZIS plugins into this load library.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--security-dry-run		boolean	no	Whether to dry run security related setup.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.
--skip-security-setup		boolean	no	Whether should skip security related setup.
--security-dry-run		boolean	no	Whether to dry run security related setup.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.

Full name	Alias	Type	Required	Help message
--update-config		boolean	no	Whether to update YAML configuration file with initialization result.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.

Error code	Exit code	Error message
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.

Error code	Exit code	Error message
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe init certificate

zwe > init > certificate

zwe init certificate [parameter [parameter]...]

Description

This command will generate certificate used by Zowe services.

If you specify `--update-config` with this command, these configurations could be written back to your Zowe YAML configuration file:

- `zowe.certificate` based on your `zowe.setup.certificate` configuration.

These Zowe YAML configurations showing with sample values are used:

- `zowe.setup.certificate.type` is the type of certificate. Valid values are "PKCS12" (USS keystore) or "JCEKS", "JCECCAKS", "JCERACFKS", "JCECCARACFKS", and "JCEHYBRIDRACFKS (z/OS keyring).
- `zowe.setup.certificate.dname` is the distinguished name of the certificate. You can define `caCommonName`, `commonName`, `orgUnit`, `org`, `locality`, `state`, and / or `country`. These configurations are optional.
- `zowe.setup.certificate.validity` is the validity days of the certificate. This is optional.
- `zowe.setup.certificate.san` is the `Subject Alternative Name`(s) of the certificate if they are different from `zowe.externalDomains`. Please note, for `JCEKS`, `JCECCAKS`, `JCERACFKS`, `JCECCARACFKS`, and `JCEHYBRIDRACFKS` type, with limitation of RACDCERT command, this should contain exact one hostname (domain) and one IP address.
- `zowe.setup.certificate.importCertificateAuthorities` is the list of certificate authorities will be imported to Zowe PKCS12 keystore or keyring. Please note, for keyring type, only maximum 2 CAs is supported. If you are using `PKCS12` certificate, this should be USS files in PEM format. If you are using `JCEKS`, `JCECCAKS`, `JCERACFKS`, `JCECCARACFKS`, or `JCEHYBRIDRACFKS` certificate, this should be certificate labels on the z/OS system.
- `zOSMF.host` and `zOSMF.port` is the z/OSMF service information. This is required if you are using z/OSMF as authentication service.
- `zowe.verifyCertificates` indicates how Zowe should validate the certificate of services registered under Zowe APIML. Valid values are "STRICT", "NONSTRICT" or "DISABLED". If this is "STRICT", this command will try to validate the z/OSMF service certificate if z/OSMF is defined.

For `PKCS12` certificate users,

- `zowe.setup.certificate.pkcs12.directory` is the directory where you plan to store the PKCS12 keystore and truststore. This is required if `zowe.setup.certificate.type` is `PKCS12`.
- `zowe.setup.certificate.pkcs12.lock` is a boolean configuration to tell if we should lock the PKCS12 keystore directory only for Zowe runtime user and group. Default value is true.
- `zowe.setup.security.groups.admin` and `zowe.setup.security.users.zowe` will be the default owner of keystore directory.
- You can also define `name`, `password`, `caAlias` and `caPassword` under `zowe.setup.certificate.pkcs12` to customized keystore and truststore. These configurations are optional, but it is recommended to update them from default values.

- Define `zowe.setup.certificate.pkcs12.import.keystore` if you already acquired certificate from other CA, stored them in PKCS12 format, and want to import into Zowe PKCS12 keystore.
- `zowe.setup.certificate.pkcs12.import.password` is the password for keystore defined in `zowe.setup.certificate.pkcs12.import.keystore`.
- `zowe.setup.certificate.pkcs12.import.alias` is the original certificate alias defined in `zowe.setup.certificate.pkcs12.import.keystore`. After imported, the certificate will be saved as alias specified in `zowe.setup.certificate.pkcs12.name`.

For keyring certificate users,

- `zowe.setup.certificate.keyring.owner` is the keyring owner. It's optional and default value is `zowe.setup.security.users.zowe`. If it's also not defined, the default value is `ZWESVUSR`.
- `zowe.setup.certificate.keyring.name` is the keyring name will be created on z/OS. This is required if `zowe.setup.certificate.type` is one of `JCEKS`, `JCECCAKS`, `JCERACFKS`, `JCECCARACFKS`, or `JCEHYBRIDRACFKS`.
- If you want to let Zowe to generate new certificate,
  - You can also customize `label` and `caLabel` under `zowe.setup.certificate.keyring` if you want to generate new certificate. Default value of `label` is `localhost` and default value of `caLabel` is `localca`.
- If you want to import certificate stored in MVS data set into Zowe keyring,
  - `zowe.setup.certificate.keyring.connect.dsName` is required in this case. It tells Zowe the data set where the certificate stored.
  - `zowe.setup.certificate.keyring.connect.password` is the password when importing the certificate.
  - The certificate will be imported with label defined in `zowe.setup.certificate.keyring.label`.
- If you want to connect existing certificate into Zowe keyring,
  - `zowe.setup.certificate.keyring.connect.user` is required and tells Zowe the owner of existing certificate. This field can have value of `SITE`.
  - `zowe.setup.certificate.keyring.connect.label` is also required and tells Zowe the label of existing certificate.
- If `zowe.verifyCertificates` is not `DISABLED`, and z/OSMF host (`zOSMF.host`) is provided, Zowe will try to trust z/OSMF certificate.
  - If you are using `RACF` or `TSS` security manager, Zowe will try to automatically detect the z/OSMF CA based on certificate owner specified by `zowe.setup.certificate.keyring.zOSMF.user`. Default value of this field is `IZUSVR`. If the automatic detection failed, you will need to define `zowe.setup.certificate.keyring.zOSMF.ca` indicates what is the label of z/OSMF root certificate authority.
  - If you are using `ACF2` security manager, `zowe.setup.certificate.keyring.zOSMF.ca` is required to indicates what is the label of z/OSMF root certificate authority.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.

Full name	Alias	Type	Required	Help message
--update-config		boolean	no	Whether to update YAML configuration file with initialization result.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.
--skip-security-setup		boolean	no	Whether should skip security related setup.
--security-dry-run		boolean	no	Whether to dry run security related setup.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.
--update-config		boolean	no	Whether to update YAML configuration file with initialization result.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.
ZWEL0164E	164	Value of %s (%s) defined in Zowe YAML configuration file is invalid. Valid values are %s.

Error code	Exit code	Error message
ZWEL0300W		%s already exists. This %s will be overwritten.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.

Error code	Exit code	Error message
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe init mvs

zwe > init > mvs

zwe init mvs [parameter [parameter]...]

Description

This command will prepare Zowe custom data sets.

These Zowe YAML configurations showing with sample values are used:

`zowe.setup.dataset.prefix` shows where the `SZWESAMP` and `SZWEAUTH` data sets are installed.

Below data sets will be initialized by this command:

- `zowe.setup.dataset.parmlib` is the user custom parameter library. Zowe server command may generate sample PARMLIB members and stores here.
- `zowe.setup.dataset.jcllib` is the custom JCL library. Zowe server command may generate sample JCLs and put into this data set.
- `zowe.setup.dataset.authLoadlib` is the user custom APF LOADLIB. This field is optional. If this is defined, members of `SZWEAUTH` will be copied over to this data set. This loadlib requires APF authorize.
- `zowe.setup.dataset.authPluginLib` is the user custom APF PLUGINLIB. You can install Zowe ZIS plugins into this load library. This loadlib requires APF authorize.

NOTE: Existing members in custom data sets will not be overwritten by default. You can pass `--allow-overwrite` parameters to force update.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.
--skip-security-setup		boolean	no	Whether should skip security related setup.

Full name	Alias	Type	Required	Help message
--security-dry-run		boolean	no	Whether to dry run security related setup.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.
--update-config		boolean	no	Whether to update YAML configuration file with initialization result.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.
ZWEL0300W		%s already exists. This %s will be overwritten.
ZWEL0301W		%s already exists and will not be overwritten. For upgrades, you must use --allow-overwrite.
ZWEL0158E	158	%s already exists.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.

Error code	Exit code	Error message
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.

Error code	Exit code	Error message
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe init security

zwe > init > security

zwe init security [parameter [parameter]...]

Description

This command will run ZWESECUR jcl.

NOTE: You require proper permission to run security configuration.

These Zowe YAML configurations showing with sample values are used:

- `zowe.setup.dataset.prefix` shows where the `SZWESAMP` data set is installed,
- `zowe.setup.dataset.jcllib` is the custom JCL library. Zowe will create customized ZWESECUR JCL here before applying it.
- `zowe.setup.security.product` is security product. Can be `RACF`, `ACF2`, or `TSS`. This configuration is optional. Default value is `RACF`.
- `zowe.setup.security.groups.admin` is the group for Zowe administrators. This configuration is optional. Default value is `ZWEADMIN`.
- `zowe.setup.security.groups.stc` is the group for Zowe started tasks. This configuration is optional. Default value is `ZWEADMIN`.
- `zowe.setup.security.groups.sysProg` is system programmer user ID/group. This configuration is optional. Default value is `ZWEADMIN`.
- `zowe.setup.security.users.zowe` is the userid for Zowe started task. This configuration is optional. Default value is `ZWESVUSR`.
- `zowe.setup.security.users.zis` is userid for ZIS started task. This configuration is optional. Default value is `ZWESIUSR`.
- `zowe.setup.security.stcs.zowe` is Zowe started task name. This configuration is optional. Default value is `ZWESLSTC`.
- `zowe.setup.security.stcs.zis` is ZIS started task name. This configuration is optional. Default value is `ZWESISTC`.
- `zowe.setup.security.stcs.aux` is ZIS auxiliary started task name. This configuration is optional. Default value is `ZWESASTC`.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--security-dry-run		boolean	no	Whether to dry run security related setup.

Full name	Alias	Type	Required	Help message
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.
--skip-security-setup		boolean	no	Whether should skip security related setup.
--security-dry-run		boolean	no	Whether to dry run security related setup.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.
--update-config		boolean	no	Whether to update YAML configuration file with initialization result.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.
ZWEL0159E	159	Failed to modify %s.
ZWEL0160E	160	Failed to write to %s. Please check if target data set is opened by others.
ZWEL0161E	161	Failed to run JCL %s.

Error code	Exit code	Error message
ZWEL0161W		Failed to run JCL %s.
ZWEL0162E	162	Failed to find job %s result.
ZWEL0162W		Failed to find job %s result.
ZWEL0163E	163	Job %s ends with code %s.
ZWEL0163W		Job %s ends with code %s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.

Error code	Exit code	Error message
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.

Error code	Exit code	Error message
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe init stc

zwe > init > stc

zwe init stc [parameter [parameter]...]

Description

This command will copy Zowe started tasks `ZWESLSTC`, `ZWESISTC`, `ZWESASTC` to your target procedure library.

NOTE: You require proper permission to write to target procedure library.

These Zowe YAML configurations showing with sample values are used:

- `zowe.setup.dataset.prefix` shows where the `SZWESAMP` data set is installed,
- `zowe.setup.dataset.proclib` shows what is the target procedure library.
- `zowe.setup.dataset.parmlib` is the user custom parameter library. Zowe server command may generate sample PARMLIB members and stores here.
- `zowe.setup.dataset.jcllib` is the custom JCL library. Zowe will create temporary started tasks here before putting into target procedure library.
- `zowe.setup.dataset.authLoadlib` is the user custom APF LOADLIB. This field is optional. If this is not defined, `SZWEAUTH` from `zowe.setup.dataset.prefix` data set will be used as STEPLIB in STCs.
- `zowe.setup.security.stcs.zowe` is Zowe started task name. This configuration is optional. Default value is `ZWESLSTC`.
- `zowe.setup.security.stcs.zis` is ZIS started task name. This configuration is optional. Default value is `ZWESISTC`.
- `zowe.setup.security.stcs.aux` is ZIS auxiliary started task name. This configuration is optional. Default value is `ZWESASTC`.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.

Full name	Alias	Type	Required	Help message
--skip-security-setup		boolean	no	Whether should skip security related setup.
--security-dry-run		boolean	no	Whether to dry run security related setup.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.
--update-config		boolean	no	Whether to update YAML configuration file with initialization result.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.
ZWEL0300W		%s already exists. This %s will be overwritten.
ZWEL0301W		%s already exists and will not be overwritten. For upgrades, you must use --allow-overwrite.
ZWEL0143E	143	%s.%s(%s) already exists. This data set member will be overwritten during configuration.
ZWEL0158E	158	%s already exists.
ZWEL0159E	159	Failed to modify %s.
ZWEL0160E	160	Failed to write to %s. Please check if target data set is opened by others.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe init vsam

zwe > init > vsam

zwe init vsam [parameter [parameter]...]

Description

This command will run ZWECSVSM JCL to create VSAM data set for Zowe APIML Caching Service.

These Zowe YAML configurations showing with sample values are used:

- `zowe.setup.dataset.prefix` shows where the `SZWESAMP` data set is installed.
- `zowe.setup.dataset.jcllib` is the custom JCL library. Zowe server command may generate sample JCLs and put into this data set.
- `zowe.setup.vsam.mode` indicates whether the VSAM will utilize Record Level Sharing (RLS) services or not. Valid value is `RLS` or `NONRLS`.
- `zowe.setup.vsam.volume` indicates the name of volume. This field is required if VSAM mode is `NONRLS`.
- `zowe.setup.vsam.storageClass` indicates the name of RLS storage class. This field is required if VSAM mode is `RLS`.
- `components.caching-service.storage.mode` indicates what storage Zowe Caching Service will use. Only if this value is `VSAM`, this command will try to create VSAM data set.
- `components.caching-service.storage.vsam.name` defines the VSAM data set name.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.
--skip-security-setup		boolean	no	Whether should skip security related setup.
--security-dry-run		boolean	no	Whether to dry run security related setup.

Full name	Alias	Type	Required	Help message
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.
--update-config		boolean	no	Whether to update YAML configuration file with initialization result.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.
ZWEL0300W		%s already exists. This %s will be overwritten.
ZWEL0301W		%s already exists and will not be overwritten. For upgrades, you must use --allow-overwrite.
ZWEL0158E	158	%s already exists.
ZWEL0159E	159	Failed to modify %s.
ZWEL0160E	160	Failed to write to %s. Please check if target data set is opened by others.
ZWEL0161E	161	Failed to run JCL %s.
ZWEL0162E	162	Failed to find job %s result.
ZWEL0163E	163	Job %s ends with code %s.
ZWEL0321W	0	Zowe Caching Service is not configured to use VSAM. Command skipped.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe init

zwe > init

zwe init [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- apfauth
- certificate
- mvs
- security
- stc
- vsam

Description

Init Zowe instance based on zowe.yaml configuration.

You can find an example zowe.yaml in Zowe runtime directory folder.

This command will run these sub-commands in sequence:

- `zwe init mvs`
- `zwe init vsam`
- `zwe init apfauth`
- `zwe init security`
- `zwe init certificate`
- `zwe init stc`

If you pass `--skip-security-setup` with this command, `zwe init apfauth` and `zwe init security` steps will be skipped.

If you pass `--update-config` with this command, these configurations could be written back to your Zowe YAML configuration file:

- `zowe.runtimeDirectory` based on where your `zwe` command is located, and if it is not defined,
- `zowe.certificate` based on your `zowe.setup.certificate` configuration,
- `java.home` based on your current JAVA_HOME or automatic detection,
- `node.home` based on your current NODE_HOME or automatic detection.

IMPORTANT, if you modify any of the values below, it's suggested to re-run relevant `zwe init` command to make them taking effect.

These Zowe YAML configurations showing with sample values are used:

- `zowe.setup.dataset.prefix` shows where the `SZWEAUTH` data set is installed.
- `zowe.setup.dataset.parmlib` is the user custom parameter library. Zowe server command may generate sample PARMLIB members and stores here.
- `zowe.setup.dataset.jcllib` is the custom JCL library. Zowe server command may generate sample JCLs and put into this data set.
- `zowe.setup.dataset.authLoadlib` is the user custom APF LOADLIB. This field is optional. If this is defined, members of `SZWEAUTH` will be copied over to this data set and it will be APF authorized. If it's not defined, `SZWEAUTH` from `zowe.setup.dataset.prefix` data set will be APF authorized.
- `zowe.setup.dataset.authPluginLib` is the user custom APF PLUGINLIB. You can install Zowe ZIS plugins into this load library. This loadlib requires APF authorize.
- `zowe.setup.security.product` is security product. Can be `RACF`, `ACF2`, or `TSS`. This configuration is optional. Default value is `RACF`.
- `zowe.setup.security.groups.admin` is the group for Zowe administrators. This configuration is optional. Default value is `ZWEADMIN`.
- `zowe.setup.security.groups.stc` is the group for Zowe started tasks. This configuration is optional. Default value is `ZWEADMIN`.
- `zowe.setup.security.groups.sysProg` is system programmer user ID/group. This configuration is optional. Default value is `ZWEADMIN`.
- `zowe.setup.security.users.zowe` is the userid for Zowe started task. This configuration is optional. Default value is `ZWESVUSR`.
- `zowe.setup.security.users.zis` is userid for ZIS started task. This configuration is optional. Default value is `ZWESIUSR`.
- `zowe.setup.security.stcs.zowe` is Zowe started task name. This configuration is optional. Default value is `ZWESLSTC`.
- `zowe.setup.security.stcs.zis` is ZIS started task name. This configuration is optional. Default value is `ZWESISTC`.
- `zowe.setup.security.stcs.aux` is ZIS auxiliary started task name. This configuration is optional. Default value is `ZWESASTC`.
- `zowe.setup.certificate.type` is the type of certificate. Valid values are "PKCS12" (USS keystore) or "JCEKS", "JCECCAKS", "JCERACFKS", "JCECCARACFKS", and "JCEHYBRIDRACFKS (z/OS keyring).
- `zowe.setup.certificate.dname` is the distinguished name of the certificate. You can define `caCommonName`, `commonName`, `orgUnit`, `org`, `locality`, `state`, and / or `country`. These configurations are optional.
- `zowe.setup.certificate.validity` is the validity days of the certificate. This is optional.
- `zowe.setup.certificate.san` is the `Subject Alternative Name`(s) of the certificate if they are different from `zowe.externalDomains`. Please note, for `JCEKS`, `JCECCAKS`, `JCERACFKS`, `JCECCARACFKS`, and `JCEHYBRIDRACFKS` type, with limitation of RACDCERT command, this should contain exact one hostname (domain) and one IP address.

- `zowe.setup.certificate.importCertificateAuthorities` is the list of certificate authorities will be imported to Zowe PKCS12 keystore or keyring. Please note, for keyring type, only maximum 2 CAs is supported. If you are using `PKCS12` certificate, this should be USS files in PEM format. If you are using `JCEKS`, `JCECCAKS`, `JCERACFKS`, `JCECCARACFKS`, or `JCEHYBRIDRACFKS` certificate, this should be certificate labels on the z/OS system.

For `PKCS12` certificate users,

- `zowe.setup.certificate.pkcs12.directory` is the directory where you plan to store the PKCS12 keystore and truststore. This is required if `zowe.setup.certificate.type` is `PKCS12`.
- `zowe.setup.certificate.pkcs12.lock` is a boolean configuration to tell if we should lock the PKCS12 keystore directory only for Zowe runtime user and group. Default value is true.
- You can also define `name`, `password`, `caAlias` and `caPassword` under `zowe.setup.certificate.pkcs12` to customized keystore and truststore. These configurations are optional, but it is recommended to update them from default values.
- Define `zowe.setup.certificate.pkcs12.import.keystore` if you already acquired certificate from other CA, stored them in PKCS12 format, and want to import into Zowe PKCS12 keystore.
- `zowe.setup.certificate.pkcs12.import.password` is the password for keystore defined in `zowe.setup.certificate.pkcs12.import.keystore`.
- `zowe.setup.certificate.pkcs12.import.alias` is the original certificate alias defined in `zowe.setup.certificate.pkcs12.import.keystore`. After imported, the certificate will be saved as alias specified in `zowe.setup.certificate.pkcs12.name`.

For keyring certificate users,

- `zowe.setup.certificate.keyring.owner` is the keyring owner. It's optional and default value is `zowe.setup.security.users.zowe`. If it's also not defined, the default value is `ZWESVUSR`.

- `zowe.setup.certificate.keyring.name` is the keyring name will be created on z/OS. This is required if `zowe.setup.certificate.type` is one of `JCEKS`, `JCECCAKS`, `JCERACFKS`, `JCECCARACFKS`, or `JCEHYBRIDRACFKS`.

- If you want to let Zowe to generate new certificate,

  - You can also customize `label` and `caLabel` under `zowe.setup.certificate.keyring` if you want to generate new certificate. Default value of `label` is `localhost` and default value of `caLabel` is `localca`.

- If you want to import certificate stored in MVS data set into Zowe keyring,

  - `zowe.setup.certificate.keyring.connect.dsName` is required in this case. It tells Zowe the data set where the certificate stored.
  - `zowe.setup.certificate.keyring.connect.password` is the password when importing the certificate.
  - The certificate will be imported with label defined in `zowe.setup.certificate.keyring.label`.

- If you want to connect existing certificate into Zowe keyring,

  - `zowe.setup.certificate.keyring.connect.user` is required and tells Zowe the owner of existing certificate. This field can have value of `SITE`.
  - `zowe.setup.certificate.keyring.connect.label` is also required and tells Zowe the label of existing certificate.

- If `zowe.verifyCertificates` is not `DISABLED`, and z/OSMF host (`zOSMF.host`) is provided, Zowe will try to trust z/OSMF certificate.
    - If you are using `RACF` security manager, Zowe will try to automatically detect the z/OSMF CA based on certificate owner specified by `zowe.setup.certificate.keyring.zOSMF.user`. Default value of this field is `IZUSVR`. If the automatic detection failed, you will need to define `zowe.setup.certificate.keyring.zOSMF.ca` indicates what is the label of z/OSMF root certificate authority.
    - If you are using `ACF2` or `TSS` (Top Secret) security manager, `zowe.setup.certificate.keyring.zOSMF.ca` is required to indicates what is the label of z/OSMF root certificate authority.
- `zowe.setup.vsam.mode` indicates whether the VSAM will utilize Record Level Sharing (RLS) services or not. Valid value is `RLS` or `NONRLS`.
- `zowe.setup.vsam.volume` indicates the name of volume. This field is required if VSAM mode is `NONRLS`.
- `zowe.setup.vsam.storageClass` indicates the name of RLS storage class. This field is required if VSAM mode is `RLS`.
- `zowe.verifyCertificates` indicates how Zowe should validate the certificate of services registered under Zowe APIML. Valid values are "STRICT", "NONSTRICT" or "DISABLED". If this is "STRICT", this command will try to validate the z/OSMF service certificate if z/OSMF is defined.
- `zOSMF.host` and `zOSMF.port` is the z/OSMF service information. This is required if you are using z/OSMF as authentication service.
- `components.caching-service.storage.mode` indicates what storage Zowe Caching Service will use. Only if this value is `VSAM`, this command will try to create VSAM data set.
- `components.caching-service.storage.vsam.name` defines the VSAM data set name.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.
--skip-security-setup		boolean	no	Whether should skip security related setup.
--security-dry-run		boolean	no	Whether to dry run security related setup.
--ignore-security-failures		boolean	no	Whether to ignore security setup job failures.
--update-config		boolean	no	Whether to update YAML configuration file with initialization result.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.

Error code	Exit code	Error message
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.

Error code	Exit code	Error message
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal config get

zwe > internal > config > get

zwe internal config get [parameter [parameter]...]

Description

Return value of a configuration defined in YAML configuration.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	Zowe high availability instance ID.
--path	-p	string	yes	Path of the configuration. For example, `components.gateway.port`.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0303E	303	Invalid config path syntax for %s. Get only supports single period delimiters between values.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.

Error code	Exit code	Error message
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal config output

zwe > internal > config > output

zwe internal config output [parameter [parameter]...]

Description

Outputs the merged YAML used at Zowe runtime into zowe.workspaceDirectory/.env/.zowe-merged.yaml

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.

Error code	Exit code	Error message
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal config set

zwe > internal > config > set

zwe internal config set [parameter [parameter]...]

Description

Set value of a configuration and write back to the YAML configuration.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	Zowe high availability instance ID.
--path	-p	string	yes	Path of the configuration. For example, `components.gateway.port`.
--value	-e	string	no	New value of the configuration.
--string		boolean	no	When specified, the value is treated as a string even if it looks like a number or boolean

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.

Full name	Alias	Type	Required	Help message
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.

Error code	Exit code	Error message
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal config

zwe > internal > config

zwe internal config [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- get
- output
- set

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.

Error code	Exit code	Error message
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal container cleanup

zwe > internal > container > cleanup

zwe internal container cleanup [parameter [parameter]...]

Description

Clean up Kubernetes runtime.

Currently this command will remove all outdated static definitions.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.

Error code	Exit code	Error message
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal container init

zwe > internal > container > init

zwe internal container init [parameter [parameter]...]

Description

Initialize special runtime environment required by Zowe containerization.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.

Error code	Exit code	Error message
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.

Error code	Exit code	Error message
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal container prestop

zwe > internal > container > prestop

zwe internal container prestop [parameter [parameter]...]

Description

Actions will be executed before a service is stopped.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Parameters

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	Zowe high availability instance ID.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.

Error code	Exit code	Error message
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal container

zwe > internal > container

zwe internal container [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- cleanup
- init
- prestop

Description

Internal commands to help manager workloads in Zowe containers.

NOTE: these internal commands are only used by Zowe Containerization use scenario.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal start component

zwe > internal > start > component

zwe internal start component [parameter [parameter]...]

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--component	-o	string	yes	Component to start.
--run-in-background		boolean	no	Whether to start this component in background.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	Zowe high availability instance ID.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.

Error code	Exit code	Error message
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal start prepare

zwe > internal > start > prepare

zwe internal start prepare [parameter [parameter]...]

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	Zowe high availability instance ID.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0141E	141	User %s does not have write permission on %s.
ZWEL0302W		You are running the Zowe process under user id IZUSVR. This is not recommended and may impact your z/OS MF server negatively.

Error code	Exit code	Error message
ZWEL0317E		Component %s commands.configure ended with rc=%s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.

Error code	Exit code	Error message
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal start

zwe > internal > start

zwe internal start [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- component
- prepare

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	Zowe high availability instance ID.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal get-launch-components

zwe > internal > get-launch-components

zwe internal get-launch-components [parameter [parameter]...]

Description

Return component list should be started in specified HA instance.

NOTE: This command only returns a list of enabled components with start command.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	Zowe high availability instance ID.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe internal

zwe > internal

zwe internal [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- config
- container
- get-launch-components
- start

Description

Commands will be executed internally by other Zowe commands.

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe migrate for kubernetes

zwe > migrate > for > kubernetes

zwe migrate for kubernetes [parameter [parameter]...]

Description

Migrate your YAML configuration on z/OS for Kubernetes.

This script will create `zowe-config` `ConfigMap` and `zowe-certificates-secret` `Secret` for Kubernetes deployment.

To manually create `zowe-config` `ConfigMap`, the `data` section should contain a key `zowe.yaml` with string value of your `zowe.yaml` used on z/OS.

To manually create `zowe-certificates-secret` `Secret`, you need 2 entries under `data` section:

- `keystore.p12`: which is base64 encoded PKCS#12 keystore,
- `truststore.p12`: which is base64 encoded PKCS#12 truststore.

And 3 entries under `stringData` section:

- `keystore.key`: is the PEM format of certificate private key,
- `keystore.cer`: is the PEM format of the certificate,
- `ca.cer`: is the PEM format of the certificate authority.

In order to make certificates working in Kubernetes, the certificate you are using should have these domains defined in certificate Subject Alt Name (SAN):

- your external domains to access Zowe APIML Gateway Service running in Kubernetes cluster,
- `*.[k8s-namespace].svc.[k8s-cluster-name]`
- `*.discovery-service.[k8s-namespace].svc.[k8s-cluster-name]`
- `*.gateway-service.[k8s-namespace].svc.[k8s-cluster-name]`
- `*.[k8s-namespace].pod.[k8s-cluster-name]`

`[k8s-namespace]` is the Kubernetes Namespace you installed Zowe into. And `[k8s-cluster-name]` is the Kubernetes cluster name, which usually should be `cluster.local`.

Without the additional domains in SAN, you may see warnings/errors related to certificate validation.

If you cannot add those domains into certificate Subject Alt Name (SAN), you can change `zowe.verifyCertificates` to `NONSTRICT` mode. Zowe components will not validate domain names but will continue to validate certificate chain, validity and whether it's trusted in Zowe truststore.

IMPORTANT: It's not recommended to disable `zowe.verifyCertificates`.

NOTES: With below conditions, this migration script will re-generate a new set of certificate for you with proper domain names listed above.

- you use `zwe init` command to initialize Zowe,
- use `PKCS#12` format keystore by defining `zowe.setup.certificate.type: PKCS12`
- did not define `zowe.setup.certificate.pkcs12.import.keystore` and let `zwe` command to generate PKCS12 keystore for you
- enabled `STRICT` mode `zowe.verifyCertificates`.

Parameters

Full name	Alias	Type	Required	Help message
--domains	-d	string	no	Domain list of certificate Subject Alternative Name (SAN).
--external-port		string	no	Port number to access APIML Gateway running in Kubernetes.
--k8s-namespace		string	no	Kubernetes namespace.
--k8s-cluster-name		string	no	Kubernetes cluster name.
--alias	-a	string	no	Certificate alias name.
--password	-p	string	no	Password of the certificate keystore.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.

Error code	Exit code	Error message
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe migrate for

zwe > migrate > for

zwe migrate for [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- kubernetes

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.

Error code	Exit code	Error message
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.

Error code	Exit code	Error message
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe migrate

zwe > migrate

zwe migrate [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- for

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.

Error code	Exit code	Error message
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.

Error code	Exit code	Error message
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe sample sub deep

zwe > sample > sub > deep

zwe sample sub deep [parameter [parameter]...]

Description

Sample of deep embedded sub-command.

Also inherit parameters from upper level.

NOTE: This command is to demonstrate how `zwe` command works. There are no real meaningful functionalities defined in this command and sub-commands.

WARNING: This command is for experimental purposes and could be changed in the future releases.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--another-parameter	-p	boolean	no	Every command level can have their own parameters.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--target-dir,--target	-d	string	yes	This parameter is required.
--auto-encoding	-e	string	no	This parameter has default value. This help message has multiple lines. - another line
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.

Full name	Alias	Type	Required	Help message
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.

Error code	Exit code	Error message
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.

Error code	Exit code	Error message
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe sample sub second

zwe > sample > sub > second

zwe sample sub second [parameter [parameter]...]

Description

Sample of second sub-command.

NOTE: This command is to demonstrate how `zwe` command works. There are no real meaningful functionalities defined in this command and sub-commands.

WARNING: This command is for experimental purposes and could be changed in the future releases.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--target-dir,--target	-d	string	yes	This parameter is required.
--auto-encoding	-e	string	no	This parameter has default value. This help message has multiple lines. - another line
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.

Full name	Alias	Type	Required	Help message
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.

Error code	Exit code	Error message
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe sample sub

zwe > sample > sub

zwe sample sub [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- deep
- second

Description

A sample sub-command.

NOTE: This command is to demonstrate how `zwe` command works. There are no real meaningful functionalities defined in this command and sub-commands.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--target-dir,--target	-d	string	yes	This parameter is required.
--auto-encoding	-e	string	no	This parameter has default value. This help message has multiple lines. - another line

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.

Full name	Alias	Type	Required	Help message
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.

Error code	Exit code	Error message
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.

Error code	Exit code	Error message
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe sample test

zwe > sample > test

zwe sample test [parameter [parameter]...]

Description

A sample command.

NOTE: This command is to demonstrate how `zwe` command works. There are no real meaningful functionalities defined in this command and sub-commands.

WARNING: This command is for experimental purposes and could be changed in the future releases.

Inherited from parent command

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.

Error code	Exit code	Error message
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe sample

zwe > sample

zwe sample [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- sub
- test

Description

This is a sample command.

NOTE: This command is to demonstrate how `zwe` command works. There are no real meaningful functionalities defined in this command and sub-commands.

WARNING: This command is for experimental purposes and could be changed in the future releases.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe support verify-fingerprints

zwe > support > verify-fingerprints

zwe support verify-fingerprints [parameter [parameter]...]

Description

This command will gather the hash (fingerprint) of every file in the `zowe.runtimeDirectory`. The result is then compared with existing hashes.

Java is required to run the hash utility. Make sure the environment variable `JAVA_HOME` is set to the directory containing `bin/java`.

For example, if java is at '/usr/lpp/java/current/bin/java', then set `JAVA_HOME` to '/usr/lpp/java/current'.

NOTE: For best results, it is recommended to set all directories in the `zowe.yaml` configuration file which reside outside the `zowe.runtimeDirectory`. These are typically `zowe.workspaceDirectory`, `zowe.logDirectory` and certificates directories.

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--target-dir		string	no	Target directory where the support package will be created. If it is not specified, system temporary directory will be used.
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0113E	113	Failed to find Zowe version. Please validate your Zowe directory.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0150E	150	Failed to find file %s. Zowe runtimeDirectory is invalid.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0181E	181	Failed to verify Zowe file fingerprints.
ZWEL0320E	320	Failed to compare hashes of %s and current.

Inherited from parent command

Error code	Exit code	Error message
ZWEL0150E	150	Failed to find file %s. Zowe runtimeDirectory is invalid.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0322E	322	%s is not a valid directory.
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.

Error code	Exit code	Error message
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.

Error code	Exit code	Error message
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe support

zwe > support

zwe support [sub-command [sub-command]...] [parameter [parameter]...]

Sub-commands

- verify-fingerprints

Description

Collect and package Zowe runtime information for support purpose.

This command will collect these information:

- Environment
  - z/OS version
  - Java version
    - Java keytool TLS information
  - Node.js version
  - zOSMF status
  - External Security Manager
  - CEE Runtime Options
  - Filesystem flags
  - ZSS Program Controlled extended attribute
- Zowe configurations
  - Zowe manifest.json
  - Zowe configuration file
  - Zowe installation logs
  - Zowe PKCS#12 keystore if used
  - Zowe temporary configuration files under "`zowe.workspaceDirectory`/.env"
  - Zowe APIML static registration files under "`zowe.workspaceDirectory`/api-mediation/api-defs"
- Zowe runtime
  - Active running Zowe processes
- Zowe fingerprints and validation result

Examples

Parameters

Full name	Alias	Type	Required	Help message
--target-dir		string	no	Target directory where the support package will be created. If it is not specified, system temporary directory will be used.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0150E	150	Failed to find file %s. Zowe runtimeDirectory is invalid.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0322E	322	%s is not a valid directory.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.

Error code	Exit code	Error message
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.

Error code	Exit code	Error message
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe diagnose

zwe > diagnose

zwe diagnose [parameter [parameter]...]

Description

Display the message corresponding to the error code.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--error-code	-e	string	yes	Error Code.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0102E	102	Invalid parameter %s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.

Error code	Exit code	Error message
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe install

zwe > install

zwe install [parameter [parameter]...]

Description

After you extract Zowe convenience build, you can run this command to install MVS data sets.

If you are using SMPE build, you can skip this command since MVS data sets are already prepared during SMPE install.

These Zowe YAML configurations showing with sample values are used:

Expected outputs:

- Will create these data sets under `zowe.setup.dataset.prefix` definition:
  - `SZWEAUTH` contains few Zowe load modules (++PROGRAM).
  - `SZWESAMP` contains several sample configurations.
  - `SZWEEXEC` contains few utilities used by Zowe.
  - `SZWELOAD` contains config manager for REXX.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	Allow overwritten existing MVS data set.
--dataset-prefix,--ds-prefix		string	no	Install Zowe to this dataset prefix. If you specify this value, --config is not required.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.

Full name	Alias	Type	Required	Help message
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.
ZWEL0300W		%s already exists. This %s will be overwritten.
ZWEL0301W		%s already exists and will not be overwritten. For upgrades, you must use --allow-overwrite.
ZWEL0158E	158	%s already exists.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.

Error code	Exit code	Error message
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.

Error code	Exit code	Error message
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe start

zwe > start

zwe start [parameter [parameter]...]

Description

Start Zowe with main started task.

These Zowe YAML configurations showing with sample values are used:

- `zowe.setup.security.stcs.zowe` is Zowe started task name. This configuration is optional. Default value is `ZWESLSTC`.
- `zowe.job.name` is the optional customized job name to start Zowe. If it's empty, the start command will not pass `JOBNAME=` option to `S` command.
- `haInstances.[ha-instance].sysname` is the SYSNAME of the target HA instance. If you pass `--ha-instance` parameter, this is the SYSNAME the start command will be routed to.

Note: `zwe start` is only identifying an already configured instance of Zowe. Any additional changes to the `zowe.yaml` config could possibly require either manual changes or running related `zwe` commands before issuing `zwe start`.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	Zowe high availability instance ID.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.

Full name	Alias	Type	Required	Help message
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0064E	64	failed to run command os.pipe - Cannot start component %
ZWEL0165E	165	Failed to start job %s: %s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.

Error code	Exit code	Error message
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.

Error code	Exit code	Error message
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe stop

zwe > stop

zwe stop [parameter [parameter]...]

Description

Stop Zowe main job.

These Zowe YAML configurations showing with sample values are used:

- `zowe.setup.security.stcs.zowe` is Zowe started task name. This configuration is optional. Default value is `ZWESLSTC`.
- `zowe.job.name` is the optional customized job name to start Zowe. If it's empty, the stop command will try to use value of `zowe.setup.security.stcs.zowe` as job name to stop.
- `haInstances.[ha-instance].sysname` is the SYSNAME of the target HA instance. If you pass `--ha-instance` parameter, this is the SYSNAME the start command will be routed to.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	Zowe high availability instance ID.

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.

Full name	Alias	Type	Required	Help message
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0166E	166	Failed to stop job %s: %s.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.

Error code	Exit code	Error message
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.

Error code	Exit code	Error message
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

zwe version

zwe > version

zwe version [parameter [parameter]...]

Description

Display Zowe version.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	Display this help.
--debug,--verbose	-v	boolean	no	Enable verbose mode.
--trace	-vv	boolean	no	Enable trace level debug mode.
--silent	-s	boolean	no	Do not display messages to standard output.
--log-dir,--log	-l	string	no	Write logs to this directory.
--config	-c	string	no	Path to Zowe configuration zowe.yaml file.
--configmgr		boolean	no	Enable use of configmgr capabilities.

Errors

Error code	Exit code	Error message
ZWEL0150E	150	Failed to find file %s. Zowe runtimeDirectory is invalid.

Inherited from parent command

Error code	Exit code	Error message
	100	If the user pass `--help` or `-h` parameter, the zwe command always exits with `100` code.
ZWEL0101E	101	ZWE_zowe_runtimeDirectory is not defined.
ZWEL0102E	102	Invalid parameter %s.
ZWEL0103E	103	Invalid type of parameter %s.
ZWEL0104E	104	Invalid command %s.
ZWEL0105E	105	The Zowe YAML config file is associated to Zowe runtime "%s", which is not same as where zwe command is located.
ZWEL0106E	106	%s parameter is required.
ZWEL0107E	107	No handler defined for command %s.
ZWEL0108E	108	Zowe YAML config file is required.
ZWEL0109E	109	The Zowe YAML config file specified does not exist.
ZWEL0110E	110	Doesn't have write permission on %s directory.
ZWEL0111E	111	Command aborts with error.
ZWEL0112E	112	Zowe runtime environment must be prepared first with "zwe internal start prepare" command.
ZWEL0114E	114	Reached max retries on allocating random number.
ZWEL0120E	120	This command must run on a z/OS system.
ZWEL0121E	121	Cannot find node. Please define NODE_HOME environment variable.
ZWEL0122E	122	Cannot find java. Please define JAVA_HOME environment variable.
ZWEL0123E	123	This function is only available in Zowe Containerization deployment.
ZWEL0131E	131	Cannot find key %s defined in file %s.
ZWEL0132E	132	No manifest file found in component %s.
ZWEL0133E	133	Data set %s already exists.
ZWEL0134E	134	Failed to find SMS status of data set %s.

Error code	Exit code	Error message
ZWEL0135E	135	Failed to find volume of data set %s.
ZWEL0136E	136	Failed to APF authorize data set %s.
ZWEL0137E	137	z/OSMF root certificate authority is not provided (or cannot be detected) with trusting z/OSMF option enabled.
ZWEL0138E	138	Failed to update key %s of file %s.
ZWEL0139E	139	Failed to create directory %s.
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0172E		Component %s has %s defined but the file is missing.
ZWEL0200E		Failed to copy USS file %s to MVS data set %s.
ZWEL0201E		File %s does not exist.
ZWEL0202E		Unable to find samplib key for %s.
ZWEL0203E		Env value in key-value pair %s has not been defined.
ZWEL0319E		NodeJS required but not found. Errors such as ZWEL0157E may occur as a result. The value 'node.home' in the Zowe YAML is not correct.
ZWEL0322E	322	%s is not a valid directory.

Version: v3.2.x LTS

Bill of Materials

Zowe™ uses the SPDX SBOM format to represent its bill of materials. To read more about why SBOMs and SPDX are used, see this blog. The hash codes can be used to validate your download is authentic using a command like `openssl dgst -sha1 <downloaded_sbom.zip>`. Zowe SBOMs are as follows:

Type	Component	SBOM Link	SHA-1 Hash
Artifact SBOM	Zowe z/OS Components (PAX, SMP/E, PSWI)	SBOM Link	3ed80afaadfdabe1112c7063fe297d5f
Artifact SBOM	Zowe CLI Standalone Package	SBOM Link	98b75ca32cc08664574da1886d28c625463cceba
Artifact SBOM	Zowe CLI Standalone Plugins Package	SBOM Link	7d1e06e579b4dcc69c44405a47dfebc386426b0f
Artifact SBOM	Zowe Client NodeJS SDK	SBOM Link	c61bd6b9f78ba2aa67a0f4e53874a097992d8155
Artifact SBOM	Zowe Client Python SDK	SBOM Link	637c5f90f94a88cb534bead7755fac112b509217
Source Code SBOM	All Zowe's Source Repositories used in final artifacts	SBOM Link	19d2b81b0fa2955d165123871c72c2c77ddf73b7