Zowe Version 2.1 Documentation

Table of contents:

- ZWEAO104W
- ZWEAO105W
- ZWEAO106W
- ZWEAO401E
- Common service core messages
  - ZWEAM100E
  - ZWEAM101E
  - ZWEAM102E
  - ZWEAM103E
  - ZWEAM104E
  - 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

- ZWEAG500E
- ZWEAG700E
- ZWEAG701E
- ZWEAG702E
- ZWEAG704E
- ZWEAG705E
- ZWEAG706E
- ZWEAG707E
- ZWEAG708E
- ZWEAG709E
- ZWEAG710E
- ZWEAG711E
- ZWEAG712E
- ZWEAG713E
- ZWEAG714E
- ZWEAG715E
- ZWEAG716E
- ZWEAG100E
- ZWEAG101E
- ZWEAG102E
- ZWEAG103E
- ZWEAG104E
- ZWEAG105E
- ZWEAG106W
- ZWEAG107W
- ZWEAG108E
- ZWEAG109E
- ZWEAG110E
- ZWEAG120E
- ZWEAG121E
- ZWEAS123E
- ZWEAG130E
- ZWEAG131E
- ZWEAG140E
- ZWEAG141E
- ZWEAG150E
- ZWEAG151E
- ZWEAG160E

Zowe overview

Zowe™ is an open source software framework that allows mainframe development and operation teams to securely manage, control, script, and develop on the mainframe. It was created to host technologies that benefit the IBM Z platform for all members of the Z community, including Integrated Software Vendors (ISVs), System Integrators, and z/OS consumers. Like Mac or Windows, Zowe comes with a set of APIs and OS capabilities that applications build on and also includes some applications out of the box. Zowe offers modern interfaces to interact with z/OS and allows you to work with z/OS in a way that is similar to what you experience on cloud platforms today. You can use these interfaces as delivered or through plug-ins and extensions that are created by clients or third-party vendors. Zowe is a project within the Open Mainframe Project.

Zowe demo video

Watch this video to see a quick demo of Zowe.

Download the deck for this video | Download the script

Component overview

Zowe consists of the following components:

- Zowe Application Framework
- API Mediation Layer
- Zowe CLI
- Zowe Explorer
- Zowe Client Software Development Kits SDKs
- Zowe Launcher
- ZEBRA (Zowe Embedded Browser for RMF/SMF and APIs) - Incubator

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 Termnial 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.
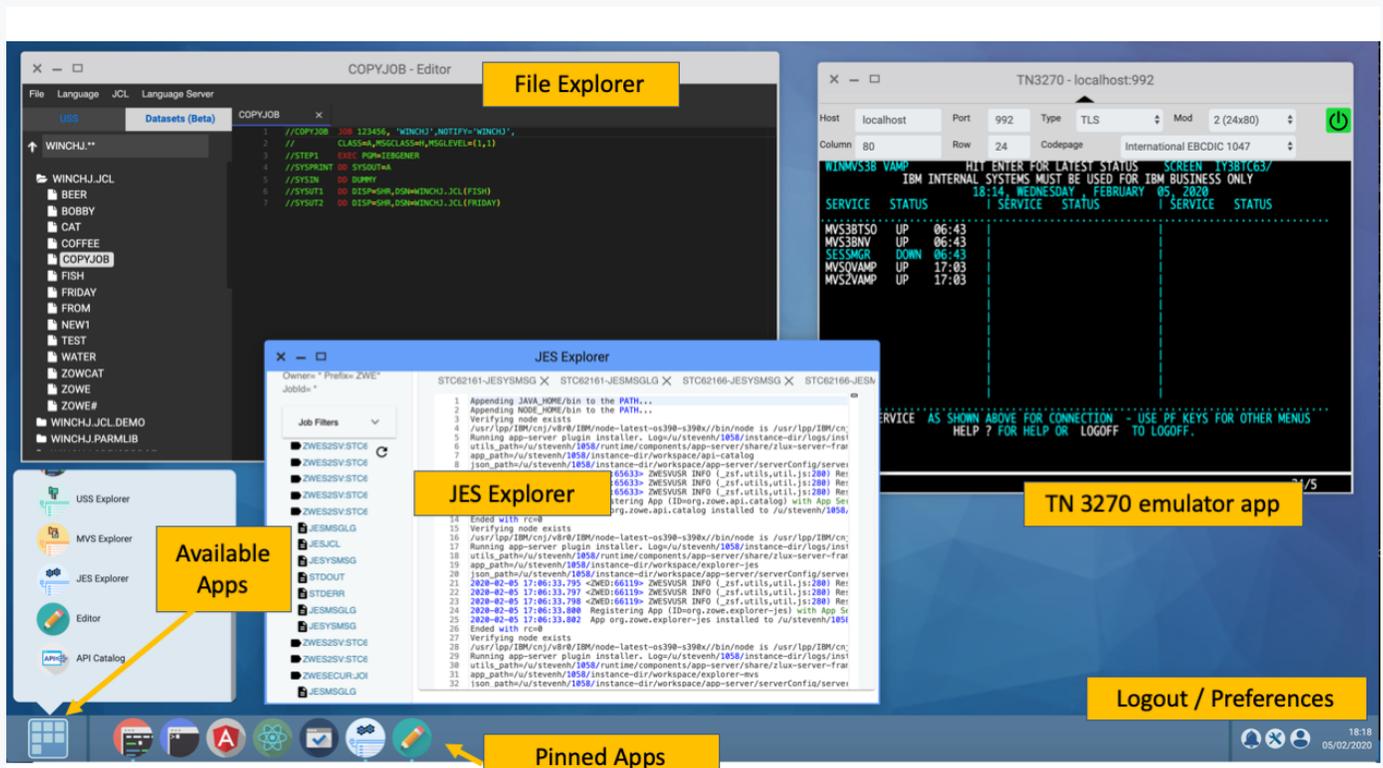
- **Zowe Application Server**

  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.

API Mediation Layer

Provides a gateway that acts as a reverse proxy for z/OS services, together with a catalog of REST APIs and a dynamic discovery capability. Base Zowe provides core services for working with MVS Data Sets, JES, as well as working with z/OSMF REST APIs. The API Mediation Layer also provides a framework for Single Sign On (SSO).

📖 Learn more

The API Mediation Layer provides a single point of access for mainframe service REST APIs. The layer offers enterprise, cloud-like features such as high-availability, scalability, dynamic API discovery, consistent security, a single sign-on experience, and documentation. The API Mediation Layer facilitates secure communication across loosely coupled microservices through the API Gateway. The API Mediation Layer consists of three components: the Gateway, the Discovery Service, and the Catalog. The Gateway provides secure communication across loosely coupled API services. The Discovery Service enables you to determine the location and status of service instances running inside the API ML ecosystem. The Catalog provides an easy-to-use interface to view all discovered services, their associated APIs, and Swagger documentation in a user-friendly manner.

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. It supports the High Availability 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.
- 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. Access to the contents of the API Catalog is controlled through a z/OS security facility.
- Encrypted Communication: API ML facilitates secure and trusted communication across both internal components and discovered API services.

API Mediation Layer architecture

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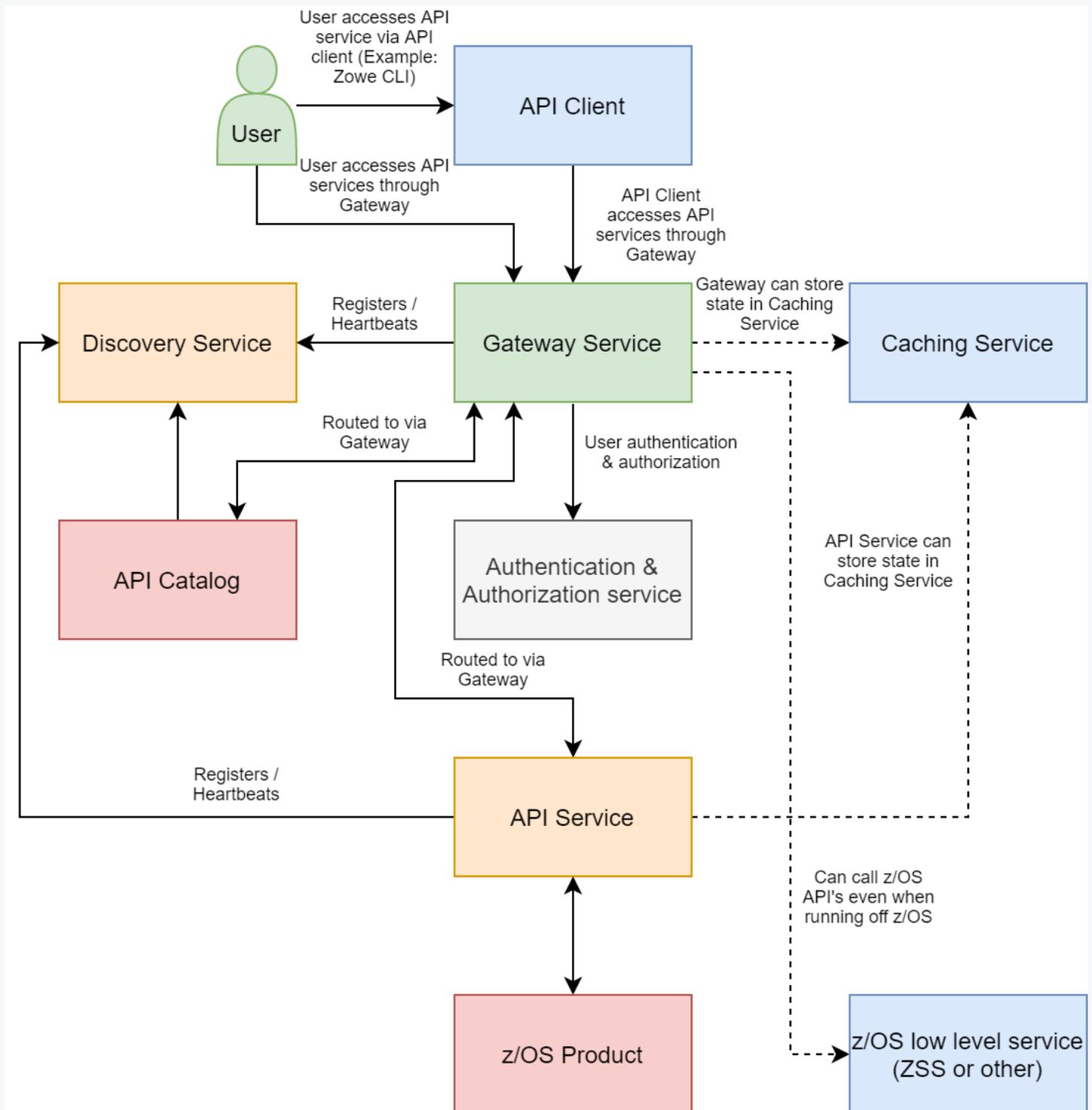
Components

The API Layer consists of the following key components:

API Gateway

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 is built using Netflix Zuul and Spring Boot technologies.

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.

Discovery Service TLS/SSL

HTTPS protocol can be enabled during API ML configuration and is highly recommended. Beyond encrypting communication, the HTTPS configuration for the Discovery Service enables heightened security for service registration. Without HTTPS, services provide a username and password to register in the API ML ecosystem. When using HTTPS, only trusted services that provide HTTPS certificates signed by a trusted certificate authority can be registered.

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.

Catalog Security

Access to the API Catalog can be protected with an Enterprise z/OS Security Manager such as IBM RACF, ACF2, or Top Secret. Only users who provide proper mainframe credentials can access the Catalog. Client authentication is implemented through the z/OSMF API.

Caching Service

It provides an API in high-availability mode which offers the possibility to store, retrieve and delete data associated with keys. The service will be used only by internal Zowe applications and will not be exposed to the internet.

Metrics Service (Technical Preview)

The Metrics Service provides a web user interface to visualize requests to API Mediation Layer services. HTTP metrics such as number of requests and error rates are displayed for each API Mediation Layer service. This service is currently in technical preview and is not ready for production.

Onboarding APIs

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

- Onboarding Overview
- Onboard an existing Spring Boot REST API service using Zowe API Mediation Layer
- Onboard an existing Node.js REST API service using Zowe API Mediation Layer
- Using API Catalog

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

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.

📖 Learn more
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

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:

- Enabling you to create, modify, rename, copy, and upload data sets directly to a z/OS mainframe.
- Enabling you to create, modify, rename, and upload USS files directly to a z/OS mainframe.
- Providing a more streamlined way to access data sets, uss files, and jobs.
- Letting you create, edit, and delete Zowe CLI `zosmf` compatible profiles.
- Letting you use the Secure Credential Store plug-in to store your credentials securely in the settings.
- Letting 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 Python Client SDK

For more information, see Using the Zowe SDKs.

Zowe Launcher

Provides an advanced launcher for Zowe z/OS server components in a high availability configuration. It performs the following operations:

- Stopping the Zowe server components using the `STOP` (or `P`) operator command
- Stopping and starting specific server components without restarting the entire Zowe instance using `MODIFY` (or `F`) operator command

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

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 or visit the ZEBRA test/trial site.

Zowe Workflow wiZard - Incubator

The Workflow wiZard delivers a workflow builder which simplifies the creation of z/OSMF workflows. The workflow builder reads a library of templates along with a set of properties, determines which steps are necessary based upon rules that use property values, determines a suitable order to satisfy the workflow engine requirements, inserts variable definitions when required, and outputs workflow XML.

For more information, see the Workflow Template Reference.

Zowe Third-Party Software Requirements and Bill of Materials

- Third-Party Software Requirements (TPSR)
- Bill of Materials (BOM)

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 high availability feature build-in. To enable this feature, you can define `haInstances` section in your YAML configuration file.

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

- The 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 on 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 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.

For simplification of the diagram above, the Jobs and Files API servers are not shown as being started. If the user defines Jobs and Files API servers to be started in the `zowe.yaml` configuration file, these servers behave the same as the servers illustrated. In other words, these services register to their API discovery server which then communicates with other discovery servers on other Zowe instances on either the same or other LPARs. The API traffic received by any API gateway on any Zowe instance is routed to any of the Jobs or Files API components that are available.

To learn more about Zowe with high availability enablement, see Configuring Sysplex for high availability.

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 node.js server that is responsible for the Zowe Application Framework. This server provides the Zowe desktop, which is accessible through a web browser via port 7556. The Zowe desktop includes a number of applications that run inside the Application Framework such as a 3270 emulator and a File Editor.

The App Server server logs write to `<zowe.logDirectory>/appServer-yyyy-mm-dd-hh-mm.log`. The Application Framework provides REST APIs for its services that are included on the API catalog tile `Zowe Application Framework` that can be viewed at `https://<ZOWE_HOST_IP>:7554/apicatalog/ui/v1/#/tile/ZLUX/zlux`.

ZSS

The Zowe desktop delegates a number of its services to the ZSS server which it accesses through the http port 7557. ZSS is written in C and has native calls to z/OS to provide its services. ZSS logs write to `STDOUT`

and `STDERR` for capture into job logs, but also as a file into `<zowe.logDirectory>/zssServer-yyyy-mm-dd-hh-mm.log`.

API Gateway

The API Gateway is a proxy server that routes requests from clients on its northbound edge, such as web browsers or the Zowe command line interface, to servers on its southbound 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.

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 servers, as well as test REST API calls.

API Discovery

The API Discovery server acts as the registration service broker between the API Gateway and its southbound 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.

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 the Caching service documentation.

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.

File API and JES API

The File API server provides a set of REST APIs for working with z/OS data sets and Unix files. These APIs can be abled in zowe server configuration.

The JES API server provides a set of REST APIs for working with JES. These APIs can be abled in zowe server configuration.

Both the File API and JES API servers are registered as tiles on the API Catalog, so users can view the Swagger definition and test API requests and responses.

Cross Memory server

The Cross Memory server is a low-level privileged server for managing mainframe data securely. 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.

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`.

FAQ: Zowe and components

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 are Java and JavaScript. Zowe CLI and Desktop are written in TypeScript. 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.

Configuring 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?

📖 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.

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

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.

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 Node.js v8.0 or later.
- 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.

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 the Theia Readme.

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.

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 profiles in the Using Zowe CLI section.

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 build, install, and use FTP 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.

FAQ: Zowe V2

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: the app server, zss, the jobs API, and the files API. The new default app server port is 7556 (previously 8544) and the new zss port is 7557 (previously 8542). The new

jobs API port is 7558 (previously 8545) and the new files API is 7559 (previously 8547). 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 pervious V1.X versions of Zowe, the desktop could be accessed via the API Medation 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.

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](#810))

- Fixed `config secure` not respecting the `rejectUnauthorized` property in team config. ([#813](#813))

- Fixed `config import` not respecting the `rejectUnauthorized` property in team config. ([#816](#816))

- Updated the `cli-table3` dependency for performance improvements.

- Fixed `config init` not replacing empty values with prompted for values in team config. ([#821](#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 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:

  Note: For more information, see [Using Profiles](#).

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.

Zowe V2 office hours videos

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	Zo

Installation and V2 conformance

SSO and APIML SSO Conformance	Systems and instal

Office hours for Zowe consumers

The following office hours walk you through Zowe V2 updates from a consumer's perspective. Listen to the recordings to learn more about the enhancements that are introduced to each core component. The videos will be ready later.

- V2 Office Hours: Zowe API Mediation Layer for Consumers
- V2 Office Hours: Zowe CLI for Consumers
- V2 Office Hours: Zowe Explorers for Consumers

Zowe CLI quick start

Get started with Zowe™ CLI quickly and easily.

This article presumes that your role is that of a systems administrator or you possess prerequisite knowledge of command-line tools and writing scripts. If you prefer more detailed instructions, see Installing Zowe CLI.

Installing

The following topics describe the Zowe CLI system requirements and the various methods to use to install Zowe CLI.

Software Requirements

Before you install Zowe CLI, download and install Node.js and npm. Use an LTS version of Node.js that is compatible with your version of npm. For a list of compatible versions, see Node.js Previous Releases.

(Linux only): On graphical Linux, install `gnome-keyring` and `libsecret` on your computer before you install the Secure Credential Store. On headless Linux, follow the procedure documented in the SCS plug-in Readme.

Installing Zowe CLI core from public npm

Issue the following command to install the core CLI.

Installing CLI plug-ins

The command installs most open-source plug-ins, but the IBM Db2 plug-in requires additional configuration to install.

For more information, see Installing plug-ins.

Issuing your first commands

Issue `zowe --help` to display full command help. Append `--help` (alias `-h`) to any command to see available command actions and options.

Optionally, you can view the Zowe CLI web help in a browser window. For more information, see Displaying help.

All Zowe CLI commands start with `zowe` followed by the name of the core command group. For example, `zowe plugins -h`. To interact with the mainframe, type `zowe` followed by a command group, action, and object. Use options to specify your connection details such as password and system name.

Listing all data sets under a high-level qualifier (HLQ)

Example:

Downloading a partitioned data-set (PDS) member to local file

Example:

See Understanding core command groups for a list of available functionality.

Team profiles

Zowe CLI V2-LTS now supports **team** profiles. The process of setting up team profiles is simple and can be rolled out easily accross your organization. We highly recommend that you configure team profiles to support your Zowe CLI implementation. For more information, see Using team profiles.

Using profiles

Zowe profiles let you store configuration details such as username, password, host, and port for a mainframe system. Switch between profiles to quickly target different subsystems and avoid typing connection details on every command.

Profile types

Most command groups require a `zosmf-profile`, but some plug-ins add their own profile types. For example, the CICS plug-in has a `cics-profile`. The profile type that a command requires is defined in the `PROFILE OPTIONS` section of the help response.

Tip: The first `zosmf` profile that you create becomes your default profile. If you don't specify any options on a command, the default profile is used. Issue `zowe profiles -h` to learn about listing profiles and setting defaults.

Creating zosmf profiles

Notes:

- The port defaults to 443 if you omit the `--port` option. Specify a different port if your host system does not use port 443.
- If z/OSMF is configured for high availability in Sysplex, create the CLI zosmf-profile with DVIPA address/hostname to ensure availability of REST services. For more information, see Configuring z/OSMF high availability in Sysplex.

Using zosmf profiles

For detailed information about issuing commands, using profiles, and more, see Using CLI.

Writing scripts

You can write Zowe CLI scripts to streamline your daily development processes or conduct mainframe actions from an off-platform automation tool such as Jenkins or TravisCI.

Example:

You want to delete a list of temporary datasets. Use Zowe CLI to download the list, loop through the list, and delete each data set using the `zowe zos-files delete` command.

For more information, see Writing scripts.

Next steps

You successfully installed Zowe CLI, issued your first commands, and wrote a simple script! Next, you might want to perform the following tasks:

- Issue the `zowe --help` command to explore the product functionality, or review the online web help.

- Learn how to configure Zowe CLI run Zowe CLI in daemon mode. **Daemon mode** significantly improves the performance of Zowe CLI commands by running Zowe CLI as a persistent background process.

- Learn about configuring environment variables to store configuration options.

- Learn about integrating with API Mediation Layer.

- Learn about how to write scripts and integrate them with automation server, such as Jenkins.

- See what plug-ins are available for the CLI.

- Learn about developing for the CLI (contributing to core and developing plug-ins).

Migrating Zowe server component from V1 to 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 Confi
APIML_ALLOW_ENCODED_SLASHES	components.gateway.apiml.service.al
APIML_CORS_ENABLED	components.gateway.apiml.service.co
APIML_DEBUG_MODE_ENABLED	components.gateway.debug , etc
APIML_ENABLE_SSO	Removed in v2
APIML_GATEWAY_EXTERNAL_MAPPER	components.gateway.apiml.security.x
APIML_GATEWAY_INTERNAL_HOST	Not configurable in v2
APIML_GATEWAY_INTERNAL_PORT	components.gateway.server.internal.
APIML_GATEWAY_TIMEOUT_MILLIS	components.gateway.apiml.gateway.ti
APIML_MAX_CONNECTIONS_PER_ROUTE	components.gateway.server.maxConnec
APIML_MAX_TOTAL_CONNECTIONS	components.gateway.server.maxTotalC
APIML_PREFER_IP_ADDRESS	Removed in v2
APIML_SECURITY_AUTH_PROVIDER	components.gateway.apiml.security.a
APIML_SECURITY_AUTHORIZATION_ENDPOINT_URL	components.gateway.apiml.security.a
APIML_SECURITY_X509_ENABLED	components.gateway.apiml.security.x
APIML_SECURITY_ZOSMF_APPLID	zOSMF.applId
CATALOG_PORT	components.api-catalog.port

Zowe v1 Variable	Zowe v2 YAML Confi
`DISCOVERY_PORT`	`components.discovery.port`
`EXTERNAL_CERTIFICATE_AUTHORITIES`	`zowe.certificate.pem.certificateAut`
`EXTERNAL_COMPONENTS`	Removed in v2
`FILES_API_PORT`	`components.files-api.port`
`GATEWAY_PORT`	`components.gateway.port`
`INSTANCE_DIR`	Removed in v2
`JAVA_HOME`	`java.home`
`JES_EXPLORER_UI_PORT`	Removed in v2
`JOBS_API_PORT`	`components.jobs-api.port`
`KEY_ALIAS`	`zowe.certificate.keystore.alias`
`KEYSTORE_CERTIFICATE_AUTHORITY`	`zowe.certificate.pem.certificateAut`
`KEYSTORE_CERTIFICATE`	`zowe.certificate.pem.certificate`
`KEYSTORE_DIRECTORY`	`zowe.setup.certificate.pkcs12.direc`

Zowe v1 Variable	Zowe v2 YAML Confi
`KEYSTORE_KEY`	`zowe.certificate.pem.key`
`KEYSTORE_PASSWORD`	`zowe.certificate.keystore.password` `zowe.certificate.truststore.passwor`
`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 Confi...
`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.`
`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 v1 Variable	Zowe v2 YAML Confi
`ZOWE_ZLUX_SSH_PORT`	-
`ZOWE_ZLUX_TELNET_PORT`	-
`ZOWE_ZSS_SERVER_PORT`	-
`ZOWE_ZSS_SERVER_TLS`	-
`ZOWE_ZSS_XMEM_SERVER_NAME`	-
`ZWE_CACHING_EVICTION_STRATEGY`	`components.caching-service.storage.`
`ZWE_CACHING_SERVICE_PERSISTENT`	`components.caching-service.storage.`
`ZWE_CACHING_SERVICE_PORT`	`components.caching-service.port`
`ZWE_CACHING_SERVICE_VSAM_DATASET`	`components.caching-service.storage.`
`ZWE_CACHING_STORAGE_SIZE`	`components.caching-service.storage.`
`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`

Zowe v1 Variable	Zowe v2 YAML Confi
`ZWE_LAUNCH_COMPONENTS`	Combined information of `components.<comp` `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.

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's happening with Zowe in the Zowe Quarterly Update Webinar Series.

- 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.

Trials

- Zowe trial

  The Zowe trial hosted by IBM is a fully configured z/OS environment with Zowe preinstalled and set up along with a set of integrated easy-to-follow tutorials that walk you through the basics of Zowe and gives you hands-on experience of extending Zowe. This no-charge trial is available in two hours for three days.

- Get started with the Zowe Web UI

  This online tutorial hosted by IBM guides you to add new apps to the Zowe Web UI. It provides a public hosted Zowe instance that allows you to perform the steps in a z/OS environment.

Overview

The installation of Zowe™ consists of the following processes:

- installation of the Zowe server 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 CLI on a desktop computer.

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.

Installation roadmap

When you install Zowe™ on z/OS, you install the following two parts:

1. The Zowe runtime, which consists of a number of components including:

    - Zowe Application Framework

    - Zowe API Mediation Layer

    - Z Secure Services (ZSS)

2. The Zowe Cross Memory Server, also known as ZIS, which is an APF authorized server application that provides privileged services to Zowe in a secure manner.

Zowe provides the ability for some of its unix components to be run not under USS, but as a container, see Installing Zowe Containers.

If you want to configure Zowe for high availability, see Installing Zowe z/OS Components with High Availability for instructions.

Stage 1: Plan and prepare

Before you start the installation, review the information on hardware and software requirements and other considerations. See Planning the installation for details.

Stage 2: Install the Zowe z/OS runtime

1. Ensure that the software requirements are met. The prerequisites are described in System requirements.

2. Choose the method of installing Zowe on z/OS.

    The Zowe z/OS binaries are distributed in the following formats. They contain the same contents but you install them by using different methods. You can choose which method to use depending on your needs.

    - **Convenience build**

The Zowe z/OS binaries are packaged as a PAX file which is a full product install. Transfer this to a USS directory and expand its contents. The command `zwe install` will extract a number of PDS members contain load modules, JCL scripts, and PARMLIB entries.

- **SMP/E build**

  The 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 it 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.

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 irrespective of how the build is obtained and installed.

3. Obtain and install the Zowe build.

   - For how to obtain the convenience build and install it, see Installing Zowe runtime from a convenience build.
   - For how to obtain the SMP/E build and install it, see Installing Zowe SMP/E.
   - For how to obtain the PSWI and install it, see Installing Zowe from a Portable Software Instance.

After successful installation of either a convenience build or an SMP/E build, there will be a zFS folder that contains the unconfigured Zowe runtime directory, a utility library `SZWEEXEC` that contains utilities, a SAMPLIB library `SZWESAMP` that contains sample members, and a load library `SZWEAUTH` that contains load modules. The steps to prepare the z/OS environment to launch Zowe are the same irrespective of the installation method.

Stage 3: Configure the Zowe z/OS runtime

You can configure the Zowe runtime with one of the following methods depending on your needs.

- Use a combination of JCL and the `zwe init` command
- Use z/OSMF Workflows

Tip: We recommend you open the links to this configuration procedure in new tabs.

Whether you have obtained Zowe from a .pax convenience build, or an SMP/E distribution, the steps to initialize the system are the same.

1. Prepare custom MVS data sets. Copy the data sets provided with Zowe to custom data sets.

2. (Required only if you are configuring Zowe for cross LPAR sysplex high availability): Create the VSAM data sets used by the Zowe API Mediation Layer caching service.

3. APF authorize load libraries containing the modules that need to perform z/OS priviledged security calls..

4. Initialize Zowe security configurations. Create the user IDs and security manager settings.

   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.

5. Configure Zowe to use TLS certificates.

6. Install Zowe main started tassks.

Looking for troubleshooting help?

If you encounter unexpected behavior when installing or verifying the Zowe runtime on z/OS, see the Troubleshooting section for tips.

Planning the installation

The following information is required during the Zowe installation process. Software and hardware prerequisites are covered in the next section.

- The zFS directory where you will install the Zowe runtime files and folders. For more details of setting up and configuring the UNIX Systems Services (USS) environment, see UNIX System Services considerations for Zowe.

- A HLQ that the installation can create a load library and samplib containing load modules and JCL samples required to run Zowe.

- 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.

- 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 API ML with basic authentication and JSON web token authentication, you need to run only `ZWESLSTC`. No need to run `ZWESISTC` and `ZWESASTC`.

- If you plan to use API ML with x509 client-side certificate authentication, you need to run `ZWESISTC` and `ZWESLSTC`.

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` **server command**

The `zwe` command is provided in the `<RUNTIME_DIR>/bin` directory. You can use this command and sub-commands to initialize Zowe, manage Zowe instances and fulfill common tasks.

The `zwe` command has built in help that can be retrieved with the `-h` suffix. For example, type `zwe -h` to display all of the supported commands. These are broken down into a number of sub-commands.

Other useful global parameters are:

- `--debug` or `-v` to enable verbose mode.
- `--trace` or `-vv` to enable trace mode for current command.
- `--log-dir` or `-l` to also write output to log files.

Add the `zwe` command to your PATH

You can 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:

This will update the `PATH` for the current shell. To make this update persistent, you can add the line to your `~/.profile` file, or the `~/.bashProfile` file if you are using a bash shell. To make this update system wide, you can 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`.

z/OS Data sets used by Zowe

After Zowe is properly installed, you should have these data sets created on z/OS under the prefix you defined:

- `<prefix>.SZWEAUTH` contains few Zowe component programs to start Zowe and ZSS.
- `<prefix>.SZWEEXEC` contains few utility executables will be used by Zowe.
- `<prefix>.SZWESAMP` contains sample JCLs to help you configure or start Zowe.

If you install Zowe with convenience build, these data sets will be created by `zwe install` command. If you install Zowe with SMPE or equivalent methods, these data sets will be created during install and you are not required to run `zwe install` command. The above data sets will be overwritten during upgrade process.

Zowe configuration and runtime also use few other data sets to store customization. These data sets will not be overwritten during upgrade.

- `zowe.setup.datasets.parmlib` defined in Zowe configuration, which contains user customized PARMLIB members.
- `zowe.setup.datasets.jcllib` defined in Zowe configuration, which contains user customized JCLs or JCLs generated by `zwe init` command.
- `zowe.setup.datasets.authLoadlib` defined in Zowe configuration is optional. If the user choose to copy out load libraries from `<prefix>.SZWEAUTH`, they will be 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` defined in Zowe configuration contains extra load libraries used by ZIS plugins.

Zowe configuration file

Zowe uses a YAML format configuration. If you store the configuration on USS, this file is usually referred as `zowe.yaml`.

This configuration file can be placed on a location with these requirements:

- 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. That means this configuration file should be placed in a shared file system (zFS directory) where all LPARs in a Sysplex can access.
- Zowe configuration file may contain sensitive configuration information so it should be protected against malicious accessing.

To create this configuration, you can copy from `example-zowe.yaml` located in Zowe runtime directory. Please be aware of the `zowe.runtimeDirectory` definition in the configuration file, it should match the Zowe runtime directory mentioned above.

To learn more about this configuration, please check Zowe YAML configuration file reference.

When you execute the `zwe` command, the `--config` or `-c` argument is used to pass the location of a `zowe.yaml` file.

> 💡 **TIP**

> To avoid passing `--config` or `-c` to every `zwe` commands, you can define `ZWE_CLI_PARAMETER_CONFIG` environment variable points to location of zowe.yaml.
>
> For example, after defining
>
> , you can simply type `zwe start` instead of full command `zwe start -c /path/to/my/zowe.yaml`.

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's 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 will write logs to file system. The directory will be created automatically when you start Zowe and the content will be automatically managed by Zowe components. It's not recommended to create log directory manually in order to avoid permission conflicts.

Multiple Zowe instances can define different log directories, they are not necessary to be shared in Sysplex deployment like 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 will be created and used if PKCS#12 keystore is chosen.

A typical PKCS#12 keystore directory looks like:

To generate keystore directory, you need proper `zowe.setup.certificate` configuration defined in Zowe configuration file and then execute server command `zwe init certificate`. To learn more about this command, check Reference of zwe init certificate.

Extension directory

Zowe allows server extensions to expand its 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 will create sub-directories or symbolic links under the extension directory.

UNIX System Services considerations for Zowe

The Zowe z/OS component runtime requires 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.

- Introduction
- Setting up USS for the first time
- Language environment
- OMVS segment
- Address space region size

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.

For more information on USS, see the following resources:

- Introduction to z/OS UNIX for z/OS 2.2
- Introduction to z/OS UNIX for z/OS 2.3
- Introduction to z/OS UNIX for z/OS 2.4

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

To ensure that Zowe has enough memory, the recommended HEAP64 site should be large enough.

OMVS segment

Users who install Zowe to run Zowe scripts need to have an OMVS segment. If the user profile doesn't have OMVS segment, the following situations might occur:

- When you access USS through TSO OMVS, you will see the following message:

- When you access USS through SSH, you will see the following message:

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 of `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 of `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.

System 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. Therefore, assess your installation scenario and install the prerequisites that meet your needs.

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
  - z/OS
  - Node.js
  - Java
  - z/OSMF (Optional)
- User ID requirements
  - ZWESVUSR
  - ZWESIUSR
  - ZWEADMIN
  - zowe_user
- Network requirements
- Zowe Containers requirements
- Zowe Desktop requirements (client PC)
- Feature requirements
  - Multi-Factor Authentication MFA
  - Single Sign-On SSO
- Memory requirements

z/OS system requirements

Be sure your z/OS system meets the following prerequisites.

z/OS

- z/OS version in active support, such as Version 2.3 and Version 2.4

  Note: z/OS V2.2 reached end of support on 30 September 2020. For more information, see the z/OS v2.2 lifecycle details https://www.ibm.com/support/lifecycle/details?q45=Z497063S01245B61.

- zFS volume with at least 833 mb of free space for Zowe server components, their keystore, instance configuration files and logs, and third-party plug-ins.

- (Optional, recommended) z/OS OpenSSH V2.2.0 or later

  Some features of Zowe require SSH, such as the Desktop's SSH terminal. Or, you want to install and manage Zowe via SSH, as an alternative to OMVS over TN3270.

- (Optional, recommended) Parallel Sysplex.

  To deploy Zowe for high availability, a Parallel Sysplex environment is recommended. Please check Configuring Sysplex for high availability for more information.

Node.js

- Node.js v14.x (except v14.17.2) or v16.x

  Node is not included with z/OS so must be installed separately. To install Node.js on z/OS, follow the instructions in Installing Node.js on z/OS.

  Note: If you are a software vendor building extensions for Zowe, when using Node.js v14.x or later, it is highly recommended that plug-ins used are tagged. For more information, see Tagging on z/OS.

Java

- IBM SDK for Java Technology Edition V8

z/OSMF (Optional)

- (Optional, recommended) IBM z/OS Management Facility (z/OSMF) Version 2.2, Version 2.3 or Version 2.4.

  z/OSMF is included with z/OS so does not need to be separately installed. If z/OSMF is present, Zowe will detect this when it is configured and use 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](). If z/OSMF is not available, then Zowe is still able to provide SSO by generating its own JWT and making direct SAF calls.

- 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.

Tips:

- For non-production use of Zowe (such as development, proof-of-concept, demo), you can customize the configuration of z/OSMF to create what is known as "z/OS MF Lite" that simplifies the setup of z/OSMF. As z/OS MF Lite only supports selected REST services (JES, DataSet/File, TSO and Workflow), you will observe considerable improvements in startup time as well as a reduction in the efforts involved in setting up z/OSMF. For information about how to set up z/OSMF Lite, see [Configuring z/OSMF Lite (non-production environment)]().

- For production use of Zowe, see [Configuring z/OSMF]().

User ID requirements

Specific user IDs with sufficient permissions are required to run or access Zowe.

ZWESVUSR

This is a started task ID for `ZWESLSTC`.

The task starts a USS environment using `BPXBATSL` that executes the core Zowe Desktop (ZLUX) node.js server, the Java API Mediation Layer, and the Z Secure Services C component. To work with USS, the user ID `ZWESVUSR` must have a valid OMVS segment.

Class	ID	Access	Reason

| CSFSERV | `Multiple` | READ | To generate symmetric keys using ICSF that is used by [Zowe Desktop cookies](). The list of IDs to enable will 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. || FACILITY | `ZWES.IS` | READ | To allow Zowe ZWESVSTC processes to access the Zowe ZIS cross memory server || FACILITY | `BPX.SERVER` + `BPX.DAEMON` | UPDATE | To allow the Zowe Desktop ZLUX server to run code on behalf of the API requester's TSO user ID. For more information, see Security Environment Switching. || FACILITY | `IRR.RUSERMAP` | READ | To allow Zowe to map an X.509 client certificate to a z/OS identity || FACILITY | `BPX.JOBNAME` | READ | To allow z/OS address spaces for unix processes to be renamed for ease of identification || FACILITY | `IRR.RADMIN.LISTUSER` | READ | To allow Zowe to obtain information about OMVS segment of the user profile using `LISTUSER` TSO command || APPL | 'OMVSAPPL' | READ | **Optional** To allow Zowe Desktop vendor extensions the ability to use single-sign on.

ZWESIUSR

This is 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.

ZWEADMIN

This is a group that `ZWESVUSR` and `ZWESIUSR` should belong to. It must have a valid OMVS segment.

zowe_user

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`.

Network requirements

The following ports are required for Zowe. These are default values. You can change the values by updating variable values in the `zowe.yaml` file.

Port number	zowe.yaml variable name	Purpose
7552	zowe.components.api-catalog.port	Used to view API swagger / openAPI specifications for registered API services in the API Catalog.

Port number	zowe.yaml variable name	Purpose
7553	zowe.components.api-catalog.port	Discovery server port which dynamic API services can issue APIs to register or unregister themselves.
7554	zowe.components.gateway.port	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	zowe.components.caching-service.port	Port of the caching service that is used to share state between different Zowe instances in a high availability topology.
7556	zowe.components.app-server.port	The Zowe Desktop (also known as ZLUX) port used to log in through web browsers.
7557	zowe.components.zss.port	Z Secure Services (ZSS) provides REST API services to ZLUX, used by the File Editor application and other ZLUX applications in the Zowe Desktop.
7558	zowe.components.jobs-api.port	Port of the service that provides REST APIs to z/OS jobs used by the JES Explorer.
7559	zowe.components.files-api.port	Port of the service that provides REST APIs to MVS and USS file systems.
	zowe.components.explorer-jes	Port of the JES Explorer GUI for viewing and working with jobs in the Zowe Desktop.
	zowe.components.explorer-mvs	Port of the MVS Explorer GUI for working with data sets in the Zowe Desktop.
	zowe.components.explorer-uss	Port of the USS Explorer GUI for working with USS in the Zowe Desktop.

Zowe Containers requirements

Zowe (server) containers are available for download as an alternative to running Zowe servers on z/OS through the Zowe convenience and SMP/E builds Check Zowe Containers Prerequisites page for more details.

Zowe Desktop requirements (client PC)

The Zowe Desktop is powered by the Application Framework which has server prereqs depending on where it is installed

- Zowe Application Framework on z/OS requirements
- Application Framework on Docker prerequisites

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.

Currently, the following browsers are supported:

- Google Chrome V79 or later
- Mozilla Firefox V68 or later
- Safari V13 or later
- Microsoft Edge 79

If you do not see your browser listed here, please contact the Zowe community so that it can be validated and included.

Feature requirements

Zowe has several optional features that have additional prerequisites as follows.

Multi-Factor Authentication (MFA)

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:

- IBM Z Multi-Factor Authentication.

Note: To support the multi-factor authentication, it is necessary to apply z/OSMF APAR PH39582.

For information on using MFA in Zowe, see Multi-Factor Authentication.

Note: MFA must work with Single sign-on (SSO). Make sure 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)

Memory requirements

Zowe API ML components have following memory requiremets:

Component name	Memory usage
Gateway service	256MB
Discovery service	256MB
API Catalog	512MB
Metrics service	512MB
Caching service	512MB

Installing Node.js on z/OS

Note: This section is not required if using Docker or only using the CLI.

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.

- Supported Node.js versions
- How to obtain IBM SDK for Node.js – z/OS
- Hardware and software prerequisites
- Installing the PAX edition of Node.js – z/OS
- Installing the SMP/E edition of Node.js – z/OS

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.

Notice: IBM SDK for node.js had withdrawn v12 from marketing on September 6, 2021 and ended v12 service on September 30, 2022.

- v14.x (except v14.17.2)

    - z/OS V2R3: PTFs UI61308, UI61375, UI61747 (APARs PH07107, PH08352, PH09543)

    - z/OS V2R4: PTFs UI64830, UI64837, UI64839, UI64940, UI65567 (APARs PH14560, PH15674, PH14559, PH16038, PH17481)

        Known issue: There is a known issue with node.js v14.17.2. It will cause the error of `ZWESLSTC` `not found in "<dsn-prefix>.SZWESAMP"` when you run the `zowe-install-proc.sh`

utility.

- v16.x

    - z/OS V2R4: PTFs UI64830, UI64837, UI64839, UI64940, UI65567.
    - z/OS V2R5: PTFs UI64830, UI64837,UI64940.

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 can run `node --version` successfully, you have 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 see whether ICSF has been started, check whether 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.

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-v6.14.4-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.

Configuring z/OSMF

The following information contains procedures and tips for meeting z/OSMF requirements. For complete information, go to IBM Knowledge Center 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

Requirements	Description	Resources in IBM Knowledge Center
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

Configuring z/OSMF

Follow these steps:

1. From the console, issue the following command to verify the version of z/OS:

   Part of the output contains the release, for example,

2. Configure z/OSMF.

   z/OSMF is a base element of z/OS V2.2 and V2.3, so it is already installed. But it might not be configured and running on every z/OS V2.2 and V2.3 system.

In short, 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: In z/OS V2.3, 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.

3. 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:

   After you see the message ""CWWKB0056I INITIALIZATION COMPLETE FOR ANGEL"", issue the following command to start the server:

   The server 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. Issue the following command to find the startup messages in the SDSF log of the z/OSMF server:

   You could see a message similar to the following message, which indicates the port number:

   In this example, the port number is 443. You will need this port number later.

   Point your browser at the nominated z/OSMF STANDALONE Server home page and 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), you 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 the Zowe CLI

The Zowe CLI uses 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/OSMF REST services	Requirements	Resources in IBM knowledge Center
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.

Configuration of 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 a possible temporary workaround. Update z/OSMF

configuration with `allowBasicAuthLookup="false"`. After applying this change, each authentication call results in generating a new JWT.

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.

- Configuring z/OSMF Lite (for non-production use)

  - Introduction
  - Assumptions
  - Software Requirements
    - Minimum Java level
    - WebSphere® Liberty profile (z/OSMF V2R3 and later)
    - System settings
    - Web browser
  - Creating a z/OSMF nucleus on your system
    - Running job IZUNUSEC to create security
      - Before you begin
      - Procedure
      - Results
      - Common errors
    - Running job IZUMKFS to create the z/OSMF user file system
      - Before you begin
      - Procedure
      - Results
      - Common errors
    - Copying the IBM procedures into JES PROCLIB
      - Before you begin
      - Procedure
      - Results

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 the best results with z/OSMF, use one of the following web browsers on your workstation:

- Microsoft Internet Explorer Version 11 or later

- Microsoft Edge (Windows 10)

- Mozilla Firefox ESR Version 52 or later.

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.

Symptom	Cause	Resolution
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.

Symptom	Cause	Resolution
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 password is expired.	Log on to TSO using your z/OS User ID and password, you will be asked 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 {"rc":16,"reason":-1,"stack":"JesException: CATEGORY_CIM rc=16 reason=-1 cause=com.ibm.zoszmf.util.eis.EisConnectionException: IZUG911I: Connection to \"http:\/\/null:5988\" cannot be established, or was lost and cannot be re-established using protocol \"CIM\"......Caused by: WBEMException: CIM_ERR_FAILED (JNI Exception type CannotConnectException:\nCannot connect to local CIM server. Connection failed.)

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: *

Setting	Purpose	Rules	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 `/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 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/liber`

Setting	Purpose	Rules	Default
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.

Installing Zowe runtime from a convenience build

You install the Zowe™ convenience build by obtaining a PAX file and using this 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 obtain the PAX file and transfer it to z/OS first. Then, to install, configure and start Zowe, you 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`. You modify the `zowe.yaml` file based on your environment.

Complete the following steps to install the Zowe runtime.

Step 1: Obtain the convenience build

To download the PAX file, open your web browser on the [Zowe Download](#) website, navigate to **Zowe V2 Preview** -> **Convenience build** section, and select the button to download the v2 convenience build.

Step 2: Transfer the convenience build to USS and expand it

After you download the PAX file, you can transfer it to z/OS and expand its contents.

1. Open a terminal in Mac OS/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, you 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:

   Where *zowe-V.v.p* is a variable that indicates 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.

   After the PAX file has sucessfully transferred, exit your `sftp` or `ftp` session.

5. Open a USS shell to expand the PAX file. This can either be an ssh terminal, OMVS, iShell, or any other z/OS unix system services command environment.

6. Expand the PAX file by issuing the following command in the USS shell.

   Where *zowe-V.v.p* is a variable that indicates the name of the PAX file you downloaded. When extracting the Zowe convenience build, you must always include the `-ppx` argument that preserves extended attributes.

   This will expand to a file structure similar to the following one.

   This is the Zowe runtime directory and is referred to as `<RUNTIME_DIR>` throughout this documentation.

   Note: Zowe version 1 had a script `zowe-install.sh` that created a separate Zowe runtime directory from the expanded contents of the Zowe PAX file. Zowe v2 no longer has this step. **In Zowe v2, 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:

`<RUNTIME_DIR>` should be replaced with your real Zowe runtime directory path. This will update the `PATH` for the current shell. To make this update persistent, you can add the line to your `~/.profile` file, or the `~/.bashProfile` file if you are using a bash shell. To make this update system wide, you can 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`.

The `zwe` command has built in help that can be retrieved with the `-h` suffix. 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 will become your configuration file that contains data used by the `zwe` command at a number of parts of the lifecycle of configuring and starting Zowe. You will need to 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 a `zowe.yaml` file.

> 💡 **TIP**
>
> To avoid passing `--config` or `-c` to every `zwe` commands, you can define `ZWE_CLI_PARAMETER_CONFIG` environment variable points to location of zowe.yaml.
>
> For example, after defining
>
> , you can simply type `zwe install` instead of full command `zwe install -c /path/to/my/zowe.yaml`.

Step 5: Install the MVS data sets

After you extract the Zowe convenience build, you can run the `zwe install` command to install MVS data sets.

About the MVS data sets

Zowe includes a number of files that are stored in the following three data sets. See the following table for the storage requirements.

Library DDNAME	Member Type	Target Volume	Type	Org	RECFM	LRECL	No. of 3390 Trks	No. of DIR Blks
SZWESAMP	Samples	ANY	U	PDSE	FB	80	15	5
SZWEAUTH	Zowe APF Load Modules	ANY	U	PDSE	U	0	15	N/A
SZWEEXEC	CLIST copy utilities	ANY	U	PDSE	FB	80	15	5

The `SZWESAMP` data set contains the following members.

Member name	Purpose
ZWESECUR	JCL member to configure z/OS user IDs and permissions required to run Zowe
ZWENOSEC	JCL member to undo the configuration steps performed in ZWESECUR and revert z/OS environment changes.
ZWEKRING	JCL member to configure a z/OS keyring containing the Zowe certificate
ZWENOKYR	JCL member to undo the configuration steps performed in ZWEKRING

Member name	Purpose
ZWESLSTC	JCL to start Zowe
ZWEXMSTC	JCL to start the Zowe cross memory server
ZWESIP00	Parmlib member for the cross memory server
ZWESASTC	Started task JCL for the cross memory Auxiliary server
ZWESIPRG	Console commands to APF authorize the cross memory server load library
ZWESISCH	PPT entries required by Cross memory server and its Auxiliary address spaces to run in Key(4)
ZWECSVSM	JCL Member to create the VSAM data set for the caching service

The `SZWEAUTH` data set is a load library containing the following members.

Member name	Purpose
ZWELNCH	The Zowe launcher that controls the startup, restart and shutdown of Zowe's address spaces
ZWESIS01	Load module for the cross memory server
ZWESAUX	Load module for the cross memory server's auxiliary address space

The `SZWEEXEC` data set contains few utilities used by Zowe.

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 three data sets and copy across their 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`.

A sample run of the command is shown below using default values.

Next steps

You successfully installed Zowe from the convenience build! However, before you start Zowe, you must complete several required configurations. Next, go to Initialize the z/OS system and permissions to initialize your z/OS system for Zowe first.

Version: v2.1.x LTS

Installing Zowe SMP/E

Contents

Introduction

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.

The Program Directory contains the following sections:

- **Program Materials** identifies the basic program materials and documentation for Zowe.
- **Program Support** describes the support available for Zowe.
- **Program and Service Level Information** lists the APARs (program level) and PTFs (service level) that have been incorporated into Zowe.
- **Installation Requirements and Considerations** identifies the resources and considerations that are required for installing and using Zowe.
- **Installation Instructions** provides detailed installation instructions for Zowe. It also describes the procedures for activating the functions of Zowe, or refers to appropriate publications.

Zowe description

Zowe™ is an open source project created to host technologies that benefit the Z platform. It is a sub-project of Open Mainframe Project which is part of the Linux Foundation. More information about Zowe is available at https://zowe.org.

Zowe FMIDs

Zowe consists of the following FMIDs:

- AZWE002

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

Publication Title	Form Number
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 https://www.ibm.com/shop/publications/order.

Program support

This section describes the support available for Zowe.

Because this is an alpha release of the Zowe FMID package for early testing and adoption, no formal support is offered. Support is available through the Zowe community. See Community Engagement 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 August 2019 have been incorporated into this packaging of Zowe.

Service level information

The Zowe SMP/E package is a distribution of Zowe version 2.0.0 with an FMID of AZWE002.

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	V2.2.0 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-01.ibm.com/software/support/lifecycle/index_z.html.

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.

If you plan to install Zowe in a zFS file system, this requires that zFS be active on the driving system. Information on activating and using zFS can be found in z/OS Distributed File Service zSeries File System Administration (SC24-5989).

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 V2.2.0 or higher
5655-SDK	IBM SDK for Node.js - z/OS V12 or higher
5655-DGH	IBM 64-bit SDK for z/OS Java Technology Edition V8.0.0

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[TM]), 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	45 Tracks	/
Distribution	12045 Tracks	/
File System(s)	21000 Tracks	/
Web Download	38666 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	(300,3000)	50
SYSUT1	U	SEQ	--	--	(300,3000)	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

Note: These target libraries are not required for the initial FMID install of Zowe SMP/E but will be required for subsequent SYSMODS so are included here for future reference.

Library DDNAME	Member Type	Target Volume	Type	Org	RECFM	LRECL	No. of 3390 Trks	No. of DIR Blks
SZWEAUTH	APF Load Modules	ANY	U	PDSE	U	0	15	N/A
SZWESAMP	Samples	ANY	U	PDSE	FB	80	15	5

Zowe file system paths

DDNAME	TYPE	Path Name
SZWEZFS	X	/usr/lpp/zowe/SMPE

Storage requirements for Zowe distribution libraries

Note: These target libraries are not required for the initial alpha drop of Zowe SMP/E but will be required for subsequent drops so are included here for future reference.

Library DDNAME	TYPE	ORG	RECFM	LRECL	No. of 3390 Trks	No. of DIR Blks
AZWEAUTH	U	PDSE	U	0	15	N/A
AZWESAMP	U	PDSE	FB	80	15	5
AZWEZFS	U	PDSE	VB	6995	12000	30

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.AZWE002.F1	U	PDSE	FB	80	5	N/A
hlq.ZOWE.AZWE002.F2	U	PDSE	FB	80	5	N/A
hlq.ZOWE.AZWE002.F3	U	PDSE	U	0	30	N/A
hlq.ZOWE.AZWE002.F4	U	PDSE	VB	6995	9900	N/A
hlq.ZOWE.AZWE002.SMPMCS	U	SEQ	FB	80	1	N/A
z/OS UNIX file system	U	zFS	N/A	N/A	28715	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.

Installation instructions

This section describes the installation method and the step-by-step procedures to install and activate the functions of Zowe.

Notes:

- If you want 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.

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 the Zowe SMP/E package
2. Allocate file system to hold web download package
3. Upload the download package to the host
4. Extract and expand the compress SMPMCS and RELFILEs
5. 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 the Zowe SMP/E package>P>

To download the Zowe SMP/E package, open your web browser and go to the Zowe Download website. Click the **Zowe SMP/E FMID AZWE002** button to save the file to a folder on your desktop.

You will receive one ZIP package on 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.

- **AZWE002.pax.Z (binary)**

The SMP/E input data sets to install Zowe are provided as compressed files in AZWE002.pax.Z. This pax archive file holds the SMP/E MCS and RELFILEs.

- **AZWE002.readme.txt (text)**

  The README file AZWE002.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.

- **AZWE002.hml (text)**

  The Program Directory for the Zowe Open Source Project.

Allocate 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 AZWE002.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 it.

Expected Return Codes and Messages: You will receive a return code of 0 if this job runs correctly.

Upload the download package to the host

Upload the AZWE002.readme.txt file in text format and the AZWE002.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 AZWE002.readme.txt file that you downloaded.

Note: 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 them available to the z/OS system where the package will be installed. In the following sample dialog, we use FTP from a Microsoft Windows command line to do the transfer. This assumes that the z/OS host is configured as an FTP host/server and that the workstation is an

FTP client. Commands or other information entered by the user are in bold, and the following values are assumed.

If you are not sure which protocol or port to use to transfer the files or any access that might be needed, you may need to consult with the 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 AZWE002.pax.Z file must be uploaded to the z/OS driving system in binary format, or the subsequent UNPAX step will fail.

This step of tranferring the files 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:

If you are unable to connect with ftp and only able to use sftp, the commands above are the same except that you will use *sftp* at the command prompt instead of *ftp*. Also, because *sftp* only supports binary file transfer, the **ascii** and **binary** commands should be omitted. After you transfer the AZWE002.readme.txt file, it will be in an ASCII codepage so you need to convert it to EBCDIC before it can be used. To convert AZWE002.readme.txt to EBCDIC, log in to the distribution system using ssh and run an ICONV command.

C:>/**ssh tsouid@mvsaddr**
tsouid@mvsaddr's password: **tsopw**
/u/tsouid:>
cd:@zfs_path@
@zfs_path:>

```
@zfs_path:>iconv -f ISO8859-1 -t IBM-1047 AZWE002.readme.txt > AZWE002.readme.EBCDIC
@zfs_path:>rm AZWE002.readme.txt
@zfs_path:>mv AZWE002.readme.EBCDIC AZWE002.readme.txt
@zfs_path:>exit
C:>/
```

Extract and expand the compressed SMPMCS and RELFILEs

The AZWE002.readme.txt file uploaded in the previous step holds a sample JCL to expand the compressed SMPMCS and RELFILEs from the uploaded AZWE002.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:

where, `&VOLSER` is a DISK volume with sufficient free space to hold temporary copies of the RELFILES. As a guide, this may require 1,000 cylinders, or about 650 MB.

Sample installation jobs

The following sample installation jobs are provided in `hlq.ZOWE.AZWE002.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.AZWE002.F1
ZWE2RCVE	RECEIVE	Sample SMP/E RECEIVE job	ZOWE.AZWE002.F1
ZWE3ALOC	ALLOCATE	Sample job to allocate target and distribution libraries	ZOWE.AZWE002.F1
ZWE4ZFS	ALLOMZFS	(Optional) Sample job to allocate, create mountpoint, and mount zFS data sets	ZOWE.AZWE002.F1
ZWE5MKD	MKDIR	Sample job to invoke the supplied ZWEMKDIR EXEC to allocate file system paths	ZOWE.AZWE002.F1
ZWE6DDEF	DDDEF	Sample job to define SMP/E DDDEFs	ZOWE.AZWE002.F1
ZWE7APLY	APPLY	Sample SMP/E APPLY job	ZOWE.AZWE002.F1
ZWE8ACPT	ACCEPT	Sample SMP/E ACCEPT job	ZOWE.AZWE002.F1

Note: When Zowe is downloaded from the web, the RELFILE data set name will be prefixed by your chosen high-level qualifier, as documented in the Extract and expand the compressed SMPMCS and RELFILEs section.

You can access the sample installation jobs by performing an SMP/E RECEIVE (refer to Perform SMP/E RECEIVE), then copy the jobs from the RELFILES to a work data set for editing and submission.

You can also copy the sample installation jobs from the product files by submitting the following job. Before you submit the job, add a job statement and change the lowercase parameters to uppercase values to meet the requirements of your site.

See the following information to update the statements in the sample above:

- IN:

  - **filevol** is the volume serial of the DASD device where the downloaded files reside.

- OUT:

  - **jcl-library-name** is the name of the output data set where the sample jobs are stored.
  - **dasdvol** is 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, as mentioned above 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:

This makes it as below:

ZWE1SMPE and ZWE4ZFS

Example error

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

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: If you want 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 Return Codes and Messages: 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 Return Codes and Messages: 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 Return Codes and Messages: 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, you must 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.

See the following information to update the statements in the previous sample:

- **#dsn** is the name of the data set holding the z/OS UNIX file system.
- **/usr/lpp/zowe** is the name of the mountpoint where the z/OS UNIX file system will be mounted.

Expected Return Codes and Messages: 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, you must 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 Return Codes and Messages: 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 Return Codes and Messages: 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, including http://service.software.ibm.com/holdata/390holddata.html. The latest HOLDDATA may identify HIPER and FIXCAT APARs for the FMIDs you will be installing. An APPLY CHECK will help you 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 will also identify 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. That is, 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.

   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).

   Here are sample APPLY commands:

   i. To ensure that all recommended and critical service is installed with the FMIDs, receive the latest HOLDDATA and use the APPLY CHECK command as follows

   ○ 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.

ii. To install the FMIDs without regard for unresolved HIPER APARs, you can add the BYPASS(HOLDCLASS(HIPER)) operand to the APPLY CHECK command. This will allow you to install FMIDs, even though one of 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.

- 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.

Expected Return Codes and Messages from APPLY CHECK: You will receive a return code of 0 if the job runs correctly.

Expected Return Codes and Messages 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 the 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 Return Codes and Messages 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 Return Codes and Messages 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 Zowe after installation.
- For more information about how to use Zowe, see Using Zowe.

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.

    For general information about how to execute z/OSMF workflow steps, watch the [z/OSMF Workflows Tutorial](#).

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](#).

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.

Prerequisites

To install Zowe using z/OSMF, ensure that you meet the following requirements:

- z/OSMF 2.3 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:

When these tasks are completed, you are ready to install preventive maintenance.

Address 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.

- **Apply required maintenance for Common Components and Services for z/OS (CCS) Version 15.0 (SO12499)**

  - **Role**: Systems programmer

  - The CCS PTF installs load module stubs for select IBM products into your installed CCS library hlq.ZWE0CALL. If you are prompted during installation for the data set name of a load library for an IBM product that is not installed, specify your installed hlq.ZWE0CALL data set name.

- **Configure z/OSMF**

  - **Role**: 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**

  - **Role**: 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**

  - **Role**: Security administrator

  - Write access is also required to the UNIX System Services (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, access to the BPX.SUPERUSER resource profile in the FACILITY class, or UID(0). For UNIXPRIV, read access is

required to SUPERUSER.FILESYS.CHOWN, SUPERUSER.FILESYS.CHGRP, and SUPERUSER.FILESYS.MOUNT.

- **Address USS requirements**

  - **Role**: Systems programmer, security administrator
  - Address the following USS requirements:
    - 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**

  - **Role**: Systems programmer, security administrator
  - 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 a Software Instance using z/OSMF Workflows.

Acquire 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 the following tasks.

1. Download the portable software instance from Zowe downloads and transfer it to the mainframe.
2. Register the portable software instance in z/OSMF.

Refer to the sections below for instructions.

Download the Portable Software Instance from Zowe Downloads

To acquire the portable software instance, you download it from the Zowe Downloads page and transfer it to a local z/OSMF host using a file transfer utility, such as FTP.

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.

1. Go to Zowe Downloads and find **Zowe - Portable Software Instance**.
2. Download the latest version of the package to your workstation.
3. Use an 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 follows:

`//USSBATCH EXEC PGM=BPXBATCH`

`//STDOUT DD SYSOUT=*` `//STDERR DD SYSOUT=*` `//STDPARM DD *` `sh cd`

`/yourUSSpaxdirectory/;`

`pax -rvf yourpaxfilename.ZOSMF.pax.Z`

`/*`

Customize the sample JCL as follows and then submit for execution:

USSBATCH can take several minutes to execute. A return code of zero is expected. Any other return code indicates a problem.

After successful execution, the individual pax files are restored and ready for use. Go to Register 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, you must 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 displays.
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.

The portable software instance is now registered in z/OSMF and ready to install (deploy).

Install Product Software Using z/OSMF Deployments

As a systems programmer, your responsibilities include installing product software in your z/OS environment. 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 it also isolates 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.

To install Zowe PSWI using z/OSMF and make the product software available for use on a system by users and other programs, define a new deployment. This step defines the SMP/E environment name and the prefix of the CSI data set in z/OSMF. You also 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 (specify the USS path, DSN, VOLSERs), and 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.

For more information about these tasks, see Deploying software in the IBM documentation.

Subsequent maintenance activities for the product update the SMP/E environment without affecting your active product runtime environments. You decide when to redeploy the maintenance-updated SMP/E target data sets to each of the product runtime environments.

Note: The installer requires read, create, update, and execute privileges in z/OS. 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, access to the BPX.SUPERUSER resource profile in the FACILITY class, or UID(0). For UNIXPRIV, read access is required to SUPERUSER.FILESYS.CHOWN, SUPERUSER.FILESYS.CHGRP, and SUPERUSER.FILESYS.MOUNT.

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. 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:

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.

Initializing the z/OS system

After you install the Zowe runtime, you must initialize Zowe with proper security configurations, certificates, and so on before you can start it. To do this, you 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.

About the `zwe init` command

The `zwe init` command is a combination of the following sub-commands. Each sub-command defines a configuration.

- `mvs` : Copy the data sets provided with Zowe to custom data sets.
- `security` : Create the user IDs and security manager settings.
- `apfauth` : APF authorize the LOADLIB containing the modules that need to perform z/OS priviledged security calls.
- `certificate` : Configure Zowe to use TLS certificates.
- `vsam` : Configure the VSAM files needed to run the Zowe caching service used for high availability (HA)
- `stc` : Configure the system to launch the Zowe started task.

You can type `zwe init --help` to learn more about the command or see the `zwe init` command reference for detailed explanation, examples, and parameters.

`zwe init` command requires a Zowe configuration file to proceed. This configuration file instructs how Zowe should be initialized. Please create and review this file before proceeding.

Procedure

To initialize the z/OS system and permissions that Zowe requires, run the following command.

Next steps

The `zwe init` command runs the sub-commands in sequence automatically. If you have successfully ran the above command, you can move on to start Zowe.

You can choose to run the sub-commands one by one to define each step based on your need, or if you encounter some failures with `zwe init` command, you can pick up the failed sub-commands step specifically and re-run it.

1. Prepare custom MVS data sets. Copy the data sets provided with Zowe to custom data sets.

2. Initialize Zowe security configurations. Create the user IDs and security manager settings.

   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.

3. APF authorize load libraries containing the modules that need to perform z/OS privileged security calls..

4. Configure Zowe to use TLS certificates.

5. (Required only if you are configuring Zowe for cross LPAR sysplex high availability): Create the VSAM data sets used by the Zowe API Mediation Layer caching service.

6. Install Zowe main started tassks.

To learn how to run the `zwe init` command step by step, type `zwe init <sub-command> --help`. For example, `zwe init stc --help`.

Initializing Zowe custom data sets

Learn how to intialize Zowe custom MVS data sets by using the `zwe init mvs` command.

Introduction

During the installation of Zowe, three data sets `SZWEAUTH`, `SZWESAMP` and `SZWEEXEC` are created and populated with members copied across from the Zowe installation files. 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 because they will be replaced during subsequent upgrades of Zowe version 2.

For modification and execution, you must 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 `zowe.yaml` section that contains the parameters for the data set names is:

The storage requirements for the three data sets are included here.

Library DDNAME	Member Type	zowe.yaml	Target Volume	Type	Org	RECF
CUST.PARMLIB	PARM Library Members	zowe.setup.dataset.parmlib	ANY	U	PDSE	FB
CUST.JCLLIB	JCL Members	zowe.setup.dataset.jcllib	ANY	U	PDSE	FB
CUST.ZWESAPL	CLIST copy utilities	zowe.setup.dataset.authPluginLib	ANY	U	PDSE	U

Procedure

To initialize Zowe custom data sets, run the following command:

Here is an example of running `zwe init mvs`.

Results

If this step is successful, there will be three custom data sets matching the values in
`zowe.setup.dataset.parmlib`, `zowe.setup.dataset.jcllib` and
`zowe.setup.dataset.authPluginLib` in the `zowe.yaml` file. The member `ZWESIP00` will exist in
the `CUST.PARMLIB` and the `JCLLIB` and `ZWESAPL` will be empty.

In addition to the three custom data sets, the PDS `SZWEAUTH` is created. This may already exist. In this
case, you will receive the error message `Error ZWEL0158E: IBMUSER.ZWEV2.SZWEAUTH already`
`exists`. 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`.

Initialize Zowe security configurations

This security configuration step is required for first time setup of Zowe. If Zowe has already been launched on a z/OS system from a previous release of Zowe v2, you can skip this 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, you should customize it 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` which contains the commands needed to perform the security configuration.

Configuring with `zwe init security` command

The `zwe init security` command reads data from `zowe.yaml` and will construct 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.

Specify the parameter `--security-dry-run` to construct a JCL member containing the security commmands without running it. 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. Here is an example:

Configuring with `ZWESECUR` JCL

You may skip using `zwe init security` to prepare a JCL member to configure the z/OS system, and edit `ZWESECUR` directly to make changes.

The JCL allows you to vary which security manager you use by setting the *PRODUCT* variable to be one of `RACF`, `ACF2`, or `TSS`.

If `ZWESECUR` encounters an error or a step that has already been performed, it will continue 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.

It is expected that the security administrator at a site will want to review, edit where necessary, and either execute `ZWESECUR` as a single job or else execute individual TSO commands one by one 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.

Undo security configurations

If you want to undo all of the z/OS security configuration steps performed by the JCL member `ZWESECUR`, Zowe provides a reverse member `ZWENOSEC` that contains the inverse steps that `ZWESECUR` performs. 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 have 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, then you will no longer be able to run Zowe until you rerun `ZWESECUR` to reinitialize the z/OS security configuration.

Next steps

The `ZWESECUR` JCL does not perform the following initialization steps so after you run `ZWESECUR`, you must complete these steps manually to further configure your z/OS environment.

- Perform APF authorization of Zowe load libraries that require access to make privileged calls
- Copy the JCL members for Zowe's started tasks to a PDS on proclib concatenation path
- Create VSAM data sets used by the Zowe caching service
- Grant users permission to access z/OSMF
- Configure an ICSF cryptographic services environment
- Configure multi-user address space (for TSS only)

The `ZWESECUR` JCL performs the following initialization steps so you do not need to perform them manually if you have successfully run the JCL. However, if you prefer to manually configure the z/OS environment, you must complete the following steps next.

- User IDs and groups for the Zowe started tasks
- Configure ZWESLSTC to run high availability instances under ZWESVUSR user ID
- Configure the cross memory server for SAF

Configuring the z/OS system for Zowe

Learn how to configure the z/OS system for Zowe. Before you begin, check the following table to understand which steps you need to perform based on your settings.

Configuration step	Purpose
Configure an ICSF cryptographic services environment	Required if you want to use Zowe desktop. This step will generate random numbers for zssServer that the Zowe desktop uses.
Configure security environment switching	Required if you want to allow users to log on to the Zowe desktop through impersonation.
Configure address space job naming	Required if you want to set the names for the different z/OS UNIX address spaces for the Zowe runtime components.
Configure multi-user address space for TSS only	Required for TSS only. A TSS FACILITY needs to be defined and assigned to the `ZWESLSTC` started task.
Configure user IDs and groups for the Zowe started tasks	Required if you have not run `ZWESECUR` and are manually creating the user ID and groups in your z/OS environment.
Configure ZWESLSTC to run Zowe high availability instances under ZWESVUSR user ID	Required if you have not run `ZWESECUR` and are configuring your z/OS environment manually. This step describes how to configure the started task ZWESLSTC to run under the correct user ID and group.
Configure the cross memory server for SAF	Required if you have not run `ZWESECUR` and are configuring your z/OS environment manually. This step describes how to configure the cross memory server for SAF to guard against access by non-priviledged clients.

Configuration step	Purpose
Configure main Zowe server to use identity mapping	Required for API Mediation Layer to map client certificate to a z/OS identity.
Configure signed SAF Identity tokens IDT	Required to configure SAF Identity tokens on z/OS so that they can be used by Zowe components like zss or API Mediation Layer.

Configure an ICSF cryptographic services environment

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:

    - If you use RACF, issue the following commands:

    - 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)

    - 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 security environment switching

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.

- If you use RACF, issue the following commands:

- If you use Top Secret, issue the following commands:

- If you use ACF2, issue the following commands:

If the user `ZWESVUSR` who runs the Zowe server started task does not have UPDATE access to both profiles follow the instructions below.

- If you use RACF, complete the following steps:

    i. 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.

    ii. Define the impersonation profiles. This may have already been done on behalf of another server such as the FTPD daemon.

    iii. 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* |

    iv. Issue the following commands to check whether permission has been successfully granted:

- If you use Top Secret, complete the following steps:

    i. 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.

ii. Issue the following commands and review the output to check whether permission has been successfully granted:

- If you use ACF2, complete the following steps:

    i. 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.

    ii. Issue the following commands and review the output to check whether permission has been successfully granted:

Configure address space job naming

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.

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)

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

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:

- To create the `ZWESVUSR` user ID for the main Zowe started task, issue the following command:

- To create the `ZWESIUSR` group for the Zowe cross memory server started task, issue the following command:

Configure ZWESLSTC to run Zowe high availability instances under ZWESVUSR user ID

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.

- If you use RACF, issue the following commands:

- If you use ACF2, issue the following commands:

- If you use Top Secret, issue the following commands:

Configure the cross memory server for SAF

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 do this, 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.

- 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.

- If you use ACF2, issue the following commands:

- If you use Top Secret, issue the following commands, where `owner-acid` can be IZUSVR or a different ACID:

  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.

Configure main Zowe server to use identity mapping

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 RACF general 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.

Using RACF

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.

Using ACF2

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.

Using TSS

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 signed SAF Identity tokens (IDT)

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 Mediation layer (Implement a new SAF IDT provider)

General steps are:

1. Create 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** – *Signed and Unsigned Identity Tokens* and **IDT Configuration** subsections in *z/OS Security Server RACROUTE Macro Reference* book, link.
- **Top Secret** – *Maintain Identity Token (IDT) Records* subsection in *Administrating* chapter, link.
- **ACF2** – *IDTDATA Profile Records* subsection in *Administrating* chapter, link.

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.

Granting users permission to access z/OSMF

For every TSO user ID that is going to log on to Zowe and use services that require z/OSMF, it must have permission to access the z/OSMF services that are used by Zowe. They should be added to the group with appropriate z/OSMF privileges, `IZUUSER` or `IZUADMIN` by default.

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,

- If you use RACF, issue the following command:

- If you use ACF2, issue the following commands:

- If you use Top Secret, issue the following commands:

APF authorize load libraries

Learn how to perform APF authorization of Zowe load libraries that require access to make privileged calls.

Zowe contains load modules that require access to make privileged z/OS security manager calls. These are held in two load libraries which must be APF authorized. The command `zwe init apfauth` will read the PDS names for the load libraries from `zowe.yaml` and perform 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` which references the load library for ZIS plugins.

Here is an example of running `zwe init apfauth`:

Specify `--security-dry-run` to have the command echo the commands that need to be run without them being executed.

Configuring PKCS12 certificates

Zowe is able to use PKCS12 certificates that are stored in USS. This certificate is used for encrypting TLS communication between Zowe clients and the Zowe z/OS servers, as well as intra z/OS Zowe server to Zowe server. 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).

Using USS PKCS12 certificates is useful for proof of concept projects using a self signed certificates. For production usage of Zowe it is recomended to work with certificates held in z/OS keystores. Working with z/OS keystores may require system administrator priviledges and working with your z/OS security team, so the self signed PKCS12 path is provided to assist with configuring and launching test and scratch Zowe instances.

Use a PKCS12 certificate

When Zowe is launched details for the PKCS12 certificate used are specified in the `zowe.yaml` section `certificates`. This contains information for the certificate name and its location, together with the truststore location.

The two most common scenario for using a PKCS12 certtificate are where you have been given an existing certificate and wish to configure Zowe to use it, or else 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`

Create a self signed PKCS12 certificate

The following `zowe.yaml` example will generate:

- A `PKCS12` certificate, specified in `zowe.setup.certificate.type`
- A keystore directory `/global/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`.

To assist with updating `zowe.yaml` the values to generate a self signed PKCS12 certificate are included in the section beginning `# >>>> Certificate setup scenario 1`. Other certificate scenarios lower down in the `zowe.yaml` file are commented out.

The `zwe init certificate` command will generate a certificate based on the `zowe.yaml` values in the `zowe.setup.certificate` section. These certificate values used at runtime are referenced in the `zowe.yanl` section `zowe.certificates`. Specify `--update-config` for the `zwe` command to update the runtime `zowe.certificates` section to reference the generated certificate generated from the `zowe.setup.certificate`.

The follow command output shows generation of a self signed PKCS12 certificate using the default values. Some detailed output messages have been omitted, but the flow can be viewed that creates the CA, creates the keystore and adds the CA to it, create the certificate and adds that to the keystore, creates the truststore, changes directory permissions to restrict access to the private key.

Because `--update-config` was specified the `zowe.certificates` section's values are updated to reference the newly generated certificate. These updates are logged by the `zwe init certificate` command output. Open the `zowe.yaml` file to check the references to the newly generated certificate values, as shown below:

When using a self-signed certificate, you will be challenged by your browser when logging in to Zowe to accept its untrusted certificate authority. Depending on the browser you are using there are different ways to proceed.

Manually import a certificate authority into a web browser

To avoid the browser untrusted CA challenge, you can import Zowe's certificates into the browser to avoid untrusted network traffic challenges. For more information, see Import the local CA certificate to your browser.

To avoid requiring each browser to trust the CA that signed the Zowe certificate, you can use a public certificate authority such as *Symantec*, *Comodo*, *Let's Encrypt*, or _GoDaddy_to create a certificate. These certificates 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.

Configuring JCERACFS certificates in a key ring

Zowe is able to work with certificates held in a **z/OS Keyring**.

The JCL member `.SZWESAMP(ZWEKRING)` contains the security commands to create a keyring named `ZoweKeyring` and manage the certificate and certificate authoritie (CA) used by Zowe's servers to encrypt TLS communications. The JCL contains commands for three z/OS security managers: RACF, TopSecret, and ACF/2.

There are two ways to configure and submit `ZWEKRING`.

- Customize and submit the `ZWEKRING` JCL member.
- Customize the `zowe.setup.certificate` section in `zowe.yaml` and use the `zwe init certificate` command.

If you use the `zwe init certificate` command this will prepare a customized JCL member using `ZWEKRING` as a template.

A number of keytring scenarios are supported

- Creation of a local certificate authority (CA) which is used to sign a locally generated certificate, both of which are placed into the `ZoweKeyring`.
- Importing an existing certificate already held in z/OS to the `ZoweKeyring` for use by Zowe.
- Creation of a locally generated certificated and signing it with an existing certificate authority, and placing the certificate into the key ring.

Create a certificate authority and use it to self sign a certificate

The `zwe init security` command takes its input from the `zowe.setup.security` section in `zowe.yaml`. To help with customizing the file there are five sections in the file

Create a self signed JCERACFKS certificate

The following `zowe.yaml` example will generate:

- A `JCERACFKS` certificate, specified in `zowe.setup.certificate.type`
- A keyring 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`.

The follow command output shows generation of a self signed JCERACFKS certificate using the default values. Some detailed output messages have been omitted.

When the command is run a customized JCL member name in created the `CUST.JCLLIB` data set. The PDS name is defined in the `zowe.setup.dataset.jcllib` property. In the sample below the PDS meember `USER.ZWEV2.CUST.JCLLIB(ZW101431)` is created that contains the security manager commands and then submitted as a job ID `ZWEKRING(JOB03054)`.

Even though the job ends with code 0 there may be failures in the individual steps. It is advised to check the job output. The security manager commands in the job will be generated based on the value of `zowe.security.product`, and the job steps for each product are broken apart by security manager.

Because the `--update-config` parmarater was specified the runtime configuration section of `zowe.yaml` is updated to match the values to the generated keystore, certificate, and certificate authority.

Set up Zowe certificates using workflows

Zowe uses 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. 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:

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:

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:

Creating VSAM caching service datasets

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.

There are different storage methods that can be used as as the caching service for Zowe. One of these is `VSAM` and this chapter describes how to create the data sets if you are using `VSAM` as your caching service. If you are using another caching service such as `redis` or `infinispan` then you do not need to create any VSAM files and you can skip the step described in this chapter. For more information on the different caching services see Configuring the Caching Service for HA.

Using `zwe init vsam` command

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.

- `zowe.components.caching-service.storage.vsam.name` variable

  This is 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.

- `zowe.components.caching-service.storage.mode` variable

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` variable

  If you use the `RLS` mode, a storage class is required.

- `zowe.setup.vsam.volume` variable

  If you set to use the `NONRLS` mode, a storage volume is required.

If you want to preview the member before submitting it use the value `--security-dry-run`, otherwise the command will submit the JCL and wait for its completion.

Installing Zowe main started tasks

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` will copy these 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`.

Here is an example:

Installing and configuring the Zowe cross memory server (ZWESISTC)

The Zowe cross memory server, also known as 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 File 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.

To install and configure the cross memory server, you must define APF-authorized load libraries, program properties table (PPT) entries, and a parmlib. This requires familiarity with z/OS.

- PDS sample library and PDSE load library
- Load module
    - APF authorize
    - Key 4 non-swappable
- PARMLIB
- PROCLIB
- SAF configuration
- Summary of cross memory server installation
- Starting and stopping the cross memory server on z/OS
- Zowe auxiliary service
    - When to configure the auxiliary service
    - Installing the auxiliary service

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 an auxiliary server it uses 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 `ZWESIS00` 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 authorize 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, you can 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. This 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, APF Authorize Load Libraries.

Making APF auth be part of the IPL

Add one of the following lines to your active `PROGxx` PARMLIB member, for example `SYS1.PARMLIB(PROG00)`, to ensure that the APF authorization is added automatically after next IPL. 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, add the following line, where `volser` is the name of the volume that holds the data set:

- If the load library is SMS-managed, add the following line:

The PDS member `SZWESAMP(ZWESIMPRG)` contains the SETPROG statement and PROGxx update for reference.

Key 4 non-swappable

The cross memory server load module `ZWESIS01` 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.ZWEV2.SZWEAUTH(ZWESIS01)` and the PDS PARMLIB containing `ZWESIP00` is `IBMUSER.ZWEV2.SZWESAMP(ZWESIP00)`.

SAF configuration

Because the ZIS server makes z/OS security calls it restrits which clients are able to use it 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 desribed in Configure the cross memory server for SAF.

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 member `ZWESVSTC` 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 `ZWESI00` is copied to an existing APF Auth LoadLib.
- The JCL member `ZWESVSTC` DD statements are updated to point to the location of `ZWESI00` and `ZWESIP00`.
- The load module `ZWESI00` must run in key 4 and be non-swappable by adding a PPT entry to the SCHEDxx member of the system PARMLIB `PPT PGMNAME(ZWESI00) KEY(4) NOSWAP`.

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 `ZWESVSTC` 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 `ZWESVSTC` 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.

To diagnose problems that may occur with the Zowe `ZWESVSTC` 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.

Zowe auxiliary service

Under some situations in support of a Zowe extension, the cross memory server will start, control, and stop an auxiliary address space. This run as a `ZWESASTC` started task that runs the load module `ZWESAUX`.

When to configure the auxiliary service

Under normal Zowe operation, you will not see any auxiliary address spaces started. However, if you have installed a vendor product running on top of Zowe, this may use the auxiliary service so it should be configured to be launchable. A vendor product documentation will specify whether it needs the Zowe auxiliary service to be configured so ensure that it is needed before attempting the configuration steps.

If you are just using core Zowe functionality, you **do not** need to configure the auxiliary service. 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 it to run, you take similar steps to install and configure the cross memory server as described above, but with 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`.

Important!

The cross memory `ZWESISTC` task starts and stops the `ZWESASTC` task as needed. **Do not start the `ZWESASTC` task manually.**

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 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.

You do not start or stop the ZWESASTC manually.

Configure Zowe with z/OSMF Workflows

As a system programmer, after you install Zowe, you can register and execute the z/OSMF workflows in the web interface to complete the Zowe configuration. z/OSMF helps to simplify the Zowe configuration tasks and reduce the level of expertise that is needed for Zowe configuration.

Ensure that you meet the following requirements before you start the Zowe configuration:

- Install and configure z/OSMF
- Install Zowe with an SMP/E build, PSWI, or a convenience build

You can complete the following tasks with the z/OSMF workflow:

- Configure the Zowe instance directory
- Enable the API ML gateway
- Enable the metrics service
- Enable the API catalog
- Enable automatic discovery
- Enable a caching service
- Enable an application server
- Enable the ZSS component
- Enable the jobs API
- Enable the files API
- 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 workflow z/OSMF during the workflow registration process.

Configure the Zowe instance directory

The Zowe instance directory contains configuration data that is required to launch a Zowe runtime. This includes port numbers, location of dependent runtime such as Java, Node, z/OSMF, as well as log files. When Zowe is started, configuration data is read from files in the instance directory and logs will be written to files in the instance directory. Zowe has three runtime systems: the z/OS Service microservice server, the Zowe Application Server, and the Zowe API Mediation Layer microservices.

Register the **ZWECONF.xml** workflow definition file in the z/OSMF web interface to create a Zowe instance directory and start the Zowe started task. The path to the workflow definition file is `<pathPrefix>/workflows/`

After you register the workflow definition file, perform the following steps to complete the process:

1. **Define variables**

   The workflow includes the list of instance configuration and the Zowe variables. Enter the values for variables based on your mainframe environment, Zowe instance configuration, and wanted components.

2. **Create configuration**

   Execute the step to create a configuration zowe.yaml file with the variable setup that was defined in step 1.

3. **Run Zowe install**

   Execute the `zwe install` command with the previously stored zowe.yaml file as a parameter.

   If you receive an error message (such as RC higher than 0), ensure that you edit incorrect input values or system setup before you re-run the `zwe install` command. To overwrite changed output, edit the step by adding the `--allow-overwritten` tag to the install command.

   Example: Command that re-runs the installation

4. **Run Zowe init**

   Execute the `zwe init` command with the previously stored zowe.yaml file as a parameter.

   Note: Messages and error codes from the subsequent JOBS command are not forwarded back to z/OSMF.

   The `zwe init` command is a combination of the following sub-commands that define configuration:

- **mvs**: Copies the data sets that are provided with Zowe to custom data sets.
- **security**: Creates user IDs and security manager settings.
- **apfauth**: APF authorizes the LOADLIB that contains the modules that perform priviledged security calls on z/OS.
- **certificate**: Configures Zowe to use TLS certificates.
- **vsam**: Configures the VSAM files that help run the Zowe caching service for high availability (HA)
- **stc**: Configures the system to launch the Zowe started task.

If you execute the init step again, either manually delete failed artifacts that are created from previous init steps or edit the step by adding the `--allow-overwritten` tag to the init command.

Example: Command that re-runs init

After you execute each step, the step is marked as complete. After completing the workflow execution, you can view the Zowe started task.

Execute the configuration workflow

You can use the following methods to execute the configuration workflow:

- Directly from a PSWI during deployment
- From a deployed software instance (SI)
- From the Workflows tab in the z/OSMF web UI

Execute workflow from PSWI

In the PSWI deployment phase, you are presented with the checklist that helps guide you during the deployment process.

The **perform workflows** step enables you to run either all attached workflows or just the mandatory one — the post-deployment workflow for mounting.

Execute workflow from software instance

Software instance is created after PSWI deployment is complete. Execute a workflow from an SI.

Follow these steps:

1. Log in to z/OSMF.

2. Select the **Software Management** panel.

3. In the displayed table, select **Software Instances**.

4. Select the checkbox next to the **Software Instance Name** column for the instance you want to execute the workflow against.

5. Select the **Perform Workflows** option from the **Actions** menu.

   The **Software Management Software Instances Perform Workflows** dialog opens.

6. Select the **Create Workflow** option from the **Actions** menu.

7. In the displayed table, click on the name of the workflow you want to execute.

8. Click **OK**.

   The **Workflows** tab with the previously selected workflow opens.

9. Execute the workflow steps.

You have successfully executed a workflow from a software instance.

Register and execute workflow in the z/OSMF web interface

z/OSMF workflow simplifies the procedure to configure and start Zowe. Execute the following steps to register and execute the workflow in the z/OSMF web interface:

1. Log in to the z/OSMF web interface and select **Use Desktop Interface**.

2. Select the Workflows File.

3. Select **Create Workflow** from the **Actions** menu.

   The **Create Workflow** panel appears.

4. Enter the complete USS path to the workflow you want to register in the **Workflow Definition File** field.

   ○ If you installed Zowe with the SMP/E build, the workflow is located in the SMP/E target zFS file system that was mounted during the installation.

   ○ (Optional) Enter the complete USS path to the edited workflow properties file in the Workflow Variable Input File field. Use this file to customize product instances and automate workflow execution, saving time and effort when deploying multiple standardized Zowe instances. The values from this file override the default values for the workflow variables.

     The sample properties file is located in the same directory with the workflow definition file. Create a copy of this file, and then modify as described in the file. Set the field to the path where the new file is located.

     Note: If you use the convenience build, the workflows and variable input files are located in the USS runtime folder in files/workflows.

5. Select the System where the workflow runs.

6. Select **Next**.

7. Specify a unique Workflow name.

8. Select or enter an Owner user ID, and select **Assign all steps to owner user ID**.

9. Select **Finish**.

   The **workflow** is registered in z/OSMF. The workflow is available for execution to deploy and configure the Zowe instance.

10. Perform the following steps to execute each step individually:

    a. Double-click the title of the step.

    b. Select the **Perform** tab.

    c. Review the step contents and update the input values.

    d. Select **Next**.

    Repeat the previous two steps to complete all items until the **Finish** option is available.

11. Select **Finish**.

After you execute each step, the step is marked as Complete. The workflow is executed.

Overview

Zowe has high availability feature built-in. This doc guides you through the configuration steps to enable this feature.

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.

(../user-guide/cli-using-using-profiles.md#base-profiles).

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.

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

- VSAM record-level sharing (RLS), see Preparing for VSAM record-level sharing

- 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 v14.x (except v14.17.2) or v16.x

  Note: It is highly recommended that Node.js 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 is the home address for SYSA.
   - x.x.x.B is the home address for SYSB.
   - x.x.x.V is Dynamic VIP Address.
   - 7554 is 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.

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.

Configuring the Caching Service for HA

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 Caching Service, see [Using the Caching Service](#).

For users

- **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 `zowe.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.

- **VSAM**

  To use this method,

    i. Set the value of `zowe.components.caching-service.storage.mode` value to `VSAM` in the `zowe.yaml` configuration file.

    ii. Create a VSAM data set. See [Initialize VSAM data set](#) for instructions. There are two ways to create the data set, either using the JCL member `SZWESAMP(ZWECVSEM)` where the data set name is defined in the `#dsname` variable.

    iii. In `zowe.yaml`, configure `zowe.components.caching-sevice.storage.vsam.name` with the VSAM data set name. If in step 2 you used `zwe init vsam` to create the VSAM data set then the values will already be set.

- **redis**

Redis is not available if you are running the API Mediation Layer on z/OS under unix system services. Its usage is for when the APIML 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 `zowe.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 will need to be set in the `zowe.yaml` file. For more information on these properties and their values see Redis configuration.

- **infinispan**

  Infinispan is designed to be run mainly on z/OS since it offers good performance. To enable this method, set the value of `zowe.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.

Starting and stopping Zowe

Zowe consists 3 main started tasks:

- `ZWESLSTC` as Zowe main started task,
- `ZWESISTC` as Zowe cross memory server
- and `ZWESASTC` as Zowe cross memory auxiliary server.

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`. 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.

Starting and stopping the cross memory auxiliary server `ZWESASTC` on z/OS

This is handled automatically by Zowe cross memory server. You don't need 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 Zowe main server.

To start Zowe, run `zwe start --config /path/to/my/zowe.yaml` command. It will issue `S` command to Zowe `ZWESLSTC`.

Here is an 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. For example, `zwe start --config /path/to/my/zowe.yaml --ha-instance hainst2`. This requires these information be defined in Zowe configuration file:

`zwe start` command will use `ROUTE` command to send `S ZWESLSTC` command to `LPAR2` system.

To stop Zowe, run `zwe stop --config /path/to/my/zowe.yaml` command. It will issue `P` command to Zowe job.

Here is an example:

Starting and stopping Zowe main server `ZWESLSTC` on z/OS manually

To start Zowe main server, you can issue `S ZWESLSTC` command. Same as normal JES `S` command, you can customize `JOBNAME`. For example, `S ZWESLSTC,JOBNAME=ZWE1SV`.

If you have Zowe high availability instance defined and want to start a specific HA instance, for example `myinst1`, you can pass with `HAINST` parameter. Here is an example: `S ZWESLSTC,HAINST=myinst1,JOBNAME=ZWE1SV1`. Zowe high availability instance name is case insensitive. `HAINST=myinst1` and `HAINST=MYINST1` are same.

If you are starting Zowe high availability instance for another LPAR in the Sysplex, you can use `ROUTE` command to route the `S` command to the target system. For example, I'm working on SYSNAME `LPAR1` and want to start HA instance `myinst2` on `LPAR2`, you can issue `RO LPAR2,S ZWESLSTC,HAINST=myinst2,JOBNAME=ZWE1SV2`.

To stop Zowe main server, you can issue `P <jobname>` command.

> ⚠ **CAUTION**
>
> With Zowe version 1, you can issue `C` command to stop Zowe main server. This is not supported in version 2 anymore. A `P` command is required to make sure Zowe components can be shuted down properly.

Stopping and starting a Zowe component without restarting Zowe main server

You can restart a Zowe component with JES modify command without restarting the whole Zowe main server. You need to know these information before issuing the modify command:

- Your Zowe main server job name. By default, it is configured as `ZWE1SV`. You can find your customized value by checking `zowe.job.name` defined in Zowe configuration file.
- The component name you want to stop or start. You can find a full list of installed components by listing `<RUNTIME>/components` directory and Zowe extension directory.

To stop a running Zowe component, issue `F <zowe-job>,APPL=STOP(<component-name>)` command. For example, if you want to stop `app-server`, issue `F ZWE1SV,APPL=STOP(app-server)`.

To start a stopped Zowe component, issue `F <zowe-job>,APPL=START(<component-name>)` command. For example, if you want to start `app-server`, issue `F ZWE1SV,APPL=START(app-server)`.

Note, please be aware that not all components can be restarted with this method. Some components may rely on another and you may need to restart affected components as well.

Verifying Zowe installation on z/OS

After the Zowe™ started task `ZWESLSTC` is running, follow the instructions in the following sections to verify that the components are functional.

- Verifying Zowe Application Framework installation
- Verifying API Mediation 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`). 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 (also known as Zowe desktop) are started. Those using containerization may only have `ZSS` started. For more information, see reference of 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 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 API Mediation Layer endpoint and the **grep** utility to parse out the response status variable value

The response `UP` confirms that API Mediation Layer is installed and is running properly.

Verifying z/OS Services installation

Zowe z/OS services usually are registered with Zowe APIML Discovery and exposed with certain service url like `/<service>/api/v1`.

Here we give an example of verifying `jobs-api` shipped with Zowe. Please be aware that `jobs-api` is not enabled by default if you created your Zowe configuration file from `example-zowe.yaml`. To enable `jobs-api`, you need to set `components.jobs-api.enabled` to be `true` and restart Zowe. You can verify the installation of `jobs-api` service from an internet browser by entering the following case-sensitive URL:

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 above link should prompt you to login. After you input correct user name and password of your target z/OS system, you should see JSON format data of all jobs running on the system.

Introduction

Zowe (server) containers are available for download as an alternative to running Zowe servers on z/OS through the Zowe convenience and SMP/E builds. You can choose the appropriate installation type for your use case. There are several advantages of using containers wherein you can:

- Run Zowe servers on other platforms including Linux on Z and your PC
- Run Zowe servers local to your system for rapid development
- Run redundant copies of servers for scaling capacity to meet workload requirements
- Leverage container monitoring tools

If you are new to containers, you can learn about the concepts from the Kubernetes website.

The Zowe containers are designed to be 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.

1. Prerequisites
2. Downloading and installing
3. Configuring the Zowe container environment
4. Starting, stopping, and monitoring
5. Known limitations

Known limitations

- You may encounter an issue that some plugins are not showing up in Zowe Desktop. You can try `Refresh Applications` icon showing up in Desktop start menu.
- You may encounter an issue that some services are not showing up in Zowe API Catalog. You can try `Refresh Static APIs` button showing up in top-right corner of API Catalog web page.

Prerequisites

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.

Downloading and installing

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.

Configuring

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

Kind	Name	Note
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.

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:

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 running Zowe services on z/OS, you can use Zowe configuration file (`zowe.yaml`) 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.

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. On z/OS, run the following command:

This migration script supports these parameters:

- `--config` or `-c` : Defines the path to your configuration file, usually referred as `zowe.yaml` .
- `--domains` : Defines the domain list will be put into certificate Subject Alternative Name (SAN). This is optional, default value is `localhost` .
- `--external-port` : Defines the external port number to access APIML Gateway running in Kubernetes. This is optional, default value is `7554` .
- `--k8s-namespace` : Defines the Kubernetes namespace. This is optional, default value is `zowe` .

- `--k8s-cluster-name` : Defines the Kubernetes cluster name. This is optional, default value is `cluster.local` .
- `--password` : Defines password of the certificate keystore. This is optional, default value is `password` .
- `--ca-alias` : Defines the alias name of the certificate authority which is used to sign CSR. This is optional, default value is `local_ca` . This argument is only used to sign a new certificate if the migration script will re-generate new certificates for Kubernetes.
- `--ca-password` : Defines the password of the certificate authority keystore which is used to sign CSR. This is optional, default value is `local_ca_password` . This argument is only used if the migration script will re-generate new certificates for Kubernetes.
- `--silent` or `-s` is an optional parameter can help you suppress all standard output except for the Kubernetes manifests will be generated.

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` , `samples/certificates-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.

To verify:

- `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:

Upon success, 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 setup 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 a. 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.

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.

> ⚠️ **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.jobs-api.port` is `7600`,
    - `components.files-api.port` is `7559`,
    - `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.

Starting, stopping, and monitoring

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 section 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 `jobs-api` 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 `jobs-api` as an example, run this command:

Installation checklist

The following checklists summarize the required steps for a base installation (*first-time installation*) in the order you should perform them. The checklist includes a brief description of the steps, with links to the comprehensive information required for the installation. The checklist also identifies the roles that are typically required to complete the step, which enables the pre-installation planning team (systems administrator, DevOps architect, application developer, and so on) to focus on the tasks for which they are responsible.

Addressing the prerequisites

To plan your Zowe CLI installation, review the following checklist.

Step	Description	Role	Time Estimate	Status
Review the Zowe CLI information roadmap	Learn about various Zowe CLI topics	Systems administrator, application developer, systems programmer, DevOps architect	**.25** hrs	Complete, TBD, NA
Review the release notes	Read about new features and enhancements included with this release of Zowe CLI	Systems administrator, DevOps architect	**.25** hours	Complete, TBD, NA
Address the requirements	Install the client-side and host-side software, and ensure that there is sufficient free disk space	Systems administrator	**See Note-1**	Complete, TBD, NA
(Optional) Install API Mediation Layer	Install the Zowe Runtime, which includes API Mediation Layer]	Systems administrator	**8** hrs	Complete, TBD, NA

Step	Description	Role	Time Estimate	Status
Install z/OSMF	Follow the steps to install z/OSMF	Systems administrator	**See Note-2**	Complete, TBD, NA
Determine the profile types that you want to use	Learn about configuration and how to use team profiles	Systems administrator, DevOps architect	**.25** hrs	Complete, TBD, NA

Note-1: Allow **.25** hours to install the client-side software. The amount of time to install the host-side software depends upon your site's implementation. For example, do you require z/OSMF, REST APIs to support the Mediation Layer, or both? See the information for the specific server-side software that you require to determine how much time to allow for complete server-side installation and configuration.

Note-2: Allow **15** to **25** hours to install and configure z/OSMF. The length of time varies depending on the External Security Manager (ESM) that you are running in your site.

You are now ready to install Zowe CLI!

Installing Zowe CLI

To install Zowe CLI, review the following checklist.

Step	Description	Role	Time Estimate	Status
Install Zowe CLI	Install Zowe CLI from an online registry or a local package	Systems administrator	**.5** hrs	Complete, TBD, NA
Install Zowe CLI (quick start)	Use the Quick Start method if you possess prerequisite knowledge of command line tools and writing scripts, and you want to get started with Zowe CLI quickly and easily.	Systems administrator	**.25** hrs	Complete, TBD, NA

Step	Description	Role	Time Estimate	Status
(Optional) Install Zowe CLI plug-ins	Install Zowe CLI plug-ins from an online registry or a local package.	Systems administrator	**.25** hrs	Complete, TBD, NA

You are now ready to configure Zowe CLI!

Configuring Zowe CLI

To configure Zowe CLI, review the following checklist.

Step	Description	Role	Time Estimate	Status
Configure environment variables	Learn how to store configuration options that are common to your environment.	Systems administrator, DevOps architect, application developer	**.25** hrs	Complete, TBD, NA
Configure Zowe profiles	Learn how to configure Zowe team profiles and user profiles.	Systems administrator, DevOps architect, application developer	**.25** hrs	Complete, TBD, NA
Configure daemon mode	Learn how to configure Zowe CLI to run as persistent background process (daemon).	Systems administrator, DevOps architect, application developer	**.25** hrs	Complete, TBD, NA

System requirements

Before installing Zowe CLI, ensure that your environment meets the prerequisites that are described in this article.

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:** Install a currently supported version of Node.js LTS. For a complete list of supported LTS versions, see Nodejs Releases.

  Note: You might need to restart the command prompt after installing Node.js. Issue the following command to verify that Node.js is installed.

  Important! If you are installing Zowe CLI with Node.js 16 on a Windows operating system, see Installing Zowe CLI with Node.js 16 on Windows.

- **npm:** Install a version of Node Package Manager (npm) that is compatible with your version of Node.js.

  Note: npm is included with *most* Node.js installations. Issue the following command to determine your currently installed version of npm.

  See Node.js release matrix to verify that the versions are compatible.

- **Secure Credential Store:** On Linux systems, you must install the packages `gnome-keyring` and `libsecret` (or `libsecret-1-0` on Debian and Ubuntu).

  Note: For information about how to configure Secure Credential Store on headless Linux and z/Linux, see Configure Secure Credential Store 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* you install it.

Host-side requirements

Zowe CLI requires the following mainframe configuration:

- **IBM z/OSMF 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 service.

- **Plug-in services 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 IMS plug-in requires an instance of IBM IMS on the mainframe with IMS Connect (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 cannot run on z/OS due to native code requirements. 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.

Installing Zowe CLI

Install Zowe™ CLI on your computer.

If your role is that of a systems administrator or you are familiar with command-line tools and want to get started using Zowe CLI quickly, see Zowe CLI quick start. You can learn about new CLI features in the Release notes.

After you install Zowe CLI and Zowe CLI plug-ins using your preferred installation method, see Using CLI to learn about how to connect Zowe CLI to the mainframe, create Zowe CLI profiles and team profiles, integrate Zowe CLI with API ML, enable daemon mode, and much, much more!

Installation guidelines

To install CLI on **Windows**, **Mac**, and **Linux** operating systems, follow the steps in Install Zowe CLI from npm or Install Zowe CLI from a local package.

However, to install Zowe CLI on **z/Linux**, **z/OS UNIX System Services (USS)**, or on an operating system where the **Secure Credential Store** is *not required* or *cannot be installed*, use the following installation guidelines:

- To install Zowe CLI on a z/Linux operating system and you **require** the Secure Credential Store:
    i. Follow the steps in Configure Secure Credential Store on headless Linux operating systems.
    ii. Follow the steps in Install Zowe CLI from npm or Install Zowe CLI from a download.
- To install Zowe CLI on a z/Linux operating system and you **do not require** the Secure Credential Store:
    i. Follow the steps in Install Zowe CLI from npm or Install Zowe CLI from a download.
    ii. Follow the steps in Configure Zowe CLI on operating systems where the Secure Credential Store is not available.
- To install Zowe CLI on a USS system or on an operating system where you **cannot install** the Secure Credential Store:
    i. Follow the steps in Install Zowe CLI from npm or Install Zowe CLI from a download.
    ii. Follow the steps in Configure Zowe CLI on operating systems where the Secure Credential Store is not available.

Installation notes

- As you are installing 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 from a local package.

Prerequisites

- Meet the software requirements for Zowe CLI.
- Meet the software requirements for each plug-in.

Prerequisite notes

- If you are installing Zowe CLI on a computer that is running Node.js 16 on a Windows operating system, see Installing Zowe CLI with Node.js 16 on Windows.

- If you are running NPM version 7 (`npm@7`) or NPM version 8 (`npm@8`) on a Windows operating system, ensure that your computer is connected to the Internet.

  Issue the following command **before** you install Zowe CLI:

- Linux users **might** need to prepend `sudo` to `npm` commands. For more information, see Troubleshooting Zowe CLI.

Install Zowe CLI from npm

Use the following procedure to install Zowe CLI from an npm registry:

1. To install or update the core CLI, open a command-line window:

   Zowe CLI is installed.

2. (Optional) Address the Software requirements for CLI plug-ins. You can install most plug-ins without meeting the requirements. However, the plug-ins will not function until you configure the back-end APIs. The IBM Db2 plug-in requires additional configuration to install.

3. (Optional) To install all available plug-ins to Zowe CLI, issue the following command:

Zowe CLI is installed on your computer. Issue the `zowe --help` command to view a list of available commands. For information about how to connect the CLI to the mainframe, create profiles, integrate with

API ML, and more, see Using Zowe CLI.

Install Zowe CLI from a local package

Use the following procedure to install Zowe CLI from a local package:

1. Meet the prerequisites for installing Zowe CLI.

2. Navigate to Download Zowe and click the **Zowe vNext CLI Core** button.

3. Read the End User License Agreement for Zowe and click **I agree** to download the core package.

   `zowe-cli-package-next-2022MMDD.zip` is downloaded to your computer (where MMDD indicates the month and day of the build).

4. **(Optional)** Meet the prerequisites for installing Zowe CLI plug-ins.

5. **(Optional)** Navigate to Download Zowe and click the **Zowe vNext CLI Plugins** button to download the plugins.

6. **(Optional)** Read the End User License Agreement for Zowe plug-ins and click **I agree** to download the plugins package.

   `zowe-cli-plugins-next-2022MMDD.zip` is downloaded to your computer (where MMDD indicates the month and day of the build).

7. Unzip the contents of `zowe-cli-package-next-2021MMDD.zip` (and optionally `zowe-cli-plugins-2021MMDD.zip`) 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 you used in Step 7:

   Note: If an `EACCESS` error displays, see Resolving EACCESS permissions errors when installing packages globally in the npm documentation.

9. **(Optional)** To install Zowe CLI plug-ins, issue the following command to the working directory that you used in Step 7:

Zowe CLI and the optional plug-ins are installed on your computer. Issue the `zowe --help` command to view a list of available commands. For information about how to connect the CLI to the mainframe, create

profiles and team profiles, integrate with API ML, enable daemon mode, and more, see Using CLI.

Configuring Secure Credential Store on headless Linux operating systems

Perform the following configurations on headless and z/Linux operating systems.

Headless Linux requirements

- Ensure that you installed the Secure Credential Store requirements that are described in System 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.

Note: On z/Linux operating systems, complete the steps in Configuring z/Linux before you continue.

Unlocking the keyring manually

Issue the following commands to unlock the keyring manually. You must unlock the keyring in each user session.

Note: The `gnome-keyring-daemon -r --unlock --components=secrets` prompts you to specify a password. Press `Ctrl+D` twice after you specify the password.

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.

Follow these steps:

1. Install 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. Apply the following edits to 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. Add the following statements to `~/.bashrc`. The statement lets you launch DBus, which the Gnome keyring requires. Also the statement lets the keyring daemon start so that it is ready to be used by Zowe CLI commands.

4. Start the Gnome keyring daemon:

5. Restart your computer.

   Issue a Zowe CLI command that uses secure credentials to test that automatic unlock of the keyring works.

Configuring z/Linux

The Secure Credential Store (SCS) does not contain the native, pre-built binaries that are required to access the credential vault on z/Linux operating systems.

Because the credential manager is now a built-in function of Zowe CLI, developers must build the credential mananger binaries on z/Linux systems during the Zowe CLI installation process.

The following steps describe how to install and build the credential store binaries on z/Linux (Red Hat Enterprise Linux (RHEL) and Ubuntu) systems.

1. 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 SCS 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 SCS. In this scenario, the z/Linux system requires Internet access to install the required packages.

2. If you are configuring SCS on a Ubuntu z/Linux operating system, no further action is required. You can now 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.

   Replace **#** with the major version of RHEL that is running on the z/Linux system.

   If your license entitles you to this repository, issue the following command to enable it:

4. If you are configuring SCS to run on RHEL V8.x or later, no further action is required. You can now install Zowe CLI. For RHEL V7.x, continue to the next step.

5. Install the Red Hat Developer Toolset to ensure that you are running a version of the gcc-c++ compiler that can build the SCS native binaries.

   Issue the following commands to enable the repositories that are required to install the toolset:

6. Install the toolset:

7. After you install the toolset on RHEL V7.x, you can install Zowe CLI.

   Important: The SCS 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. For example:

   When you run these commands, Zowe CLI is installed globally and the system will use the latest version of the C++ compiler to build the native components. Refer back to the instructions to set up the Secure Credential Storage component of the Zowe CLI.

Configure Zowe CLI on operating systems where the Secure Credential Store is not available

By default, Zowe CLI attempts to store sensitive information and credentials in the operating system's credential manager. When the information cannot be stored securely, Zowe CLI displays an error when you attempt to create V1 style profiles or a V2 configuration. The actions that are required to disable secure credential management differ depending on the type of configuration being used.

V1 profiles

Existing V1 profiles will continue to function properly. However, it will not be possible to create new profiles without disabling secure credential management. To disable secure credential management for V1 profiles:

1. Navigate to the `.zowe/settings` directory.
2. Modify the `imperative.json` file by replacing the Credential Manager override value to the following:

3. Save the changes.

Team configuration

Team configuration is stored in `zowe.config.json`.

Team configuration can be created without access to the Secure Credential Store. However, team configuration does not store sensitive user information on the system. Subsequent commands prompt for the user's sensitive information when it not provided on the command line, and will attempt to save it with the new Auto Store functionality. Users may experience errors when Auto Store cannot save sensitive information securely. To mitigate this error, disable the Auto Store functionality by changing the value of the autoStore property from `true` to `false` in the `zowe.config.json` or `zowe.config.user.json` file.

Example:

Installing Zowe CLI with Node.js 16 on Windows

There are several preferred installation workarounds when you encounter the following scenarios:

- Using Node.js version 16 with npm version 8 on Windows, want to install from the TGZ, and have restricted Internet access
- Unable to install Zowe CLI while offline using the TGZ bundle

The workaround installation options are, in order of preference:

- Configure NPM proxy to access the public NPM registry (npmjs.org) so that the install from TGZ can succeed. To configure an NPM proxy:
  - If your proxy is HTTP: `npm config set proxy <proxyUrl>`
  - If your proxy is HTTPS: `npm config set https-proxy <proxyUrl>`
- Install CLI from an online registry instead of TGZ. This may also require configuring an NPM proxy. See Installing Zowe CLI from an online registry.
- Downgrade NPM to version 6. To downgrade from a newer version of NPM, issue the command: `npm install -g npm@6.x`

Additional Considerations

There are issues with Node 16 and bundled optional dependencies in offline node installs. Because of the issues, the optional `cpu-features` package was removed from the offline .tgz file that is available from zowe.org and Broadcom. The installation process attempts to reach a configured registry and to use any NPM proxy configured on the system. If the attempt fails, the installation process completes normally.

`cpu-features` changes the SSH cipher order that is used on the `zowe uss issue ssh` commands, favoring `chacha20-poly1305` cipher in cases where CPUs do not have built in AES instructions. This should not affect performance.

Install CLI from Online Registry Via Proxy

This topic describes how to install Zowe CLI using the NPM install command when you are working behind a proxy server. Use this installation method when your site blocks access to public npm.

You can install Zowe CLI from an online registry via proxy on Windows, macOS, or Linux operating systems:

- This method requires access to an internal server that will allow you to connect to the appropriate registries. For other installation methods, see Installing CLI.
- Your default registry must be public npm (or a mirror of public npm).
- If you previously installed the CLI and want to update to a current version, see Updating Zowe CLI

Follow these steps:

1. Identify the proxy server, including the IP address or hostname and the port number.

    - If your proxy server **does not require** login credentials, issue the following commands to add the proxy URL to the NPM config file:

        - [proxy_name]: The IP or hostname
        - [port_number]: The port number of the proxy server.

    - If your proxy server **requires** login credentials, issue the following commands to add the proxy URL, with login credentials, to the NPM config file:

        - [username] and [password]: The required login credentials
        - [proxy_name]: The IP or hostname
        - [port_number]: The port number of the proxy server

2. Ensure that you meet the System requirements for CLI.

3. To install Zowe CLI, issue the following command. On Linux, you might need to prepend `sudo` to your npm commands:

4. **(Optional)** To install open-source Zowe plug-ins:

    a. Ensure that your system meets the Software requirements for Zowe CLI plug-ins.

b. Issue the following command to install all of the plug-ins:

Zowe CLI is installed.

5. **(Optional)** Verify that a Zowe plug-in is operating correctly.

   ○ [my-plugin]: The syntax for the plug-in. For example, `@zowe/cics@zowe-v2-lts`.

6. **(Optional)** Test the connection to z/OSMF. See Testing connections to z/OSMF

7. **(Optional)** Access the Zowe CLI Help (`zowe --help`) or the Zowe CLI Web Help for a complete reference of Zowe CLI. After you install Zowe CLI, you can connect to the mainframe directly issuing a command, by creating user profiles and making use of them on commands, or by using environment variables. For more information, see Displaying help.

Updating Zowe CLI

Zowe™ CLI is updated continuously. You can update Zowe CLI to a more recent version using online registry method or the local package method.

You must update Zowe CLI using the method that you used to install Zowe CLI.

Updating to the Zowe CLI V2 Long-term Support (v2-lts) version

If you are running Zowe CLI version v1.8.x to v1.27.x, you can update to `@zowe-v2-lts` (LTS version) to leverage the latest Zowe CLI and plug-ins functionality.

1. Update Zowe CLI. Open a command line window and issue the following command:

2. Update Zowe plug-ins. Issue the following command to install all Zowe plug-ins:

   Note: To install a subset of the plug-ins, remove the syntax for the plug-ins that you do not want to update. For example:

3. (Optional) Migrate your Zowe CLI profiles from your current installation to your V2 installation. Issue the following command:

   Although you can run Zowe CLI V2 successfully using CLI V1 profiles, we strongly recommend using CLI V2 profiles.

   Note: Profile data is backed up in case you want to revert the profiles to your previous Zowe CLI installation.

4. (Optional) If you no longer require the profiles for your previous Zowe CLI installation, you can delete them. Issue the following command:

   Important: We do not recommend deleting the profiles from your previous Zowe CLI installation until you have tested your V2 installation and are satisfied with its performance.

You updated to the Zowe CLI V2-LTS version!

Ensure that you review the [Release Notes](), which describes **Notable Changes** in this version. We recommend issuing familiar commands and running scripts to ensure that your profiles/scripts are compatible. You might need to take corrective action to address the breaking changes.

Identify the currently installed version of Zowe CLI

Issue the following command (case-sensitive):

Identify the currently installed versions of Zowe CLI plug-ins

Issue the following command:

Update Zowe CLI from the online registry

You can update Zowe CLI to the latest version from the online registry on Windows, Mac, and Linux computers.

Note: The following steps assume that you previously installed the CLI as described in [Installing Zowe CLI from an online registry]().

1. Update Zowe CLI. Open a command line window and issue the following command:

2. Update Zowe plug-ins. Issue the following command to install all Zowe plug-ins:

   Note: To install a subset of the plug-ins, remove the syntax for the plug-ins that you do not want to update. For example:

3. Recreate any user profiles that you created before you updated to the latest version of Zowe CLI.

Update or revert Zowe CLI to a specific version

Optionally, you can update Zowe CLI (or revert) to a known version. The following example illustrates the syntax to update Zowe CLI to version 7.0.0:

Update Zowe CLI from a local package

To update Zowe CLI from an offline (`.tgz`), local package, uninstall your current package then reinstall from a new package using the Install from a Local package instructions. For more information, see Uninstalling Zowe CLI and Installing Zowe CLI from a local package.

Important! Recreate any user profiles that you created before the update.

Uninstalling Zowe CLI

You can uninstall Zowe™ CLI from the desktop if you no longer need to use it.

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.

The following steps describe how 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, go to Step 5.

2. List all configuration files that you created. Issue the following command:

   Example:

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.

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. In the event that you receive the error, open an issue in the Zowe CLI GitHub repository.

   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.

   Tip: Deleting the directory does not harm your computer.

Visual Studio Code (VS Code) Extension for Zowe

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. Install the extension directly to VSCode to enable the extension within the GUI. Working with data sets and USS files from VSCode 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.
- Lets you use the Secure Credential Store plug-in to store your credentials securely in the settings.

Note: Zowe Explorer is a subcomponent of Zowe. The extension demonstrates the potential for plug-ins powered by Zowe.

Software Requirements

Ensure that you meet the following prerequisites before you use the extension:

- Get access to z/OSMF.
- Install Node.js v8.0 or later.
- 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.
- Create one Zowe CLI `zosmf` profile so that the extension can communicate with the mainframe.

Profile notes:

- You can use your existing Zowe CLI `zosmf` profiles that are created with the Zowe CLI v.2.0.0 or later.

- Zowe CLI `zosmf` profiles that are created in Zowe Explorer can be interchangeably used in the Zowe CLI.

- *Optionally*, you can continue using Zowe CLI V1 profiles with Zowe Explorer. For more information, see ***instert link here***.

Installing

Use the following steps to install Zowe Explorer:

1. Address [the software requirements](#).

2. Open VSCode, and navigate to the **Extensions** tab on the left-hand side of the UI.

3. Type **Zowe Explorer** in the search field.

   Zowe Explorer appears in the list of extensions in the left-hand panel.

4. Click the green **Install** button to install the extension.

5. Restart VSCode.

The extension is now installed and available for use.

- **Note:** For information about how to install the extension from a `VSIX` file and run system tests on the extension, see the [Developer README](#).

You can also watch the following videos to learn how to get started with Zowe Explorer, and work with data sets.

Configuration

Configure Zowe Explorer in the settings file of the extension. To access the extension settings, navigate to **Manage (the gear icon)** > **Settings**, then select **Extensions** > **Zowe Explorer Settings**. For example, you can modify the following settings:

- **Data set creation settings:** You can change the default creation settings for various data set types.

Follow these steps:

1. Click the **Edit in settings.json** button under the Data Set, USS or JOBS settings that you want to edit.

2. Edit the settings as needed.

3. Save the settings.

- **Set the Temporary Folder Location:** You can change the default folder location where temporary files are stored.

  Follow these steps:

  i. Click the **Edit in settings.json** button under the Data Set, USS or JOBS settings that you want to edit.

  ii. Modify the following definition:

  where **/path/to/directory** is the folder location that you specify.

  iii. Save the settings.

Relevant Information

In this section you can find useful links and other relevant to Zowe Explorer information that can improve your experience with the extension.

- For information about how to develop for Eclipse Theia, see Theia README.
- For information about how to create a VSCode extension for Zowe Explorer, see VSCode extensions for Zowe Explorer.
- Visit the **#zowe-explorer** channel on Slack for questions and general guidance.

Zowe Explorer Profiles

After you install Zowe Explorer, you need to have a Zowe Explorer profile to use all functions of the extension.

Note: You can continue using Zowe V1 profiles with Zowe Explorer V2.

Configuring team profiles

Zowe CLI team profiles simplify profile management by letting you to edit, store, and share mainframe configuration details in one location. You can use a text editor or an IDE to populate configuration files with connection details for your mainframe services. By default, your team configuration file is located in the `.zowe home` folder, whereas the project-level configuration file is located in the main directory of your project. You can create profiles that you use globally, given that the names of the globally-used profiles are different from your other profile names.

Note: A project context takes precedence over global configuration.

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. Chose either a global configuration file or a project-level configuration file.
6. Edit the config 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 shows in VS Code after config file creation will include the path of the file created.

Managing profiles

You can edit your project-level or global configuration files.

Follow these steps:

1. Right-click on your profile.

2. Select the **Add**, **Update**, or **Delete Profile** options to edit the zowe config file in place.

   Tip: Use the Intellisense prompts if you need assistance with filling parameters in the file.

3. Save the config file.

4. Refresh the view by clicking the refresh icon in the Data Sets, USS, or Jobs view.

   Alternatively, press F1 to open the command palette, type and execute the **Zowe Explorer: Refresh Zowe Explorer** option.

You successfully edited your configuration file.

Sample profile configuration

View the profile configuration sample. In the sample, the default `lpar1.zosmf` profile will be loaded upon activation.

You can use the sample to customize your profile configuration file. Ensure that you edit the `host` and `port` values before you work in your environment.

Working with Zowe Explorer profiles

Important! The information in this section applies to only Zowe CLI V1 profiles unless otherwise noted. Zowe CLI V1 profiles are defined by having one yaml file for each user profile.

You must have a `zosmf` compatible profile before you can use Zowe Explorer. You can set up a profile to retain your credentials, host, and port name. In addition, you can create multiple profiles and use them simultaneously.

Follow these steps:

1. Navigate to the explorer tree.

2. Click the **+** button next to the **DATA SETS**, **USS** or **JOBS** bar.

   Note: If you already have a profile, select it from the drop-down menu.

3. Select the **Create a New Connection to z/OS** option.

   Note: When you create a new profile, user name and password fields are optional. However, the system will prompt you to specify your credentials when you use the new profile for the first time.

4. Follow the instructions, and enter all required information to complete the profile creation.

You successfully created a Zowe CLI `zosmf` profile. Now you can use all the functionalities of the extension.

If you need to edit a profile, right-click the profile and select **Update Profile** option.

In addition, you can hide a profile from the explorer tree, and permanently delete a profile. When you delete your profile permanently, the extension erases the profile from the `.zowe` folder. To hide or delete a profile, right-click the profile and choose one of the respective options from the list.

Validating profiles

Note: The following information applies to Zowe CLI V1 profiles (one yaml file for each user profile) and Zowe CLI team profiles (Zowe CLI V2).

Zowe Explorer includes the profile validation feature that helps to ensure that z/OSMF is accessible and ready for use. If a profile is valid, the profile is active and can be used. By default, the feature is automatically enabled. You can disable the feature by right-clicking on your profile and selecting the **Disable Validation for Profile** option. Alternatively, you can enable or disable the feature for all profiles in the VS Code settings.

Follow these steps:

1. Navigate to the VS Code settings.
2. Open Zowe Explorer Settings.
3. Enable or disable the automatic validation of profiles option.
4. Restart VS Code.

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.

Before you log in and connect your service profile, ensure that you have Zowe CLI v6.16 or higher installed.

Accessing services through API ML using SSO

Connect your service profile with a base profile and token.

Follow these steps:

1. Open Zowe CLI and issue the following command:

2. Follow the onscreen instructions to complete the login process.

   A local base profile is created that contains your token. For more information about the process, see Token Management.

3. Run Zowe Explorer and click the **+** icon.

4. Select the profile you use with your base profile with the token.

   The profile appears in the tree and you can now use this profile to access z/OSMF via the API Mediation Layer.

For more information, see Integrating with API Mediation Layer.

Logging in to the Authentication Service

If the token for your base profile is no longer valid, you can log in again to get a new token with the **Log in to Authentication Service** feature.

Notes:

- The feature is only available for base profiles.
- The feature supports only API Mediation Layer at the moment. Other extenders may use a different authentication service.

Follow these steps:

1. Open Zowe Explorer.

2. Right-click your profile.

3. Select the **Log in to Authentication Service** option.

   You will be prompted to enter your username and password beforehand.

The token is stored in the corresponding base profile.

If you do not want to store your token, request from the server to end the session of your token. Use the **Log out from Authentication Service** feature to invalidate the token.

Follow these steps:

1. Open Zowe Explorer.
2. Right-click your profile.
3. Select the **Log out from Authentication Service** option.

Your token has been successfully invalidated.

Configuring Zowe Application Framework

The Zowe Application ("App") Framework is configured in the Zowe configuration file. Configuration can be used to change things 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 a 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 the App Server

When the server is enabled and given a port within the configuration file, the App server will print a message ZWED0031I in the log output. At that time, it is ready to accept network communication. When using the API Mediation Layer (recommended), app-server URLs should be reached from the Gateway, and you should additionally wait for the message ZWEAM000I for the Gateway to be ready.

When Zowe is ready, the app-server can be found at `https://<zowe.externalDomain>:<components.gateway.port>/zlux/ui/v1`

(Not recommended): If the API Mediation Layer is not used, or you need to contact the App server directly, the ZWED0031I message states which port it is accessible from, though generally it will be the same value as specified within `components.app-server.port`. In that case, the server would be available at `https://<zowe.externalDomain>:<components.app-server.port>/`

Accessing the Desktop

The `app-server` should be accessed through the `gateway` when both are present. When both are ready, the Desktop can be accessed from the API Mediation Layer Gateway, such as

`https://<zowe.externalDomain>:<components.gateway.port>/zlux/ui/v1/`, which will redirect to `https://<zowe.externalDomain>:<components.gateway.port>/zlux/ui/v1/ZLUX/plugins/org.zowe.zlux.bootstrap/web/index.html`

Although you access the App server via the Gateway port, the App server still needs a port assigned to it which is the value of the *components.app-server.port* variable in the Zowe configuration file.

(Not recommended): If the mediation layer is not used, the Desktop will be accessible from the App server directly at `/ZLUX/plugins/org.zowe.zlux.bootstrap/web/index.html`

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.

Environment variables

In the latest version of Zowe, `instance.env` is no longer used. However, some environment variables that could be specified within v1 can still be set within v2 in the `zowe.environments` section of the server configuration file. Environment variables starting with `ZWED_` map to values that can be specified within `components.app-server` and `components.zss` so they are redundant, but you can refer to the above json-schema document to see which values are useful or deprecated.

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 can be accessed over HTTP and/or HTTPS, provided it has been configured for either. HTTPS should be used, as HTTP is not secure unless AT-TLS is used. When AT-TLS is used by ZSS, `components.zss.agent.http.attls` must be set to true.

HTTPS

Both `app-server` and `zss` server components use HTTPS by default, and the `port` parameters `components.app-server.port` and `components.zss.port` control which port they are accessible from. However, each have advanced configuration options to control their HTTPS behavior.

The `app-server` component configuration can be used to customize its HTTPS connection such as which certificate and ciphers to use, and these parameters are to be set within `components.app-server.node.https` as defined within the json-schema file

The `zss` component configuration can be used to customize its HTTPS connection such as which certificate and ciphers to use, and these parameters are to be set within `components.zss.agent.https` as defined within the json-schema file

HTTP

The `app-server` can be configured for HTTP via the `components.app-server.node.http` section of the Zowe configuration file, as specified within the `app-server` json-schema file.

The `zss` server can be configured for HTTP via the `components.zss.agent.http` section of the Zowe configuration file, as specified within the `zss` json-schema file. Note that `components.zss.tls` must be set to false for HTTP to take effect, and that `components.zss.agent.http.attls` must be set to true for AT-TLS to be recognized correctly.

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

Old defaults

Prior to Zowe release 2.0.0, the location of the configuration directories were initialized to be within the `<INSTANCE_DIR>` folder unless otherwise customized. 2.0.0 does have backwards compatibility for the existence of these directories, but `<INSTANCE_DIR>` folder no longer exists, so they should be migrated to match the ones specified in the Zowe configuration file.

Folder	New Location	Old Location	
siteDir	`<zowe.workspaceDirectory>/app-server/site`	`<INSTANCE_DIR>/workspace/app-server/site`	

Folder	New Location	Old Location	
instanceDir	`<zowe.workspaceDirectory>/app-server`	`<INSTANCE_DIR>/workspace/app-server`	insta isn't work is us
groupsDir	`<zowe.workspaceDirectory>/app-server/groups`	`<INSTANCE_DIR>/workspace/app-server/groups`	
usersDir	`<zowe.workspaceDirectory>/app-server/users`	`<INSTANCE_DIR>/workspace/app-server/users`	
pluginsDir	`<zowe.workspaceDirectory>/app-server/plugins`	`<INSTANCE_DIR>/workspace/app-server/plugins`	

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

Running ZSS requires a Zowe configuration file configuration that is similar to the one used for the Zowe App Server (by structure and property names). The attributes that are needed for ZSS (*components.zss*) at minimum, are: *port*, *crossMemoryServerName*.

By default, ZSS is configured to use HTTPS with the same certificate information and port specification as the other Zowe services. If you are looking to use AT-TLS instead, then you must set *component.zss.tls* variable to false and define `component.zss.agent.http` section with port, ipAddresses, and attls: true as shown below

(Recommended) Example of the agent body:

(Not recommended) Unsecure, HTTP example with AT-TLS:

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 2.0.0 64-bit
```

Or

```
ZWES1013I ZSS Server has started. Version 2.0.0 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 ambiguous 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.

Using AT-TLS in the App Framework

By default, both ZSS and the App server use HTTPS regardless of platform. However, some may wish to use AT-TLS on z/OS as an alternative way to provide HTTPS. In order to do this, the servers must run in HTTP mode instead, and utilize AT-TLS for HTTPS. **The servers should never use HTTP without AT-TLS, it would be insecure**. If you want to use AT-TLS, you must have a basic knowledge of your security product and you must have Policy Agent configured. For more information on AT-TLS and Policy Agent, see the z/OS Knowledge Center.

There are a few requirements to working with AT-TLS:

- You must have the authority to alter security definitions related to certificate management, and you must be authorized to work with and update the Policy Agent.
- AT-TLS needs a TLS rule and keyring. The next section will cover that information.

Note: Bracketed values below (including the brackets) are variables. Replace them with values relevant to your organization. Always use the same value when substituting a variable that occurs multiple times.

Creating AT-TLS certificates and keyring using RACF

In the following commands and examples you will create a root CA certificate and a server certificate signed by it. These will be placed within a keyring which is owned by the user that runs the Zowe server. **Note: These actions can be done for various Zowe servers, but in these examples we set up ZSS for AT-TLS. You can subsitute ZSS for another server if desired.**

Key variables:

Variable	Value
[ca_common_name]	
[ca_label]	
[server_userid]	
[server_common_name]	
[server_label]	
[ring_name]	
[output_dataset_name]	

Note:

- [server_userid] must be the server user ID, such as the STC user.
- [server_common_name] must be the z/OS hostname that runs Zowe

1. Enter the following RACF command to generate a CA certificate:

2. Enter the follow RACF command to generate a server certificate signed by the CA certificate:

3. Enter the following RACF commands to create a key ring and connect the certificates to the key ring:

4. Enter the following RACF command to refresh the DIGTRING and DIGTCERT classes to activate your changes:

5. Enter the following RACF commands to verify your changes:

6. Enter the following RACF commands to allow the ZSS server to use the certificates. Only issue the RDEFINE commands if the profiles do not yet exist.

Note: These sample commands use the FACILTY class to manage certificate related authorizations. You can also use the RDATALIB class, which offers granular control over the authorizations.

7. Enter the following RACF command to export the CA certificate to a dataset so it can be imported by the Zowe server:

Defining the AT-TLS rule

To define the AT-TLS rule, use the sample below to specify values in your AT-TLS Policy Agent Configuration file:

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.

Defining the RACF ZOWE class

If you use RACF security, take the following steps define the ZOWE class to the CDT class:

1. Make sure that the CDT class is active and RACLISTed.

2. In TSO, issue the following command:

   If you receive the following message, ignore it:

3. In TSO, issue the following command to refresh the CDT class:

4. In TSO, issue the following command to activate the ZOWE class:

For more information on RACF security administration, see the IBM Knowledge Center at https://www.ibm.com/support/knowledgecenter/.

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 Dataservice endpoint URL lengths and RBAC

Multi-factor authentication configuration

Multi-factor authentication is an optional feature for Zowe.

As of Zowe version 1.8.0, the Zowe App Framework, Desktop, and all apps present in the SMP/E or convenience builds support out-of-band MFA by entering an MFA assigned token or passcode into password field of the Desktop login screen, or by accessing the app-server `/auth` REST API endpoint.

For a list of compatible MFA products, see Known compatible MFA products.

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.

Zowe is bundled with a few of these plugins:

- **sso-auth**: Uses either ZSS or the API Mediation Layer for authentication, and ZSS for RBAC authorization. This plugin also supports resetting or changing your password via a ZSS API. Whether ZSS or API Mediation Layer or both are used for authentication depends upon SSO settings. Starting with Zowe 1.28.0, SSO is enabled by default such that only API Mediation Layer is called at authentication time. By default, the Mediation Layer calls z/OSMF to answer the authentication request. The session created mirrors the z/OSMF session.

- **trivial-auth**: This plugin is used for development and testing, as it always returns true for any function. It could be used if there were specific services you did not need authentication for, while you wanted authentication elsewhere.

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.

Configuration

When you use the default Zowe SMP/E or convenience build configuration, you do not need to change Zowe to get started with MFA.

To configure Zowe for MFA with a configuration other than the default, take the following steps:

1. Choose an App Server security plugin that is compatible with MFA. The sso-auth plugin is compatible.

2. Locate the App Server's configuration file in `zowe.yaml`.

3. Edit the configuration file to modify the section `components.app-server.dataserviceAuthentication`.

4. Set `defaultAuthentication` to the same category as the plugin of choice, as seen in its pluginDefinition.json file. For example:

   - **sso-auth**: "saf"
   - **trivial-auth**: "fallback"

The following is an example configuration for `sso-auth`, as seen in a default installation of Zowe:

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.

API	Description
/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.
/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.

API	Description
/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.

Configuring Zowe CLI environment variables

This section explains how to configure Zowe CLI using environment variables.

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 CLI plug-ins. When troubleshooting, refer to the logs in the `imperative` and `zowe` folders.

Setting the 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 CLI log levels

You can set the log level to adjust the level of detail that is written to log files:

Important! 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.

Environment Variable	Description	Values	Default
`ZOWE_APP_LOG_LEVEL`	Zowe CLI logging level	Log4JS log levels (OFF, TRACE, DEBUG, INFO, WARN, ERROR, FATAL)	WARN

Environment Variable	Description	Values	Default
`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, 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	Defaul
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>/.z` **Examples:** • **Windows:** `%HOMEPATH%\.zc` • **Linux:** `$HOME/.zc`
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`

Configuring the Zowe APIs

Review the security considerations for Zowe APIs and learn how to prevent the Denial of Service (DoS) attacks.

The default configuration before Zowe version 1.14.0 contains **Data sets and Unix files** and **Jobs** API microservices which might be vulnerable to DoS attacks in the form of slow https attacks. You can add additional configuration to the start script of these components in order to prevent resource starvation via slow https attacks.

- To update the configuration of the **Data sets and Unix files** component, modify the `start.sh` script within the runtime component directory `/zowe/runtime/components/files-api/bin`.
- To update the configuration of the **Jobs** component, modify the `start.sh` script within the runtime component directory `/zowe/runtime/components/jobs-api/bin`.

Ensure that the `-Dserver.connection-timeout=8000` parameter is set. This parameter specifies how long the component waits to receive all the required information from the client that makes a request.

See a snippet of a configured `start.sh` script for the Jobs component as follows:

In version 1.14.0 and later, the preceding snippet reflects the default configuration.

Advanced Gateway features configuration

As a system programmer who wants to configure advanced Gateway features of the API Mediation Layer, you can customize Gateway parameters by modifying either of the following files:

- `<Zowe runtime directory>/components/gateway/bin/start-gateway.sh`
- `<Zowe runtime directory>/components/gateway/manifest.yaml`
- `zowe.yaml`

The parameters begin with the `-D` prefix, similar to all the other parameters in the file.

Note: Restart Zowe to apply changes to the parameter.

Follow the procedures in the following sections to customize Gateway parameters according to your preferences:

- Prefer IP Address for API Layer services
- SAF as an Authentication provider
- Enable JWT token refresh endpoint
- Change password with SAF provider
- Gateway retry policy
- Gateway client certificate authentication
- Gateway timeouts
- CORS handling
- Encoded slashes
- Connection limits
- Routed instance header
- Distributed load balancer cache
- Replace or remove catalog with another service
- API Mediation Layer as a standalone component
- SAF resource checking

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.

Follow these steps:

1. Open the `zowe.yaml` configuration file.
2. Find or add the property `components.gateway.apiml.security.auth.provider` and set the value to `saf`.
3. Restart Zowe&trade.

Authentication requests now utilize SAF as the authentication provider. API ML can run without z/OSMF present on the system.

Enable JWT token refresh endpoint

Enable the `/gateway/api/v1/auth/refresh` endpoint to exchange a valid JWT token for a new token with a new expiration date. Call the endpoint with a valid JWT token and trusted client certificate. In case of z/OSMF authentication provider, enable API Mediation Layer for passticket generation and configure z/OSMF APPLID. Configure Passtickets

Follow these steps:

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`.

3. Restart Zowe.

Change password with SAF provider

Update the user password using the SAF Authentication provider. To use this functionality, add the parameter `newPassword` on the login endpoint `/gateway/api/v1/auth/login`. 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. If it is not possible to change the password for any reason, the response code is `401`.

This feature is also available in the API Catalog.

This feature is also available in the API Catalog.

Use a `POST` REST call against the URL `/gateway/api/v1/auth/login`:

Note: It is a common practice to set the limit for changing the password 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 changing the password again.

Example:

`MINCHANGE=120`

where:

- `120`

  Specifies the number of days before the password can be reset

Change password with z/OSMF provider

Update the user password using the z/OSMF Authentication provider. To use this functionality, add the parameter `newPassword` on the login endpoint `/gateway/api/v1/auth/login`. 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. If it is not possible to change the password for any reason, the response code is `401`.

This feature is also available in the API Catalog.

Use a `POST` REST call against the URL `/gateway/api/v1/auth/login`:

Note: In order to use the password change functionality via z/OSMF, it is necessary to install the PTF for APAR PH34912.

Gateway retry policy

To change the Gateway retry policy, edit properties in the `<Zowe install directory>/components/gateway/bin/start.sh` file:

All requests are disabled as the default configuration for retry with one exception: the server retries `GET` requests that finish with status code `503`. To change this default configuration, include the following parameters:

- **ribbon.retryableStatusCodes**

  Provides a list of status codes, for which the server should retry the request.

  Example: `-Dribbon.retryableStatusCodes="503, 404"`

- **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.

- **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`.

- **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`.

Gateway client certificate authentication

Use the following procedure to enable the feature to use a client certificate as the method of authentication for the API Mediation Layer Gateway.

Follow these steps:

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:

   - **components.gateway.apiml.security.x509.externalMapperUrl**

   Note: Skip this step if user mapping is not provided by an external API.

   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`:

   - **components.gateway.apiml.security.x509.externalMapperUser**

   Note: Skip this step if the Zowe runtime userId is not altered from the default `ZWESVUSR`.

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&trade`.

Gateway timeouts

Use the following procedure to change the global timeout value for the API Mediation Layer instance.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.apiml.gateway.timeoutmillis`, and set the value to the desired value.
3. Restart `Zowe&trade`.

If you require finer control, you can edit the `<Zowe install directory>/components/gateway/bin/start.sh`, and modify the following properties:

- **apiml.gateway.timeoutMillis**

  This property defines the global value for http/ws client timeout.

Add the following properties to the file for the API Gateway:

Note: Ribbon configures the client that connects to the routed services.

- **ribbon.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.

- **ribbon.readTimeout**

  Specifies the time in milliseconds 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.

- **ribbon.connectionManagerTimeout**

  The HttpClient employs a special entity to manage access to HTTP connections called by the HTTP connection manager. The purpose of an HTTP connection manager is to serve as a factory for new HTTP connections, to manage the life cycle of persistent connections, and to synchronize access to persistent connections. Internally, the connections that are managed serve as proxies for real connections. `ConnectionManagerTimeout` specifies a period during which managed connections with API ML should be established. The value is in milliseconds. If omitted, the default value specified in the API ML Gateway service configuration is used.

CORS handling

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 prodecure below, API Gateway endpoints start handling CORS requests and 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, it sanitizes defined headers from the communication (upstream and downstream). `Access-Control-Request-Method,Access-Control-Request-Headers,Access-Control-Allow-Origin,Access-Control-Allow-Methods,Access-Control-Allow-Headers,Access-Control-Allow-Credentials,Origin` The resulting request to the service is not a CORS request and the service does not need to do anything extra. The list can be overridden by specifying 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.

Follow these steps:

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&trade`.

Requests through the Gateway now contain a CORS header.

Encoded slashes

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.

Follow these steps:

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&trade`.

Requests with encoded slashes are now rejected by the API Mediation Layer.

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. For more information, see Apache documentation.

Use the following procedure to change the number of concurrent connections.

Follow these steps:

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.
3. Find or add the property `components.gateway.server.maxTotalConnections` and set the value to an appropriate positive integer.

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.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property with value `components.gateway.apiml.routing.instanceIdHeader:true`.
3. Restart Zowe.

Distributed load balancer cache

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 reuqired to have the same DN (Distinguished name) on the server certificate.

Use the following procedure to distribute the load balancer cache between instances of the API Gateway.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property with value `components.gateway.apiml.loadBalancer.distribute: true`.
3. Restart Zowe.

Replace or remove the Catalog with another service

By default, the API Mediation Layer contains 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

- **`metrics-dashboard`**

A possible dashboard that could appear in place of the API Catalog

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.

Follow these steps:

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.

API Mediation Layer as a standalone component

You can start the API Mediation Layer independently of other Zowe components. By default, the Gateway, Zowe System Services, and Virtual Desktop start when Zowe runs. To limit consumed resources when the Virtual Desktop or Zowe System Services are not required, it is possible to specify which components start in the context of Zowe. No change is required during the installation process to support this setup.

Once Zowe is installed, use the following procedure to limit which components start.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property `components.*.enabled` and set this property to `false` for all components that should not be started.
3. Restart `Zowe&trade`.

To learn more about the related section of the environment file, see Creating and configuring the Zowe instance directory. We recommend you open this page in a new tab.

SAF Resource Checking

The API ML can check for the authorization of the user on certain endpoints. Access to a SAF resource is checked with ESM.

Verification of the SAF resource is provided by the following three providers:

- `endpoint`

  This is the highest priority provider, such as a REST endpoint call (ZSS or similar one). This option is disabled by default. In Zowe, ZSS has the API to check for SAF resource authorization.

- `native`

  The Native JZOS classes from Java are used to determine SAF resource access. This is the default provider.

- `dummy`

  This 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.

You can select a specific provider by specifying the `components.gateway.apiml.security.authorization.provider` key in the `zowe.yaml` file. Use the parameter value to strictly define a provider. If verification is disabled, select the `endpoint` option.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.apiml.security.authorization.provider` and set desired value.
3. Restart `Zowe&trade`.

Examples:

Note: To configure the `endpoint` provider, add the following additional property:
`components.gateway.apiml.security.authorization.endpoint.enabled: true`

To use the endpoint provider, customize the URL corresponding to the SAF resource authorization. By default, the ZSS API is configured and used.

Follow these steps:

1. Open the file `zowe.yaml`.

2. Find or add the property
   `components.gateway.apiml.security.authorization.endpoint.url` and set desired value.
   The default value for ZSS API is
   `https://${ZWE_haInstance_hostname}:${GATEWAY_PORT}/zss/api/v1/saf-auth`

3. Restart `Zowe&trade`.

Checking providers

REST endpoint call

The REST provider calls the external API to retrieve information about access rights. To enable the feature outside of the mainframe, such as when running in Docker, you can use a REST endpoint call using the `GET` method:

- Method: `GET`
- URL: `{base path}/{userId}/{class}/{entity}/{level}`
- Response:

Note: For more information about this REST endpoint call, see ZSS implementation.

Native

The Native provider is the easiest approach to use the SAF resource checking feature on the mainframe.

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 following method described in the IBM documentation: method.

Note: Ensure that the version of Java on your system has the same version of classes and method signatures.

Dummy implementation

The Dummy provider is for testing purpose outside of the mainframe.

Create the file `saf.yml` and locate it in the folder, where is application running or create file `mock-saf.yml` in the test module (root folder). The highest priority is 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:

Notes:

- Classes and resources are mapped into a map, user IDs into a list.
- The load method does not support formatting with dots, 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.

Discovery Service configuration parameters

Zowe runtime configuration parameters

As an application developer who wants to run Zowe, set the following parameters during the Zowe runtime configuration by modifying the `<Zowe install directory>/components/discovery/bin/start.sh` file:

- **API ML configuration**
- **Eureka configuration**

API ML configuration

- **apiml.discovery.userid**

  The Discovery service in HTTP mode protects it's endpoints with basic authentication instead of client certificate. This parameter specifies the userid. The default value is `eureka`.

- **apiml.discovery.password**

  This parameter specifies the password for the basic authentication used by the Discovery Service in HTTP mode. The default value is `password`.

- **apiml.discovery.allPeersUrls**

  This parameter contains the list of URLs of the Discovery Service in case of multiple instances of the service on different host. **Example:**

  Note: Each URL within the list must be separated by a comma.

- **apiml.discovery.staticApiDefinitionsDirectories**

  The static definition directories can be specified as a parameter at startup and will be scanned by the Discovery Service. These directories contains the definitions of static services. **Example:**

- **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 v2, based on Zowe v2 conformance. The value of the `*apiml.discovery.serviceIdPrefixReplacer` parameter is represented as a tuple that contains two strings, separated by a comma. The format of this parameter contains the following two elements:

- First, the prefix that you want to replace in the service ID
- Second, the new prefix that will be replaced

Example: The value of the parameter has the following format:
`oldServiceIdPrefix,newServiceIdPrefix`

Set this parameter in your Zowe YAML configuration (typically `zowe.yaml`) by defining `configs.apiml.discovery.serviceIdPrefixReplacer`. For example, defining it globally:

Or defining it only for lpar1 high availability instance:

Eureka configuration

The Discovery Service contains a configuration for implementing the client-side service discovery and for defining a Eureka Server for service registry. Such configuration is shown below:

- **eureka.client.registerWithEureka** If we make this property as true then while the server starts the inbuilt client will try to register itself with the Eureka server.

- **eureka.client.registerWithEureka** The inbuilt client will try to fetch the Eureka registry if we configure this property as true.

- **eureka.client.serviceUrl.defaultZone** A fallback value that provides the Eureka service URL for any client that does not express a preference (in other words, it is a useful default).

More information about the other Eureka parameters can be found in the Spring Cloud Netflix Eureka documentation.

API Gateway configuration parameters

As an application developer who wants to change the default configuration of the API Mediation Layer, set the following parameters by modifying the `<Zowe install directory>/components/gateway/bin/start.sh` file:

- Runtime configuration
  - Environment variables
- Service configuration
- Zuul configuration
- Hystrix configuration
- AT-TLS

Runtime configuration

This section describes runtime configuration properties.

- **apiml.service.hostname**

  This property is used to set the API Gateway hostname.

- **apiml.service.port**

  This property is used to set the API Gateway port.

- **apiml.service.discoveryServiceUrls**

  This property specifies the Discovery Service URL used by the service to register to Eureka.

- **apiml.service.preferIpAddress**

  Set the value of this property to `true` to advertize a service IP address instead of its hostname.

  Notes:

  - If you set this property to `true` on the Discovery Service, ensure that you modify the value of `discoveryLocations:` to use the IP address instead of the hostname. Failure to modify the

`discoveryLocations:` value prevents Eureka from detecting registered services. As a result, the **available-replicas** is empty.

- Enabling this property may also cause issues with SSL certificates and Subject Alternative Name (SAN).

- **apiml.cache.storage.location**

  This property specifies the location of the EhCache used by Spring.

  Note: It is necessary for the API ML process to have write access to the cache location.

- **apiml.security.ssl.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.

- **apiml.security.auth.zosmfServiceId**

  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 `zosmf`.

- **apiml.zoweManifest**

  This parameter lets you view the Zowe version by using the `/version` endpoint. To view the version requires setting up the launch parameter of the API Gateway - `apiml.zoweManifest` with a path to the Zowe build `manifest.json` file. This file is usually located in the root folder of Zowe build. If the encoding of `manifest.json` file is different from UTF-8 and IBM1047, ensure that you set up the launch parameter of API Gateway - `apiml.zoweManifestEncoding` with correct encoding.

  Note: It is also possible to know the version of API ML and Zowe (if API ML used as part of Zowe), using the `/gateway/api/v1/version` endpoint in the API Gateway service in the following format:

- **apiml.security.auth.tokenProperties.expirationInSeconds**

  This property is relevant only when the JWT is generated by the API Mediation Layer. API ML generation of the JWT occurs in the following cases:

- z/OSMF is only available as an older version which does not support JWT tokens

- 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.

  Note: The default value is 8 hours which mimicks the 8 hour default expiration of the LTPA token in z/OSMF.

  Follow these steps:

  i. Open the file `<Zowe install directory>/components/gateway/bin/start.sh`.
  ii. Find the line that contains `-cp ${ROOT_DIR}"/components/gateway/gateway-service.jar":/usr/include/java_classes/IRRRacf.jar`.
  iii. Before this line, add a new line in the following format:

  where:

  - `{expirationTimeInSeconds}`

    refers to the specific time before expiration

  iv. Restart Zowe&trade.

- **ibm.serversocket.recover**

  In a multiple network stack environment (CINET), when one of the stacks fails, no notification or Java™ exception occurs for a Java program that is listening on an `INADDR_ANY` socket. When new stacks become available, the Java application does not become aware of these stacks until the application rebinds the `INADDR` socket. By default, this parameter is enabled in the API Gateway. As a result, the `NetworkRecycledException` exception is thrown to the application to allow it to either fail or attempt to rebind. For more information, see the IBM documentation.

- **java.io.tmpdir**

  This property is a standard Java system property which is used by the disk-based storage policies. This property determines where the JVM writes temporary files, including those written by these storage policies. The default value is typically `/tmp` on Unix-like platforms.

- **spring.profiles.include**

  This property can be used to unconditionally add active profiles. For more information, see the [Spring documentation](#).

- **server.maxTotalConnections and server.maxConnectionsPerRoute**

  These two properties are used to set the number of concurrent connections. Further connection requests that put the number of connections over either of these limits are queued until an existing connection completes. The API Gateway is built on top of Apache HTTP components that require these two connection limits for concurrent requests. For more information, see [Apache documentation](#).

Environment variables

You can add additional environment variables to store configuration properties for the API Mediation Layer.

Note: Use either dot separation, or the UPPER_CASE naming convention when adding an additional environmental variable.

One use case for adding an environmental variable is to change the 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 this procedure to customize authentication provider.

Follow the steps:

1. Open the file `<Zowe instance directory>/instance.env`.

2. Add a new line with the following property:

   `apiml.security.auth.provider=saf`.

Service configuration

For information about service configuration parameters, see [Onboarding a REST API service with the Plain Java Enabler (PJE)](#).

Zuul configuration

As a provider for routing and filtering, the API Gateway contains a Zuul configuration as shown in the following example.

Example:

The Zuul configuration allows the API Gateway to act as a reverse proxy server through which API requests can be routed from clients on the northbound edge to z/OS servers on the southbound edge.

Note: For more information about Zuul configuration parameters, see the Spring Cloud Netflix documentation.

Hystrix configuration

The API Gateway contains a Hystrix configuration as shown in the following example.

Example:

Hystrix is a latency and fault tolerance library designed to isolate points of access to remote systems, services and third-party libraries, stop cascading failure, and enable resilience in complex distributed systems where failure is inevitable.

Note: For more information about Hystrix configuration parameters, see the Netflix – Hystrix documentation.

AT-TLS

The communication server on z/OS provides a functionality to encrypt HTTP communication for on-platform running jobs. This functionality is refered to as Application Transparent Transport Layer Security (AT-TLS). Starting with Zowe version 1.24, it is possible to leverage AT-TLS within the API Mediation Layer. Each API ML component can run with AT-TLS rules applied. Some components, such as the Discovery service, can be made AT-TLS aware by enabling the AT-TLS profile, whereby TLS information can be utilized. Such information could be a client certificate. To enable the AT-TLS profile and disable the TLS application in API ML, update `zowe.yaml` with following values under the respective component in the `components` section:

While API ML can not handle TLS on its own, the Mediation Layer needs information about the server certificate that is defined in the AT-TLS rule. Update the `zowe.yaml` file for each respective APIML component in the `components` sections with the path to the SAF Key ring from the AT-TLS rule and specify the alias that is used for Inbound communication:

Note: This procedure does not configure AT-TLS on z/OS, but rather enables API ML to work with AT-TLS in place.

Getting started

Learn how to start exploring the Zowe components, applications and plug-ins.

Use core components:

- Using Zowe Desktop
- Using Zowe API Mediation Layer
- Using Zowe CLI
- Using Zowe Explorer
- Using Zowe SDKs

Explore available plug-ins:

- Zowe CLI plug-ins
- Zowe Explorer extensions

Using the 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.

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.

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**.
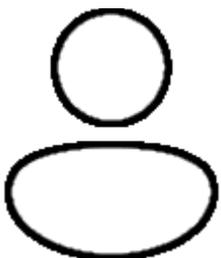
Changing user password

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/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.

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. Developers can create application plugins using a sample application as a guide. The following application plugins are installed by default:

Hello World Sample

The Hello World sample application plugin for developers demonstrates how to create a dataservice and how to create an application plugin using Angular and using React.

IFrame Sample

Github Sample Repo: [sample-iframe-app](#)

Sample Angular App

Github Sample Repo: [sample-angular-app](#)

Sample React App

Github Sample Repo: [sample-react-app](#)

3270 Terminal

The 3270 Terminal plugin provides a user interface that emulates the basic functions of IBM 3270 family terminals. On the "back end," the plugin and the Zowe Application Server connect to any standard TN3270E server.

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 standard network protocols.

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 modify the properties of files such as ownership and permissions. You can also view and edit datasets. Navigation is controlled by the [File Tree.](#) Other actions are

available using the top left menu, a toolbar above the tree, or hotkeys.

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.

IP Explorer

With the IP Explorer you can monitor the TCP/IP stacks, view active connections and reserved ports.

MVS Explorer

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.

USS Explorer

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.

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).

Hotkeys

The following hotkeys can be used in the editor to navigate or perform actions with only the keyboard.

- 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).

Hot Key	Command
ALT+K	Open a dataset
ALT+O	Open a directory

Hot Key	Command
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+T+CTRL	Undo close/close all
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

Using API Catalog

As an application developer, use the API Catalog to view what services are running in the API Mediation Layer. Through the API Catalog, you can also view the associated API documentation corresponding to a service, descriptive information about the service, and the current state of the service. The tiles in the API Catalog can be customized by changing values in the `apiml.catalog.tile` section defined in the application.yml of a service. A microservice that is onboarded to the API Mediation Layer and configured appropriately, registers automatically with the API Catalog and a tile for that service is added to the Catalog.

Note: For more information about how to configure the API Catalog in the application.yml, see: Add API Onboarding Configuration.

API Versioning

See API Catalog and Versioning for more information about the API versioning.

View 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.

Swagger "Try it out" functionality in the API Catalog

The API Catalog enables 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:

  Note: Before making requests to protected endpoints, authorize your session by clicking the lock icon and complete the required information in the Authorization modal shown below:

  Example:

To demonstrate **Try it out**, we use the example of the Swagger Petstore.

Example:

Make a request

This section outlines the process for making a request.

Follow these steps:

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:

Static APIs refresh functionality 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.

Change password via API Catalog

In case expiration of a mainframe password, the API Catalog offers the possibility to set a new password, using either the SAF or the z/OSMF provider. For more information about the password change functionality, see Advanced Gateway features configuration.

Using Metrics Service (Technical Preview)

As a system administrator, use the Metrics Service to view information about the acitivty of services running in the API Mediation Layer. Currently, only HTTP metrics are displayed for core API Mediation Layer services.

In order for the Metrics Service to run, you must set `components.metrics-service.enabled` in `zowe.yaml` to `true`. Additionally, for each APIML service you want to have metrics collected for, you must set `components.<service>.apiml.metrics.enabled` set to `true` in `zowe.yaml`, or `configs.apiml.metrics.enabled` set to `true` in the service's manifest. When metrics are enabled for the API Gateway, the Gateway homepage displays a link to the Metrics Service dashboard. The dashboard is available at `https://{gateway_host}:{gateway_port}/metrics-service/ui/v1`.`

API Mediation Layer Metrics Service Demo Video

Watch this video to see a demo of the Metrics Service.

View HTTP Metrics in the Metrics Service Dashboard

Use the Metrics Service to view HTTP metrics such as number of requests, response times, and error rates. The below image describes the information provided in the Metrics Service dashboard.

To view the HTTP metrics for a service, select the corresponding tab in the Metrics Service dashboard. Metrics are displayed for each endpoint of a service, aggregated from all service instances.

Example:

Metrics are provided on a near real-time basis, so the display shows the current activity of the selected service. At this time there is no persistence for this information.

Service instances expose their HTTP metrics at `https://<service_host>: <service_port>/application/hystrix.stream` using the Server-Sent-Events protocol. The Metrics Service collects these streams and aggregates them across service instances before displaying.

Note: At this time, the `/application/hystrix.stream` endpoint for a service does not require authentication if metrics are enabled for that service. If metrics for that service are not enabled, `/application/hystrix.stream` is protected by authentication.

Using Zowe CLI

Learn about how to use Zowe CLI, including connecting to the mainframe, managing profiles, integrating with 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: If you want to use the CLI together with a screen reader to provide accessibility, we recommend using the Mac™ Terminal application enabled for Accessibility through System Preferences > Accessibility. On Windows™, adjust the Properties settings in Command Prompt. For other operating systems, or for alternative terminals, check the specification for the terminal to ensure that it meets accessibility requirements.

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:

Alternatively, issue the following command 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:

Launch local web help

Launch an interactive form of help 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

We provide you with several methods to view Zowe CLI web help. You can browse Zowe CLI web help online, download the web help in a ZIP file that contains the HTML, or download the web help in a PDF file.

- Browse Online

- [Download (ZIP)](#)

- [Download (PDF)](#)

Understanding core command groups

Zowe CLI contains command groups that focus on specific business processes. For example, the `zos-files` command group lets you interact with mainframe data sets. This article provides a brief synopsis of the tasks that you can perform with each group. For more information, see Displaying help.

The commands available in the product are organized in a hierarchical structure. Command groups (for example, `zos-files`) contain actions (for example, `create`) that let you perform actions on specific objects (for example, a specific type of data set). For each action that you perform on an object, you can specify options that affect the operation of the command. Zowe CLI contains the following command groups:

auth

The auth command group lets you connect to 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 JSON projects, global configuration, and convert profiles (service profiles and base profiles) to team profiles.

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 daemon 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:

profiles

The profiles command group lets you create and manage profiles for use with other Zowe CLI command groups. Profiles allow you to issue commands to different mainframe systems quickly, without specifying your connection details with every command. With the profiles command group, you can perform the following tasks:

- Create, update, and delete profiles for any Zowe CLI command group that supports profiles.
- Set the default profile to be used within any command group.
- List profile names and details for any command group, including the default active profile.

Note: For more information about `profiles` 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 resides 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-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-uss 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-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:

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:

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:

- Create and manage your Zowe CLI `zosmf` profiles. Profiles let you store configuration information for use on multiple commands. You can create a profile that contains your username, password, and connection details for a particular mainframe system, then reuse that profile to avoid typing it again on every command. You can switch between profiles to quickly target different mainframe subsystems. For more information, see Using profiles.

- Verify that your profiles are set up correctly to communicate with z/OSMF on your system. For more information, see Test Connection 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:

Issuing your first command

You can provide all connection options directly on commands 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), the CLI prompts you to enter a value.

Using 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.

When you run Zowe 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.

Important: We do not recommend using daemon mode in an environment where multiple users use the same system. For example, a shared Linux server.

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 to run 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 Configure Secure Credential Store on headless Linux operating systems. The sections Enable daemon mode and Disable 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.
- 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.

Enable daemon mode

The following steps describe how to enable daemon mode and how to 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 executables 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 path to the Zowe executable to your PATH environment variable. For example:

   Important! Ensure that you position the path to your Zowe executables 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.

   Alternative configuration: By default, the daemon 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. To change the location that the daemon uses, see Setting CLI daemon mode properties.

   Note: Complete the environment variable configuration step (Step 2) only once.

The following example illustrates running Zowe CLI commands with daemon mode enabled:

Note: When you are running Zowe CLI in daemon mode using a Git Bash terminal on a Windows operating system, special characters might display using the wrong code page. For example, the default code page 437 renders a form-feed character (\f) as an emoji (♀). To correct the problem, issue the command `chcp.com 65001` to change the code page to UTF-8. If you want the change to be persistent, add the command to your `.bashrc` file.

Restart daemon mode

Daemon mode is a long-running background process (waits for work) that significantly improves Zowe CLI performance. When you make changes to your work environment, daemon mode does not capture the changes. Restarting daemon mode lets the daemon capture the changes. Issue the following command to stop the currently running daemon and start a new daemon:

You **must** restart daemon mode under the following scenarios:

- You changed the value of any of the following Zowe CLI environment variables:

- $\circ$ `ZOWE_CLI_HOME`
- $\circ$ `ZOWE_APP_LOG_LEVEL`
- $\circ$ `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 appeared:

Disable daemon mode

You can disable Zowe from running in daemon mode at any time. For example, daemon mode lacks functionality that you desire, such as viewing colored-coded commands.

1. Open a terminal window and issue the following command:

   The disable command stops daemon mode, removes the Zowe executables from your `.zowe/bin` directory, and disables daemon mode.

Configure daemon mode on z/Linux operating systems

Currently, Zowe does not offer a prebuilt daemon that can run on z/Linux operating systems. However, developers can build the daemon binary from source.

The following steps describe how to install and build the daemon binary on z/Linux systems and the technical limitations.

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. 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 it to your PATH.

8. (Optional) Modify the file permissions to allow others to use the same binary:

Example: 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.

Using profiles

As a system programmer, profiles let you store configuration details for reuse, and for logging in to authentication servers such as API Mediation layer. Create a profile that contains your username, password, and connection details for a mainframe service, then use that profile to avoid typing the information on every command. Switch between profiles to quickly target different mainframe subsystems.

Zowe CLI profile types

Zowe CLI contains the following types of profiles:

- **Team profiles** simplify profile management by letting you edit, store, and share mainframe configuration details in one location. You can use a text editor to populate global profiles with connection details for your mainframe services.

  For more information, see Configuring team profiles.

- **Service profiles:** let you store connection information for 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.

- **Base profiles:** let you store connection information for use with one or more services. Your service profiles can pull information from- base profiles as needed, so that you can specify a common username and password once. 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).

Tips for using Zowe CLI profiles

- You can have multiple service profiles and multiple base profiles.
- Profiles are **not** required. You can choose to specify all connection details for every command.
- Profile values are stored on your computer in plaintext in `C:\Users\<yourUsername>\.zowe\profiles` (Windows) or in `~/.zowe/profiles` (Mac/Linux).

Important information about team profiles

- With the introduction of [team profiles](#), the Secure Credential Store (SCS) Plug-in is deprecated. Secure credential encryption is now handled by the the secure array in the `zowe.config.json` file.

- You can convert all of your Zowe CLI and Zowe CLI plug-ins V1 profiles to team profiles by issuing the following command:

  Note: You can continue using Zowe CLI and Zowe CLI plug-ins V1 profiles with Zowe CLI V2. However, we highly recommend that you implement V2 profiles with Zowe CLI V2.

- Commands in the `zowe config` [command group](#) now let you manage security for any option value.

- The `zowe scs` and `zowe config` command groups were repurposed to work with team profiles.

- Zowe CLI V2 prompts you to enter the username and password securely by default.

Displaying profile help

Use help to learn about options for creating profiles. For example, for a `zosmf` profile, issue the following command:

Service profiles

Create profiles that target a specific mainframe service, then use profiles to issue commands. For example, issue the following command (substituting your connection details) to create a `zosmf` service profile named `myprofile123`:

Use the profile. For example, issue the following command to list all data sets under the name `ibmuser` on the system that you specified in your profile:

Note: If you do not specify a profile, your default profile is used. The first profile that your create is your default. You can set a service profile as your default with the `zowe profiles set-default <profileType> <profileName>` command.

Base profiles

Base profiles store your connection details and provide them to service profiles and commands as needed. The base profile can also contain a token to connect to services through API ML.

For example, if you use the same username and password across multiple services, you can create a base profile with your username and password. After the base profile is created, you can omit the `--username` and `--password` options when you issue commands or use service profiles such as `zosmf` and `tso`. Commands will use the values provided by the base profile. For example, create the base profile:

The first profile that you create for a service is set as your default profile. When you create subsequent profiles, you can select one as the default with the `zowe profiles set-default <profileType> <profileName>` command.

Use the default profile to issue a command:

Note: If you choose to log in to Zowe API Mediation Layer, a base profile is created for you to store a web token, host, and port.

Tips for using base profiles

Use the base profile to share option values between services. You might share option values between services in the following situations:

- You have multiple services that share the same username, password, or other value.
- You want to store a web token to access all services through Zowe API Mediation Layer.
- You want to trust a known self-signed certificate or your site does not have server certificates configured. You can define `reject-unauthorized` in the base profile with a value of false to apply to all services. Understand the security implications of accepting self-signed certificates at your site before you use this method. If you have multiple LPARs and want to share option values only between services that run on the same LPAR, you can use nested profiles to achieve this (see Example 1 below).

Profile best practices

According to order of precedence, base profiles are used as a fallback for service profiles. This means that after you create a base profile, you might need to update your service profiles to remove username, password, host, and port. Otherwise, commands will use the information stored in your service profile and will ignore your base profile definition.

Testing connections to z/OSMF

Optionally, 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.

Important! By default, the server certificate is verified against a list of Certificate Authorities (CAs) trusted by Mozilla. This handshake ensures that the CLI can trust the server. You can append the flag `--ru false` to the following commands to bypass the certificate verification against CAs. If you use the `--ru false` flag, ensure that you understand the potential security risks of bypassing the certificate requirement at your site. For the most secure environment, system administrators configure a server keyring with a server certificate signed by a Certificate Authority (CA). For more information, see Working with certificates.

Without a profile

Verify that your CLI instance can communicate with z/OSMF:

Default profile

After you create a profile, verify that you can use your *default profile* to communicate with z/OSMF:

Specific profile

After you create a profile, verify that you can use *a specific profile* to communicate with z/OSMF:

The 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 information for diagnostic purposes.

Using team profiles

This version of Zowe CLI (V2) introduces the concept of **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.

Consider the following benefits of using team profiles:

- As an application developer or team member, you can manage your connection details efficiently in one location.
- As a Dev-Ops advocate, or team leader, you can share global profiles with your team members so that they can easily access mainframe services. You can add the file directly to your project in a software change management (SCM) application.
- As a Dev-Ops advocate, you can quickly onboard new application developers by sharing the configuration file that your team uses with the new team member.
- As an application developer in a small shop where your role is that of an application developer **and** a Dev-Ops advocate, you can create team profiles, base profiles, or service profiles; whatever profile type is most suitable for your needs!

Important: With the introduction of team profiles, the Secure Credential Store (SCS) Plug-in is deprecated. The `zowe scs` and `zowe config` command groups are obsolete. Secure credential encryption is now included in the core CLI. The CLI prompts you to enter the username and password securely by default. Commands in the `zowe config` command group now let you manage security for any option value.

Initializing team configuration

You can use one of the following methods to initialize team configuration.

Tip: 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.

Create team profile configuration files

1. Issue the following command:

   Zowe CLI responds with prompts for a username and password.

2. Respond to the 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.

   After you respond, the `zowe.config.json` team configuration file is added to your local `.zowe` directory. You can then use a text editor or IDE, such as *Visual Studio Code*, to add the connection details for your mainframe services.

3. (Optional) Issue a Zowe CLI command to test that you can access z/OSMF.

   Example: List all data sets under your user ID:

   A list of data sets is returned. You successfully configured Zowe CLI to access a z/OSMF instance.

   If the CLI returns an error message, verify that you have access to the target system. Examine your configuration files in a text editor to verify that the information you entered is correct.

Important: After the configuration files are in place (either by using the `zowe config init` command or by manually creating the files), the now-deprecated zowe profiles commands no longer function. Zowe CLI returns errors when you attempt to use deprecated profile commands.

Connecting profiles to API Mediation Layer

If you are using the API Mediation Layer, you can set up your `zowe.config.json` file to automatically access the services that are registered to the API ML by issuing the following command:

After you issue the command, Zowe CLI prompts you to specify the following information:

- The host name and port to your API ML instance
- Your username and password

Using Certificates:

If you are using certificates to authenticate, you can specify the details for the certificates by issuing the following command:

Team configuration for application developers

As an application developer or Zowe CLI user, you want to manage your connection details efficiently and in one location.

Initializing user-specific configuration

As an application developer, you can optionally generate a *user-specific* configuration file that overrides the values defined in the global `zowe.config.json` file.

To generate a profile configuration file (`zowe.config.json`) that you can use globally, issue the following command:

To generate the global user profile configuration file (`zowe.config.user.json`), issue the following command:

In your *user-specific* file , observe that the "defaults" object is empty and the profiles do not have properties (illustrated in the following example). You can add your connection details as properties here to override properties in `zowe.config.json` , or add add new connections.

Editing team profiles

After the initial setup, as an application developer you can define additional mainframe services to the team (or *user-specific*) configuration file.

Open the `~/.zowe/zowe.config.json` file in a text editor or an IDE (such as Visual Stuide Code) on your computer. The profiles object contains connection and other frequently needed information for accessing various services.

Example:

Team configuration for team leaders

As a Dev-Ops advocate or team leader, you can share team profiles with your team members so that they can easily access mainframe services.

Sharing team configuration files

As a DevOps advocate or team leader, 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, application developers can pull the project to their local computer and use the defined *team* or *global* 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 a CI/CD pipeline, which lets your pipelines make use of the project configuration.

For information about how to share team configuration files, see Sharing team configuration files.

Profile scenarios

The following topics describe various profile scenarios that DevOps advocates (team leaders) can share with their teams, and application developers that function as DevOps advocates can create.

Access to one or more LPARs that contain services that share the same credentials

The following example illustrates that the settings are using nested profiles to access multiple services directly on one or more LPARs that share the same username and password.

Access to one or more LPARs contain services that do not share the same credentials

The following example illustrates that the settings are using nested profiles to access multiple services directly on one or more LPARs that do not share (different) user names and passwords.

Access to LPARs that access services through one API Mediation Layer

The following example illustrates that the settings access multiple services using the API ML where multi-factor authentication (MFA) or single sign-on (SSO) is achievable using token-based authorization.

Access to LPARs that access services through one API Mediation Layer using certificate authentication

Access LPARs containing multiple services through API Mediation Layer with certificate authentication

Sharing team configuration files

Team leaders can share team configuration files using several methods:

- Shared network drive
- Project repository (for example, GitHub)
- Web server

The following topics describe how to share the team configuration files.

Network drive

1. Store the configuration files on a shared network drive.

2. Issue the following command:

   - DriveLetter:

     The drive letter of the shared network drive

   - FolderPath:

     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

Team leaders can import configuration files from a web URL that is in raw json format. The following steps describe how to import the 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 (GitHub) repository**

  - 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**

  - 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

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.

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:

Managing credential security

When you first run the `zowe config init --global-config` command, the `profiles.base.properties.user` and `profiles.base.properties.password` fields are defined to the "secure" array in your configuration file, which helps to ensure that the username and password are stored securely on your computer.

To store or update values for the secure fields (for example, when you want to change your username and password), issue the `zowe config secure` command. If, for example, you want to update several property values in a long list of properties, press Enter to skip a field.

To secure a specific field, issue `zowe config set --secure <property-path>`. For example, `zowe config set --secure profiles.base.properties.password`. When you issue the command for an option that is already secured, the CLI prompts you to enter a new option value.

You can use an editor to define options to the secure array in `zowe.config.json`. Any option that you define to there becomes secure/prompted-for.

Changes to secure credential storage

With the introduction of team profiles in Zowe CLI V2, the **Secure Credential Store (SCS) Plug-in** is deprecated. The `zowe scs` and `zowe config` command groups are obsolete. Secure credential encryption is now included with the Zowe CLI core application.

Zowe CLI V2 prompts you to enter the `username` and `password` securely by default. Commands in the `zowe config` command group let you manage security for any option value.

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. In the V1-LTS version of Zowe CLI, the value that was specified was not stored for future commands to use. As a result, you either responded to a prompt on every command issued or issued a profile update command to store the missing 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, and the other values are written to `zowe.config.json` on disk.

The default value of the `autoStore` property is true. However, if this behavior is undesirable (you do not want to store properties automatically), set the value of `autoStore` to false. A value of false uses the V1-LTS behavior, which prompts for missing values on all commands that you issue.

Integrating with API Mediation Layer

Zowe API ML provides a single point of access to a defined set of mainframe services. The layer provides API management features such as high-availability, consistent security, and a single sign-on (SSO) and multi-factor authentication (MFA) experience.

You can access services through API ML without reauthenticating every time you issue a command. Tokens allow for a secure interaction between the client and server. When you issue commands to API ML, the layer routes requests to an appropriate API instance based on system load and available API instances.

How token management works

When you log in with the CLI, an API ML token is supplied and stored on your computer in place of username and password. The token allows for a secure handshake with API ML when you issue each command, such 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

To request a token and "log in" to API ML, issue the following command:

The CLI prompts you to enter your username, password (where password can be a PIN concatenated with a second factor for MFA), host, and port for the API ML instance.

Tip: If you already created a base profile, you might not be prompted for host and port.

A local base profile is created that contains your token. When you issue commands, you can omit your username, password, host, and port. Instead, provide a base path and base profile on commands to connect to API ML.

Optionally, when you do not want to store the token on disk, append the `--show-token` option to the login command. If you choose this option, you must manually supply the token on each command using the `--token-value` option.

Notes:

- Tokens expire after a period of time defined by your security administrator. When a token expires, you must log in 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 out

Log out to expire the API ML token and remove it from your base profile.

Issue the following command:

`zowe auth logout`

The token is expired. Log in again to obtain a new token.

Accessing a service through API ML

To access services through API ML using the token in your base profile, specify the following options on commands and service profiles:

- `--base-path` : The base path of the API ML instance that you want to access.
- `--disable-defaults` : Specify this flag to prevent default values from being stored in service profiles. If you do not use this flag, the defaults can override values in your base profile.

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 directly access the service.

Specifying a base path

The following example illustrates a complete path for a z/OSMF instance registered to API ML. The format of base path can vary based on how API ML is configured at your site:

To access that API ML instance, create a service profile (or issue a command) with the `--base-path` value of `api/v1`. Your service profile uses the token and credentials stored in your default base profile.

Commands issued with this profile are routed through the layer to access an appropriate z/OSMF instance.

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.

When you are logged-in, supply the `--base-path` option on commands for each service. Ensure that you do not provide username, password, host, or port directly on your service commands or profiles. Supplying those options causes the CLI to ignore the token in your base profile and directly access the service. You might need to remove those options from existing profiles to use SSO.

For information about registering an API service at your site, see Developing for API Mediation Layer.

Accessing services through SSO + one service not through APIML

There might be a scenario where you log in to API ML with SSO, but you also want access a different service directly (not through API ML).

To access the SSO-enabled services, log in and issue commands with the `--base-path` and `--base-profile` options. The token from your base profile is used for authentication. Remember, your command or service profile must *not* contain username, password, host, or port.

To access the other service directly (circumvent API ML), supply all connection information (username, password, host, and port) on a command or service profile. When you explicitly supply username and password in a command or service profile, the CLI always uses that connection information instead of the API ML token.

Accessing services through SSO + one 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, log in to API ML and supply the `--base-path` and `--base-profile` on commands. For more information, see [Accessing multiple services with SSO](#).

To access the service that is *not* SSO-enabled, explicitly provide your username and password when you issue commands. Using the `--base-path` option ensures that the request is routed to API ML, but the username and password that you provide overrides the credentials in your base profile. This lets you sign in to the individual service.

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. **Related information:**

- Using certificates with z/OS client/server applications in the IBM Knowledge Center.
- Configuring the z/OSMF key ring and certificate in the IBM Knowledge Center.
- 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 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. This blog post outlines the process for using environment variables to trust the 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.

Example:

Completing advanced tasks

This section describes how to use Zowe CLI using its advanced capabilities.

Using 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. You might want to assign a variable in the following scenarios:

- **Store a value that is commonly used.**

  For example, you might want to specify your mainframe username as an environment variable. Now you can issue commands and omit the `--user` option, and Zowe CLI automatically uses the value that you defined in the environment variable.

- **Override a value in existing profiles.**

  For example, you might want to override a value that you previously defined in multiple profiles to avoid recreating each profile. Specify the new value as a variable to override the value in profiles.

- **Secure credentials in an automation server or container** You can set environment variables for use in scripts that run in your CI/CD pipeline. For example, can define environment variables in Jenkins so that your password is not seen in plaintext in logs. You can also define sensitive information in the Jenkins secure credential store.

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:

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.

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 either set environment variables using the `SET` command within your scripts, or navigate to **Manage Jenkins > Configure System > Global Properties** and define an environment variable in the Jenkins GUI. For example:

Global properties

☐ Disable deferred wipeout on this node

☑ Environment variables

List of variables

Name | TEST_VARIABLE

Value | test-value

Name |

Using the prompt feature

Zowe CLI has a command-line "prompt" feature that asks you to provide required option values. The CLI always prompts for host, port, username, and password if you do not supply them 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 choose to always prompt for a particular option.

Enable prompt

Enable one-time prompting as needed.

1. Begin typing a command.

2. For the option(s) that you want to mask, insert the value `"PROMPT*"`. For example, prompt for your password:

   The CLI prompts you to enter a value for the `--password` field.

3. Enter a value to complete the command.

   Tip: Enter the value carefully. The backspace key does not work in prompt mode.

Always prompt

You can configure your environment so that the CLI *always* prompts for a particular option, such as `--password`.

To enable the feature, set an environment variable named `ZOWE_OPT_PASSWORD` with the value `"PROMPT*"`. With the environment variable set, the CLI automatically enables the prompt when you omit a required `--password` value.

Tip The procedure for setting environment variables is dependent on your operating systems. Refer to documentation for your OS to learn about setting environment variables.

Change the keyword for prompt

The default keyword that enables prompting is `"PROMPT*"`. You might want to change the keyword if there is a chance that `"PROMPT*"` could exist as a valid value for the field. For example, if you mask the `data-set` argument and are working with real mainframe data sets that begin with the characters `"PROMPT*"`.

To configure the keyword, choose a new value. Then define the value to to the environment variable on your computer named `ZOWE_PROMPT_PHRASE`.

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.

Follow these steps:

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. **(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.

Extending Zowe CLI

You can install plug-ins to extend the capabilities of Zowe™ CLI. Plug-ins CLI to third-party applications are also available, such as Visual Studio Code Extension for Zowe (powered by Zowe CLI). 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 your CLI application legitimately during the execution of every command. Install third-party plug-ins at your own risk. We make no warranties regarding the use of third-party plug-ins.

- Install Zowe CLI 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
- Visual Studio Code (VSCode) Extension for Zowe

Software requirements for Zowe CLI plug-ins

Before you use Zowe™ CLI plug-ins, complete the following steps:

Important! You can perform the required configurations for the plug-ins that you want to use *before* or *after* you install the plug-ins. However, if you do not perform the required configurations, the plug-ins will not function as designed.

Plug-in	Required Configurations
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.
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 IMS Plug-in for Zowe CLI	- Ensure that IBM® IMS™ v14.1.0 or later is installed and running in your mainframe environment. - Configure IBM® IMS™ Connect. - Configure IBM IMS Operations APIs to enable communication between the CLI and the IMS instance.

Plug-in	Required Configurations
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.

Important! You can perform the required configurations for the plug-ins that you want to use **before** or **after** you install the plug-ins. However, if you do not perform the required configurations, the plug-ins will not function as designed.

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 your CLI application legitimately during the execution of commands. Install third-party plug-ins at your own risk. We make no warranties regarding the use of third-party plug-ins.

You can install the following Zowe plug-ins:

- IBM® CICS® Plug-in for Zowe CLI
- IBM® Db2® 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.

Installing plug-ins from an online registry

Install Zowe CLI plug-ins using npm commands on Windows, Mac, and Linux. The procedures in this article assume that you previously installed the core CLI.

Follow these steps:

1. Meet the software requirements for each plug-in that you install.

2. Issue the following command to install a plug-in from public npm:

   Note: Replace `<my-plugin>` with the installation command syntax in the following table:

Plug-in	Syntax
IBM CICS Plug-in for Zowe CLI	`@zowe/cics-for-zowe-cli@zowe-v2-lts`
IBM Db2 Plug-in for Zowe CLI	`@zowe/db2-for-zowe-cli@zowe-v2-lts`
IBM z/OS FTP Plug-in for Zowe CLI	`@zowe/zos-ftp-for-zowe-cli@zowe-v2-lts`
IBM IMS Plug-in for Zowe CLI	`@zowe/ims-for-zowe-cli@zowe-v2-lts`
IBM MQ Plug-in for Zowe CLI	`@zowe/mq-for-zowe-cli@zowe-v2-lts`

3. (Optional) Issue the following command to install two or more plug-ins using one command. Separate the `<my-plugin>` names with one 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 installed Zowe CLI plug-ins.

Installing plug-ins from a local package

Install plug-ins from a local package on any computer that has limited or no access to the Internet. The procedure assumes that you previously installed the core CLI.

Follow these steps:

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-*v*.*r*.*m*.zip` to your computer.

   Note: `v` indicates the version, `r` indicates the release number, and `m` indicates 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 IMS Plug-in for Zowe CLI	`ims-for-zowe-cli.tgz`
IBM MQ Plug-in for Zowe CLI	`mq-for-zowe-cli.tgz`

You installed 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]` (Optional) 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 IMS Plug-in for Zowe CLI	`@zowe/ims-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 IMS Plug-in for Zowe CLI	`@zowe/ims-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:

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
- Commands
- Software requirements
- Installing
- Creating a user profile

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. It is available for download in three formats: a PDF document, an interactive online version, and a ZIP file containing the HTML for the online version.

- Browse Online
- Download (ZIP)
- Download (PDF)

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

You can set up a CICS profile to avoid typing your connection details on every command. The profile contains your host, port, username, and password for the CMCI instance of your choice. You can create multiple profiles and switch between them if necessary. Issue the following command to create a cics profile:

The plug-in uses HTTPS by default. Use the optional flag `--protocol http` to override the default with HTTP.

Note: For more information, issue the command `zowe profiles create cics --help`

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.

Commands

For detailed documentation on commands, actions, and options available in this plug-in, see our Web Help. It is available for download in three formats: a PDF document, an interactive online version, and a ZIP file containing the HTML for the online version.

- Browse Online
- Download (ZIP)
- Download (PDF)

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

Complete the following steps if you installed Zowe CLI from **online registry**:

1. If you are installing the plug-in on an Apple computer that contains an M1 (or later architecture) processor, complete the steps in M1 processor installation. If not, continue to Step 2.

2. Open a command line window and issue the following command:

3. 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.

Follow these steps:

1. If you are installing the plug-in on a Apple computer that contains an M1 (or later architecture) processor, complete the steps in M1 processor installation. If not, continue to Step 2.

2. Download the ODBC CLI Driver (Darwin x64). Use the table within the download URL to select the correct CLI Driver for your platform and architecture.

3. Create a new directory named `odbc_cli` on your computer. Remember the path to the new directory. You will need to provide the full path to this directory immediately before you install the Db2 plug-in.

4. 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

Now that the Db2 ODBC CLI driver is downloaded, set the `IBM_DB_INSTALLER_URL` environment variable and install the Db2 plug-in to Zowe CLI.

Follow these steps:

1. Open a command line window and change the directory to the location where you extracted the `zowe-cli-bundle.zip` file. If you do not have the `zowe-cli-bundle.zip` file, see the topic **Install Zowe CLI from local package** in Installing Zowe CLI for information about how to obtain and extract it.

2. From a command line window, set the `IBM_DB_INSTALLER_URL` environment variable by issuing the following command:

   o Windows operating systems:

   o Linux and Mac operating systems:

   For example, if you downloaded the Windows x64 driver (ntx64_odbc_cli.zip) to C:\odbc_cli, you would issue the following command:

3. Issue the following command to install the plug-in:

4. Address the license requirements to begin using the plug-in.

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 else on z/OS. If you do not have a license configured when you execute Db2 CLI commands, you will receive an error `SQL1598N`, for example:

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. To know more 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 Aand Mac systems, and `C:\Users\<Your_User>\.zowe` on Windows systems.

   After the license is copied, you can use the Db2 plugin functionality.

Creating a user profile

Before you start using the IBM Db2 plug-in, create a profile with details of the Db2 system you're connecting to.

- The Db2 server host name

- The Db2 server port number
- The database name (you can also use the location)

To get the Db2 system information, the following two methods can be used.

- Issue the command `-DISPLAY DDF` in the Db2 SPUFI command on z/OS

or

- View the JES spool for the MSTR job for the Db2 subsystem and search for the message `DSNL004I`. For example, for the database DI2E the JES job `DI2EMSTR` will have an entry with similar to:

The DOMAIN is used for the <hostname>, the TCPPORT for the <port> and the LOCATION for the <database> in the zowe create profile command.

In addition to the host, port and database you'll need

- The user name
- The password
- If your Db2 systems use a secure connection, you can also provide an SSL/TSL certificate file.

To create a db2 team profile in Zowe CLI, open the `zowe.config.json` file and specify the properties for the `port` and `database`:

SQL0805N: Database BIND

To be able to run remote SQL commands against a Db2 database, you must invoke a `BIND` command against it. If the `BIND` command is not run, you will see an error that contains `SQL0805N` similar to the log below:

If you receive this error, a user with `DBADM` authority must run the `BIND` command. This will typically be done by a Db2 System Programmer. More information can be found in the Db2 product documentation and The Bind process.

M1 processor installation

The IBM ODBC DB2 driver functions only on MacOS x86_64 architecture.

Use the following steps to configure an M1 (or later architecture) processor to behave as MacOS x86_64 architecture so that it can communicate with the IBM ODBC DB2 driver.

1. Install Rosetta. Open a terminal window and issue the following command:

2. Modify `~/.zshrc` to contain the following syntax:

3. Source the new file by issuing the following command:

4. Switch to the x86_64 architecture by issuing the following command:

5. Reinstall Zowe CLI.

6. After you complete these steps, do one of the following:

   - If you are installing the plug-in from an online registry, continue with Step 2 in Install from an online registry.

   - If you are installing the plug-in from a local package, continue with Step 2 in Installing from a local package.

Important! You must issue the `intel` command **every time** that you open a new terminal window to help ensure that Zowe CLI, Secure Credential Storage and the DB2 plug-in function properly on x86_64 architecture. Also, issue the command **before** you issue Zowe CLI commands.

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 datasets, 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 datasets or USS files.
- Upload local files or `stdin` to z/OS datasets or USS files.
- List, view, and download job status or job spool files.
- Delete a z/OS dataset, USS file, or job.

Commands

For detailed documentation on commands, actions, and options available in this plug-in, see our Web Help. It is available for download in three formats: a PDF document, an interactive online version, and a ZIP file containing the HTML for the online version.

- [Browse Online](#)
- [Download (ZIP)](#)
- [Download (PDF)](#)

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

You can create a `zftp` user profile to avoid typing your connection details on every command. A `zftp` profile contains the host, port, username, and password for the z/OS instance to which you want to connect. You can create multiple profiles and switch between them as needed.

Issue the following command:

Note: There is an option named `--secure-ftp` that is set to `true` by default. If FTPS (FTP over SSL) is not enabled in z/OS FTP service, we recommend using `--secure-ftp false`. FTPS is not equivalent to SFTP (FTP over SSH).

Note: For more information about the syntax, actions, and options, for a profiles create command, open Zowe CLI and issue the following command:

IBM® IMS™ Plug-in for Zowe CLI

The IBM IMS Plug-in for Zowe CLI lets you extend Zowe CLI such that it can interact with IMS resources (regions, programs and transactions). You can use the plug-in to start, stop, and query regions and start, stop, query, and update programs and transactions.

Note: For more information about IMS, see IBM Information Management System (IMS) on the IBM Knowledge Center.

Use cases

As an application developer or DevOps administrator, you can use IBM IMS Plug-in for Zowe CLI to perform the following tasks:

- Refresh IMS transactions, programs, and dependent IMS regions.
- Deploy application code into IMS production or test systems.
- Write scripts to automate IMS actions that you traditionally perform using ISPF editors, TSO, and SPOC.

Commands

For detailed documentation on commands, actions, and options available in this plug-in, see our Web Help. It is available for download in three formats: a PDF document, an interactive online version, and a ZIP file containing the HTML for the online version.

- Browse Online
- Download (ZIP)
- Download (PDF)

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 user profiles

You can set up an `ims` profile to retain your credentials, host, and port name. You can create multiple profiles and switch between them as needed. Issue the following command to create an `ims` profile:

Example: Setting up an IMS profile

The following example creates an ims profile named 'ims123' to connect to IMS APIs at host zos123 and port 1490. The name of the IMS plex in this example is 'PLEX1' and the IMS region we want to communicate with has a host of zos124 and a port of 1491:

Note: For more information, issue the command `zowe profiles create ims-profile --help`.

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 to 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. It is available for download in three formats: a PDF document, an interactive online version, and a ZIP file containing the HTML for the online version.

- Browse Online
- Download (ZIP)
- Download (PDF)

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

You can create an `mq` user profile to avoid typing your connection details on every command. An `mq` profile contains the host, port, username, and password for the MQ Rest API server of your choice. You can create multiple profiles and switch between them as needed.

Follow these steps:

1. Create an `mq` profile:

   The result of the command displays as a success or failure message. You can use your profile when you issue commands in the mq command group.

Tip: For more information about the syntax, actions, and options, for a profiles create command, open Zowe CLI and issue the following command:

Visual Studio Code (VS Code) Extension for Zowe

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. Install the extension directly to VSCode to enable the extension within the GUI. Working with data sets and USS files from VSCode 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.
- Lets you use the Secure Credential Store plug-in to store your credentials securely in the settings.

Note: Zowe Explorer is a subcomponent of Zowe. The extension demonstrates the potential for plug-ins powered by Zowe.

Software Requirements

Ensure that you meet the following prerequisites before you use the extension:

- Get access to z/OSMF.
- Install Node.js v8.0 or later.
- 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.
- Create one Zowe CLI `zosmf` profile so that the extension can communicate with the mainframe.

Profile notes:

- You can use your existing Zowe CLI `zosmf` profiles that are created with the Zowe CLI v.2.0.0 or later.

- Zowe CLI `zosmf` profiles that are created in Zowe Explorer can be interchangeably used in the Zowe CLI.

- *Optionally*, you can continue using Zowe CLI V1 profiles with Zowe Explorer. For more information, see ***instert link here***.

Installing

Use the following steps to install Zowe Explorer:

1. Address [the software requirements](#).

2. Open VSCode, and navigate to the **Extensions** tab on the left-hand side of the UI.

3. Type **Zowe Explorer** in the search field.

   Zowe Explorer appears in the list of extensions in the left-hand panel.

4. Click the green **Install** button to install the extension.

5. Restart VSCode.

The extension is now installed and available for use.

- **Note:** For information about how to install the extension from a `VSIX` file and run system tests on the extension, see the [Developer README](#).

You can also watch the following videos to learn how to get started with Zowe Explorer, and work with data sets.

Configuration

Configure Zowe Explorer in the settings file of the extension. To access the extension settings, navigate to **Manage (the gear icon)** > **Settings**, then select **Extensions** > **Zowe Explorer Settings**. For example, you can modify the following settings:

- **Data set creation settings:** You can change the default creation settings for various data set types.

Follow these steps:

1. Click the **Edit in settings.json** button under the Data Set, USS or JOBS settings that you want to edit.

2. Edit the settings as needed.

3. Save the settings.

- **Set the Temporary Folder Location:** You can change the default folder location where temporary files are stored.

  Follow these steps:

  i. Click the **Edit in settings.json** button under the Data Set, USS or JOBS settings that you want to edit.

  ii. Modify the following definition:

  where **/path/to/directory** is the folder location that you specify.

  iii. Save the settings.

Relevant Information

In this section you can find useful links and other relevant to Zowe Explorer information that can improve your experience with the extension.

- For information about how to develop for Eclipse Theia, see [Theia README](#).
- For information about how to create a VSCode extension for Zowe Explorer, see [VSCode extensions for Zowe Explorer](#).
- Visit the **#zowe-explorer** channel on [Slack](#) for questions and general guidance.

Zowe Explorer Profiles

After you install Zowe Explorer, you need to have a Zowe Explorer profile to use all functions of the extension.

Note: You can continue using Zowe V1 profiles with Zowe Explorer V2.

Configuring team profiles

Zowe CLI team profiles simplify profile management by letting you to edit, store, and share mainframe configuration details in one location. You can use a text editor or an IDE to populate configuration files with connection details for your mainframe services. By default, your team configuration file is located in the `.zowe home` folder, whereas the project-level configuration file is located in the main directory of your project. You can create profiles that you use globally, given that the names of the globally-used profiles are different from your other profile names.

Note: A project context takes precedence over global configuration.

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. Chose either a global configuration file or a project-level configuration file.

6. Edit the config 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 shows in VS Code after config file creation will include the path of the file created.

Managing profiles

You can edit your project-level or global configuration files.

Follow these steps:

1. Right-click on your profile.

2. Select the **Add**, **Update**, or **Delete Profile** options to edit the zowe config file in place.

   Tip: Use the Intellisense prompts if you need assistance with filling parameters in the file.

3. Save the config file.

4. Refresh the view by clicking the refresh icon in the Data Sets, USS, or Jobs view.

   Alternatively, press F1 to open the command palette, type and execute the **Zowe Explorer: Refresh Zowe Explorer** option.

You successfully edited your configuration file.

Sample profile configuration

View the profile configuration sample. In the sample, the default `lpar1.zosmf` profile will be loaded upon activation.

You can use the sample to customize your profile configuration file. Ensure that you edit the `host` and `port` values before you work in your environment.

Working with Zowe Explorer profiles

Important! The information in this section applies to only Zowe CLI V1 profiles unless otherwise noted. Zowe CLI V1 profiles are defined by having one yaml file for each user profile.

You must have a `zosmf` compatible profile before you can use Zowe Explorer. You can set up a profile to retain your credentials, host, and port name. In addition, you can create multiple profiles and use them simultaneously.

Follow these steps:

1. Navigate to the explorer tree.

2. Click the **+** button next to the **DATA SETS**, **USS** or **JOBS** bar.

   Note: If you already have a profile, select it from the drop-down menu.

3. Select the **Create a New Connection to z/OS** option.

   Note: When you create a new profile, user name and password fields are optional. However, the system will prompt you to specify your credentials when you use the new profile for the first time.

4. Follow the instructions, and enter all required information to complete the profile creation.

You successfully created a Zowe CLI `zosmf` profile. Now you can use all the functionalities of the extension.

If you need to edit a profile, right-click the profile and select **Update Profile** option.

In addition, you can hide a profile from the explorer tree, and permanently delete a profile. When you delete your profile permanently, the extension erases the profile from the `.zowe` folder. To hide or delete a profile, right-click the profile and choose one of the respective options from the list.

Validating profiles

Note: The following information applies to Zowe CLI V1 profiles (one yaml file for each user profile) and Zowe CLI team profiles (Zowe CLI V2).

Zowe Explorer includes the profile validation feature that helps to ensure that z/OSMF is accessible and ready for use. If a profile is valid, the profile is active and can be used. By default, the feature is automatically enabled. You can disable the feature by right-clicking on your profile and selecting the **Disable Validation for Profile** option. Alternatively, you can enable or disable the feature for all profiles in the VS Code settings.

Follow these steps:

1. Navigate to the VS Code settings.
2. Open Zowe Explorer Settings.
3. Enable or disable the automatic validation of profiles option.
4. Restart VS Code.

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.

Before you log in and connect your service profile, ensure that you have Zowe CLI v6.16 or higher installed.

Accessing services through API ML using SSO

Connect your service profile with a base profile and token.

Follow these steps:

1. Open Zowe CLI and issue the following command:

2. Follow the onscreen instructions to complete the login process.

   A local base profile is created that contains your token. For more information about the process, see Token Management.

3. Run Zowe Explorer and click the **+** icon.

4. Select the profile you use with your base profile with the token.

   The profile appears in the tree and you can now use this profile to access z/OSMF via the API Mediation Layer.

For more information, see Integrating with API Mediation Layer.

Logging in to the Authentication Service

If the token for your base profile is no longer valid, you can log in again to get a new token with the **Log in to Authentication Service** feature.

Notes:

- The feature is only available for base profiles.
- The feature supports only API Mediation Layer at the moment. Other extenders may use a different authentication service.

Follow these steps:

1. Open Zowe Explorer.

2. Right-click your profile.

3. Select the **Log in to Authentication Service** option.

    You will be prompted to enter your username and password beforehand.

The token is stored in the corresponding base profile.

If you do not want to store your token, request from the server to end the session of your token. Use the **Log out from Authentication Service** feature to invalidate the token.

Follow these steps:

1. Open Zowe Explorer.
2. Right-click your profile.
3. Select the **Log out from Authentication Service** option.

Your token has been successfully invalidated.

Configuring Zowe Application Framework

The Zowe Application ("App") Framework is configured in the Zowe configuration file. Configuration can be used to change things 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 a 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 the App Server

When the server is enabled and given a port within the configuration file, the App server will print a message ZWED0031I in the log output. At that time, it is ready to accept network communication. When using the API Mediation Layer (recommended), app-server URLs should be reached from the Gateway, and you should additionally wait for the message ZWEAM000I for the Gateway to be ready.

When Zowe is ready, the app-server can be found at `https://<zowe.externalDomain>:<components.gateway.port>/zlux/ui/v1`

(Not recommended): If the API Mediation Layer is not used, or you need to contact the App server directly, the ZWED0031I message states which port it is accessible from, though generally it will be the same value as specified within `components.app-server.port`. In that case, the server would be available at `https://<zowe.externalDomain>:<components.app-server.port>/`

Accessing the Desktop

The `app-server` should be accessed through the `gateway` when both are present. When both are ready, the Desktop can be accessed from the API Mediation Layer Gateway, such as

`https://<zowe.externalDomain>:<components.gateway.port>/zlux/ui/v1/`, which will redirect to `https://<zowe.externalDomain>:<components.gateway.port>/zlux/ui/v1/ZLUX/plugins/org.zowe.zlux.bootstrap/web/index.html`

Although you access the App server via the Gateway port, the App server still needs a port assigned to it which is the value of the *components.app-server.port* variable in the Zowe configuration file.

(Not recommended): If the mediation layer is not used, the Desktop will be accessible from the App server directly at `/ZLUX/plugins/org.zowe.zlux.bootstrap/web/index.html`

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.

Environment variables

In the latest version of Zowe, `instance.env` is no longer used. However, some environment variables that could be specified within v1 can still be set within v2 in the `zowe.environments` section of the server configuration file. Environment variables starting with `ZWED_` map to values that can be specified within `components.app-server` and `components.zss` so they are redundant, but you can refer to the above json-schema document to see which values are useful or deprecated.

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 can be accessed over HTTP and/or HTTPS, provided it has been configured for either. HTTPS should be used, as HTTP is not secure unless AT-TLS is used. When AT-TLS is used by ZSS, `components.zss.agent.http.attls` must be set to true.

HTTPS

Both `app-server` and `zss` server components use HTTPS by default, and the `port` parameters `components.app-server.port` and `components.zss.port` control which port they are accessible from. However, each have advanced configuration options to control their HTTPS behavior.

The `app-server` component configuration can be used to customize its HTTPS connection such as which certificate and ciphers to use, and these parameters are to be set within `components.app-server.node.https` as defined within the [json-schema file](#)

The `zss` component configuration can be used to customize its HTTPS connection such as which certificate and ciphers to use, and these parameters are to be set within `components.zss.agent.https` as defined within the [json-schema file](#)

HTTP

The `app-server` can be configured for HTTP via the `components.app-server.node.http` section of the Zowe configuration file, as specified within the `app-server` json-schema file.

The `zss` server can be configured for HTTP via the `components.zss.agent.http` section of the Zowe configuration file, as specified within the `zss` json-schema file. Note that `components.zss.tls` must be set to false for HTTP to take effect, and that `components.zss.agent.http.attls` must be set to true for AT-TLS to be recognized correctly.

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

Old defaults

Prior to Zowe release 2.0.0, the location of the configuration directories were initialized to be within the `<INSTANCE_DIR>` folder unless otherwise customized. 2.0.0 does have backwards compatibility for the existence of these directories, but `<INSTANCE_DIR>` folder no longer exists, so they should be migrated to match the ones specified in the Zowe configuration file.

Folder	New Location	Old Location	
siteDir	`<zowe.workspaceDirectory>/app-server/site`	`<INSTANCE_DIR>/workspace/app-server/site`	

Folder	New Location	Old Location	
instanceDir	`<zowe.workspaceDirectory>/app-server`	`<INSTANCE_DIR>/workspace/app-server`	insta isn't work is us
groupsDir	`<zowe.workspaceDirectory>/app-server/groups`	`<INSTANCE_DIR>/workspace/app-server/groups`	
usersDir	`<zowe.workspaceDirectory>/app-server/users`	`<INSTANCE_DIR>/workspace/app-server/users`	
pluginsDir	`<zowe.workspaceDirectory>/app-server/plugins`	`<INSTANCE_DIR>/workspace/app-server/plugins`	

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

Running ZSS requires a Zowe configuration file configuration that is similar to the one used for the Zowe App Server (by structure and property names). The attributes that are needed for ZSS (*components.zss*) at minimum, are: *port*, *crossMemoryServerName*.

By default, ZSS is configured to use HTTPS with the same certificate information and port specification as the other Zowe services. If you are looking to use AT-TLS instead, then you must set *component.zss.tls* variable to false and define `component.zss.agent.http` section with port, ipAddresses, and attls: true as shown below

(Recommended) Example of the agent body:

(Not recommended) Unsecure, HTTP example with AT-TLS:

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 2.0.0 64-bit
```

Or

```
ZWES1013I ZSS Server has started. Version 2.0.0 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.

Using AT-TLS in the App Framework

By default, both ZSS and the App server use HTTPS regardless of platform. However, some may wish to use AT-TLS on z/OS as an alternative way to provide HTTPS. In order to do this, the servers must run in HTTP mode instead, and utilize AT-TLS for HTTPS. **The servers should never use HTTP without AT-TLS, it would be insecure**. If you want to use AT-TLS, you must have a basic knowledge of your security product and you must have Policy Agent configured. For more information on AT-TLS and Policy Agent, see the z/OS Knowledge Center.

There are a few requirements to working with AT-TLS:

- You must have the authority to alter security definitions related to certificate management, and you must be authorized to work with and update the Policy Agent.
- AT-TLS needs a TLS rule and keyring. The next section will cover that information.

Note: Bracketed values below (including the brackets) are variables. Replace them with values relevant to your organization. Always use the same value when substituting a variable that occurs multiple times.

Creating AT-TLS certificates and keyring using RACF

In the following commands and examples you will create a root CA certificate and a server certificate signed by it. These will be placed within a keyring which is owned by the user that runs the Zowe server. **Note: These actions can be done for various Zowe servers, but in these examples we set up ZSS for AT-TLS. You can subsitute ZSS for another server if desired.**

Key variables:

Variable	Value
[ca_common_name]	
[ca_label]	
[server_userid]	
[server_common_name]	
[server_label]	
[ring_name]	
[output_dataset_name]	

Note:

- [server_userid] must be the server user ID, such as the STC user.
- [server_common_name] must be the z/OS hostname that runs Zowe

1. Enter the following RACF command to generate a CA certificate:

2. Enter the follow RACF command to generate a server certificate signed by the CA certificate:

3. Enter the following RACF commands to create a key ring and connect the certificates to the key ring:

4. Enter the following RACF command to refresh the DIGTRING and DIGTCERT classes to activate your changes:

5. Enter the following RACF commands to verify your changes:

6. Enter the following RACF commands to allow the ZSS server to use the certificates. Only issue the RDEFINE commands if the profiles do not yet exist.

Note: These sample commands use the FACILTY class to manage certificate related authorizations. You can also use the RDATALIB class, which offers granular control over the authorizations.

7. Enter the following RACF command to export the CA certificate to a dataset so it can be imported by the Zowe server:

Defining the AT-TLS rule

To define the AT-TLS rule, use the sample below to specify values in your AT-TLS Policy Agent Configuration file:

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.

Defining the RACF ZOWE class

If you use RACF security, take the following steps define the ZOWE class to the CDT class:

1. Make sure that the CDT class is active and RACLISTed.
2. In TSO, issue the following command:

    If you receive the following message, ignore it:

3. In TSO, issue the following command to refresh the CDT class:

4. In TSO, issue the following command to activate the ZOWE class:

For more information on RACF security administration, see the IBM Knowledge Center at https://www.ibm.com/support/knowledgecenter/.

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 Dataservice endpoint URL lengths and RBAC

Multi-factor authentication configuration

Multi-factor authentication is an optional feature for Zowe.

As of Zowe version 1.8.0, the Zowe App Framework, Desktop, and all apps present in the SMP/E or convenience builds support out-of-band MFA by entering an MFA assigned token or passcode into password field of the Desktop login screen, or by accessing the app-server `/auth` REST API endpoint.

For a list of compatible MFA products, see Known compatible MFA products.

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.

Zowe is bundled with a few of these plugins:

- **sso-auth**: Uses either ZSS or the API Mediation Layer for authentication, and ZSS for RBAC authorization. This plugin also supports resetting or changing your password via a ZSS API. Whether ZSS or API Mediation Layer or both are used for authentication depends upon SSO settings. Starting with Zowe 1.28.0, SSO is enabled by default such that only API Mediation Layer is called at authentication time. By default, the Mediation Layer calls z/OSMF to answer the authentication request. The session created mirrors the z/OSMF session.

- **trivial-auth**: This plugin is used for development and testing, as it always returns true for any function. It could be used if there were specific services you did not need authentication for, while you wanted authentication elsewhere.

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.

Configuration

When you use the default Zowe SMP/E or convenience build configuration, you do not need to change Zowe to get started with MFA.

To configure Zowe for MFA with a configuration other than the default, take the following steps:

1. Choose an App Server security plugin that is compatible with MFA. The sso-auth plugin is compatible.

2. Locate the App Server's configuration file in `zowe.yaml`.

3. Edit the configuration file to modify the section `components.app-server.dataserviceAuthentication`.

4. Set `defaultAuthentication` to the same category as the plugin of choice, as seen in its pluginDefinition.json file. For example:

   - **sso-auth**: "saf"
   - **trivial-auth**: "fallback"

The following is an example configuration for `sso-auth`, as seen in a default installation of Zowe:

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.

API	Description
/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.
/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.

API	Description
/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.

Configuring Zowe CLI environment variables

This section explains how to configure Zowe CLI using environment variables.

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 CLI plug-ins. When troubleshooting, refer to the logs in the `imperative` and `zowe` folders.

Setting the 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 CLI log levels

You can set the log level to adjust the level of detail that is written to log files:

Important! 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.

Environment Variable	Description	Values	Default
`ZOWE_APP_LOG_LEVEL`	Zowe CLI logging level	Log4JS log levels (OFF, TRACE, DEBUG, INFO, WARN, ERROR, FATAL)	WARN

Environment Variable	Description	Values	Default
`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, 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	Defaul
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>/.` **Examples:** • **Windows:** `%HOMEPATH%\.zo` • **Linux:** `$HOME/.zc`
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`

Configuring the Zowe APIs

Review the security considerations for Zowe APIs and learn how to prevent the Denial of Service (DoS) attacks.

The default configuration before Zowe version 1.14.0 contains **Data sets and Unix files** and **Jobs** API microservices which might be vulnerable to DoS attacks in the form of slow https attacks. You can add additional configuration to the start script of these components in order to prevent resource starvation via slow https attacks.

- To update the configuration of the **Data sets and Unix files** component, modify the `start.sh` script within the runtime component directory `/zowe/runtime/components/files-api/bin` .
- To update the configuration of the **Jobs** component, modify the `start.sh` script within the runtime component directory `/zowe/runtime/components/jobs-api/bin` .

Ensure that the `-Dserver.connection-timeout=8000` parameter is set. This parameter specifies how long the component waits to receive all the required information from the client that makes a request.

See a snippet of a configured `start.sh` script for the Jobs component as follows:

In version 1.14.0 and later, the preceding snippet reflects the default configuration.

Advanced Gateway features configuration

As a system programmer who wants to configure advanced Gateway features of the API Mediation Layer, you can customize Gateway parameters by modifying either of the following files:

- `<Zowe runtime directory>/components/gateway/bin/start-gateway.sh`
- `<Zowe runtime directory>/components/gateway/manifest.yaml`
- `zowe.yaml`

The parameters begin with the `-D` prefix, similar to all the other parameters in the file.

Note: Restart Zowe to apply changes to the parameter.

Follow the procedures in the following sections to customize Gateway parameters according to your preferences:

- Prefer IP Address for API Layer services
- SAF as an Authentication provider
- Enable JWT token refresh endpoint
- Change password with SAF provider
- Gateway retry policy
- Gateway client certificate authentication
- Gateway timeouts
- CORS handling
- Encoded slashes
- Connection limits
- Routed instance header
- Distributed load balancer cache
- Replace or remove catalog with another service
- API Mediation Layer as a standalone component
- SAF resource checking

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.

Follow these steps:

1. Open the `zowe.yaml` configuration file.
2. Find or add the property `components.gateway.apiml.security.auth.provider` and set the value to `saf`.
3. Restart Zowe&trade.

Authentication requests now utilize SAF as the authentication provider. API ML can run without z/OSMF present on the system.

Enable JWT token refresh endpoint

Enable the `/gateway/api/v1/auth/refresh` endpoint to exchange a valid JWT token for a new token with a new expiration date. Call the endpoint with a valid JWT token and trusted client certificate. In case of z/OSMF authentication provider, enable API Mediation Layer for passticket generation and configure z/OSMF APPLID. Configure Passtickets

Follow these steps:

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`.

3. Restart Zowe.

Change password with SAF provider

Update the user password using the SAF Authentication provider. To use this functionality, add the parameter `newPassword` on the login endpoint `/gateway/api/v1/auth/login`. 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. If it is not possible to change the password for any reason, the response code is `401`.

This feature is also available in the API Catalog.

This feature is also available in the API Catalog.

Use a `POST` REST call against the URL `/gateway/api/v1/auth/login`:

Note: It is a common practice to set the limit for changing the password 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 changing the password again.

Example:

`MINCHANGE=120`

where:

* `120`

  Specifies the number of days before the password can be reset

Change password with z/OSMF provider

Update the user password using the z/OSMF Authentication provider. To use this functionality, add the parameter `newPassword` on the login endpoint `/gateway/api/v1/auth/login`. 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. If it is not possible to change the password for any reason, the response code is `401`.

This feature is also available in the API Catalog.

Use a `POST` REST call against the URL `/gateway/api/v1/auth/login`:

Note: In order to use the password change functionality via z/OSMF, it is necessary to install the PTF for APAR PH34912.

Gateway retry policy

To change the Gateway retry policy, edit properties in the `<Zowe install directory>/components/gateway/bin/start.sh` file:

All requests are disabled as the default configuration for retry with one exception: the server retries `GET` requests that finish with status code `503`. To change this default configuration, include the following parameters:

- **ribbon.retryableStatusCodes**

  Provides a list of status codes, for which the server should retry the request.

  Example: `-Dribbon.retryableStatusCodes="503, 404"`

- **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.

- **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`.

- **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`.

Gateway client certificate authentication

Use the following procedure to enable the feature to use a client certificate as the method of authentication for the API Mediation Layer Gateway.

Follow these steps:

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:

    - **components.gateway.apiml.security.x509.externalMapperUrl**

    Note: Skip this step if user mapping is not provided by an external API.

    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`:

    - **components.gateway.apiml.security.x509.externalMapperUser**

    Note: Skip this step if the Zowe runtime userId is not altered from the default `ZWESVUSR`.

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&trade`.

Gateway timeouts

Use the following procedure to change the global timeout value for the API Mediation Layer instance.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.apiml.gateway.timeoutmillis`, and set the value to the desired value.
3. Restart `Zowe&trade`.

If you require finer control, you can edit the `<Zowe install directory>/components/gateway/bin/start.sh`, and modify the following properties:

- **apiml.gateway.timeoutMillis**

  This property defines the global value for http/ws client timeout.

Add the following properties to the file for the API Gateway:

Note: Ribbon configures the client that connects to the routed services.

- **ribbon.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.

- **ribbon.readTimeout**

  Specifies the time in milliseconds 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.

- **ribbon.connectionManagerTimeout**

  The HttpClient employs a special entity to manage access to HTTP connections called by the HTTP connection manager. The purpose of an HTTP connection manager is to serve as a factory for new HTTP connections, to manage the life cycle of persistent connections, and to synchronize access to persistent connections. Internally, the connections that are managed serve as proxies for real connections. `ConnectionManagerTimeout` specifies a period during which managed connections with API ML should be established. The value is in milliseconds. If omitted, the default value specified in the API ML Gateway service configuration is used.

CORS handling

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 prodecure below, API Gateway endpoints start handling CORS requests and 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, it sanitizes defined headers from the communication (upstream and downstream). `Access-Control-Request-Method,Access-Control-Request-Headers,Access-Control-Allow-Origin,Access-Control-Allow-Methods,Access-Control-Allow-Headers,Access-Control-Allow-Credentials,Origin` The resulting request to the service is not a CORS request and the service does not need to do anything extra. The list can be overridden by specifying 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.

Follow these steps:

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&trade`.

Requests through the Gateway now contain a CORS header.

Encoded slashes

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.

Follow these steps:

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&trade`.

Requests with encoded slashes are now rejected by the API Mediation Layer.

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. For more information, see Apache documentation.

Use the following procedure to change the number of concurrent connections.

Follow these steps:

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.
3. Find or add the property `components.gateway.server.maxTotalConnections` and set the value to an appropriate positive integer.

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.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property with value
   `components.gateway.apiml.routing.instanceIdHeader:true`.
3. Restart Zowe.

Distributed load balancer cache

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 reuqired to have the same DN (Distinguished name) on the server certificate.

Use the following procedure to distribute the load balancer cache between instances of the API Gateway.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property with value `components.gateway.apiml.loadBalancer.distribute: true`.
3. Restart Zowe.

Replace or remove the Catalog with another service

By default, the API Mediation Layer contains 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

- `metrics-dashboard`

A possible dashboard that could appear in place of the API Catalog

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.

Follow these steps:

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.

API Mediation Layer as a standalone component

You can start the API Mediation Layer independently of other Zowe components. By default, the Gateway, Zowe System Services, and Virtual Desktop start when Zowe runs. To limit consumed resources when the Virtual Desktop or Zowe System Services are not required, it is possible to specify which components start in the context of Zowe. No change is required during the installation process to support this setup.

Once Zowe is installed, use the following procedure to limit which components start.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property `components.*.enabled` and set this property to `false` for all components that should not be started.
3. Restart `Zowe&trade`.

To learn more about the related section of the environment file, see Creating and configuring the Zowe instance directory. We recommend you open this page in a new tab.

SAF Resource Checking

The API ML can check for the authorization of the user on certain endpoints. Access to a SAF resource is checked with ESM.

Verification of the SAF resource is provided by the following three providers:

- `endpoint`

  This is the highest priority provider, such as a REST endpoint call (ZSS or similar one). This option is disabled by default. In Zowe, ZSS has the API to check for SAF resource authorization.

- `native`

  The Native JZOS classes from Java are used to determine SAF resource access. This is the default provider.

- `dummy`

  This 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.

You can select a specific provider by specifying the `components.gateway.apiml.security.authorization.provider` key in the `zowe.yaml` file. Use the parameter value to strictly define a provider. If verification is disabled, select the `endpoint` option.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property `components.gateway.apiml.security.authorization.provider` and set desired value.
3. Restart `Zowe&trade`.

Examples:

Note: To configure the `endpoint` provider, add the following additional property:
`components.gateway.apiml.security.authorization.endpoint.enabled: true`

To use the endpoint provider, customize the URL corresponding to the SAF resource authorization. By default, the ZSS API is configured and used.

Follow these steps:

1. Open the file `zowe.yaml`.
2. Find or add the property
   `components.gateway.apiml.security.authorization.endpoint.url` and set desired value.
   The default value for ZSS API is
   `https://${ZWE_haInstance_hostname}:${GATEWAY_PORT}/zss/api/v1/saf-auth`
3. Restart `Zowe&trade`.

Checking providers

REST endpoint call

The REST provider calls the external API to retrieve information about access rights. To enable the feature outside of the mainframe, such as when running in Docker, you can use a REST endpoint call using the `GET` method:

- Method: `GET`
- URL: `{base path}/{userId}/{class}/{entity}/{level}`
- Response:

Note: For more information about this REST endpoint call, see [ZSS implementation](#).

Native

The Native provider is the easiest approach to use the SAF resource checking feature on the mainframe.

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 following method described in the IBM documentation: [method](#).

Note: Ensure that the version of Java on your system has the same version of classes and method signatures.

Dummy implementation

The Dummy provider is for testing purpose outside of the mainframe.

Create the file `saf.yml` and locate it in the folder, where is application running or create file `mock-saf.yml` in the test module (root folder). The highest priority is 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:

Notes:

- Classes and resources are mapped into a map, user IDs into a list.
- The load method does not support formatting with dots, 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.

Discovery Service configuration parameters

Zowe runtime configuration parameters

As an application developer who wants to run Zowe, set the following parameters during the Zowe runtime configuration by modifying the `<Zowe install directory>/components/discovery/bin/start.sh` file:

- **API ML configuration**
- **Eureka configuration**

API ML configuration

- **apiml.discovery.userid**

  The Discovery service in HTTP mode protects it's endpoints with basic authentication instead of client certificate. This parameter specifies the userid. The default value is `eureka`.

- **apiml.discovery.password**

  This parameter specifies the password for the basic authentication used by the Discovery Service in HTTP mode. The default value is `password`.

- **apiml.discovery.allPeersUrls**

  This parameter contains the list of URLs of the Discovery Service in case of multiple instances of the service on different host. **Example:**

  Note: Each URL within the list must be separated by a comma.

- **apiml.discovery.staticApiDefinitionsDirectories**

  The static definition directories can be specified as a parameter at startup and will be scanned by the Discovery Service. These directories contains the definitions of static services. **Example:**

- **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 v2, based on Zowe v2 conformance. The value of the `*apiml.discovery.serviceIdPrefixReplacer` parameter is represented as a tuple that contains two strings, separated by a comma. The format of this parameter contains the following two elements:

- First, the prefix that you want to replace in the service ID
- Second, the new prefix that will be replaced

Example: The value of the parameter has the following format:
`oldServiceIdPrefix,newServiceIdPrefix`

Set this parameter in your Zowe YAML configuration (typically `zowe.yaml`) by defining `configs.apiml.discovery.serviceIdPrefixReplacer`. For example, defining it globally:

Or defining it only for lpar1 high availability instance:

Eureka configuration

The Discovery Service contains a configuration for implementing the client-side service discovery and for defining a Eureka Server for service registry. Such configuration is shown below:

- **eureka.client.registerWithEureka** If we make this property as true then while the server starts the inbuilt client will try to register itself with the Eureka server.

- **eureka.client.registerWithEureka** The inbuilt client will try to fetch the Eureka registry if we configure this property as true.

- **eureka.client.serviceUrl.defaultZone** A fallback value that provides the Eureka service URL for any client that does not express a preference (in other words, it is a useful default).

More information about the other Eureka parameters can be found in the Spring Cloud Netflix Eureka documentation.

API Gateway configuration parameters

As an application developer who wants to change the default configuration of the API Mediation Layer, set the following parameters by modifying the `<Zowe install directory>/components/gateway/bin/start.sh` file:

- [Runtime configuration](#)
  - [Environment variables](#)
- [Service configuration](#)
- [Zuul configuration](#)
- [Hystrix configuration](#)
- [AT-TLS](#)

Runtime configuration

This section describes runtime configuration properties.

- **apiml.service.hostname**

  This property is used to set the API Gateway hostname.

- **apiml.service.port**

  This property is used to set the API Gateway port.

- **apiml.service.discoveryServiceUrls**

  This property specifies the Discovery Service URL used by the service to register to Eureka.

- **apiml.service.preferIpAddress**

  Set the value of this property to `true` to advertize a service IP address instead of its hostname.

  Notes:

  - If you set this property to `true` on the Discovery Service, ensure that you modify the value of `discoveryLocations:` to use the IP address instead of the hostname. Failure to modify the

`discoveryLocations:` value prevents Eureka from detecting registered services. As a result, the **available-replicas** is empty.

- Enabling this property may also cause issues with SSL certificates and Subject Alternative Name (SAN).

- **apiml.cache.storage.location**

  This property specifies the location of the EhCache used by Spring.

  Note: It is necessary for the API ML process to have write access to the cache location.

- **apiml.security.ssl.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.

- **apiml.security.auth.zosmfServiceId**

  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 `zosmf`.

- **apiml.zoweManifest**

  This parameter lets you view the Zowe version by using the `/version` endpoint. To view the version requires setting up the launch parameter of the API Gateway – `apiml.zoweManifest` with a path to the Zowe build `manifest.json` file. This file is usually located in the root folder of Zowe build. If the encoding of `manifest.json` file is different from UTF-8 and IBM1047, ensure that you set up the launch parameter of API Gateway – `apiml.zoweManifestEncoding` with correct encoding.

  Note: It is also possible to know the version of API ML and Zowe (if API ML used as part of Zowe), using the `/gateway/api/v1/version` endpoint in the API Gateway service in the following format:

- **apiml.security.auth.tokenProperties.expirationInSeconds**

  This property is relevant only when the JWT is generated by the API Mediation Layer. API ML generation of the JWT occurs in the following cases:

- z/OSMF is only available as an older version which does not support JWT tokens

- 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.

  Note: The default value is 8 hours which mimicks the 8 hour default expiration of the LTPA token in z/OSMF.

  Follow these steps:

  i. Open the file `<Zowe install directory>/components/gateway/bin/start.sh`.
  ii. Find the line that contains `-cp ${ROOT_DIR}"/components/gateway/gateway-service.jar":/usr/include/java_classes/IRRRacf.jar`.
  iii. Before this line, add a new line in the following format:

  where:

  - `{expirationTimeInSeconds}`

  refers to the specific time before expiration

  iv. Restart Zowe&trade.

- **ibm.serversocket.recover**

  In a multiple network stack environment (CINET), when one of the stacks fails, no notification or Java™ exception occurs for a Java program that is listening on an `INADDR_ANY` socket. When new stacks become available, the Java application does not become aware of these stacks until the application rebinds the `INADDR` socket. By default, this parameter is enabled in the API Gateway. As a result, the `NetworkRecycledException` exception is thrown to the application to allow it to either fail or attempt to rebind. For more information, see the IBM documentation.

- **java.io.tmpdir**

  This property is a standard Java system property which is used by the disk-based storage policies. This property determines where the JVM writes temporary files, including those written by these storage policies. The default value is typically `/tmp` on Unix-like platforms.

- **spring.profiles.include**

  This property can be used to unconditionally add active profiles. For more information, see the Spring documentation.

- **server.maxTotalConnections and server.maxConnectionsPerRoute**

  These two properties are used to set the number of concurrent connections. Further connection requests that put the number of connections over either of these limits are queued until an existing connection completes. The API Gateway is built on top of Apache HTTP components that require these two connection limits for concurrent requests. For more information, see Apache documentation.

Environment variables

You can add additional environment variables to store configuration properties for the API Mediation Layer.

Note: Use either dot separation, or the UPPER_CASE naming convention when adding an additional environmental variable.

One use case for adding an environmental variable is to change the 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 this procedure to customize authentication provider.

Follow the steps:

1. Open the file `<Zowe instance directory>/instance.env`.

2. Add a new line with the following property:

   `apiml.security.auth.provider=saf`.

Service configuration

For information about service configuration parameters, see Onboarding a REST API service with the Plain Java Enabler (PJE).

Zuul configuration

As a provider for routing and filtering, the API Gateway contains a Zuul configuration as shown in the following example.

Example:

The Zuul configuration allows the API Gateway to act as a reverse proxy server through which API requests can be routed from clients on the northbound edge to z/OS servers on the southbound edge.

Note: For more information about Zuul configuration parameters, see the Spring Cloud Netflix documentation.

Hystrix configuration

The API Gateway contains a Hystrix configuration as shown in the following example.

Example:

Hystrix is a latency and fault tolerance library designed to isolate points of access to remote systems, services and third-party libraries, stop cascading failure, and enable resilience in complex distributed systems where failure is inevitable.

Note: For more information about Hystrix configuration parameters, see the Netflix – Hystrix documentation.

AT-TLS

The communication server on z/OS provides a functionality to encrypt HTTP communication for on-platform running jobs. This functionality is refered to as Application Transparent Transport Layer Security (AT-TLS). Starting with Zowe version 1.24, it is possible to leverage AT-TLS within the API Mediation Layer. Each API ML component can run with AT-TLS rules applied. Some components, such as the Discovery service, can be made AT-TLS aware by enabling the AT-TLS profile, whereby TLS information can be utilized. Such information could be a client certificate. To enable the AT-TLS profile and disable the TLS application in API ML, update `zowe.yaml` with following values under the respective component in the `components` section:

While API ML can not handle TLS on its own, the Mediation Layer needs information about the server certificate that is defined in the AT-TLS rule. Update the `zowe.yaml` file for each respective APIML component in the `components` sections with the path to the SAF Key ring from the AT-TLS rule and specify the alias that is used for Inbound communication:

Note: This procedure does not configure AT-TLS on z/OS, but rather enables API ML to work with AT-TLS in place.

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:

- Extend Zowe CLI
- Extend Zowe API Mediation Layer
    - Dynamic API registration
    - Static API registration
- Add a plug-in to the Zowe Desktop
- Extend Zowe Explorer

To help Zowe extenders better understand how extensions are developed and deployed, we provide a set of sample extensions. 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.

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 z/OS, 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 API Mediation Layer

Zowe API Mediation Layer extenders can build and onboard additional API services to the API ML microservices ecosystem. REST APIs can register with the API Mediation Layer, which makes them available in the API Catalog and for routing through the API Gateway.

To register a z/OS service with the API Mediation Layer, there are two approaches:

- Dynamic API registration
- Static API registration

For information about how to onboard REST APIs, see the Onboarding Overview.

To streamline the process of onboarding new REST API services to the API Mediation Layer, see Onboarding a REST API service with the YAML Wizard

Dynamic API registration

Registration of a REST API service to the API ML is performed through a call to the Discovery Service by sending registration data and metadata for the service being registered. Registration requires that the z/OS service must know the web address of the API ML Discovery Service. When Dynamic registration is performed, the service that performs the registration must periodically send heartbeat requests to the Discovery Service for each registered service instance. These heartbeat requests serve to renew the corresponding service instance registration with API ML. These requests enable the Discovery Service to monitor the availability of registered service instances. Services that are registered dynamically display the status of the service in the API Catalog after initial service registration.

For more information about how to build a service which is able to register, see the Onboarding Overview.

Static API registration

For services that cannot be modified to be dynamically discoverable, it is possible onboard them to the API ML by providing the API ML a static definition file with API service details. This registration method does not require modifications to the existing API service code. For more information, see Onboard a REST API without code changes required. Unlike services that use Dynamic API registration, the status of services onboarded through Static API registration is not displayed in the API Catalog.

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.

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.

Sample extensions

Sample Zowe API and API Catalog extension

The repository https://github.com/zowe/sample-node-api contains a sample Zowe extension with a node server providing sample APIs for looking at cars in a dealership. For more information, see sample-node-api.

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.

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, for example, `jobs-api-package-1.0.4.zip`, 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.

- `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 and 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.

Zowe component manifest

Zowe extensions, as well as core components, can use a manifest file to describe itself. Check Server Component Manifest File Reference for details.

Sample manifests

For examples of manifests thoughout Zowe GitHub repositories, see the following links:

- API Catalog manifest.yaml
- Jobs API manifest.yaml
- Sample Node API and API Catalog extension manifest.yaml
- Sample Zowe App Framework extension manifest.yaml

Server component schemas

Starting with Zowe v2.0, 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.

Install Zowe server component

Learn how to install Zowe server components or extensions by using `zwe components install` commands or manually.

Install component

Zowe ships `zwe components install` command to help end-user to install any Zowe server components (extensions). Zowe core components are also installed with this command. In order to be compatible with the command, components must follow Zowe server component package format standard.

Important this command will also enable the component globally by updating your `zowe.yaml` configuration file. You can pass `--skip-enable` to disable this behavior.

Execute the command from z/OS USS. Use the following command line parameters:

- `--component-file|--component|-o`

  (String, Required) Defines the path to the component package or directory.

- `--config|-c`

  (String, Required) Defines the path to the Zowe YAML configuration. `zwe components install` relies on the `zowe.extensionDirectory` definition to know where the component will be installed.

-- `--skip-enable`

(Boolean, Optional) Tells the command do not enable the component by updating `zowe.yaml` configuration file.

- `--auto-encoding|-e`

  (String, Optional) Defines whether to automatically tag the encoding of the files that are shipped with the component. The default value is `auto`, which indicates that the script determines whether the automatic tagging is needed or not.

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.

Examples:

The following command installs the `my-zowe-component-1.2.3.pax` into `/global/zowe/extensions` which is defined as `zowe.extensionDirectory` in `/path/to/my/zowe.yaml`.

Enable and disable component

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.

Execute these commands from z/OS USS. Use the following command line parameters:

- `--component|-o`

  (String, Required) Defines the component name should be enabled or disabled.

- `--config|-c`

  (String, Required) Defines the path to the Zowe YAML configuration. `zwe components install` relies on the `zowe.extensionDirectory` definition to know where the component will be installed.

- `--ha-instance|-i`

  (String, Optional) Defines the Zowe high availability instance ID of where the component will be enabled or disabled. If this argument is not passed, the component will be enabled/disabled globally from `components.<component>.enabled`. If this argument has a value, only specified HA instance will be changed, which is `haInstances.<ha-instance>.components.<component>.enabled`.

- `--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.

Examples:

The following command enables `my-zowe-component`.

The following command will disable `my-zowe-component` on HA instance `lpar1`. The configuration logs write to `/var/zowe/logs`.

Install and configure manually

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.

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.

Creating and adding Zowe extension containers

Zowe extensions such as services and plug-ins that use Zowe component packaging 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. You can follow Zowe's container conformance criteria to understand and achieve compatibility.

Note: Missing z/OS dependencies must be checked before creating and adding Zowe extension containers.

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,

- `jobs-api` is a component which has built-in web service. To build the images, this component defines a Dockerfile at https://github.com/zowe/jobs/blob/v2.x/master/container/Dockerfile and defines a GitHub Actions workflow at https://github.com/zowe/jobs/blob/v2.x/master/.github/workflows/jobs-api-images.yml.
- `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. Similar to `jobs-api`, 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.

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).

Developing for Zowe CLI

You can extend Zowe™ CLI by developing plug-ins and contributing code to the base Zowe CLI or existing plug-ins.

How to contribute

You can contribute to Zowe CLI in the following ways:

- Add new commands, options, or other improvements to the base CLI.
- Develop a plug-in that users can install to Zowe CLI.

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 (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. The zowe-cli-sample-plugin GitHub repository is a sample plug-in that adheres to the guidelines for contributing to Zowe CLI projects.

Tutorials

Follow these tutorials to get started working with the sample plug-in:

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 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.

Plug-in development overview

At a high level, a plug-in must have `imperative-framework` configuration [(sample here)](). This configuration is discovered by `imperative-framework` through the [package.json]() `imperative` key.

A Zowe CLI plug-in will minimally contain 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.

The following guidelines and documentation will assist you during development:

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!

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]()

For more information about …	See:
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

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

To create your development space, clone and build zowe-cli-sample-plugin from source.

Before you clone the repository, create a local development folder named `zowe-tutorial`. You will clone and build all projects in this folder.

Branches

There are two branches in the repository that correspond to different Zowe CLI versions. You can develop two branches of your plug-in so that users can install your plug-in into `@latest` or `@zowe-v2-lts` CLI. Developing for both versions will let you take advantage of new core features quickly and expose your plug-in to a wider range of users.

The `master` branch of Sample Plug-in is compatible with the `@zowe-v2-lts` version of core CLI (Zowe LTS release).

The `master` branch of Sample Plug-in is also compatible with the `@latest` version of core CLI (Zowe Active Development release) at this time.

For more information about the versioning scheme, see Maintainer Versioning in the Zowe CLI repository.

Clone zowe-cli-sample-plugin and build from source

Clone the repository into your development folder to match the following structure:

Follow these steps:

1. `cd` to your `zowe-tutorial` folder.
2. `git clone https://github.com/zowe/zowe-cli-sample-plugin`
3. `cd` to your `zowe-cli-sample-plugin` folder.
4. `git checkout master`
5. `npm install`
6. `npm run build`

(Optional) Run the automated tests

We recommend running automated tests on all code changes. Follow these steps:

1. `cd` to the `__tests__/__resources__/properties` folder.
2. Copy `example_properties.yaml` to `custom_properties.yaml`.
3. Edit the properties within `custom_properties.yaml` to contain valid system information for your site.
4. `cd` to your `zowe-cli-sample-plugin` folder
5. `npm run 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

Before you begin, set up your local environment to install a plug-in.

Overview

This tutorial covers installing and running this bundled Zowe™ CLI plugin as-is (without modification), which will display your current directory contents.

The plug-in adds a command to the CLI that lists the contents of a directory on your computer.

Installing the sample plug-in to Zowe CLI

To begin, `cd` into your `zowe-tutorial` folder.

Issue the following commands to install the sample plug-in to Zowe CLI:

`zowe plugins install ./zowe-cli-sample-plugin`

Viewing the installed plug-in

Issue `zowe --help` in the command line to return information for the installed `zowe-cli-sample` command group:

Using the installed plug-in

To use the plug-in functionality, issue: `zowe zowe-cli-sample list directory-contents`:

Testing the installed plug-in

To run automated tests against the plug-in, `cd` into your `zowe-tutorial/zowe-cli-sample-plugin` folder.

Issue the following command:

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.

Extending a plug-in

Before you begin, be sure to complete the [Installing the sample plug-in](#) tutorial.

Overview

This tutorial demonstrates how to extend the plug-in that is bundled with this sample by:

1. Creating a Typescript interface for the Typicode response data
2. Creating a programmatic API
3. Creating a command definition
4. Creating a command handler

We'll do this by using `@zowe/imperative` infrastructure to surface REST API data on our Zowe™ CLI plug-in.

Specifically, we're going to show data from [this URI](#) by [Typicode](#). Typicode serves sample REST JSON data for testing purposes.

At the end of this tutorial, you will be able to use a new command from the Zowe CLI interface: `zowe zowe-cli-sample list typicode-todos`

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, we'll create a Typescript interface to map the response data from a server.

Within `zowe-cli-sample-plugin/src/api`, create a folder named `doc` to contain our interface (sometimes referred to as a "document" or "doc"). Within the doc folder, create a file named `ITodo.ts`.

The `ITodo.ts` file will contain the following:

Creating a programmatic API

Next, we'll create a Node.js API that our command handler uses. This API can also be used in any Node.js application, because these Node.js APIs make use of REST APIs, Node.js APIs, other NPM packages, or custom logic to provide higher level functions than are served by any single API.

Adjacent to the existing file named `zowe-cli-sample-plugin/src/api/Files.ts`, create a file `Typicode.ts`.

`Typicode.ts` should contain the following:

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 interface and programmatic API for other Node.js applications

Update zowe-cli-sample-plugin/src/index.ts to contain the following:

A sample invocation of your API might look similar to the following, if it were used by a separate, standalone Node.js application:

Checkpoint one

Issue `npm run build` to verify a clean compilation and confirm that no lint errors are present. At this point in this tutorial, you have a programmatic API that will be used by your handler or another Node.js application. Next you'll define the command syntax for the command that will use your programmatic Node.js APIs.

Creating a command definition

Within Zowe CLI, the full command that we want to create is `zowe zowe-cli-sample list typicode-todos`. Navigate to `zowe-cli-sample-plugin/src/cli/list` and create a folder `typicode-todos`. Within this folder, create `TypicodeTodos.definition.ts`. Its content should be as follows:

This describes the syntax of your command.

Defining command to list group

Within the file `zowe-cli-sample-plugin/src/cli/list/List.definition.ts`, add the following code below other `import` statements near the top of the file:

Then add `TypicodeTodosDefinition` to the children array. For example:

Creating a command handler

Also within the `typicode-todos` folder, create `TypicodeTodos.handler.ts`. Add the following code to the new file:

The `if` statement checks if a user provides an `--id` flag. If yes, we call `getTodo`. Otherwise, we call `getTodos`. If the Typicode API throws an error, the `@zowe/imperative` infrastructure will automatically surface this.

Checkpoint two

Issue `npm run build` to verify a clean compilation and confirm that no lint errors are present. You now have a handler, definition, and your command has been defined to the `list` group of the command.

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:

```
$ zowe zowe-cli-sample list typicode-todos --id 4
userId:     1
id:         4
title:      et porro tempora
completed:  true
```

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 plugin, 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.

Developing a new plug-in

Before you begin this tutorial, complete the [Extending an existing plug-in](#) tutorial.

Overview

This tutorial demonstrates how to create a brand new Zowe™ CLI plug-in that uses Zowe CLI Node.js programmatic APIs.

At the end of this tutorial, you will have created a data set diff utility plug-in for Zowe CLI, from which you can pipe your plugin's output to a third-party utility for a side-by-side diff of data set member contents.

Completed source for this tutorial can be found on the `develop-a-plugin` branch of the zowe-cli-sample-plugin repository.

Cloning the sample plug-in source

Clone the sample repo, delete the irrelevant source, and create a brand new plug-in. Follow these steps:

1. `cd` into your `zowe-tutorial` folder
2. `git clone https://github.com/zowe/zowe-cli-sample-plugin files-util`
3. `cd files-util`
4. Delete the `.git` (hidden) folder.
5. Delete all content within the `src/api`, `src/cli`, and `docs` folders.
6. Delete all content within the `__tests__/__system__/api`, `__tests__/__system__/cli`, `__tests__/api`, and `__tests__/cli` folders
7. `git init`
8. `git add .`
9. `git commit -m "initial"`

Changing package.json

Use a unique `npm` name for your plugin. Change `package.json` name field as follows:

Issue the command `npm install` against the local repository.

Adjusting Imperative CLI Framework configuration

Change `imperative.ts` to contain the following:

Here we adjusted the description and other fields in the `imperative` JSON configuration to be relevant to this plug-in.

Adding third-party packages

We'll use the following packages to create a programmatic API:

- `npm install --save diff`
- `npm install -D @types/diff`

Creating a Node.js programmatic API

In `files-util/src/api`, create a file named `DataSetDiff.ts`. The content of `DataSetDiff.ts` should be the following:

Exporting your API

In `files-util/src`, change `index.ts` to contain the following:

Checkpoint

At this point, you should be able to rebuild the plug-in without errors via `npm run build`. You included third party dependencies, created a programmatic API, and customized this new plug-in project. Next, you'll define the command to invoke your programmatic API.

Defining commands

In `files-util/src/cli`, create a folder named `diff`. Within the `diff` folder, create a file `Diff.definition.ts`. Its content should be as follows:

Also within the `diff` folder, create a folder named `data-sets`. Within the `data-sets` folder create `DataSets.definition.ts` and `DataSets.handler.ts`.

`DataSets.definition.ts` should contain:

`DataSets.handler.ts` should contain the following:

Trying your command

Be sure to build your plug-in via `npm run build`.

Install your plug-in into Zowe CLI via `zowe plugins install`.

Issue the following command. Replace the data set names with valid mainframe data set names on your system:

```
$ zowe files-util diff data-sets "_____.cntl(iefbr14)" ":_____.cntl(iefbr15)" | diff2html -i stdin
```

The raw diff output is displayed as a command response:

Bringing together new tools!

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.

diff2html is a free tool to generate HTML side-by-side diffs to help see actual differences in diff output.

Install the `diff2html` CLI via `npm install -g diff2html-cli`. Then, pipe your Zowe CL plugin's output into `diff2html` to generate diff HTML and launch a web browser that contains the content in the screen shot at the top of this file.

- `zowe files-util diff data-sets "IBMUSER.work.jcl(iefbr14)" "IBMUSER.work.jcl(iefbr15)" | diff2html -i stdin`

Next steps

Try the Implementing profiles in a plug-in tutorial to learn about using profiles with your plug-in.

Implementing profiles in a plug-in

You can use this profile template to create a profile for your product.

The profile definition is placed in the `imperative.ts` file.

The `type: "someproduct"` property represents the profile name that you might require on various commands to have credentials loaded from a secure credential manager and retain the host/port information, so that you can easily swap to different servers from the CLI.

By default, if your plug-in that is installed into Zowe™ CLI contains a profile definition that is similar to the following example, a profile template is added automatically to team config JSON when you run the `zowe config init` command. Any properties for which `includeInTemplate` is true are included in the template. Additionally, commands that manage V1 profiles are created automatically under `zowe profiles`. For example, `create`, `validate`, `set-default`, `list`, and so on.

Next steps

If you completed all previous tutorials, you now understand the basics of extending and developing plug-ins for Zowe CLI. Next, we recommend reviewing the project contribution guidelines and Imperative CLI Framework documentation to learn more.

Onboarding Overview

As an API developer, you can onboard a REST API service to the Zowe™ API Mediation Layer (API ML). Onboarding your REST service to the Zowe™ API Mediation Layer will make your service discoverable by the API ML Discovery Service, enable routing through the API Gateway, and make service information and API documentation available through the API Catalog.

The specific method you use to onboard a REST API to the 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 Mediation Layer, 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 the API ML
- Verify successful onboarding to the API ML
- Using the Sample REST API Service to learn how to onboard a REST service to the API ML

Prerequisites

Meet the following prerequisites before you onboard your service:

- 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 API Mediation Layer security setup 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 the API Mediation Layer natively by updating the service code. Use one of the following guides to onboard your REST service to the Zowe API Mediation Layer:

Recommended guides for services using Java

- Onboard a REST 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

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

For legacy enabler documentation (version 1.2 and lower), refer to the previous version of the documentation:

- Zowe Docs version 1.8.x

Note: 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 the Zowe API Medaition Layer.

Verify successful onboarding to the API ML

Verifying that your service was successfully onboraded to the 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.

Follow these steps:

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.

Follow these steps:

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 http://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 the 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:
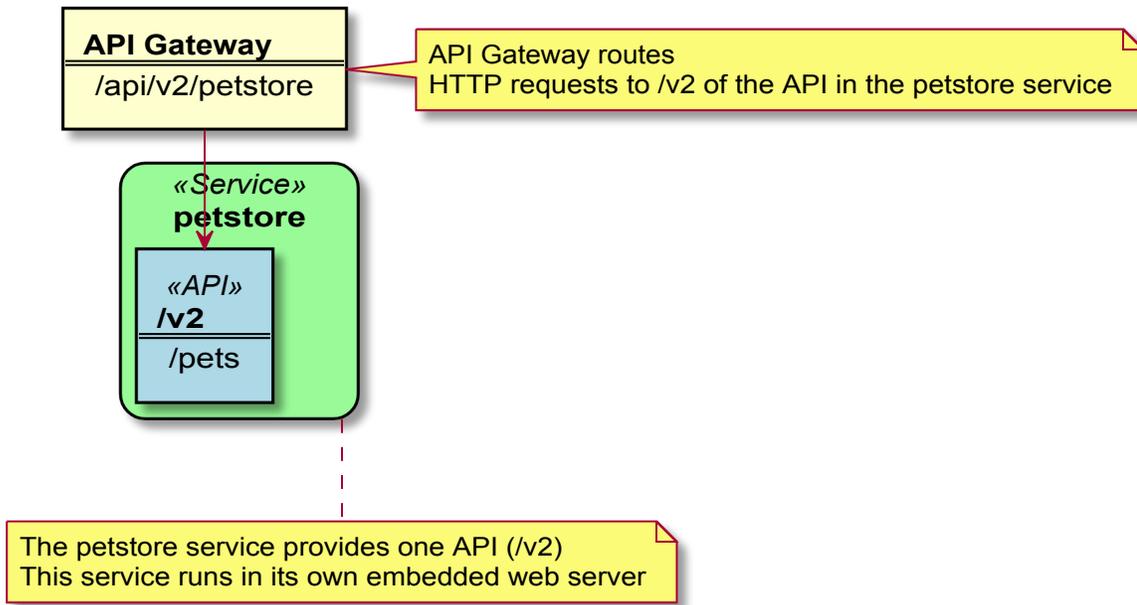
This sample service provides a Swagger document in JSON format at the following URL:

The Swagger document is used by the API Catalog to display API documentation.

Onboarding a REST API service with the Plain Java Enabler (PJE)

This article is part of a series of onboarding guides, which outline the process of onboarding REST API services to the Zowe API Mediation Layer (API ML). As a service developer, you can onboard a REST service with the API ML with the Zowe API Mediation Layer using our Plain Java Enabler (PJE). This enabler is built without a dependency on Spring Cloud, Spring Boot, or SpringFramework.

Tip: For more information about onboarding API services with the 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
- Zuul – reverse proxy / API Gateway
- Ribbon – load balancer

The API ML Discovery Service component uses Netflix/Eureka as a REST 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 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: For more information about how to utilize another API ML enablers, see the documentation in the Onboarding Overview.

Onboarding your REST service with API ML

The following steps outline the overall process to onboard a REST service with the API ML using the PJE. Each step is described in further detail in this article.

1. Prerequisites

2. Configuring your project

   - Gradle build automation system
   - Maven build automation system

3. Configuring your service

   - REST service identification
   - Administrative endpoints
   - API info
   - API routing information
   - API Catalog information
   - Authentication parameters
   - API Security
   - SAF Keyring configuration
   - Eureka Discovery Service

4. Registering your service with API ML

5. (Optional) Validating the discoverability of your API service by the Discovery Service

6. (Optional) Troubleshooting

   - Log messages during registration problems

Prerequisites

Ensure that the prerequisites from the Onboarding Overview are met.

- The REST 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

Notes:

- This documentation is valid for API ML version `ZoweApimlVersion 1.3.0` and higher. We recommend that you check the [Zowe Artifactory](#) for latest stable versions.

- Following this guide enables REST 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

Use the following 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 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`:

The published artifact from the Zowe Artifactory also contains the enabler dependencies from other software packages. If you are using an artifactory other than Zowe, add also the following dependencies in your service `build.gradle` script:

Notes:

- You may need to add more dependencies as required by your service implementation.
- The information provided in this file is valid for `ZoweApimlVersion 1.3.0` and higher.

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

Use the following procedure if you 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:

3. In the directory of your project, run the `mvn clean package` command to build the project.

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.

Example:

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:

- REST service identification
- Administrative endpoints
- API info
- API routing information
- API catalog information
- Authentication parameters
- API security
- SAF Keyring configuration
- Eureka Discovery Service
- Custom Metadata
- Connection Timeout

REST 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**

  This parameter 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**

  This parameter is 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**

  This parameter 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)

  This parameter 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

The following snippet presents the format of the administrative endpoint properties:

where:

- **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

REST services can provide multiple APIs. Add API info parameters for each API that your service wants to expose on the API ML.

The following snippet presents the information properties of a single API:

where:

- **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.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`.

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 REST API service. A single route can be used to direct REST 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.

The following snippet is an example of the API routing information properties.

Example:

where:

- **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 REST 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 code block is an example of configuration of a service tile in the Catalog:

Example:

where:

- **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**

  is 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. For more information, see Authentication Parameters for Onboarding REST API Services.

API Security

REST services onboarded with the API ML act as both a client and a server. When communicating to API ML Discovery service, a REST service acts as a client. When the API ML Gateway is routing requests to a service, the REST 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.

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**

  This parameter 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**

  This parameter specifies the `alias` used to address the private key in the keystore.

- **keyPassword**

  This parameter specifies the password associated with the private key.

- **keyStore**

  This parameter 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**

  This parameter specifies the password used to unlock the keystore.

- **keyStoreType**

  This parameter specifies the type of the keystore.

- **trustStore**

  This parameter 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**

  This parameter specifies the password used to unlock the truststore.

- **trustStoreType: PKCS12**

  This parameter 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:

where:

- **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:

The following code block is 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:

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:

The Logback framework provides a filter tool, DuplicateMessageFilter.

Add the following code to your configuration file if you use XML configuration:

Note: For more information, see the full configuration used in the Core Services in GitHub.

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. As a service developer, you can provide basic configuration of a service to onboard to the API ML. You can also 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.

Note: For more information about specific configuration parameters and their possible values, and the service registration process, see the specific documentation of the onboarding approach you are using for your project:

- Direct REST call registration (No enabler)

- Plain Java Enabler

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, it will not match every possible production environment and its corresponding requirements.

- **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:

Where the two parameters corresponding to the location of the configuration files are:

- `apiml.config.location`

  This 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 the API Mediation Layer

Ensure that you successfully onboarded a service with the API Mediation Layer.

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.

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:

Onboarding a service with the Zowe API Meditation Layer without an onboarding enabler

This article is part of a series of guides to onboard a REST service with the Zowe API Mediation Layer (API ML). Onboarding with API ML makes services accessible through the API Gateway and visible in the API Catalog. Once a service is successfully onboarded, users can see if the service is currently available and accepting requests.

This guide describes how a REST service can be onboarded with the Zowe API ML independent of the language used to write the service. As such, this guide does not describe how to onboard a service with a specific enabler. Similarly, various Eureka client implementations are not used in this onboarding method.

Tip: If possible, we recommend that you onboard your service using the API ML enabler libraries. The approach described in this article should only be used if other methods to onboard your service are not suitable.

For more information about how to onboard a REST service, see the following links:

- API ML onboarding overview
- python-eureka-client
- eureka-js-client
- Rest API developed based on Java

This article outlines a process to make an API service available in the API Mediation Layer by making a direct call to the Eureka Discovery Service.

- Introduction
- Registering with the Discovery Service
    - API Mediation Layer Service onboarding metadata
        - Catalog parameters
        - Service parameters
        - Routing parameters
        - API Info Parameters
- Sending a heartbeat to API Mediation Layer Discovery Service

Introduction

The API ML Discovery Service uses [Netflix/Eureka](#) as a REST services registry. Eureka is a REST-based service that is primarily used to locate services.

Eureka [endpoints](#) are used to register a service with the API ML Discovery Service. Endpoints are also used to send a periodic heartbeat to the Discovery Service to indicate that the onboarded service is available.

Note: Required parameters should be defined and sent at registration time.

Registering with the Discovery Service

Begin the onboarding process by registering your service with the API ML Discovery Service.

Use the `POST` Http call to the Eureka server together with the registration configuration in the following format:

The following code block shows the format of the parameters in your `POST` call, which are sent to the Eureka registry at the time of registration.

where:

- **app**

  uniquely identifies one or more instances of a microservice in the API ML.

  The API ML Gateway uses the `serviceId` for routing to the API service instances. As such, the `serviceId` is part of the service URL path in the API ML Gateway address space.

  Important! Ensure that the service ID is set properly with the following considerations:

    - The service ID value contains only lowercase alphanumeric characters.

    - The service ID does not contain more than 40 characters.

- The same service ID is only set for multiple API service instances to support API scalability. When two API services use the same service ID, the API Gateway considers the services as clones of each other. An incoming API request can be routed to either instance through load balancing.

  Example:

- If the `serviceId` is `sampleservice`, the service URL in the API ML Gateway address space appears as:

- **ipAddr**

  specifies the IP address of this specific service instance.

- **port**

  specifies the port of the instance when you use Http. For Http, set `enabled` to `true`.

- **securePort**

  specifies the port of the instance for when you use Https. For Https, set `enabled` to `true`.

- **hostname**

  specifies the hostname of the instance.

- **vipAddress**

  specifies the `serviceId` when you use Http.

  Important! Ensure that the value of `vipAddress` is the same as the value of `app`. Furthermore, be sure not to omit `vipAddress`, even if you provided `secureVipAddress`. Due to a current limitation in Spring Cloud Netflix, routes are created only for instances in which `vipAddress` is defined.

- **secureVipAddress**

  specifies the `serviceId` when you use Https.

  Important! Ensure that the value of `secureVipAddress` is the same as the value of `app`.

- **instanceId**

specifies a unique id for the instance. Define a unique value for the `instanceId` in the following format:

`{hostname}:{serviceId}:{port}`

- **metadata**

  specifies the set of parameters described in the following section addressing API ML service metadata.

API Mediation Layer Service onboarding metadata

At registration time, provide metadata in the following format. Metadata parameters contained in this code block are described in the following section.

Metadata parameters are broken down into the following categories:

- Catalog parameters
- Service parameters
- Routing parameters
- Authentication parameters
- API Info parameters

Catalog parameters

Catalog parameters are grouped under the prefix: `apiml.catalog.tile`.

The API ML Catalog displays information about services registered with the API ML Discovery Service. Information displayed in the Catalog is defined in the metadata provided by your service during registration. The Catalog groups correlated services in the same tile when these services are configured with the same `catalog.tile.id` metadata parameter.

The following parameters are used to populate the API Catalog:

- **apiml.catalog.tile.id**

  This parameter specifies the specific 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 identifier represents a single API dashboard tile in the Catalog.

Important! 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.

- **apiml.catalog.tile.title**

  This parameter specifies the title of the API services product family. This value is displayed in the API Catalog dashboard as the tile title.

- **apiml.catalog.tile.description**

  This parameter is the detailed description of the API services product family. This value is displayed in the API Catalog UI dashboard as the tile description.

- **apiml.catalog.tile.version**

  This parameter 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.

Service parameters

Service parameters are grouped under the prefix: `apiml.service`

The following parameters define service information for the API Catalog:

- **apiml.service.title**

  This parameter 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.

- **apiml.service.description**

  This parameter specifies a short description of the API service.

  This value is displayed in the API Catalog when a specific API service instance is selected.

- **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 `false` is the recommended setting.

Change this setting to `true` only if you expect 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 info see Installing the Zowe runtime on z/OS.

- **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.

- **apiml.readTimeout**

  The value in milliseconds that specifies maximum 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.

- **apiml.connectionManagerTimeout**

  HttpClient employs a special entity to manage access to HTTP connections called by HTTP connection manager. The purpose of an HTTP connection manager is to serve as a factory for new HTTP connections, to manage the life cycle of persistent connections, and to synchronize access to persistent connections. Internally, an 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 should be established. The value is in milliseconds. If omitted, the default value specified in the API ML Gateway service configuration is used.

- **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.

- **apiml.service.corsEnabled**

  When this parameter is set to `true`, CORS is enabled on the service level for all service routes. The same parameter can also be set on the service level, by providing the parameter as `customMetadata`

as shown in the Custom Metadata.

- **apiml.response.compress**

  When this parameter is set to `true`, API ML compresses content for all responses from these services using GZIP. API ML also adds the `Content-Encoding` header with the value `gzip` to responses.

- **customMetadata.apiml.response.compressRoutes**

  When the `customMetadata.apiml.response.compress` parameter is set to `true`, this parameter allows the 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 require specification, 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

Routing parameters

Routing parameters are grouped under the prefix: `apiml.routes`

The API routing group provides necessary routing information used by the API ML Gateway when routing incoming requests to the corresponding service. A single route can be used to make direct REST 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.

Routing information consists of two parameters per route:

- `gatewayUrl`

- `serviceUrl`

These two parameters together specify a rule of how the API service endpoints are mapped to the API Gateway endpoints.

The following snippet is an example of the API routing information properties.

Example:

where:

- **apiml.routes.{route-prefix}.gatewayUrl**

  The `gatewayUrl` parameter specifies the portion of the gateway URL which is replaced by the `serviceUrl` path.

- **apiml.routes.{route-prefix}.serviceUrl**

  The `serviceUrl` parameter provides a portion of the service instance URL path which replaces the `gatewayUrl` part.

Note: The routes configuration used for a direct REST call to register a service must also contain a prefix before the `gatewayUrl` and `serviceUrl`. This prefix is used to differentiate the routes. This prefix must be provided manually when *XML* configuration is used.

For more information about API ML routing, see API Gateway Routing.

Authentication parameters

Authentication parameters are grouped under the prefix: `apiml.authentication`. When unspecified, the default values are used.

This parameter enables a service to accept the Zowe JWT token. The API Gateway translates the token to an authentication method supported by a service.

The following parameters define the service authentication method:

- **apiml.authentication.scheme**

  This parameter specifies a service authentication scheme. The following schemes are supported by the API Gateway:

- **bypass**

  This value specifies that the token is passed unchanged to the service.

  Note: This is the default scheme when no authentication parameters are specified.

- **zoweJwt**

  This value specifies that a service accepts the Zowe JWT token. No additional processing is done by the API Gateway.

- **httpBasicPassTicket**

  This value 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 `apiml.authentication.applid` parameter.

  Tip: For more information, see Enabling PassTicket creation for API Services that Accept PassTickets.

- **zosmf**

  This value 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.

- **safIdt**

  This value specifies that the application recognizes the SAF IDT scheme and fills the `X-SAF-Token` header with the token produced by the Saf IDT provider implementation. For more information, see SAF IDT provider.

- **x509**

  This value specifies that a service accepts client certificates forwarded in the HTTP header. The Gateway service extracts information from a valid client certificate. For validation, the certificate needs to be trusted by API Mediation Layer, and needs to contain a Client Authentication

(1.3.6.1.5.5.7.3.2) entry in Extended Key Usage. To use this scheme, it is also necessary to specify which headers to include. Specify these parameters in `headers`.

- **zosmf**

  This value 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.

- **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 the client certificate base64 encoded

  - `X-Certificate-DistinguishedName`

    The distinguished name the from client certificate

  - `X-Certificate-CommonName`

    The common name from the client certificate

- **apiml.authentication.applid**

  This parameter specifies a service APPLID. This parameter is valid only for the `httpBasicPassTicket` authentication scheme.

API Info parameters

API Info parameters are grouped under the prefix: `apiml.apiInfo`.

REST services can provide multiple APIs. Add API info parameters for each API that your service wants to expose on the API ML. These parameters provide information for API (Swagger) documentation that is displayed in the API Catalog.

The following parameters provide the information properties of a single API:

- **apiml.apiInfo.{api-index}.apiId**

  The API ID uniquely identifies the API in the API ML. Multiple services can provide the same API. 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.

- **apiml.apiInfo.{api-index}.version**

  This parameter specifies the API version. This parameter is used to correctly retrieve the API documentation according to the requested version of the API.

- **apiml.apiInfo.{api-index}.gatewayUrl**

  This parameter 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 for the routes, which belong to this API.

- **apiml.apiInfo.{api-index}.swaggerUrl**

  (Optional) This parameter specifies the Http or Https address where the Swagger JSON document is available.

- **apiml.apiInfo.{api-index}.documentationUrl**

  (Optional) This parameter specifies the link to the external documentation. A link to the external documentation can be included along with the Swagger documentation.

- **apiml.apiInfo.{api-index}.defaultApi**

  (Optional) This parameter specifies if the API is the default one shown in the API Catalog. If no API has this parameter set to `true`, or multiple APIs have it set to `true`, then the default API becomes the API with the highest major version seen in `apiml.apiInfo.{api-index}.version`.

Note: The `{api-index}` is used to differentiate the service APIs. This index must be provided manually when *XML* configuration is used. In the following example, `0` represents the `api-index`.

Sending a heartbeat to API Mediation Layer Discovery Service

After registration, a service must send a heartbeat periodically to the Discovery Service to indicate that the service is available. When the Discovery Service does not receive a heartbeat, the service instance is deleted from the Discovery Service.

If the server does not receive a renewal in 90 seconds, it removes the instance from its registry.

Note: We recommend that the interval for the heartbeat is no more than 30 seconds.

Use the Http `PUT` method in the following format to tell the Discovery Service that your service is available:

```
https://{eureka_hostname}:{eureka_port}/eureka/apps/{serviceId}/{instanceId}
```

Validating successful onboarding with the API Mediation Layer

Ensure that you successfully onboarded a service with the API Mediation Layer.

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.

External Resources

- https://blog.asarkar.org/technical/netflix-eureka/
- https://medium.com/@fahimfarookme/the-mystery-of-eureka-health-monitoring-5305e3beb6e9
- https://github.com/Netflix/eureka/wiki/Eureka-REST-operations

Onboarding a Spring Boot based REST API Service

This guide is part of a series of guides to onboard a REST API service with the Zowe API Mediation Layer. As an API developer, you can 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:

- Onboard a REST API service with the Plain Java Enabler (PJE)
- Onboard a REST service directly calling eureka with xml configuration
- Onboard an existing REST API service without code changes

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.

1. Selecting a Spring Boot Enabler

2. Configuring your project

   - Gradle build automation system
   - Maven build automation system

3. 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

Selecting a Spring Boot Enabler

Add a dependency on the Spring Enabler version to your project build configuration that corresponds to the Spring Boot version that you use for the whole project:

- onboarding-enabler-spring-v1
- onboarding-enabler-spring-v2

Note: The process of onboarding an API service is the same for both Spring Boot enabler versions.

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

Use the following 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.

   ○ For Zowe APIML versions greater than 1.23.5 use the following artifact:

   ○ For Zowe APIML version 1.23.5 use the following artifact:

   ○ For Zowe APIML versions 1.22.3, 1.22.4, and 1.23.0 - 1.23.4 use the following artifact:

   ○ For Zowe APIML versions 1.21.6 - 1.21.13 and 1.22.0 - 1.22.2 use the following artifact:

   ○ For Zowe APIML versions earlier than 1.21.6 that use Spring 2.1.1 use the following artifact:

   ○ For Zowe APIML versions earlier than 1.21.6 that use Spring 1.5.9 use the following artifact:

   Notes:

   ○ You may need to add additional dependencies as required by your service implementation.
   ○ The information provided in this file is valid for `ZoweApimlVersion 1.3.0` and above.

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

Use the following procedure if you 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

   - For Zowe APIML versions greater than 1.23.5 use the following artifact:

   - For Zowe APIML version 1.23.5 use the following artifact:

   - For Zowe APIML versions 1.22.3, 1.22.4, and 1.23.0 - 1.23.4 use the following artifact:

   - For Zowe APIML versions 1.21.6 - 1.21.13 and 1.22.0 - 1.22.2 use the following artifact:

   - For Zowe APIML versions earlier than 1.21.6 that use Spring 2.1.1 use the following artifact:

   - For Zowe APIML versions earlier than 1.21.6 that use Spring 1.5.9 use the following artifact:

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. See [Authentication Parameters for Onboarding REST API Services](#) for more details.

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.

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 a REST 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

Custom metadata are described here.

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

See API ML Basic Routing for more information about basic routing in the API ML.

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 Springfox documentation.

   Note: The current SpringFox Version 2.9.2 does not support OpenAPI 3.0. For more information about the open feature request see this issue.

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.

Tip: Wait for the Discovery Service to fully register 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:

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:

The Logback framework provides a filter tool, DuplicateMessageFilter.

Add the following code to your configuration file if you use XML configuration:

Note: For more information, see the full configuration used in the Core Services in GitHub.

Onboarding a Micronaut based REST API service

As an API developer, you can onboard a REST service to the Zowe API Mediation Layer 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.

- Set up your build automation system
    - Specify the main class
    - Define the output jar file
    - (Optional) Create a shadow jar
    - Start the application
- Configure the Micronaut application
    - Add API ML configuration
    - Add Micronaut configuration
    - 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*.

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 `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:

where:

- `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.

Follow these steps:

1. Add the following yaml snippet with the micronaut configuration parameters:

   where:

   - `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 the article validating the discoverability of your API service by teh Discovery Service, which describes the validation procedure common for all enablers.

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). As a service developer, you can onboard a REST service based on NodeJS with the API ML with the Zowe API Mediation Layer using our 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.

1. Prerequisites

2. Install the npm dependency

3. Configure your service

4. Register your service with API ML

5. (Optional) Validate 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.

Follow these steps:

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.

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 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.

Note: Wait for the Discovery Service to fully register your service. This process may take a few minutes after your service starts successfully.

Onboard a REST API without code changes required

As a user of Zowe™, onboard an existing REST 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 REST service using this method, as this method is non-native to the API Mediation Layer. For a complete list of methods to onboard a REST service natively to the API Mediation Layer, see 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.

- Identify the API 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 REST 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:

- **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.

  Important! 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:

- If customer system administrator sets the service ID to `authenticationprod1`, the API URL in the API Gateway appears as the following URL:

- **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 REST 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**

  Parameters under this grouping allow a service to accept the Zowe JWT token. The API Gateway translates the token to an authentication method supported by a service.

  - **authentication.scheme**

    This parameter specifies a service authentication scheme. The following schemes are supported by the API Gateway:

    - **bypass**

      This value specifies that the token is passed unchanged to the service. This is the default scheme when no authentication parameters are specified.

    - **zoweJwt**

      This value specifies that a service accepts the Zowe JWT token. No additional processing is done by the API Gateway.

    - **httpBasicPassTicket**

      This value 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 `apiml.authentication.applid` parameter.

      Tip: For more information, see Enabling PassTicket creation for API Services that accept PassTickets.

    - **safIdt**

      This value specifies that the application recognizes the SAF IDT scheme and fills the `X-SAF-Token` header with the token produced by the Saf IDT provider implementation.

      For more information, see SAF IDT provider

    - **x509**

      This value specifies that a service accepts client certificates forwarded in the HTTP header. The Gateway service extracts information from a valid client certificate. For validation, the certificate needs to be trusted by API Mediation Layer, and needs to contain a Client

Authentication (1.3.6.1.5.5.7.3.2) entry in Extended Key Usage. To use this scheme, it is also necessary to specify which headers to include. Specify these parameters in `headers`.

- **zosmf**

  This value 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.

- **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

- **authentication.applid**

  This parameter specifies a service APPLID. This parameter is only valid for the `httpBasicPassTicket` authentication scheme.

- **apiInfo**

  This section defines APIs that are provided by the service. Currently, only one API is supported.

  - **apiInfo.apiId**

    that uses lowercase alphanumeric characters and a dot: `.`.

- **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.documentationUrl**

  (Optional) This parameter specifies a URL to a website where external documentation is provided. This can be used when *swaggerUrl* is not 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`.

- **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 ZWESVSTC,INSTANCE=`. This is the fully qualified path to the instance directory.

   Note: We use the `${zoweInstanceDir}` symbol 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.

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

The following procedure describes how to onboard your REST service with the Wizard.

Follow these steps:

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.

Zowe API Mediation Layer Single-Sign-On Overview

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.

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.

- Zowe API ML client
- API service accessed via Zowe API ML
- Existing services that cannot be modified

The following diagram describes 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).
  - API ML clients can be confidential or public.
  - A Zowe API ML client calls API services through the API ML.
  - An example of such clients are Zowe CLI or Zowe Desktop.

- An API service accessed through Zowe API ML

  - A service that is registered to API ML and is accessed through the API 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 Gateway is first validated and then may be passed directly to the service. Alternatively, the Gateway can exchange the token for a PassTicket if the API service is configured to expect a PassTicket.
- The API service can validate the token and 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.

Note: For more information, see Enabling PassTicket creation for API Services that Accept PassTickets for more details.

Further resources

- Authentication Methods
- User guide for SSO in Zowe CLI
- System requirements for using web tokens for SSO in Zlux and ZSS
- Certificate configuration for the usage of web tokens for SSO in Zlux and ZSS

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.

- API ID in the API Mediation Layer
- Protection of Service Information
- API Endpoints
  - Obtain Information about a Specific Service
  - Obtain Information about All Services
  - Obtain Information about All Services with a Specific API ID

API ID in the API Mediation Layer

The *API ID* uniquely identifies the API in the 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.

For more information about *baseUrl* or *basePath*, see Components of URL.

Protection of 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, and a SAF resource check is done. The resource class and resource is defined in the `ZWESECUR` job. You can find more details about the `ZWESECUR` job in Configuring the z/OS system for Zowe.

The security administrator needs to permit READ access to the `APIML.SERVICES` resource in the `ZOWE` resource class to the your that can access the information about API services.

In IBM RACF, the access to the service information can be given by:

In Top Secret:

In ACF2:

API Gateway can be configured to check for SAF resource authorization in several ways. For details, see SAF Resource Checking

API Endpoints

Obtain Information about a Specific Service

Use the following method to get information about a specific service:

`GET /gateway/{serviceId}/api/v1/services`

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.

Obtain 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.

Obtain 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:

WebSocket support in API Gateway

The API Gateway includes a basic WebSocket proxy which enables the Gateway to access applications that use the WebSocket protocol together with a web UI and REST API.

The service can define what WebSocket services are exposed using Eureka metadata.

Example:

These metadata make it possible for requests from
`wss://gatewayHost:port/serviceId/ws/v1/path` to map to
`ws://serviceHost:port/discoverableclient/ws/path` , where:

- `serviceId`
  is the service ID of the service
- `path`
  is the remaining path segment in the URL.

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, the API Gateway makes it possible to open a new Websocket session by utilizing the load balancing mechanism. Communication between the client and the server is handled by the API Gateway by propagating the session to a live instance.

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.

Limitations

Different HTTP status code errors may result. The WebSocket session starts before the session between the Gateway and the service starts. When a failure occurs when connecting to a service, the WebSocket session terminates with a WebSocket close code and a description of the failure rather than an HTTP error code.

Create 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.

API Mediation Layer Message Service Component

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.

- API Mediation Layer Message Service Component
  - 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:

Zowe API Mediation Layer Security

How API ML transport security works

Security within the API Mediation Layer (API ML) is performed on several levels. This article describes how API ML uses Transport Layer Security (TLS). As a system administrator or API developer, use this guide to familiarize yourself with the following security concepts:

Transport layer security

The TLS protocol should be used to ensure secure data-transport for all connections to API Mediation Layer services. While it is possible to disable the TLS protocol for debugging purposes or other use-cases, the enabled TLS protocol is the default mode.

Authentication

Authentication is how an entity, whether it be a user (API Client), or an application (API Service), proves its true identity.

API ML uses the following authentication methods:

- **User ID and password**

- The user ID and password are used to retrieve authentication tokens

- Requests originate from a user

- The user ID and password are validated by a z/OS security manager whereby a token is issued that is then used to access the API service

- **TLS client certificates**

  - Certificates are used for service-only requests

Zowe API ML services

The following range of service types apply to the Zowe™ API ML:

- **Zowe API ML services**

  - **Gateway Service (GW)** The Gateway is the access point for API clients that require access to API services. API services can be accessed through the Gateway by API Clients. The Gateway receives information about an API Service from the Discovery Service.

  - **Discovery Service (DS)** The Discovery Service collects information about API services and provides this information to the Gateway and other services. API ML internal services also register to the Discovery Service.

  - **API Catalog (AC)** The Catalog displays information about API services through a web UI. The Catalog receives information about an API service from the Discovery Service.

- **Authentication and Authorization Service (AAS)**

  AAS provides authentication and authorization functionality to check user access to resources on z/OS. The API ML uses z/OSMF API for authentication. For more information, see the API ML wiki

- **API Clients**

  API Clients are external applications, users, or other API services that access API services through the API Gateway

- **API Services**

  API services are applications that are accessed through the API Gateway. API services register themselves to the Discovery Service and can access other services through the Gateway. If an API

service is installed so that direct access is possible, API services can access other services without the Gateway. When APIs access other services, they can also function as API clients.

Zowe API ML TLS requirements

The API ML TLS requires servers to provide HTTPS ports. Each API ML service has the following specific requirements:

- **API Client**

  - The API Client is not a server
  - Requires trust of the API Gateway
  - Has a truststore or SAF keyring that contains certificates required to trust the Gateway

- **Gateway Service**

  - Provides an HTTPS port
  - Has a keystore or SAF keyring with a server certificate
    - The certificate needs to be trusted by API Clients
    - This certificate should be trusted by web browsers because the API Gateway can be used to display web UIs
  - Has a truststore or SAF keyring that contains certificates needed to trust API Services

- **API Catalog**

  - Provides an HTTPS port
  - Has a keystore or SAF keyring with a server certificate
    - The certificate needs to be trusted by the API Gateway
    - This certificate does not need to be trusted by anyone else

- **Discovery Service**

  - Provides an HTTPS port
  - Has a keystore or SAF keyring with a server certificate
  - Has a truststore or SAF keyring that contains certificates needed to trust API services

- **API Service**

  - Provides an HTTPS port

- Has a keystore or SAF keyring with a server and client certificate
    - The server certificate needs to be trusted by the Gateway
    - The client certificate needs to be trusted by the Discovery Service
    - The client and server certificates can be the same
    - These certificates do not need to be trusted by anyone else
- Has a truststore or SAF keyring that contains one or more certificates that are required to trust the Gateway and Discovery Service

Authentication for API ML services

- **API Gateway**

    - The API Gateway handles authentication
    - There are two authentication endpoints that allow authentication of the resource by providers
    - Diagnostic endpoints `https://{gatewayUrl}:{gatewayPort}/application/**` in API Gateway are protected by basic authentication, Zowe JWT token, or a client certificate

- **API Catalog**

    - API Catalog is accessed by users and requires a login
    - Protected access is performed by the Authentication and Authorization Service

- **Discovery Service**

    - Discovery Service is accessed by API Services
    - This access (reading information and registration) requires protection by means of a client certificate
    - (Optional) Access can be granted to users (administrators)
    - Diagnostic endpoints `https://{gatewayUrl}:{gatewayPort}/application/**` in Discovery Service are protected by basic authentication, Zowe JWT token, or a client certificate

- **API Services**

    - Authentication is service-dependent
    - It is recommended to use the Authentication and Authorization Service for authentication

Authentication endpoints

The API Gateway contains the following REST API authentication endpoints:

- `auth/login`

  The full path of the `auth/login` endpoint appears as `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/login`.

  The `auth/login` endpoint authenticates mainframe user credentials and returns an authentication token. The login request requires user credentials though one of the following methods:

  - Basic access authentication
  - JSON with user credentials
  - Client certificate

  When authentication is successful, the response to the request is an empty body and a token is contained in a secure `HttpOnly` cookie named `apimlAuthenticationToken`. When authentication fails, the user receives a 401 status code.

- `auth/query`

  The full path of the `auth/query` endpoint appear as `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/query`.

  The `auth/query` endpoint validates the token and retrieves the information associated with the token. The query request requires the token through one of the following methods:

  - A cookie named `apimlAuthenticationToken`

  - Bearer authentication

    When authentication is successful, the response to the request is a JSON object which contains information associated with the token. When authentication fails, the user receives a 401 status code.

- `auth/ticket`

  The `auth/ticket` endpoint generates a PassTicket for the user associated with a token. The full path of the `auth/ticket` endpoint appears as `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/ticket`.

  This endpoint is protected by a client certificate. The ticket request requires the token in one of the following formats:

- Cookie named `apimlAuthenticationToken`.
  - Bearer authentication

The request takes the `applicationName` parameter, which is the name of the application for which the PassTicket should be generated. Supply this parameter.

The response is a JSON object, which contains information associated with the ticket.

- `auth/refresh`

  Notes:

  - The endpoint is disabled by default. For more information, see [Enable JWT token endpoint](#).
  - The endpoint is protected by a client certificate.

  The `auth/refresh` endpoint generates a new token for the user based on valid jwt token. The full path of the `auth/refresh` endpoint appears as `https://{gatewayUrl}:{gatewayPort}/gateway/api/v1/auth/refresh`. The new token overwrites the old cookie with a `Set-Cookie` header. As part of the process, the old token gets invalidated and is not usable anymore.

  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.

Supported authentication methods

The API Mediation Layer provides multiple methods which clients can use to authenticate. When the API ML is run as part of Zowe, all of the following methods are enabled and supported. All methods are supported at least to some extent with each authentication provider.

Authentication with Username/Password

The client can authenticate via Username and password. There are multiple methods which can be used to deliver
credentials. For more details, see the ZAAS Client documentation.

Authentication with Client certificate

Beginning with release 1.19 LTS, it is possible to perform authentication with client certificates. This feature is functional and tested, but automated testing on various security systems is not yet complete. As such, the feature is provided as a beta release for early preview. If you would like to offer feedback using client certificate authentication, please create an issue against the api-layer repository. Client Certificate authentication will move out of Beta once test automation is fully implemented across different security systems.

If the keyring or a truststore contains at least one valid certificate authority (CA) other than the CA of the API ML, it is possible to use the client certificates issued by this CA to authenticate to the API ML. This feature is not enabled by default and needs to be configured.

When providing credentials in any form together with client certificate on the same login request, the credentials take precedence and client certificate is ignored.

Authentication is performed in the following ways:

- The client calls the API ML Gateway login endpoint with the client certificate.
- The client certificate and private key are checked as a valid TLS client certificate against the Gateway's trusted CAs.
- The public part of the provided client certificate is checked against SAF, and SAF subsequently returns a user ID that owns this certificate. ZSS provides this API for the Mediation Layer.
- The Gateway performs the login of the mapped user and returns a valid JWT token.

Prerequisites:

- Alter the Zowe runtime user and set protection by password. 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:

  For other security systems, please refer to the documentation for an equivalent command.

- Ensure that the Zowe runtime user is allowed to log in to z/OSMF (For example user is member of the default IZUUSER group)

- Ensure that you have an external Certificate Authority and signed client certificates, or generate these certificates in SAF. The client certificate has to have correct `Extended Key Usage` metadata to allow being used for TLS client authentication. (`OID: 1.3.6.1.5.5.7.3.2`)

- Import the client certificates to SAF, or add them to a user profile. (Examples: `RACDCERT ADD` or `RACDCERT GENCERT`). For more information, see your security system documentation.

- Import the external CA to the truststore or keyring of the API Mediation Layer.

- Configure Gateway for client certificate authentication.

- To upgrade from Zowe 1.18 or lower, see the Additional security rights that need to be granted.

- PassTicket generation must be enabled for the Zowe runtime user. The user has to be able to generate PassTicket for itself and for the APPLID of z/OSMF. For more information, see Configure Passticket.

- The Zowe runtime user has to be enabled to perform identity mapping in SAF. For more information, see Additional security rights that need to be granted.

- ZSS has to be configured to participate in Zowe SSO. For more information, see Using web tokens for sso on Zlux and ZSS.

Authentication with JWT Token

When the client authenticates with the API ML, the client receives the JWT token in exchange. This token can be used for further authentication. If z/OSMF is configured as the authentication provider and the client already received a JWT token produced by z/OSMF, it is possible to reuse this token within API ML for authentication.

Authentication parameters

Parameters are specified in the onboarding enablers.

Authentication parameters enable a service to accept a Zowe JWT or client certificate. The API Gateway translates the authentication token to an authentication method supported by a service.

The following example shows the parameters that define the service authentication method:

Example:

- **authentication.scheme**

  The value of this parameter specifies a service authentication scheme. Any valid headers or `X-Zowe-Auth-Failure` error headers are set and passed to southbound services. In addition, any `X-Zowe-Auth-Failure` error headers coming from the northbound service are also be passed to the

southbound services without setting the valid headers. The `X-Zowe-Auth-Failure` error header contains details about the error and suggests potential actions. The following schemes are supported by the API Gateway:

- **bypass**

  This value specifies that the token is passed unchanged to service.

  Note: This is the default scheme when no authentication parameters are specified.

- **zoweJwt**

  - 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 southbound service performs the authentication.

- **httpBasicPassTicket**

  This value 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.

  - 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 it to a mainframe user to use for passticket generation.

  For more information, see Enabling PassTicket creation for API Services that Accept PassTickets

- **zosmf**

  This value specifies that a service accepts z/OSMF LTPA (Lightweight Third-Party Authentication). This scheme should only be used only for a z/OSMF service used by the API Gateway Authentication Service and other z/OSMF services that use the same LTPA key.

  - When a JWT is provided, the token extracts the LTPA and forwards it to the service.
  - When a client certificate is provided, the certificate translates into a z/OSMF token, and also extracts the LTPA for the service to use.

  For more information about z/OSMF Single Sign-on, see Establishing a single sign-on environment

- **safIdt**

  This value 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.

  For more information, see Implement a SAF IDT provider.

- **x509**

  This value specifies that a service accepts client certificates forwarded in the HTTP header. The Gateway service extracts information from a valid client certificate. For validation, the certificate needs to be trusted by API Mediation Layer, and needs to contain a Client Authentication (1.3.6.1.5.5.7.3.2) entry in Extended Key Usage. To use this scheme, it is also necessary to specify which headers to include. Specify these parameters in `headers`.

- **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

- **authentication.applid**

  This parameter specifies a service APPLID. This parameter is valid only for the `httpBasicPassTicket` authentication scheme.

Authentication providers

API ML contains the following providers to handle authentication for the API Gateway:

- `z/OSMF Authentication Provider`
- `SAF Authentication Provider`
- `Dummy Authentication Provider`

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`:

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`:

Note: To provide your own implementation of the SAF IDT provider, see the Implement new SAF provider guidelines.

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 API Gateway to enable the `Dummy Authentication Provider`:

Authorization

Authorization is a method used to determine access rights of an entity.

In the API ML, authorization is performed by the z/OS security manager (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.

JWT Token

The JWT secret that signs the JWT Token is an asymmetric private key that is generated during Zowe keystore configuration. The JWT token is signed with the RS256 signature algorithm.

You can find the JWT secret, alias `localhost`, in the PKCS12 keystore that is stored in `${KEYSTORE_DIRECTORY}/localhost/localhost.keystore.p12`. The public key necessary to validate the JWT signature is read from the keystore.

You can also use the `/gateway/api/v1/auth/keys/public/all` endpoint to obtain all public keys that can be used to verify JWT tokens signature in standard JWK format.

z/OSMF JSON Web Tokens Support

Your z/OSMF instance can be enabled to support JWT tokens as described at Enabling JSON Web Token support. In this case, the Zowe API ML uses this JWT token and does not generate its own Zowe JWT token. All authentication APIs, such as `/gateway/api/v1/login` and `/gateway/api/v1/check` function in the same way as without z/OSMF JWT. Gateway service endpoint `/gateway/api/v1/auth/keys/public/all` serves the z/OSMF JWK that can be used for JWT signature validation.

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 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 define the class to handle the RACF keyring using the `-D` options to specify the `java.protocol.handler.pkgs property`:

The elements in the following list, which apply to the API ML SAF Keyring, have these corresponding characteristics:

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

- Server certificate of the Gateway (with PK). This can be signed by the local CA or an external CA.
- Server certificate of the Discovery Service (with PK). This can be signed by the local CA.
- Server certificate of the Catalog (with PK). This 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 APIML 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.

Discovery Service authentication

There are several authentication mechanisms, depending on the desired endpoint, as described by the following matrix:

Endpoint	Authentication method	Note
UI (eureka homepage)	basic auth(MF), token	see note about mainframe authentication
application/**	basic auth(MF), token	see note about mainframe authentication
application/health, application/info	none	
eureka/**	client certificate	Allows for the other services to register without mainframe credentials or token. API ML's certificate can be used. It is stored in the `keystore/localhost/localhost.keystore.p12` keystore or in the SAF keyring. It is exported to .pem format for convenience. Any other certificate which is valid and trusted by Discovery service can be used.
discovery/**	certificate, basic auth(MF), token	see note about mainframe authentication

Note: Some endpoints are protected by mainframe authentication. The authentication function is provided by the API Gateway. This functionality is not available until the Gateway registers itself to the Discovery Service.

Since the Discovery Service uses HTTPS, your client also requires verification of the validity of its certificate. Verification is performed by validating the client certificate against certificates stored in the truststore or SAF keyring.

Some utilities including HTTPie require the certificate to be in PEM format. The exported certificate in .pem format is located here: `keystore/localhost/localhost.pem` .

The following example shows the HTTPie command to access the Discovery Service endpoint for listing registered services and provides the client certificate:

Setting ciphers for API ML services

You can override ciphers that are used by the HTTPS servers in API ML services by configuring properties of the Gateway, Discovery Service, and API Catalog.

Note: You do not need to rebuild JAR files when you override the default values in shell scripts.

The *application.yml* file contains the default value for each service, and can be found here. The default configuration is packed in .jar files. On z/OS, you can override the default configuration in `<RUNTIME_DIR>/components/<APIML_COMPONENT>/bin/start.sh` . Add the launch parameter of the shell script to set a cipher:

On localhost, you can override the default configuration in config/local/gateway-service.yml (including other YAML files for development purposes).

The following list shows the default ciphers. API ML services use the following cipher order:

Note: Ensure that the version of Java you use is compatible with the default cipherset.

Only IANA ciphers names are supported. For more information, see Cipher Suites or List of Ciphers.

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

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.

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 PassTicket creation for API Services that Accept PassTickets.

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`.

   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:

   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:

Certificate management in Zowe API Mediation Layer

Running on localhost

How to start API ML on localhost with full HTTPS

The https://github.com/zowe/api-layer repository already 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.

The certificates are described in more detail in the TLS Certificates for localhost.

Note: When running on localhost, only the combination of using a keystore and truststore is supported.

Certificate management script

Zowe API Mediation Layer provides a script that can be used on Windows, Mac, Linux, and z/OS to generate a certificate and keystore for the local CA, API Mediation Layer, and services.

This script is stored in `zowe/zowe-install-packaging` repository bin/apiml_cm.sh. It is a UNIX shell script that can be executed by Bash or z/OS Shell. For Windows, install Bash by going to the following link: cmder.

Generate certificates for localhost

Follow these steps:

1. Clone the `zowe-install-packaging` repository to your local machine.
2. Place the `bin/apiml_cm.sh` script intoto `scripts` directory in your API Mediation Layer repository folder
3. Use the following script in the root of the `api-layer` repository to generate certificates for localhost:

`scripts/apiml_cm.sh --action setup`

This script creates the certificates and keystore for the API Mediation Layer in your current workspace.

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 more 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. Follow the instructions in Installing the Zowe runtime on z/OS.

There are two ways to set up certificates on a z/OS machine:

- Certificates in SAF keyring
- Certificates in UNIX files (keystore and truststore)

The Configuring PKCS12 certificates and Configuring JCERACFS certificates in a key ring contain instructions about how to set up certificates during installation. Follow the procedure in the applicable section described 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 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 `<RUNTIME_DIR>/bin/zowe-setup-certificates.env` 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.

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:

   ```
   zowe zos-files download uss-file --binary
   $KEYSTORE_DIRECTORY/local_ca/localca.cer
   ```

   - **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:

   ```
   certutil -enterprise -f -v -AddStore "Root" localca.cer
   ```

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:

```
$ sudo security add-trusted-cert -d -r trustRoot -k
/Library/Keychains/System.keychain localca.cer
```

- **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

Note: This procedure applies to 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.

You can generate a keystore and truststore for a new service by calling the `apiml_cm.sh` script in the directory with API Mediation Layer:

Call the `apiml_cm.sh` script in the directory with the API Mediation Layer as in the following example.

Example:

where:

- `service-alias`

  is 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`

  Specifies repository of security certificates plus 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.keystore`.

- `service-truststore`

Contains certificates from other parties that you expect to communicate with, or from Certificate Authorities that you trust to identify other parties. The `<truststore_path>` is the path excluding the extension to the trust store that is generated. It can be an absolute path or a path relative to the current working directory. The truststore is generated in PKCS12 format.

- `service-ext`

Specifies the X.509 extension that should be the Subject Alternate Name (SAN). The SAN contains host names that are used to access the service. You need to specify the same hostname that is used by the service during API Mediation Layer registration.

Example: `"SAN=dns:localhost.localdomain,dns:localhost,ip:127.0.0.1"`

Note: For more information about SAN, see *SAN or SubjectAlternativeName* at Java Keytool - Common Options.

- `service-dname`

Specifies the X.509 Distinguished Name and is used to identify entities, such as those which are named by the subject and issuer (signer) fields of X.509 certificates.

Example: `"CN=Zowe Service, OU=API Mediation Layer, O=Zowe Sample, L=Prague, S=Prague, C=CZ"`

- `service-validity`

Specifies the number of days until the certificate expires.

- `service-password`

Specifies the keystore password. The purpose of the password is the integrity check. The access protection for the keystore and keystore need to be achieved by making them accessible only by the ZOVESVR user ID and the system administrator.

The `local-ca-filename` is the path to the keystore that is used to sign your new certificate with the local CA private key. It should point to the `$KEYSTORE_DIRECTORY/local_ca/localca` where `$KEYSTORE_DIRECTORY` is defined in a customized `$ZOWE_ROOT_DIR/bin/zowe-setup-certificates.env` file during the installation step that generates Zowe certificates.

Add a service with an existing certificate to API ML on z/OS

Note: This procedure applies only to UNIX file keystore/truststore. For the SAF keyring option, we recommend to perform the actions manually using your security system commands.

The API Mediation Layer requires validation of the certificate of each service that it accessed by the API Mediation Layer. The API Mediation Layer requires validation of the full certificate chain. Use one of the following methods:

- Import the public certificate of the root CA that has signed the certificate of the service to the APIML truststore.

- Ensure that your service has its own certificate. If it was signed by intermediate CA, ensure that all intermediate CA certificates are contained in the service's keystore.

  Note: If the service does not provide an intermediate CA certificates to the API ML, then validation fails. This can be circumvented by importing the intermediate CA certificates to the API ML truststore.

The following path is an example of importing a public certificate to the API ML truststore by calling in the directory with API Mediation Layer.

Example:

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 errror response may occur.

Example:

```
http --verify=$KEYSTORE_DIRECTORY/local_ca/localca.cer GET https://<gatewayHost>:<port>/<untrustedService>/api/v1/greeting
```

In this example, you receive a similar response:

The message has the key `apiml.common.tlsError`, and the message number `AML0105`, and content that 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.

API Mediation Layer routing

As an application developer, you can route your service through the Gateway using the API Mediation Layer to consume a specific resource.

There are two ways to route your service to the API Mediation Layer:

- Basic Routing (using Service ID and version)
- Basic Routing (using only the service ID)

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 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, 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.

- **URI (Uniform Resource Identifier)**

  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.

APIML Basic Routing (using Service ID and version)

This method of basic routing is based on the service ID that identifies the service. The specific instance is selected by the API Gateway. All instances require an identical response. Eureka and Zuul expect this type of routing.

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. For example, when a service is running in high-availability (HA) mode.

Services of the same product that provide different resources, such as SYSVIEW on one system and SYSVIEW in a different sysplex, cannot have the same service ID (the same URI cannot have two different meanings).

In addition to the basic Zuul routing, the Zowe API Gateway supports versioning in which you 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 and the prefix `/ws/` applies to WebSockets.

You can implement additional routing using a Zuul pre-filter. For more information about how to implement a Zuul filter, see Router and Filter: Zuul

The URL format expected by the API Gateway is:

`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

Service instances provide information about routing to the API Gateway via Eureka metadata.

Example:

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`

where:

- 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.

Basic Routing (using only the service ID)

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: `https://gateway:10010/zosmf/api/restjobs/jobs/...`

where:

- `zosmf` is the service ID.
- `/restjobs/1.0/...` is the rest of the endpoint segment.

Note that no version is specified in this URL.

Enabling PassTicket creation for API Services that Accept PassTickets

As system programmer, you can configure Zowe to use PassTickets for API services that are compatible to accept them to authenticate your service with the API Mediation Layer.

Overview

API clients can use either a Zowe JWT token or client certificate to access an API service even if the API service itself does not support the JWT token or client certificate. The Zowe JWT token is available through the API Gateway authentication endpoint.

When an API client provides a valid Zowe JWT token or client certificate to the API ML, the API Gateway then generates a valid PassTicket for any API service that supports PassTickets. The API Gateway then uses the PassTicket to access that API service. The API Gateway provides the user ID and password in the Authorization header of the HTTP requests using the Basic authentication scheme.

- Outline for enabling PassTicket support

- Security configuration that allows the Zowe API Gateway to generate PassTickets for an API service

  - ACF2
  - Top Secret
  - RACF

- API services that support PassTickets

  - API Services that register dynamically with API ML that provide authentication information
  - API Services that register dynamically with API ML but do not provide metadata
  - API services that are defined using a static YAML definition

- Adding YAML configuration to API services that register dynamically with API ML

Outline for enabling PassTicket support

The following steps outline the procedure for enabling PassTicket Support:

1. Follow the API service documentation that explains how to activate support for PassTickets.
   - The PassTickets for the API service must have the replay protection switched off. The PassTickets are exchanged between Zowe API Gateway and the API Service in a secure mainframe environment.
2. Record the value of the APPLID of the API service.
3. Enable the Zowe started task user ID to generate PassTickets for the API service.
4. Enable PassTicket support in the API Gateway for your API service.

Note: PassTickets must be enabled for every user who requires access to the API service.

Security configuration that allows the Zowe API Gateway to generate PassTickets for an API service

Consult with your security administrator to issue security commands to allow the Zowe started task user ID to generate PassTickets for the API service.

Use the following variables to generate PassTickets for the API service to enable the Zowe started task user ID:

- `<applid>` is the APPLID value used by the API service for PassTicket support (e.g. `OMVSAPPL`)

- `<zowesrv>` is Zowe started task user ID used during the Zowe installation

Replace the variables in the following examples with actual values.

ACF2

Grant the Zowe started task user ID permission to generate PassTickets for users of that API service. The following code is an example of security commands that need to be issued.

Example:

Top Secret

Grant the Zowe started task user ID permission to generate PassTickets for users of that API service.

Example:

RACF

To enable PassTicket creation for API service users, define the profile `IRRPTAUTH.<applid>.*` in the `PTKTDATA` class and set the universal access authority to `NONE`.

Grant the Zowe started task user ID permission to generate PassTickets for users of that API service.

Example:

API services that support PassTickets

The following types of API services support PassTickets:

- API Services that register dynamically with API ML that provide authentication information
- API Services that register dynamically with API ML but do not provide metadata
- API services that are defined using a static YAML definition

API Services that register dynamically with API ML that provide authentication information

API services that support Zowe API Mediation Layer and use dynamic registration to the Discovery Service already provide metadata that enables PassTicket support.

As a system programmer, you are not required to do anything in this case. All required information is provided by the API service automatically.

API Services that register dynamically with API ML but do not provide metadata

Some services can use PassTickets but the API ML does not recognize that the service can accept PassTickets. For such services, you can provide additional service metadata externally in the same file that contains the static YAML definiton. The static YAML definitions are described in REST APIs without code changes required.

Add the following section to the YAML file with a static definition:

where:

- `<serviceId>`

is the service ID of the service to which you want to add metadata.

API services that are defined using a static YAML definition

Add the following metadata to the same level as the `serviceId`:

Example:

Note: The fields in this example are explained later in this article.

Adding YAML configuration to API services that register dynamically with API ML

As a developer of an API service that registers dynamically with the API ML, you need to provide additional metadata to tell the API Gateway to use PassTickets. Additional metadata tells the API Gateway how to generate them. The following code shows an example of the YAML configuration that contains this metadata.

Example:

where:

- `httpBasicPassTicket`

  is the value that indicates that the HTTP Basic authentication scheme is used with PassTickets.

- `<applid>`

  is the `APPLID` value that is used by the API service for PassTicket support (e.g. `OMVSAPPL`).

Custom 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 `false` is the recommended setting. Change this setting to `true` only if you expect 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 Installing the Zowe runtime on z/OS.

  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 MLGateway 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 a special entity to manage access to HTTP connections called by the HTTP connection manager. The purpose of an HTTP connection manager is to serve as a factory for new HTTP connections, to manage the life cycle of persistent connections, and to synchronize access to persistent connections. Internally, it works with managed connections which serve as proxies for real connections. `connectionManagerTimeout` specifies a period in which managed connections with API ML should 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: Advanced Gateway features configuration. 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 will be accepted by Gateway during the CORS handling. When this parameter is not set, the accepted origins are `*` by default. You can provide a coma 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: Advanced Gateway features configuration.

- **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 Distributed 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.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:

  1) Header with name `Strict-Transport-Security` and value `max-age=1234; includeSubDomains`. 2) 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 `,`.

API Versioning

Introduction

API Catalog is the catalog of published API services and their associated documentation that have been discovered or might get available if provisioned from the service catalog.

Application program interface (API) is a set of functions and procedures that allow the creation of applications which access the features or data of other applications, service, or systems.

Our API Catalog contains APIs of services provided by implementations of mainframe products. Service can be implemented by one or more service instances (that provide exactly the same service for high-availability or scalability).

Versioning

APIs are versioned. Users of the API specify the major version (`v1`, `v2`). Backward incompatible changes can be introduced only with changing major version. The service can provide multiple versions of the API (it should provide `v{n}` and previous `v{n-1}` versions).

REST

In our case, we are speaking about REST APIs, which is a way how to access and manipulate textual representations of Web resources using uniform and a predefined set of stateless operations. Usually via HTTP(S) protocol and using JSON format. Resources are identified by their Uniform Resource Identifier (URIs). The services are accessed via APIML gateway. Example of a URI:
`https://host:10010/endevormfno/api/v1/ENWSQA01/packages/PACKAGETST`
(`https://{gatewayHost}:{port}/{serviceName}/api/v{majorVersion}/{resource}`) See
[Components of URL](#) for more information about the URL components of REST APIs.

Data Model

The following data model describes the model behind data about APIs and API services in the API Catalog. The most of the data are provided during service registration. In case of the dynamic registration they are

provided by the service. Some of them are determined by the service developer (API-related), system administrator (service-related), and some of them can be altered by user (catalog tiles - in future).

(this a UML class diagram)

Catalog Tile - API Catalog UI groups API services into tiles. An API service can be in multiple tiles. The purpose of titles is to organize API services on the dashboard of the API Catalog. Default catalog tiles are constructed from the definitions provided by the services. In future, it will be possible for the user to modify the tiles.

API - *Api* object represents a collection of specific versions of the same API which share the same *apiId*.

API Version represents a specific version of the API. This version can be documented by an external documentation or by a Swagger document. This information is set by the developer of the API.

Swagger represents a Swagger specification instance for a specific API version. See https://swagger.io/docs/specification/ for more details.

API Association provides information how a specific API version is provides by a specific service. Different services can use different basePath. The full path to access endpoints is: `scheme://host:port/basePath/endpointPath`. This information is set by the service developer.

Service represents a collection of all service instances. The description and title are taken from the service with highest version, in case if this is not clear then the latest registered wins. API clients are using a service and the API gateway chooses what service instance will be accessed. The same API version can be implemented by multiple services. Such services are not interchangeable because they contain or access different data.

Service instance is a real implementation of a service. It contains the information about where service is running. The information are provided by the system programmer. The default title and description is provided by service developer. Instances are interchangeable and they are used to achieve high availability.

Route - *Routes* provide a way how service URLs are mapped to the gateway. Gateway translates an URL based on the start of the base path on the gateway and translates it to a base path that is used in the URL to access the service. The purpose is to make possible to access services via the gateway with a consistent URL format no matter what is the format at the service.

Version type follows semantic versioning (http://semver.org/) and is used on multiple places.

Service and instance

Service and *instance* are overloaded words that have a different meaning in different contexts. This document uses similar meaning as in (Netflix) Eureka discovery service. Service (or application) is a logical entity that is comprised of functionality to access and manipulate specific resources. Instances are real processes (servers) that provide that functionality to clients. Eureka is used in distributed software world where a service is implemented by many instances. But z/OSMF software services registry defines software service instance and software service templates in the context of the provisioning where "instances" are provisioned from "templates". z/OSMF service instance does not need to correspond exactly to Eureka service. z/OSMF service instance does need to provide REST API. z/OSMF service instance can be anything that can be provisioned (e.g. multiple services that provide REST API, one API service, additional instance for a service, just a container for other services, a database server, a database, a table...).

API Versioning

Service instances provide one or more different API versions (we take only one assumption: one service instance will not provide two versions with the same major version, no other assumptions which versions will be provided and how – e.g. an instance can provide only one version and another version will be provided by different instance, 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 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, not dependent on the product release

- Two last versions are supported

- Major version – specified by the user of the API in the URI – increased only when backward incompatible change is introduced (it is rare because the REST APIs should be designed to allow extensibility)

- Minor version – not specified in the URI but the user should know what is it, important to display the correct level of documentation. Increased when the API is extended with a new feature (if you use a new resource available in v1.2, the service has to provide at least 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 say that has the lowest minor version (e.g instance A provide v1.3 and v2.2, instance B was not yet upgraded and provides v1.2 and v2.1, then the service provides v1.2 and v2.1)

- Patch version – not specified in the URI, no difference in the API, used only when the API documentation is patched or a bug was fixed, there is no change in the API

Implement 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 `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_authorization_endpoint_url=https://${ZWE_haInstance_hostname}:${GATEWAY_PORT}/zss/api/v1/saf/authenticate`
- `ZWE_configs_apiml_security_authorization_endpoint_url=https://${ZWE_haInstance_hostname}:${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:

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 in two ways:

- Using VSAM to store key/value pairs for production

- Using InMemory

Note: In the current implementation of the Caching service, VSAM is required for the storage of key/value pairs for production, as VSAM is a native z/OS solution for storing key/value pairs.

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.

- Architecture
- Storage methods
  - VSAM
  - Redis
  - Infinispan
  - InMemory
- How to start the service
- Methods to use the Caching service API
- Configuration properties
- Authentication

Architecture

A precondition to provide for High Availability of all components within Zowe is the requirement for these components to 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.

VSAM

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.

Infinispan

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.

InMemory

TODO (add in memory procedure) 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

Notes:

- 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

Caching service requires TLS mutual authentication. This verifies authenticity of client. Calls without valid client certificate generate 403 response code: Forbidden. This requirement is disabled when `VERIFY_CERTIFICATES=false` in `zowe-certificates.env` configuration file.

Call must have a header `X-Certificate-DistinguishedName` containing information about certificate's distinguished name. This header is added by API Gateway. It needs to be added manually for direct call. Calls without this header produce 401 response code: Unauthorized.

Routed calls through API Gateway

Caching service registers with the following authentication scheme to Discovery service:

which makes Gateway to attempt mutual authentication with Client and if succesfull, propagate the Client's certificate information to `X-Certificate-` headers. With this scheme, Gateway will use it's server/client certificate for the routed call to caching service.

Using VSAM as a storage solution through the Caching service

As an API developer, you can configure VSAM as a storage solution through the Caching service. The procedure in this article describes how to configure your storage solution for VSAM. 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.

- 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 `zowe.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 implemetation appears to be sufficient for user-based workloads. For light automation workloads VSAM implementation appears to be acceptable as well. For heavy workloads this implementatin may not be sufficient.
- VSAM does not scale well beyond 1000 RPM on a node.

Using Redis as a storage solution through the Caching service

As an API developer, you can configure Redis as a storage solution through the Caching service. This article describes how to configure your storage solution for Redis. You can configure Redis for high availability as well as 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 `zowe.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.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.

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

- **User Browser Workshop App**

> 💡 **GITHUB REPO:**
>
> [User Browser Workshop App](#)

- **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:

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.

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.

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.

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.

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.

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 Applying role-based access control 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.

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.

{ "success": true, "categories": { "saf": { "success": true, "plugins": { "org.zowe.zlux.auth.safsso": { "success": true "username":"foo", "expms": 60000 } } } } }

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.

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:

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.

Function	Description
`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.

Item	Description
`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 if (this.windowActions) { this.windowActions.maximize(); }

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.

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.

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:

Plugin

Configuration defaults that come with a plugin. Cannot be modified.

Product

Configuration defaults that come with the product. Cannot be modified.

Site

Data that can be used between multiple instances of the Zowe Application Server.

Instance

Data within an individual Zowe Application Server.

Group

Data that is shared between multiple users in a group.(Pending)

User

Data for an individual user.(Pending)

Note: While Authorization tuning can allow for settings such as GET from Instance to work without login, *User* and *Group* scope queries will be rejected if not logged in due to the requirement to pull resources from a specific user. Because of this, *User* and *Group* scopes will not be functional until the Security Framework is merged into the mainline.

Where *Plugin* is the broadest scope and *User* is the narrowest scope.

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

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.

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".

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. [URI Parameters](#)

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.

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.

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:
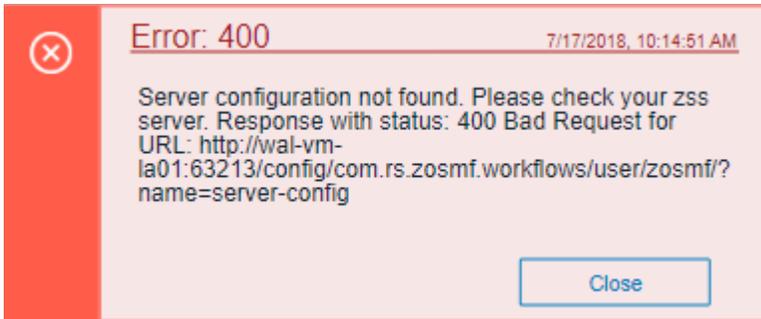
The order in which you place the pop-up manager determines how the error dialog will overlap in your UI. If you want the error dialog to overlap other UI elements, place it at the end of the `.html` file. You can also create custom styling through a CSS template, and add it within the scope of your application plug-in.

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`	

Attribute	Type	Description	Arguments
`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`
`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

Level	Number
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

Using Conda to make and manage packages of Application Framework Plugins

As Zowe is composed of components which can be extended by Plugins, a standardized and simple way to find, install, upgrade, and list Plugins in your Zowe environment is important to make it easy to get the most out of Zowe.

Package management as a concept generally provides a way to find packages such as plugins, check and possible co-install dependencies the package has, and ultimately install the desired package. Post-install, management tasks such as upgrading and uninstalling are common.

Conda is one such package manager, and if you are familiar with apt, yum, or npm, you will find that using Conda is very similar. But, there are some important abilities that make Conda stand out:

- Very cross platform: Conda is available, and acts very similar on z/OS, Windows, Linux, macOS, and various Unix. Packages can state which platforms they support, so it easy to know what packages you can install.
- Tagging: On z/OS, Conda packages can contain tagging information, to avoid issues around the difference between EBCDIC & ASCII.
- Software neutrality: Language-specific package managers are becoming popular, but Conda does not assume the purpose of the package, so you can install almost anything.
- Environments: If desired, every user can have a different set of packages, because Conda can install & manage packages in personal folders instead of system ones. A user can even have multiple such environments, and switch between them rapidly to work with different sets of related software without conflict.

Initial Conda setup

If you have not installed Conda yet, it can be downloaded as an all-in-one package that has no extra dependencies, known as "miniconda". For Linux, Unix, macOS, and Windows, this can be downloaded at https://docs.conda.io/en/latest/miniconda.html For z/OS, Conda can be downloaded from Rocket Software at https://www.rocketsoftware.com/zos-open-source

Conda will prompt during the install for certain setup options, and ultimately you'll want to put some Conda initialization content into your startup script so that whenever you open your terminal, Conda will be ready

for your use.

Once you have Conda downloaded and installed, you'll want to create your first Conda "environment" this can be done by providing a path or a nickname

`conda create --prefix PATH` `conda create --name ENVIRONMENT`

Either will work, but path helps you better separate your content from content others use by placing it in a folder that you can have stricter permissions on.

If you need to know more about certain commands, you can use the help command for any.

`conda create --help`

Or, check the official documentation: https://docs.conda.io/en/latest/index.html

Once you have an environment, you should activate it so that the actions you do are on that environment, as opposed to the base one.

`conda activate PATH_OR_NAME`

Conda will detect whether the parameter is a path or a nickname, so this command works for both.

Finally, you can view the Conda environment and other information by checking "info"

`conda info`

Managing Conda channels

When downloading a package, such as a Zowe Plugin, the place that you download from is configurable. These are called "Channels", but are very similar to "Repositories" seen in other package managers. With Conda, you can install from:

- A network channel (Internet or company internal)
- A local channel (Collection of plugins on your computer)
- Just an individual package, without a channel

You can have multiple of each, and if a package is present in more than one location, you can specify which one to use.

Searching for packages

Conda has a search utility that searches for all Channels,

`conda search anything_you_want`

but it's important to note that because any type of software can be installed through Conda, you probably want to search through a detailed view to help identify which ones are meant for Zowe, or use Channels that are distinctly for Zowe so that you can get packages that are strictly for Zowe.

`conda search --info anything_you_want`

Using Conda with Zowe

Zowe is not yet available in the form of Conda packages yet, so it must be installed separately. If you have Zowe installed on the same system as Conda, some Zowe Plugins installed through Conda will automatically register into Zowe. In order to do this, the Plugins must be able to find Zowe. You should set environment variables before trying to install the Plugins:

Setting environment variables temporarily:

z/OS, Linux, Unix:

Windows cmd.exe:

`INSTANCE_DIR` and `ROOT_DIR` are also supported, but the `ZOWE_` prefix helps distinguish its purpose.

Setting environment variables persistently

z/OS, Linux, Unix: You can put the `export` statements into the `.profile` file in your home directory to have them apply on login.

Windows: There is a UI to set variables, but it varies depending on Windows version. Try typing 'environment variable' into the Windows search bar to get to the relevant menu.

Installing a Zowe plugin

A Conda package could contain one or more Zowe Plugins, and a Conda package could contain non-Zowe code alongside Zowe Plugins. This is left up to the program vendor and regardless the install process is the

same:

```
conda install package_name
```

If the Zowe environment variables are set, such a package may automatically register Plugins into the Zowe instance of your choice.

Zowe plugin configuration

Aside from possible automation during install and uninstall, Conda does not manage Zowe, its configuration, or configuration of the Plugins. However, Conda does manage the package files, and therefore you can do additional Zowe tasks on the Plugins by going into the Conda environment. Zowe Plugins are intended to be found in a standardized location in the Conda environment,

```
/opt/zowe/plugins
```

This folder contains Plugins, which in turn contain sub-folders that are the Zowe components that they utilize. If a plugin uses multiple Zowe components, its contents could be found within multiple component folders.

```
/opt/zowe/plugins/my_plugin/app-server
```   ```
/opt/zowe/plugins/my_plugin/cli
```

## Zowe package structure

Zowe Plugins packaged into Conda follow the structure outlined here: https://github.com/zowe/zowe-install-packaging/issues/1569 This structure allows for plugin to have content meant for one or more Zowe components. The Conda packages extend this by allowing for more than one Plugin, or a mix of Zowe Plugins and other software to be within a single package.

# Building Conda packages for Zowe

This document is intended to be provided with example scripts by the Zowe community, which shows you how you can build a simple Zowe plugin into a Conda package. You can find the example scripts on the Zowe zlux-build github repository. This is not intended to be a one-size-fits-all set of scripts. If you have more advanced needs, you can use these scripts as a basis for writing your own scripts.

To make a Conda package, you need conda-build, which you can install into a Conda environment:

```
conda install conda-build
```

Once you have it, you can build a package via

```
conda build path/to/build/scripts
```

However, first you must set up the build information.

Defining package properties

Conda needs a metadata file, `meta.yaml` to state information about the package, such as dependencies, what OS it supports, its name and version. This information can be programmatically found, and Zowe provides examples of how to do this by reading Zowe's own metadata files into this one.

Creating build step

It's recommended not to build your code from scratch to put into Conda. Rather, build your code however you want, and then just copy the contents into a Conda package. This keeps the Conda scripting small and simple.

In the same folder as `meta.yaml`, Conda requires `build.sh` for building on Unix, Linux, or z/OS and `build.bat` for Windows. Except for z/OS, this script does not determine where your package can be used, it's just about where you are building it. z/OS is the exception because when you build on z/OS, unix file tagging information is preserved. So, it's highly recommended that you tag your files so that users do not have to deal with encoding issues. For code that works equally well on all platforms, a simple way to build for all is:

1. Build your code on Linux
2. Transfer the output to z/OS
3. Run a Conda build on the output on Linux
4. Run a Conda build on the output on z/OS
5. Deliver the Linux package as 'noarch' content, and the z/OS package as 'zos-z' content.

Lifecycle scripts

When a Conda package is installed or uninstalled, a script from the package can be run. For Zowe, the scripts `post-link.sh` and `pre-unlink.sh` can be important, and you must put them into the same folder as `meta.yaml` for building.

Install automation

`post-link.sh` runs at install, after Conda has put the package content onto the system. At this time, registration into Zowe is recommended if the Plugin does not require any information from the user for configuration. If the Plugin is okay to be automatically installed, we recommend putting a script into the package folder named `autoinstall.sh` Zowe's provided Conda examples will utilize `autoinstall.sh` to do any install steps your package needs, and provides Zowe information to make install simple. However, it's possible to do what you want in your own `post-link.sh` script instead.

Uninstall automation

`pre-unlink.sh` is the opposite of `post-link.sh`. It allows you to do anything you need to before the package is removed from the system. This is a good time to remove any package information from Zowe, but you should be careful because users may uninstall and later re-install, so you should not remove configuration information without consent.

Adding configuration to Conda packages

As a package manager, Conda is not responsible for configuration. Your packages can include defaults to utilize, but if configuration is needed you should alert the user to perform a post-install task. `post-link.sh` could be used to print such an alert.

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.

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 packages that exposes programmatic APIs for your service.

For detailed contribution guidelines, see the following documents:

- Node.js SDK guidelines
- **Coming soon! Python SDK guidelines**

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.

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.

Troubleshooting

To isolate and resolve Zowe™ problems, you can use the troubleshooting and support information.

Known problems and solutions

Some common problems with Zowe are documented, 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 API Mediation Layer
- Troubleshooting Zowe Application Framework
- Troubleshooting Zowe CLI
- Troubleshooting Zowe Launcher

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 then 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

Understanding the Zowe release

Knowing which version of Zowe you are running might help you isolate the problem. Also, the Zowe community who helps you will need to know this information. For more information, see Understanding the Zowe release.

Understanding the Zowe release

Zowe releases

Zowe uses semantic versioning for its releases, also known as SemVer. 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 first 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`.

Patch

A patch is usually reserved for a bug fix to a minor release.

Minor release

A minor release indicates that new functionality is added but the code is compatible with an earlier version. The Zowe community works on two-week sprints and creates a minor release at the end of these, typically once per month although the frequency might vary.

Major release

A major release is required if changes are made to the public API and the code is no longer compatible with an earlier version.

When Zowe is version one, it is associated with the Zowe v1 conformance program. Offerings that extend Zowe and achieve the Zowe v1 conformance badge will remain compatible with Zowe throughout its version 1 lifetime. A major release increment because of incompatibility is sometimes referred to as a "breaking" change.

The first SMP/E build for Zowe v2 has a Functional Module ID (FMID) of AZWE002, which was created with content from the 2.0.0 release. Each major release will be its own SMP/E FMID where the last digit is updated, for example AZWE00V where V represents the major version.

Subsequent minor and patch releases to V2 are delivered as SMP/E PTF SYSMODs. Because of the size of the content, two co-requisite PTFs are created for each Zowe release.

While Major releases are required for a "breaking" change, they also can be used to indicate to the community a significant content update over and above what would be included in a minor release.

Check the Zowe release number

To see the release number of Zowe, look at the `manifest.json` file. This is included in the top-level [directory of where a Zowe convenience build is expanded to](), the top-level directory of a Zowe runtime `<RUNTIME_DIR>`.

To see the version of a Zowe release, use the `zwe version` command.

will return a single line with the Zowe release number. For example,

You can pass `debug` or `trace` mode argument to this command to show more information. For example,

You can see in `trace` mode, it also tells you where is the Zowe runtime directory where `zwe` command you are running.

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.

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.

Troubleshooting API ML

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.

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

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, so 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**

     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, you 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:

Known Issues

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 a 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.

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 ZWESVSTC 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
- Missing z/OSMF host name in subject alternative names
- Invalid z/OSMF host name in subject alternative names

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 Configuring PKCS12 certificates. 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. For more information, see Configuring PKCS12 certificates. In the `zowe-setup-certificates.env` file that is used to generate the keystore, ensure that the property `VERIFY_CERTIFICATES` and `NONSTRICT_VERIFY_CERTIFICATES` are set to `false`.

Important! Disabling `VERIFY_CERTIFICATES` or `NONSTRICT_VERIFY_CERTIFICATES` may expose your server to security risks. Ensure that you contact your system administrator before you do so and use these options only for troubleshooting purpose.

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 [Configuring PKCS12 certificates](#). The Zowe keystore directory is the value of the `KEYSTORE_DIRECTORY` variable in the `zowe.yaml` file that is used to launch Zowe.

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 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 the same user ID as z/OSMF (typically IZUSVR). This is stated in the [installation documentation](#).

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 USILCA32.lvn.broadcom.net`. If it is valid, then the problem can be caused by insufficient privileges of your started task that is not allowed to do network access.

You can fix it by setting up the security environment as described in the [Zowe documentation](#).

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 `ZWESVSTC` started task that launches the API Mediation Layer.

In the `java.security` file, there is a parameter value for `jdk.tls.disabledAlgorithms`, for 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 above the line ends `<224, GCM`, remove the preceding comma so the values remain a well-formed list of comma-separated algorithms:

Note: The file permissions of `java.security` might be restricted for privileged users at most z/OS sites.

After you remove `GCM`, restart the `ZWESVSTC` 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 will show ! 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 message below 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. More detail can be found in Configuring PKCS12 certificates.

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 teh following example where Java treats the SAF keyring as a file.

Example:

Solution:

Apply the following APAR to address this issue:

- APAR IJ31756

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.

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.

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.

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.

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.

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.

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

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

ZWEAG500E

Client certificate is missing in request.

Reason:

No client certificate is present in the HTTPS request.

Action:

Properly configure client to send client certificate.

ZWEAG700E

No instance of the service '%s' found. Routing will not be available.

Reason:

The Gateway could not find an instance of the service from the Discovery Service.

Action:

Check that the service was successfully registered to the Discovery Service and wait for Spring Cloud to refresh the routes definitions.

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.

ZWEAG704E

Configuration error '%s' when trying to read the public and private key for signing JWT: %s

Reason:

A problem occurred while trying to read the certificate-key pair from the keystore.

Action:

Review the mandatory fields used in the configuration such as the keystore location path, the keystore and key password, and the keystore type.

ZWEAG705E

Failed to load public or private key from key with alias '%s' in the keystore '%s'. Gateway is shutting down.

Reason:

Failed to load a public or private key from the keystore during JWT Token initialization.

Action:

Check that the key alias is specified and correct. Verify that the keys are present in the keystore.

ZWEAG706E

RequestContext is not prepared for load balancing.

Reason:

Custom Ribbon load balancing is not in place before calling Ribbon.

Action:

Contact Broadcom support.

ZWEAG707E

The request to the URL '%s' aborted without retrying on another instance. Caused by: %s

Reason:

The request to the server instance failed and will not be retried on another instance.

Action:

Refer to 'Caused by' details for troubleshooting.

ZWEAG708E

The request to the URL '%s' failed after retrying on all known service instances. Caused by: %s

Reason:

Request to the server instance could not be executed on any known service instance.

Action:

Verify the status of the requested instance.

ZWEAG709E

Service is not available at URL '%s'. Error returned: '%s'

Reason:

The service is not available.

Action:

Make sure that the service is running and is accessible by the URL provided in the message.

ZWEAG710E

Load balancer does not have available server for client: %s

Reason:

The service is not available. It might be removed by the Circuit Breaker or by requesting specific instance that is not available.

Action:

Try the request later, or remove the request for the specific instance.

ZWEAG711E

The principal '%s' is missing queried authorization.

Reason:

The principal does not have the queried access to the resource name within the resource class.

Action:

No action is needed.

ZWEAG712E

The URI '%s' is an invalid format

Reason:

The URI does not follow the format /{serviceId}/{type}/{version}/{endpoint} or /{type}/{version}/{serviceId}/{endpoint}.

Action:

Use a properly formatted URI.

ZWEAG713E

Configuration error when trying to establish JWT producer. Events: %s

Reason:

A problem occurred while trying to make sure that there is a valid JWT producer available.

Action:

Based on the specific information in the message, verify that the key configuration is correct, or alternatively, that z/OSMF is available.

ZWEAG714E

Unknown error occurred while retrieving the used public key

Reason:

An unknown problem occurred when retrieving the used public key. This should never occur.

Action:

Try again later.

ZWEAG715E

The wrong amount of keys retrieved. The amount of retrieved keys is: %s

Reason:

There are too many keys in the JWK set. As such, it is not possible to choose the correct one.

Action:

Verify the configuration of the z/OSMF to make sure that z/OSMF provides only one used key.

ZWEAG716E

The system does not know what key should be used.

Reason:

Typically z/OSMF is either unavailable or offline.

Action:

Verify that z/OSMF is available, accessible by the Gateway service, and online.

ZWEAG100E

Authentication exception: '%s' for URL '%s'

Reason:

A generic failure occurred during authentication.

Action:

Refer to the specific authentication exception details for troubleshooting.

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.

ZWEAG102E

Token is not valid

Reason:

The JWT token is not valid.

Action:

Provide a valid token.

ZWEAG103E

The token has expired

Reason:

The JWT token has expired.

Action:

Obtain a new token by performing an authentication request.

ZWEAG104E

Authentication service is not available at URL '%s'. Error returned: '%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.

ZWEAG105E

Authentication is required for URL '%s'

Reason:

Authentication is required.

Action:

Provide valid authentication.

ZWEAG106W

Login endpoint is running in dummy mode. Use credentials '%s'/'%s' to log in. Do not use this option in the production environment.

Reason:

The authentication is running in dummy mode.

Action:

Ensure that this option is not being used in a production environment.

ZWEAG107W

Incorrect value: apiml.security.auth.provider = '%s'. The authentication provider is not set correctly. The default 'zosmf' authentication provider is being used.

Reason:

An incorrect value of the apiml.security.auth.provider parameter is set in the configuration.

Action:

Ensure that the value of apiml.security.auth.provider is set either to 'dummy' if you want to use dummy mode, or to 'zosmf' if you want to use the z/OSMF authentication provider.

ZWEAG108E

z/OSMF instance '%s' not found or incorrectly configured. Gateway is shutting down.

Reason:

The Gateway could not find the z/OSMF instance from the Discovery Service or it could not communicate with the provided z/OSMF instance.

Action:

Ensure that the z/OSMF instance is configured correctly and that it is successfully registered to the Discovery Service and that the API Mediation Layer can communicate with the provided z/OSMF instance. The default timeout is 5 minutes. On a slower system, add the variable APIML_SECURITY_JWTINITIALIZERTIMEOUT=... and the value in minutes into Zowe's configuration to override this value.

ZWEAG109E

z/OSMF response does not contain field '%s'.

Reason:

The z/OSMF domain cannot be read.

Action:

Review the z/OSMF domain value contained in the response received from the 'zosmf/info' REST endpoint.

ZWEAG110E

Error parsing z/OSMF response. Error returned: '%s

Reason:

An error occurred while parsing the z/OSMF JSON response.

Action:

Check the JSON response received from the 'zosmf/info' REST endpoint.

ZWEAG120E

Invalid username or password for URL '%s'

Reason:

The username and/or password are invalid.

Action:

Provide a valid username and password.

ZWEAG121E

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.

ZWEAG130E

Token is not valid for URL '%s'

Reason:

The token is not valid.

Action:

Provide a valid token.

ZWEAG131E

No authorization token provided for URL '%s'

Reason:

No authorization token is provided.

Action:

Provide a valid authorization token.

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.

ZWEAG150E

SAF IDT generation failed. Reason: %s

Reason:

An error occurred during SAF verification. Review the reason in the error message.

Action:

Verify the Identity Token configuration.

ZWEAG151E

SAF IDT is not generated because authentication or authorization failed. Reason: %s

Reason:

The user credentials were rejected during SAF verification. Review the reason in the error message.

Action:

Provide a valid username and password.

ZWEAG160E

No authentication provided in the request

Reason:

The JWT token or client certificate was not provided with the request

Action:

Configure your client to provide valid authentication.

ZWEAG161E

No user was found

Reason:

It was not possible to map provided token or certificate to the mainframe identity.

Action:

Ask your security administrator to connect your token or client certificate with your mainframe user.

ZWEAG162E

Gateway service failed to obtain token.

Reason:

Authentication request to get token failed.

Action:

Contact your administrator.

ZWEAG163E

Error occurred while parsing X509 certificate.

Reason:

%s

Action:

Configure your client to provide valid x509 certificate.

ZWEAG164E

Error occurred while validating X509 certificate. %s

Reason:

X509 certificate cannot be validated or the certificate cannot be used for client authentication.

Action:

Configure your client to provide valid x509 certificate.

ZWEAG165E

X509 certificate is missing the client certificate extended usage definition

Reason:

X509 certificate cannot be used for client authentication.

Action:

Configure your client to provide valid x509 certificate.

ZWEAG166E

ZOSMF authentication scheme is not supported for this API ML instance.

Reason:

z/OSMF is not used as security provider for API ML.

Action:

Contact your administrator.

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.

ZWEAG168E

Invalid authentication provided in request

Reason:

The JWT token or client certificate is not valid

Action:

Configure your client to provide valid authentication.

ZWEAG169E

The 'apiml.authentication.applid' parameter is not specified for a service.

Reason:

The applid parameter is required for the calling service.

Action:

Provide the 'apiml.authentication.applid' parameter.

API Catalog messages

ZWEAC100W

Could not retrieve all service info from discovery -- %s -- %s -- %s

Reason:

The response from The Discovery Service about the registered instances returned an error or empty body.

Action:

Make sure the Discovery Service is up and running. If the http response error code refers to a security issue, check that both the Discovery Service and Catalog are running with the https scheme and that security is configured properly.

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.

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.

Raising a Zowe Application Framework issue on GitHub

When necessary, you can raise GitHub issues against the Zowe™ zlux core repository here. It is suggested that you use either the bug or enhancement template.

For issues with particular applications, such as Code Editor or JES Explorer, create the issue in the application's project.

Raising a bug report

Please provide as much of the information listed on Troubleshooting Zowe Application Framework as possible. 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.

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

ZWES0013I

ZSS Server has started. Version '%s' '%s'

Reason:

ZSS Server has started.

Action:

No action required.

ZWES0014I

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` see check `<cmsRC>` and description. 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=39`, description=`'Cross-memory server abended'`

- `cmsRC=47`, description=`'ZVT is NULL'`
- `cmsRC=64`, description=`'PC is unavailable'`

ZWES0035I

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.

ZWES0039I

Installing '%s' service...

Reason:

`<Service>` is about to install.

Action:

No action required.

ZWES0061I

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.

ZWES0063I

Caching Service settings: gateway host '%s', port %d

Reason:

Caching Service settings are gateway host `<Gateway-host>`, port `<Gateway-port>`. HA is mode enabled.

Action:

No action required.

ZWES0064I

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

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.

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 occupped.

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.

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.

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 `pluginId` property into `<path-to-pluginDefinition.json>` file. Otherwise, contact the plugin vendor.

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 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.

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 `bpxmtext` command.

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.

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:

No action required.

Troubleshooting Zowe CLI

Problem

Zowe™ CLI is experiencing a problem. You need to collect information that will help you resolve the issue.

Environment

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.

Before 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 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.
- List of plug-ins installed and their version numbers.
- Node.js and NPM versions installed.
- List of environment variables in use.

For instructions on how to collect the information, see Gathering information for Zowe CLI.

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?
- What operating system and version are you running?

- What shell/terminal are you using (bash, cmd, powershell, etc...)?

- Which queue managers are you trying to administer, and on what systems are they located?

- Are the relevant API endpoints online and valid?

- Are you running in daemon mode?

Gathering information to troubleshoot Zowe CLI

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` or `@zowe-v1-lts`, or `@lts-incremental` version is installed.

For the `@zowe-v1-lts` and the `@latest` (forward-development) version tags:

For the `@lts-incremental` version tag:

More information regarding versioning conventions for Zowe CLI and plug-ins is located in Versioning Guidelines.

Identify the currently installed versions of plug-ins

Issue the following command:

The output describes version and the registry information.

Environment variables

The following settings are configurable via environment variables:

Log levels

Environment variables are available to specify logging level and the CLI home directory.

Important! 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. For example, the home directory resides on a network drive and has poor file performance. 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 of logs

There are two sets of logs to be aware of:

- Imperative CLI Framework log, which generally contains installation and configuration information.

- Zowe CLI log, which contains information about interaction between CLI and the server endpoints.

Analyze these logs for any information relevant to your issue.

Profile configuration

The `profiles` folder stores connection information.

Important! The profile directory might contain "sensitive" information, such as your mainframe password. You should obfuscate any sensitive references before providing configuration files.

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, run the following command:

By default, npm keeps only 10 log files, but sometimes more are needed. Increase the log count by issuing the following command:

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.

As the log files are created only when an npm command fails, but you are interested to see what is executed, you can increase the log level of npm. Issue the following command:

- 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", and "notice". "Notice" is the default.

- Alternatively, you can pass `--loglevel verbose` on the command line, but 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`).

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:

1. The IZU* (IZUSVR and IZUANG) joblogs (z/OSMF server)
2. 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:

1. Any security violations for the TSO user in SYSLOG

Alternative 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`:

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.

EACCESS error when issing `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.

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.

More Information:

`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 more information, see Install Zowe CLI.

- `Add the --no-optional` flag to the end of the `npm install` command.

`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.

`npm install -g` command fails due to `npm ERR! Cannot read property 'pause' of undefined` error

Valid on Windows or Linux

Symptom:

You receive the error message `npm ERR! Cannot read property 'pause' of undefined` when you attempt to install the product.

Solution:

This behavior is due to a problem with Node Package Manager (npm). If you encounter this problem, revert to a previous version of npm that does not contain this defect. To revert to a previous version of npm, issue the following command:

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.

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.

Raising a CLI issue on GitHub

When necessary, you can raise GitHub issues against the Zowe™ CLI repository here. 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.

Troubleshooting Zowe Explorer

As a Zowe Explorer user, you may encounter problems with how the VS Code extension functions. This article presents known Zowe Explorer issues and their solutions.

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.

3. Collect the following information to help diagnose the issue:

   - Zowe Explorer and VS Code version installed.

   - Node.js and NPM versions installed.

   - Whether you have Zowe CLI and the Secure Credential Store (SCS) Zowe CLI plug-in installed.

     Note: Zowe CLI V2 does not require the SCS plug-in to manage security. Security is now managed by Zowe CLI core functionality.

   - Your operating system.

   - Zowe Logs, which usually, can be found in `C:\Users\userID\.zowe\zowe\logs`.

Use the Slack channel to reach the Zowe Explorer community for assistance.

Known Zowe Explorer issues

The following topics contain information that can help you troubleshoot problems when you encounter unexpected behavior, using Zowe Explorer.

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.

Raising a Zowe Explorer issue on GitHub

You can raise GitHub issues against the Zowe Explorer 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.

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 inline statements

3. Add a new line

   By default debug mode is disabled, so the `ZLDEBUG` is set to `OFF`. To disable debug mode remove the line or set `ZLDEBUG` to `OFF`.

4. Restart ZWESLSTC Started Task.

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:

Component `<component-name>` started.

Action:

No action required.

ZWEL0002I

component %s stopped

Reason:

Component `<component-name>` stopped.

Action:

No action required.

ZWEL0003I

new component initialized %s, restart_cnt=%d, min_uptime=%d seconds, share_as=%s

Reason:

Component `<component-name>` initialized.

- `restart_cnt` – Number of attempts to restart the component in case of failure

- `min_uptime` – Minimum uptime that the component can be considered as successfully started

- `share_as` – One of `<yes|no|must>` which indicates whether child processes of the component start in the same address space. See documentation for _BPX_SHAREAS for details.

  Action:

  No action required.

ZWEL0004I

component %s(%d) terminated, status = %d

Reason:

Component `<component-name>` (`<pid>`) terminated with status `<code>` .

Action:

No action required.

ZWEL0005I

next attempt to restart component %s in %d seconds

Reason:

Component failure detected.

Action:

No action required. The component `<component-name>` will be restarted in `<n>` seconds.

Zowe Launcher error messages

ZWEL0030E

failed to prepare Zowe instance

Reason:

Failed to prepare the Zowe high availability (HA) instance.

Action:

Check previous messages in the Zowe Launcher SYSPRINT to find the reason and correct it.

ZWEL0038E

failed to restart component %s, max retries reached

Reason:

Maximum retries reached for restarting component `<component-name>`.

Action:

Check `<component-name>` configuration and correct the maximum restart count via configuration attribute `restartIntervals` if needed, then restart the component by using z/OS MODIFY command `F ZWESLSTC,APPL=STOP(<component-name>)`

ZWEL0040E

failed to start component %s

Reason:

Failed to start component `<component-name>`.

Action:

Check `<component-name>` configuration and correct if needed, then either 1) start the component manually by using z/OS MODIFY command `F ZWESLSTC,APPL=STOP(<component-name>)` or 2) restart the entire HA instance

Contribute 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!

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 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

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

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](#).

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).

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.

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 TypeScript code, comment objects and functions in the Javadoc format.

C

When writing C code, comment functions and structures in compliance with Doxygen.

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.

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.

Light theme

Dark theme

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/

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:

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

Example: Screen Width 320px

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

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.

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.

In addition to being familiar with the Zowe community and how we work together, you will need to sign the CNCF Contributor License Agreement. The Contributor License Agreement defines the terms under which you contribute to Zowe documentation. Contributions to Zowe documentation are reviewed before being committed to the repository. 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.
- 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 edit 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.

Word usage

Note headings such as Note, Important, and Tip should be formatted using the lower case and bold format.

Example:

- **Note:**
- **Important!**
- **Tip:**

Use of "following"

For whatever list or steps we are introducing, the word "following" should precede a noun.

Example:

- 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".

Example:

❌ Complete the following.

✔️ Complete the following tasks.

Use a consistent style for referring to version numbers.

When talking about a specific version, capitalize the first letter of Version.

Example:

✔️ 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.

Example:

- 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:

Abbreviations

Do not use an abbreviation as a noun unless the sentence makes sense when you substitute the spelled-out form of the term.

Example:

✖ The tutorials are available as PDFs. [portable document formats]

✔ The tutorials are available as PDF files.

Do not use abbreviations as verbs.

Example:

✖ You can FTP the files to the server.

✔ You can use the FTP command to send 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
application	app
Capitalize "Server" when it's part of the product name	
Java	java
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

Do	Don't
plug-in	plugin
REXX	Rexx
UNIX System Services z/OS UNIX System Services	USS
zLUX	ZLUX zLux

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.

Currently, this reference documentation only contains the web help for the Zowe CLI core component and CLI plug-ins maintained by Zowe. As third-party plug-ins are approved under the Zowe V2 LTS Conformance Program and contribute their web help to Zowe, we will update the documentation accordingly. To view the web help for V1 conformant plug-ins, click the version drop-menu on the top right corner of this page and click the link to any previous v1.xx.x version of this page.

- Browse online
- Download CLI reference in PDF format
- Download CLI reference in ZIP format

Zowe API reference

Find and learn about the Zowe APIs that you can use.

- **REST API for the Data sets and z/OS Unix Files Services**

- **REST API for the API Gateway service**

- **REST API for the JES Jobs Service**

- **REST API for ZLUX Plug-in**

zwe certificate keyring-jcl clean

zwe > certificate > keyring-jcl > clean

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	
--jcllib		string	yes	
--security-dry-run		boolean	no	
--security-product		string	no	
--keyring-owner		string	yes	
--keyring-name		string	yes	
--alias	-a	string	yes	
--ca-alias	-ca	string	yes	

Full name	Alias	Type	Required	Help message
--ignore-security-failures		boolean	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate keyring-jcl connect

zwe > certificate > keyring-jcl > connect

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	
--jcllib		string	yes	
--security-dry-run		boolean	no	
--security-product		string	no	
--keyring-owner		string	yes	
--keyring-name		string	yes	
--trust-cas		string	no	
--connect-user		string	yes	

Full name	Alias	Type	Required	Help message
--connect-label		string	yes	
--trust-zosmf		boolean	no	
--zosmf-ca		string	no	
--zosmf-user		string	no	
--ignore-security-failures		boolean	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.
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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate keyring-jcl generate

zwe > certificate > keyring-jcl > generate

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	
--jcllib		string	yes	
--security-dry-run		boolean	no	
--security-product		string	no	
--keyring-owner		string	yes	
--keyring-name		string	yes	
--domains	-d	string	yes	
--alias	-a	string	yes	

Full name	Alias	Type	Required	Help message
--ca-alias	-ca	string	yes	
--common-name	-cn	string	no	
--org-unit		string	no	
--org		string	no	
--locality		string	no	
--state		string	no	
--country		string	no	
--validity		string	no	
--trust-cas		string	no	
--trust-zosmf		boolean	no	
--zosmf-ca		string	no	
--zosmf-user		string	no	
--ignore-security-failures		boolean	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	

Full name	Alias	Type	Required	Help message
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate keyring-jcl import-ds

zwe > certificate > keyring-jcl > import-ds

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	
--jcllib		string	yes	
--security-dry-run		boolean	no	
--security-product		string	no	
--keyring-owner		string	yes	
--keyring-name		string	yes	
--alias	-a	string	yes	
--trust-cas		string	no	

Full name	Alias	Type	Required	Help message
--trust-zosmf		boolean	no	
--zosmf-ca		string	no	
--zosmf-user		string	no	
--import-ds-name		string	yes	
--import-ds-password		string	yes	
--ignore-security-failures		boolean	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.
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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate keyring-jcl

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	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	

Full name	Alias	Type	Required	Help message
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate pkcs12 create ca

zwe > certificate > pkcs12 > create > ca

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	
--alias	-a	string	yes	
--password	-p	string	yes	
--common-name	-cn	string	no	
--org-unit		string	no	
--org		string	no	
--locality		string	no	
--state		string	no	

Full name	Alias	Type	Required	Help message
--country		string	no	
--validity		string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--keystore-dir	-d	string	yes	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Error code	Exit code	Error message
ZWEL0300W		%s already exists. This %s will be overwritten during configuration.
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.
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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate pkcs12 create cert

zwe > certificate > pkcs12 > create > cert

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	
--keystore	-k	string	yes	
--alias	-a	string	yes	
--password	-p	string	yes	
--common-name	-cn	string	no	
--domains	-d	string	no	
--ca-alias		string	yes	
--ca-password		string	yes	

Full name	Alias	Type	Required	Help message
--org-unit		string	no	
--org		string	no	
--locality		string	no	
--state		string	no	
--country		string	no	
--validity		string	no	
--key-usage		string	no	
--extended-key-usage		string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--keystore-dir	-d	string	yes	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Error code	Exit code	Error message
ZWEL0300W		%s already exists. This %s will be overwritten during configuration.
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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate pkcs12 create

zwe > certificate > pkcs12 > create

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	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	

Full name	Alias	Type	Required	Help message
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate pkcs12 export

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	
--password	-p	string	yes	
--private-keys		string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	

Full name	Alias	Type	Required	Help message
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate pkcs12 import

zwe > certificate > pkcs12 > import

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	
--password	-p	string	yes	
--alias	-a	string	no	
--source-keystore	-sf	string	no	
--source-password	-sp	string	no	
--source-alias	-sa	string	no	
--trust-cas		string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate pkcs12 lock

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	
--user		string	yes	
--group		string	yes	
--group-permission		string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	

Full name	Alias	Type	Required	Help message
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate pkcs12 trust-service

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	
--keystore-dir	-d	string	yes	
--keystore	-k	string	yes	
--password	-p	string	yes	
--host		string	yes	
--port		string	yes	
--alias	-a	string	yes	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Error code	Exit code	Error message
ZWEL0300W		%s already exists. This %s will be overwritten during configuration.
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.

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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate pkcs12

zwe > certificate > pkcs12

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	
--debug,--verbose	-v	boolean	no	

Full name	Alias	Type	Required	Help message
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate verify-service

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	
--port		string	yes	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	

Full name	Alias	Type	Required	Help message
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe certificate

zwe > certificate

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	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	

Full name	Alias	Type	Required	Help message
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe components install extract

zwe > components > install > extract

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	
--auto-encoding	-e	string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	

Full name	Alias	Type	Required	Help message
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.
ZWEL0167E	167	Cannot find component name from %s package manifest.

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.
	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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe components install process-hook

zwe > components > install > process-hook

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	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	

Full name	Alias	Type	Required	Help message
--config	-c	string	no	

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.
	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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe components install

Sub-commands

- extract
- process-hook

Description

Install a Zowe module.

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	
--auto-encoding	-e	string	no	
--skip-enable		boolean	no	

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe components disable

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	
--ha-instance	-i	string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	

Full name	Alias	Type	Required	Help message
--config	-c	string	no	

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.

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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe components enable

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	
--ha-instance	-i	string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	

Full name	Alias	Type	Required	Help message
--config	-c	string	no	

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.

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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe components

Sub-commands

- disable
- enable
- install

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe init apfauth

zwe > init > apfauth

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	
--ignore-security-failures		boolean	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	
--skip-security-setup		boolean	no	
--security-dry-run		boolean	no	
--ignore-security-failures		boolean	no	
--update-config		boolean	no	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe init certificate

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 "JCERACFKS" (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 `JCERACFKS`` 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 JCERACFKS keyring. Please note, for JCERACFKS 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 `JCERACFKS` 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 `JCERACFKS` certificate (z/OS keyring) 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 `JCERACFKS`.
- 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 existsing 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.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	
--update-config		boolean	no	
--ignore-security-failures		boolean	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	
--skip-security-setup		boolean	no	

Full name	Alias	Type	Required	Help message
--security-dry-run		boolean	no	
--ignore-security-failures		boolean	no	
--update-config		boolean	no	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

Inherited from parent command

Error code	Exit code	Error message

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe init mvs

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

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	
--skip-security-setup		boolean	no	
--security-dry-run		boolean	no	
--ignore-security-failures		boolean	no	
--update-config		boolean	no	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Error code	Exit code	Error message

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.
ZWEL0300W		%s already exists. This data set member will be overwritten during configuration.
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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe init security

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	
--ignore-security-failures		boolean	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	
--skip-security-setup		boolean	no	
--security-dry-run		boolean	no	
--ignore-security-failures		boolean	no	
--update-config		boolean	no	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.
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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe init stc

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	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	
--skip-security-setup		boolean	no	
--security-dry-run		boolean	no	
--ignore-security-failures		boolean	no	
--update-config		boolean	no	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Error code	Exit code	Error message

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.
ZWEL0300W		%s already exists. This data set member will be overwritten during configuration.
ZWEL0301W		%s already exists and will not be overwritten. For upgrades, you must use --allow-overwrite.
ZWEL0143E	143	Cannot find data set member %s. You may need to re-run `zwe install`.
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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe init vsam

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 will create customized ZWESECUR JCL here before applying it.
- `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	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	
--skip-security-setup		boolean	no	
--security-dry-run		boolean	no	
--ignore-security-failures		boolean	no	
--update-config		boolean	no	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.
ZWEL0300W		%s already exists. This data set member will be overwritten during configuration.
ZWEL0301W		%s already exists and will not be overwritten. For upgrades, you must use --allow-overwrite.

Error code	Exit code	Error message
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.
ZWEL0301W	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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe init

zwe > init

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 "JCERACFKS" (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 `JCERACFKS` 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 JCERACFKS keyring. Please note, for JCERACFKS 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 `JCERACFKS` 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 `JCERACFKS` certificate (z/OS keyring) 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 `JCERACFKS`.

- 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	
--skip-security-setup		boolean	no	
--security-dry-run		boolean	no	
--ignore-security-failures		boolean	no	
--update-config		boolean	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Inherited from parent command

Error code	Exit code	Error message

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal config get

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	
--path	-p	string	yes	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	

Full name	Alias	Type	Required	Help message
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal config set

zwe > internal > config > set

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	
--path	-p	string	yes	
--value	-e	string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	

Full name	Alias	Type	Required	Help message
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal config

Sub-commands

- get

- 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	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal container cleanup

zwe > internal > container > cleanup

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	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal container init

zwe > internal > container > init

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	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal container prestop

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	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal container

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	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	

Full name	Alias	Type	Required	Help message
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal start component

zwe > internal > start > component

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	
--run-in-background		boolean	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	

Full name	Alias	Type	Required	Help message
--config	-c	string	no	

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.

Error code	Exit code	Error message
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal start prepare

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	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

Error code	Exit code	Error message
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal start

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	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	

Full name	Alias	Type	Required	Help message
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal get-launch-components

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	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	

Full name	Alias	Type	Required	Help message
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe internal

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	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	

Full name	Alias	Type	Required	Help message
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe migrate for kubernetes

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	
--external-port		string	no	
--k8s-namespace		string	no	
--k8s-cluster-name		string	no	
--alias	-a	string	no	
--password	-p	string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe migrate for

zwe > migrate > for

Sub-commands

- kubernetes

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Inherited from parent command

Error code	Exit code	Error message

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe migrate

Sub-commands

- for

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Inherited from parent command

Error code	Exit code	Error message

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe sample sub deep

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	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--target-dir,--target	-d	string	yes	
--auto-encoding	-e	string	no	

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe sample sub second

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	
--auto-encoding	-e	string	no	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	

Full name	Alias	Type	Required	Help message
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe sample sub

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	
--auto-encoding	-e	string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe sample test

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	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	

Full name	Alias	Type	Required	Help message
--config	-c	string	no	

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.

Error code	Exit code	Error message
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe sample

zwe > sample

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	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	

Full name	Alias	Type	Required	Help message
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe support verify-fingerprints

zwe > support > verify-fingerprints

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--target-dir		string	no	
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Error code	Exit code	Error message
ZWEL0113E	113	Failed to find Zowe version. Please validate your Zowe directory.
ZWEL0150E	150	Failed to find file %s. Zowe runtimeDirectory is invalid.

Error code	Exit code	Error message
ZWEL0151E	151	Failed to create temporary file %s. Please check permission or volume free space.
ZWEL0181E	181	Failed to verify Zowe file fingerprints.

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.

Error code	Exit code	Error message
ZWEL0140E	140	Failed to translate Zowe configuration (%s).
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe support

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
    - Node.js version
- Zowe configurations
    - Zowe manifest.json
    - Zowe configuration file
    - Zowe installation logs
    - Zowe PKCS#12 keystore if used
    - Zowe temporary configuration files under `<workspace>/.env`
    - Zowe APIML static registration files under `<workspace>/api-mediation/api-defs`
- Zowe runtime
    - Active running Zowe processes
    - Zowe job log
- Zowe fingerprints and validation result

Parameters

Full name	Alias	Type	Required	Help message
--target-dir		string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe install

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.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--allow-overwrite,--allow-overwritten		boolean	no	
--dataset-prefix,--ds-prefix		string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Error code	Exit code	Error message
ZWEL0157E	157	%s (%s) is not defined in Zowe YAML configuration file.
ZWEL0300W		%s already exists. Members in this data set 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

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe start

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.jobname` 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.

Examples

Parameters

Full name	Alias	Type	Required	Help message
--ha-instance	-i	string	no	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	

Full name	Alias	Type	Required	Help message
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Error code	Exit code	Error message
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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe stop

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.jobname` 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	

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	

Full name	Alias	Type	Required	Help message
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

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.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe version

zwe > version

Description

Display Zowe version.

Examples

Parameters

Inherited from parent command

Full name	Alias	Type	Required	Help message
--help	-h	boolean	no	
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

Errors

Error code	Exit code	Error message

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.

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).

Error code	Exit code	Error message
ZWEL0142E	142	Failed to refresh APIML static registrations.
ZWEL0172E		Component %s has %s defined but the file is missing.

zwe

zwe

Sub-commands

- certificate
- components
- 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	

Full name	Alias	Type	Required	Help message
--debug,--verbose	-v	boolean	no	
--trace	-vv	boolean	no	
--silent	-s	boolean	no	
--log-dir,--log	-l	string	no	
--config	-c	string	no	

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.

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.

Error code	Exit code	Error message
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.
ZWEL0172E		Component %s has %s defined but the file is missing.

Zowe YAML configuration file reference

Zowe v2 uses a YAML configuration file during installation, configuration and runtime. This file is usually referred to as `zowe.yaml`. YAML is a human-friendly data serialization language for all programming languages. To learn more about YAML specifications, see https://yaml.org/.

Note: In the following sections, we refer to configuration keys by using concatenation of key names and dots. For example, if you want to update the configuration key `zowe.certificate.keystore.type` with value `PKCS12`, you should set value for this entry in the `zowe.yaml`:

Table of Contents

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 configuration for 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 a special `@include` annotation that can be used in any level of the configuration. This enables you to organize your YAML configuration files and extract sharable configurations to a separate YAML file.

For example, you can define a sharable certificate configuration file `<keystore-dir>/zowe-certificates.yaml` like this:

Then in your `zowe.yaml`, you can import this certification file like this:

Configuration override

Inside `zowe.yaml`, you can define default values and they may 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, if it's not overridden, it falls back to default configurations.

Example:

App Server will use the certificate alias `app-server` instead of `localhost` from the same keystore defined in `zowe.certificate.keystore.file`. And it will use the exact 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 you can find in `components.<component>` level can be overridden in `haInstances.<ha-instance>.components.<component>` level. For example, in this configuration:

  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, certificate definition shares the same format and this format 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`**
  Defines 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`**
  Defines 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`**
  Defines 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`**

  Defines 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`**

  Defines the path to the truststore file. If you are using keyring, this should look like `safkeyring:////<keyring-owner>/<keyring-name>`, usually will be the same value of `keystore.file`.

- **`truststore.password`**

  Defines the password of the truststore.

- **`pem.key`**

  Defines 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`**

  Defines the public key file in PEM format. This can be used by applications that do not support either PKCS12 keystore format or z/OS keyring.

- **`pem.certificateAuthorities`**

  Defines certificate authorities in PEM format. This can be used by applications that do not support either PKCS12 keystore format or z/OS keyring.

YAML configurations - zowe

The high-level configuration `zowe` supports these definitions:

Directories

- **`zowe.runtimeDirectory`**

  Tells Zowe the runtime directory where it's installed.

- **`zowe.logDirectory`**

  Some Zowe components write logs to file system. This tells Zowe which directory should be used to store log files.

- **`zowe.workspaceDirectory`** Tells Zowe components where they can write temporary runtime files.

- `zowe.extensionDirectory`

  Tells Zowe where you put the runtime of all your extensions.

  Zowe Job

- `zowe.job.name`

  Defines the Zowe job name for the ZWESLSTC started task.

- `zowe.job.prefix`

  Defines the Zowe address space prefix for Zowe components.

Domain and port to access Zowe

- `zowe.externalDomains`

  Defines a list of external domains that will be used by the Zowe instance. This configuration is an array of domain name strings. In Sysplex deployment, this is the DVIPA domain name defined in Sysplex Distributor. For example,

  In Kubernetes deployment, this is the domain name you will use to access your Zowe running in Kubernetes cluster.

- `zowe.externalPort`

  Defines the port that will 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. See Configure Sysplex Distributor for more information. In Kubernetes deployment, this is the gateway Service port will be exposed to external.

Extra environment variables

- `zowe.environments`

  Defines extra environment variables to customize the Zowe runtime. This configuration is a list of key / value pairs. **Example:**

  Please be aware that variables defined here are global to all Zowe components, on all HA instances.

Certificate

- `zowe.certificate`

  Defines the northbound certificate facing Zowe users.

- `zowe.verifyCertificates` Defines how Zowe should validate the certificates used by components or external service(s) like z/OSMF. It can be a value of:

- `STRICT` : This is the default value. Zowe will validate if the certificate is trusted in our trust store and if the certificate Command Name and Subject Alternative Name (SAN)is validated. This is recommended for the best security.
  - `NONSTRICT` : Zowe will validate if the certificate is trusted in our trust store. In this mode, Zowe does not validate certificate Common Name and Subject Alternative Name (SAN). This option does not have the best security but allows you to try out Zowe when you don't have permission to fix certificate used by external services like z/OSMF.
  - `DISABLED` : This will disable certificate validation completely. This is **NOT** recommended for security purpose.

Launcher and launch scripts

Launcher is the program behind `ZWESLSTC` started task.

- `zowe.launcher`

  The launcher section defines defaults about how the Zowe launcher should act upon components.
- `zowe.launcher.restartIntervals`

  An array of positive integers that defines how many times a component should be tried to be restarted if it fails, and how much time to wait in seconds for that restart to succeed before retrying.
- `zowe.launcher.minUptime`

  The minimum amount of time a zowe component should be running in order to be declared as started successfully.
- `zowe.launcher.shareAs`

  Whether or not the launcher should start components in the same address space as it. See documentation for _BPX_SHAREAS for details.
- `zowe.launchScript.logLevel` You can set it to `debug` or `trace` to enable different level of debug messages from Zowe launch scripts. This may help to troubleshoot issues during Zowe start.

Setup

Zowe YAML configuration uses `zowe.setup` section to instruct how Zowe should be installed and configured. This section is optional for Zowe runtime but only be used for `zwe install` and `zwe init` commands.

- `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` will be APF authorized.

- `zowe.setup.dataset.authPluginLib` is the user custom APF PLUGINLIB. You can install Zowe ZIS plug-ins 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 AUX started task name. This configuration is optional. Default value is `ZWESASTC`.

- `zowe.setup.certificate.type` is the type of certificate. Valid values are `PKCS1` (USS keystore) or `JCERACFKS` (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`. 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` is the list of certificate authorities will be imported to Zowe `PKCS12` keystore or `JCERACFKS` keyring. Please note, for JCERACFKS 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 `JCERACFKS` 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 `JCERACFKS` certificate (z/OS keyring) 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 `JCERACFKS`.

- 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`.

YAML configurations - java

The high-level configuration `java` supports these definitions:

- `home`

  Defines the path to the Java runtime directory.

YAML configurations - node

The high-level configuration `node` supports these definitions:

- `home`

  Defines the path to the Node.js runtime directory.

YAML configurations - zOSMF

The high-level configuration `zOSMF` supports these definitions:

- `zOSMF.host`

  Defines the hostname of your z/OSMF instance.
- `zOSMF.port`

  Defines the port of your z/OSMF instance.
- `zOSMF.applId`

  Defines 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 extensions. For all components and extensions, these are the common definitions.

- `components.<component>.enabled`

  Defines if you want to start this component in this Zowe instance. This allows you to control each component instead of a group.

- `components.<component>.certificate`

  You can customize a component to use different certificate from default values. This section follows same format defined in YAML configurations - certificate. If this is not customized, the component will use certificates defined in `zowe.certificate`.

- `components.<component>.launcher`

  Any component can have 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`

  Defines the port which the gateway should be started on. This must be a valid port number.

- `debug`

  Defines whether to enable debug mode for the Gateway.

- `apiml.service.allowEncodedSlashes`

  When this parameter is set to `true`, the Gateway allows encoded characters to be part of URL requests redirected through the Gateway.

- `apiml.service.corsEnabled`

  When this parameter is set to `true`, CORS are enabled in the API Gateway for Gateway routes `gateway/api/v1/**`.

- `apiml.service.preferIpAddress`

  Set this parameter to `true` to advertise a service IP address instead of its hostname. **Note:** This configuration is deprecated. Zowe start script will ignore this value and always set it to `false`.

- `apiml.gateway.timeoutMillis`

  Specifies the timeout for connection to the services in milliseconds.

- `apiml.security.x509.enabled`

  Set this parameter to `true` to enable the client certificate authentication functionality through ZSS.

- `apiml.security.x509.externalMapperUrl`

  Defines the URL where Gateway can query the mapping of client certificates.

- `apiml.security.auth.provider`

  Defines the authentication provider used by the API Gateway.

- `apiml.security.authorization.endpoint.url`
  Defines the URL to the authorization endpoint. This endpoint tells Gateway if a user has a particular permission on SAF profile. For example, permission to the `APIML.SERVICES` profile of `ZOWE` class.

- `apiml.security.ssl.verifySslCertificatesOfServices`
  Defines whether APIML should verify certificates of services in strict mode. Setting to `true` will enable the `strict` mode where APIML will validate if the certificate is trusted in turststore, and also if the certificate Common Name or Subject Alternate Name (SAN) matches the service hostname.

- `apiml.security.ssl.nonStrictVerifySslCertificatesOfServices`
  Defines whether APIML should verify certificates of services in non-strict mode. Setting the value to `true` will enable the `non-strict` mode where APIML will validate if the certificate is trusted in turststore, but ignore the certificate Common Name or Subject Alternate Name (SAN) check. Zowe will ignore this configuration when strict mode is enabled with `apiml.security.ssl.verifySslCertificatesOfServices`.

- `apiml.server.maxConnectionsPerRoute`
  Specifies the maximum connections for each service.

- `apiml.server.maxTotalConnections`
  Specifies the total connections for all services registered under API Mediation Layer.

Configure component discovery

These configurations can be used under the `components.discovery` section:

- `port`
  Defines the port which discovery 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`
  Defines whether to enable debug mode for the Discovery Service.

- `apiml.service.preferIpAddress`
  Set this parameter to `true` to advertise a service IP address instead of its hostname. **Note:** This configuration is deprecated. The Zowe start script will ignore this value and always set it to `false`.

- `apiml.security.ssl.verifySslCertificatesOfServices`
  Defines whether APIML should verify certificates of services in strict mode. Setting to `true` will enable the `strict` mode where APIML will validate both if the certificate is trusted in turststore, and also if the certificate Common Name or Subject Alternate Name (SAN) matches the service hostname.

- `apiml.security.ssl.nonStrictVerifySslCertificatesOfServices`
  Defines whether APIML should verify certificates of services in non-strict mode. Setting to `true` will enable the `non-strict` mode where APIML will validate if the certificate is trusted in turststore, but ignore the certificate Common Name or Subject Alternate Name (SAN) check. Zowe will ignore this configuration if strict mode is enabled with `apiml.security.ssl.verifySslCertificatesOfServices`.

- `alternativeStaticApiDefinitionsDirectories`
  Specifies the alternative directories of static definitions.

- `apiml.server.maxTotalConnections`
  Specifies the total 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. Using this parameter ensures compatibility of services that use a non-conformant organization prefix with v2, based on Zowe v2 conformance.

Configure component api-catalog

These configurations can be used under the `components.api-catalog` section:

- `port`
  Defines the port which API Catalog should be started on.

- `debug`
  Defines if we want to enable debug mode for the API Catalog. This is equivalent to the `APIML_DEBUG_MODE_ENABLED` variable but with better granular level.

- `environment.preferIpAddress`
  Set this parameter to `true` to advertise a service IP address instead of its hostname.
  Note: This configuration is deprecated. Zowe start script will ignore this value and always set it to `false`.

Configure component caching-service

These configurations can be used under the `components.caching-service` section:

- `port`
  Defines 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`

  Defines if we want to enable debug mode for the Caching Service.
- `storage.mode`

  Sets the storage type used to persist data in the Caching Service.
- `storage.size`

  Specifies amount of records before eviction strategies start evicting.
- `storage.evictionStrategy`

  Specifies eviction strategy to be used when the storage size is achieved.
- `storage.vsam.name`

  Specifies the data set name of the caching service VSAM data set.
- `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.
- `environment.preferIpAddress`

  Set this parameter to `true` to advertise a service IP address instead of its hostname. **Note:** this
  configuration is deprecated. Zowe start script will ignore this value and always set it to `false`.

- `apiml.security.ssl.verifySslCertificatesOfServices`
  Specifies whether APIML should verify certificates of services in strict mode. Set to `true` will enable `strict` mode that APIML will validate both if the certificate is trusted in turststore, and also if the certificate Common Name or Subject Alternate Name (SAN) match the service hostname.

- `apiml.security.ssl.nonStrictVerifySslCertificatesOfServices`
  Defines whether APIML should verify certificates of services in non-strict mode. Setting to `true` will enable `non-strict` mode where APIML will validate if the certificate is trusted in turststore, but ignore the certificate Common Name or Subject Alternate Name (SAN) check. Zowe will ignore this configuration if strict mode is enabled with `apiml.security.ssl.verifySslCertificatesOfServices`.

Configure component app-server

These configurations can be used under the `components.app-server` section:

- `port`
  Defines the port which App Server 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 `-`.

Configure component zss

These configurations can be used under the `components.zss` section:

- `port`
  Defines the port which ZSS 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 `-`.

Configure component jobs-api

These configurations can be used under the `components.jobs-api` section:

- `port`
  Defines the port which Jobs API 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`
  Defines whether to enable debug logging for the Jobs API.

Configure component files-api

These configurations can be used under the `components.files-api` section:

- `port`
  Defines the port which Files API 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`
  Defines whether to enable debug logging for the Files API.

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.

For all high availability instances, these are the common definitions.

- `haInstances.<ha-instance>.hostname`
  Defines the host name where you want to start this instance. This could be the host name of one LPAR in your Sysplex.
- `haInstances.<ha-instance>.sysname`
  Defines the system name of the LPAR where the instance is running. Zowe will use `ROUTE` command to send JES2 start or stop command to this HA instance.
- `haInstances.<ha-instance>.components.<component>`
  Optional settings you can override component configurations for this high availability instance. See

Auto-generated environment variables

Each line of Zowe YAML configuration will have a matching environment variable during runtime. This is converted based on pre-defined pattern:

- All configurations under `zowe`, `components`, `haInstances` will be converted to a variable with name:
  - prefixed with `ZWE_`,
  - any non-alphabetic-numeric characters will be converted to underscore `_`,
  - and no double underscores like `__`.
- Calculated configurations of `haInstance`, which is portion of `haInstances.<current-ha-instance>` will be converted same way.
- Calculated configurations of `configs`, which is portion of `haInstances.<current-ha-instance>.components.<current-component>` will be converted same way.
- All other configuration entries will be converted to a variable with name:
  - all upper cases,
  - any non-alphabetic-numeric characters will be converted to underscore `_`,
  - and no double underscores like `__`.

For examples:

- `ZWE_zowe_runtimeDirectory`, parent directory of where `zwe` server command is located.
- `ZWE_zowe_workspaceDirectory` is the path of 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.

Server component manifest file reference

Zowe server component manifest file defines the name and purpose of the component. It also provides information about how this component should be installed, configured, and started. It can be named as `manifest.yaml`, `manifest.yml`, or `manifest.json` and should be located in the root directory of the component. Currently, only `YAML` or `JSON` format are supported.

The manifest file contains the following properties:

- `name`

  (Required) Defines a short, computer-readable name of the component. This component name is used as directory name after it is installed. The allowed characters in the name are alphabets, numbers, hyphen (`-`) and underscore (`_`). For example, `explorer-jes` is a valid extension name.

- `id`

  (Optional) Defines a long, computer-readable identifier of the component. If the component is hosted as one of the projects in Open Mainframe Project, the identifier also matches the component path in the Zowe Artifactory. For example, `org.zowe.explorer-jes` is a valid identifier. You can locate the component's official releases by looking into the `libs-release-local/org/zowe/explorer-jes/` directory in the Zowe Artifactory.

- `version`:

  (Optional but recommended) This is the current version of the component without the prefix of `v`. For example, `2.0.0` is a valid `version` value.

- `title`

  (Optional) Defines a short human-readable name for this component. This value will also be used as the default title for API Catalog tile, or App Framework plug-in title. For example, `JES Explorer` is a valid `title` for the `explorer-jes` component.

- `description`

  (Optional) Defines a long human-readable description of this component. There is no restriction on what you can put in the field.

- `license`

  (Optional but recommended) Defines the license code of the component. For example, Zowe core components have `EPL-2.0` value in this field.

- `schemas`

  (Required) Defines the location of json schema files that are compatible with certain portions of Zowe as denoted by each child property.

  - `configs`

    (Required) Defines the location of the json schema file which extends the Zowe Component base schema.

- `build`

  (Optional but strongly recommended) Defines the build information of the current package, including git commit hash, and so on. When Zowe core components define manifest file, these fields are left as template variables. The template will be updated when a publishable package is created. It supports the following subfields:

  - `branch`

    It indicates which branch this package is built from.

  - `number`

    You may create multiple packages in the same branch. This is the sequential number of the current package.

  - `commitHash`

    This is the commit hash of the package that can be used to match the exact source code in the repository. Zowe core components usually use `git rev-parse --verify HEAD` to retrieve the commit hash.

  - `timestamp`

    This is the UNIX timestamp when the package is created.

- `commands`

  This defines actions that should be taken when the component is installed, configured, started, or tested. You must issue this command with one or more subfields as listed below. For example, `commands.install`. All subfields are optional and usually should point to a USS command or script.

  - `install`

    This defines extra steps when installing this component. It will be automatically executed if you install your component with the `zwe components install` server command.

  - `validate`

    This defines extra validations that the component requires other than global validations. It is for runtime purpose, and will be automatically executed each time Zowe is started.

  - `configure`

    This defines extra configuration steps before starting the component. It is for runtime purpose, and will be automatically executed each time Zowe is started.

  - `start`

    This tells the Zowe launch script how to start the component. It is for runtime purpose, and will be automatically executed each time Zowe is started.

- `apimlServices`

  This section defines how the component will be registered to the API Mediation Layer Discovery Service. All subfields are optional.

  - `dynamic`

    Array of objects. This information will tell Zowe and users what services you will register under the Discovery service.

    - `serviceId`

      This defines the service ID registered to the Discovery service.

  - `static`

Array of objects. When the component is statically registered under the Discovery service, this tells Zowe where to find these static definitions. This information is for the Zowe runtime. When Zowe is starting, the launch script will check this field and put the parse static definition file into the directory defined as `ZWE_STATIC_DEFINITIONS_DIR` in the Zowe instance.

- `file`

  Defines the path to the static definition file. This file is supposed to be a template.

- `basePackage`

  Defines the base package name of the extension. It is used to notify the extended service of the location for component scan.

- `appfwPlugins`

  Array of objects. This section defines how the component will be registered to the App Framework plug-in. All subfields are optional.

  - `path`

    This points to the directory where App Framework `pluginDefinition.json` file is located. When Zowe is starting, the launch script will check this field and register the plug-in to Zowe App Framework Server.

- `gatewaySharedLibs` : Array of objects. This section defines the API ML extension(s) attributes which will get installed and used by API ML.

  - `path`

    This points to the directory where the JAR files are housed for an extension and later on copied into the API ML extensions workspace directory. If there is more than 1 extension to a single manifest (say for a product family of multiple extensions), then multiple path variables can be contained within the manifest denoted by individual folders, for example `path/to/yourextension1/`. Alternatively, `path` can be the JAR file path rather than a directory path.

- `zisPlugins`

  List of ZIS plugin objects. This section defines the ZIS plugin(s) attributes necessary for ZIS plugin installation and automation.

- `id`

  This is the unique plugin ID of the ZIS plugin.

- `path`

  This points to the directory where the load modules are housed for a plugin, for example `/zisServer`. If there is more than 1 plugin to a single manifest (say for a product family of multiple plugins), then multiple path variables can be contained within the manifest denoted by individual folders, for example `yourplugin1/zisServer`. The parameters for the Zowe parmlib are assumed to be in `<PATH>/samplib`. The names of the plugin executables are assumed to be in `<PATH>/loadlib`.

For example,

- `configs`

Component can define it's own configuration in this section in desired hierarchy. This is the brief guidance for component user to learn what are the configurations and what are the default values. Any configurations defined here can be placed into `zowe.yaml` `components.<component-name>` section for customization.

For example, if the component has this defined in component manifest,

You can choose to put those configurations into `components.myextension` or `haInstance.<ha-instance>.components.myextension` of `zowe.yaml` like this:

Component can use auto-generate environment variables in lifecycle scripts to learn how the component is configured for current HA instance. In the preceding use case,

- For HA instance `lpar1`, `ZWE_configs_port` value is `14567`, `ZWE_configs_another_config` value is `my-value`, which are default values.
- For HA instance `lpar2`, `ZWE_configs_port` value is `24567`, `ZWE_configs_another_config` value is `my-value2`.

From another component, you can find `myextension` configurations like this,

- For HA instance `lpar1`, `ZWE_components_myextension_port` value is `14567`, `ZWE_components_myextension_another_config` value is `my-value`, which are default values.

- For HA instance `lpar2`, `ZWE_components_myextension_port` value is `24567`, `ZWE_components_myextension_another_config` value is `my-value2`.

Note: All paths of directories or files mentioned previously should be relative paths to the root directory where manifest is located.

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