



WebSphere Liberty Profile on z/OS

Managing, Monitoring and Problem Determination

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<https://ibm.biz/BdahrR>



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Slide 1

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Managing, Monitoring and Problem Determination

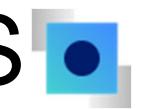
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Notes and Disclaimers

- Additional information included in this presentation was distilled from experience implementing security using RACF with z/OS products like CICS, IMS, Db2, MQ, etc. as well as Java runtimes environments like WebSphere Application Server and WebSphere Application Server Liberty (commonly called Liberty).
- There will be additional information on slides that will be designated as Tech/Tips. These contain information that at perhaps at least interesting and hopefully, useful to the reader.
- A z/OS , or a Java , or a Liberty , or a z/OS Connect , or a CICS  or a MQ  or an IMS  icon will appear on slides where the information is specific to these products. Don't hesitate to ask questions as to why the icon does or does not appear on certain slides.
- The examples, tips, etc. present in this material are based on firsthand experiences.

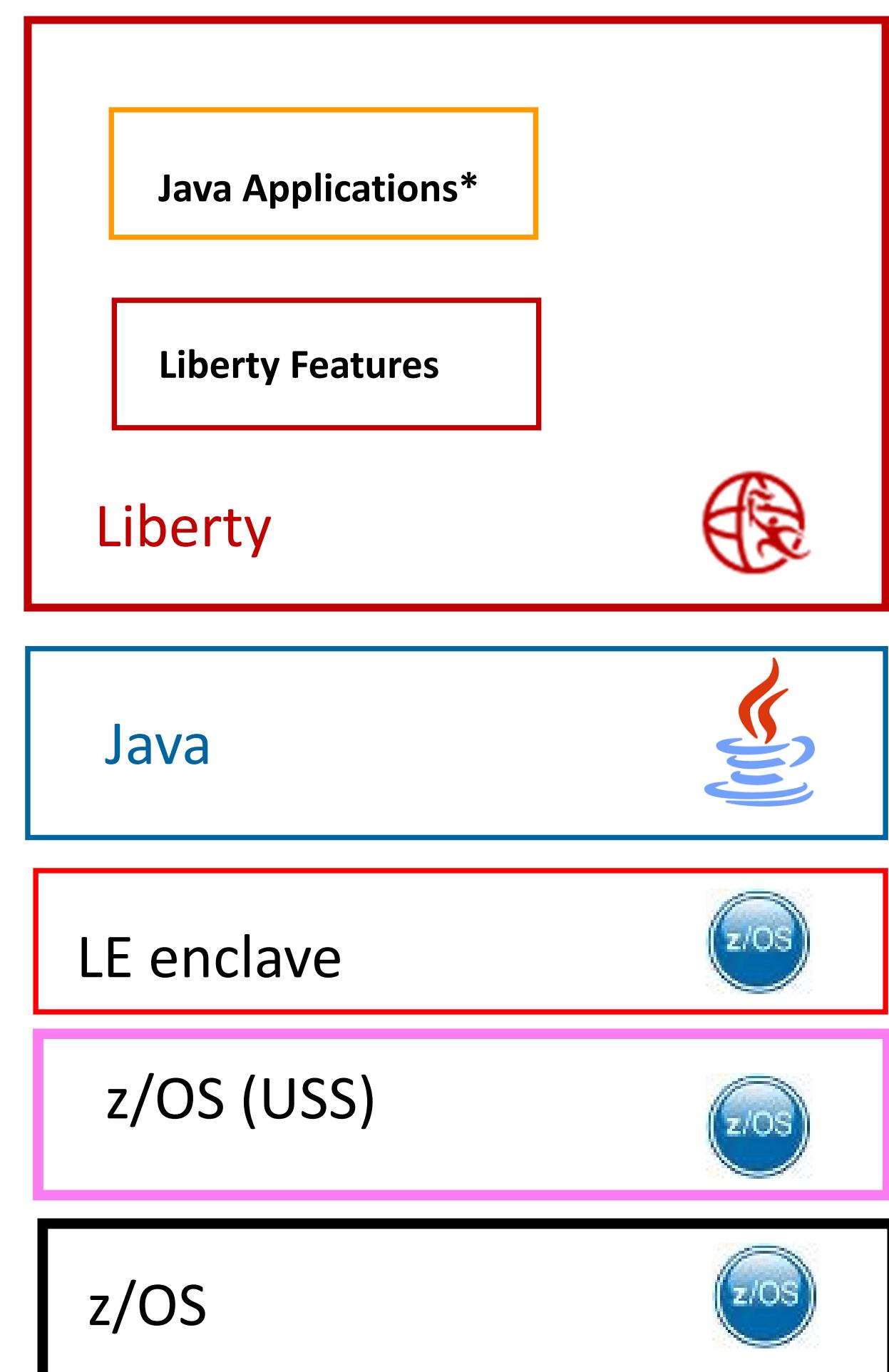
Agenda

- **Administering Liberty Servers**
 - Useful Liberty features and MVS commands
- **Managing and Monitoring Liberty servers**
 - WLM configurations
 - SMF options
 - Monitoring OMVS processes
 - Connection pooling options
 - Above the bar storage
 - High availability options
- **Where do I look when things go wrong?**
 - Problem determination techniques
 - Understand the anatomy of messages
- **Appendix – JCL, etc. samples**



Liberty basics: It helps to think of a Liberty server on z/OS as a stack or layers of software

- At the foundation, Liberty servers run on z/OS to exploit z/OS quality of services
- Liberty servers are OMVS processes that are either directly started invoking a script or binary executable(e.g. An OMVS command or JCL) or spawn by parent process (e.g., CICS or z/OS Connect).
- A Liberty server process runs in a Language Environment (LE) enclave configured for Unix System Services tailored for running Java applications.
- The Liberty server provides a environment for running user Java application. A Liberty enviroment on z/OS enables s a set of features that provide access to z/OS services like SAF, WLM, RRS, SMF, etc. to user Java applications.
- Liberty provides an execution environment for multiple concurrent Java application threads and manages connections and security for accessing z/OS resources.



Knowing and understanding the different layers and their relationships is important regarding:

- Understanding which layer a configuration options, e.g., environment variables, Java directives, etc.
- Monitoring and understanding the health of the server
- Performing problem determination and performance tuning

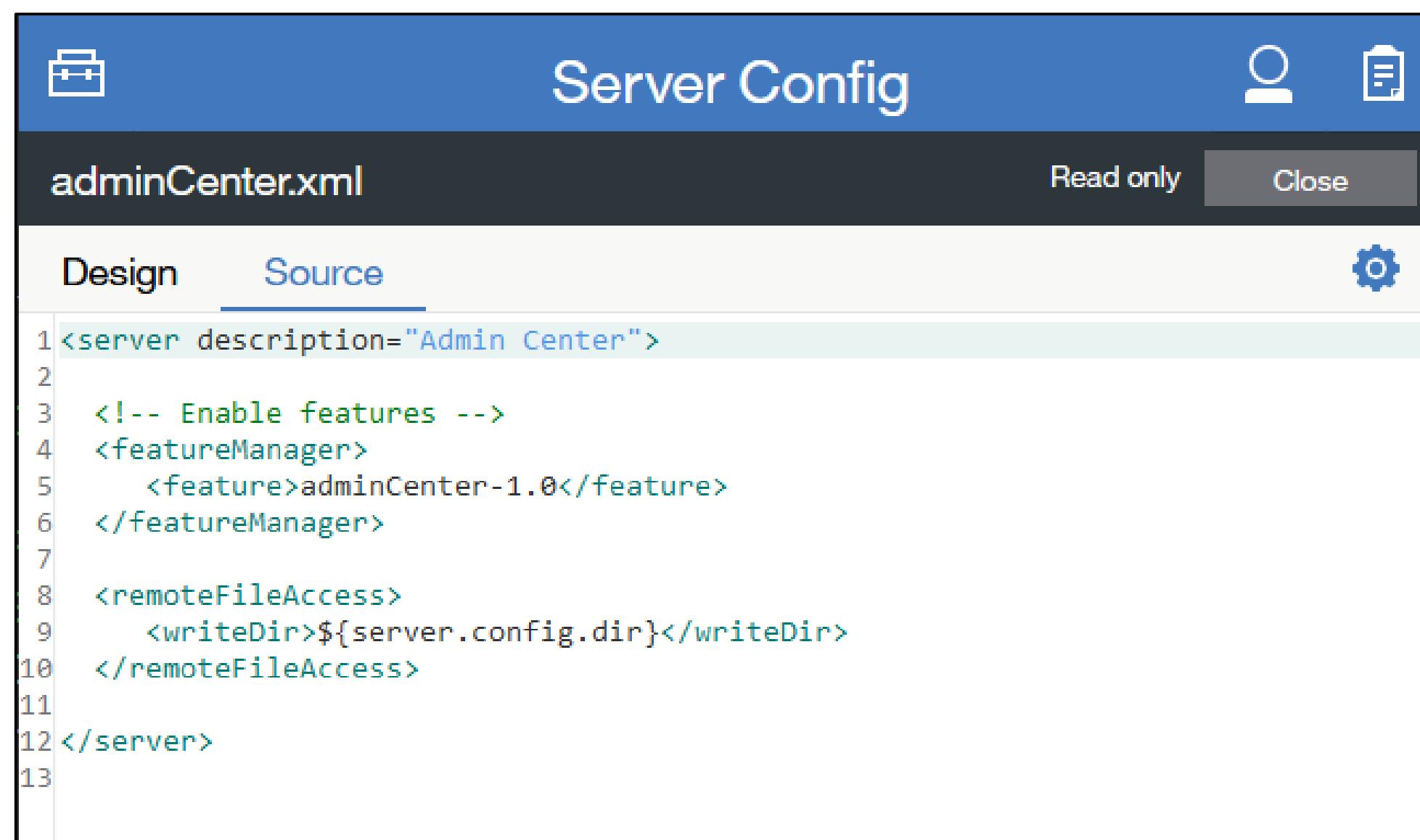
Managing Liberty Servers

**Useful Liberty features and
MVS commands**



Liberty feature: adminCenter-1.0

This feature provides a web interface to Administrators for reviewing and changing the server XML configuration.



The screenshot shows a 'Server Config' interface titled 'adminCenter.xml'. It has tabs for 'Design' and 'Source', with 'Source' selected. The XML code is as follows:

```
1 <server description="Admin Center">
2
3     <!-- Enable features -->
4     <featureManager>
5         <feature>adminCenter-1.0</feature>
6     </featureManager>
7
8     <remoteFileAccess>
9         <writeDir>${server.config.dir}</writeDir>
10    </remoteFileAccess>
11
12 </server>
13
```

Required EJBRoles

```
RDEFINE EJBROLE BBGZDFLT.com.ibm.ws.management.security.resource.Administrator OWNER(SYS1) UACC(NONE)
RDEFINE EJBROLE BBGZDFLT.com.ibm.ws.management.security.resource.Reader OWNER(SYS1) UACC(NONE)
```

```
PERMIT BBGZDFLT.com.ibm.ws.management.security.resource.Administrator CLASS(EJBROLE) ID(FRED) ACCESS(READ)
PERMIT BBGZDFLT.com.ibm.ws.management.security.resource.Reader CLASS(EJBROLE) ID(FRED) ACCESS(READ)
```

```
SETR RACLIST(EJBROLE) REFRESH
```



Liberty feature: adminCenter-1.0 – example

- Provides a web browser interface to the server's configuration files

The screenshot shows the IBM Liberty adminCenter-1.0 interface. On the left, there is a navigation sidebar with various configuration sections like 'server.xml', 'Design', 'Source', 'Include', 'Feature Manager', 'z/OS Connect Manager', 'z/OS Logging', 'z/OS Connect policy name', 'Cross-Origin Resource Sharing', 'HTTP Endpoint', 'Configuration Management', 'z/OS Connect APIs', 'z/OS Connect Services', and 'Application Monitoring'. The 'z/OS Connect Manager' section is currently selected.

The main area displays the 'server.xml' configuration file. A modal dialog is open over the 'Preserve JSON payload character format' section, showing a dropdown menu with options 'true' and 'false (default)'. The 'true' option is highlighted.

In the 'server.xml' code editor, a tooltip for the 'zosconnect_apiRequester' element is displayed, stating: 'Required z/OS Connect API Requester.'

The status bar at the bottom right of the 'server.xml' panel contains the message: 'Press Ctrl+space for content assist.' with a red circle around it.

```
<server description="new server">
<include location="/var/zosconnect/servers/myServer/resources/imsmobile-config/services/ims-services.xml" optional="true"/>
<include location="/var/zosconnect/servers/myServer/resources/imsmobile-config/interactions/ims-interactions.xml" optional="true"/>
<include location="/var/zosconnect/servers/myServer/resources/imsmobile-config/connections/ims-connections.xml" optional="true"/>
<include location="${server.config.dir}/includes/safSecurity.xml"/>
<include location="${server.config.dir}/includes/saTrace.xml"/>
<include location="${server.config.dir}/includes/ipic.xml"/>
<include location="${server.config.dir}/includes/keyring.xml"/>
<include location="${server.config.dir}/includes/apiRequesterHTTPS.xml"/>
<include location="${server.config.dir}/includes/shared.xml"/>
<include location="${server.config.dir}/includes/oauth.xml"/>
<include location="${server.config.dir}/includes/audit.xml"/>
<include location="${server.config.dir}/includes/mq.xml"/>
<include location="${server.config.dir}/includes/db2.xml"/>
<include location="${server.config.dir}/includes/wlm.xml"/>
<include location="${server.config.dir}/includes/restConnector.xml"/>
<wsSecurityProvider>
<zosconnect_apiRequester>
<zosconnect_apiRequesters>
<zosconnect_auditInterceptor>
<zosconnect_authData>
<zosconnect_authorizationInterceptor>
<zosconnect_authorizationServer>
<zosconnect_authToken>
<zosconnect_zosConnectServiceRestClientBasicAuth />

<httpEndpoint host="*" httpPort="9080" httpsPort="9443" id="defaultHttpEndpoint"/>

<cors allowCredentials="true" allowedHeaders="Origin, Content-Type, Authorization, Cache-Control, Expires, Pragma" allowedMethods="GET, POST, PUT, DELETE, HEAD, OPTIONS" maxAge="1728000" />
```



Liberty feature: restConnector-2.0

A REST administrative connector that provides real time access to configuration settings from Java clients or a Web browser (GET only) or directly through an HTTPS call to the current runtime configuration.

URI Path is the concatenation of the path `/ibm/api/config` with the server XML configuration element and any optional query strings.

```
<?xml version="1.0" encoding="UTF-8"?>
<server description="REST Connector">
  <featureManager>
    <feature>restConnector-2.0</feature>
  </featureManager>
</server>
```

<https://wg31.washington.ibm.com:9443/ibm/api/config/jmsQueue>
https://wg31.washington.ibm.com:9443/ibm/api/config/zosconnect_cicsIpicConnection?port=1491
https://wg31.washington.ibm.com:9443/ibm/api/config/zosconnect_zosConnectServiceRestClientConnection
https://wg31.washington.ibm.com:9443/ibm/api/config/zosconnect_cicsIpicConnection?id=miniloan
<https://wg31.washington.ibm.com:9443/ibm/api/config/safCredentials>
<https://wg31.washington.ibm.com:9443/ibm/api/config/connectionFactory>
https://wg31.washington.ibm.com:9443/ibm/api/config/zosconnect_zosConnectManager
<https://wg31.washington.ibm.com:9443/ibm/api/config/keyStore>
<https://wg31.washington.ibm.com:9443/ibm/api/config/ssl>
<https://wg31.washington.ibm.com:9443/ibm/api/config/sslDefault>
https://wg31.washington.ibm.com:9443/ibm/api/config/zosconnect_zosConnectManager
https://wg31.washington.ibm.com:9443/ibm/api/config/zosconnect_zosConnectAPIs
https://wg31.washington.ibm.com:9443/ibm/api/config/zosconnect_services
https://wg31.washington.ibm.com:9443/ibm/api/config/zosconnect_apiRequesters

```
RDEFINE EJBROLE BBGZDFLT.com.ibm.ws.management.security.resource.Administrator OWNER(SYS1) UACC(NONE)
RDEFINE EJBROLE BBGZDFLT.com.ibm.ws.management.security.resource.Reader OWNER(SYS1) UACC(NONE)
RDEFINE EJBROLE BBGZDFLT.com.ibm.ws.management.security.resource.allAuthenticatedUsers OWNER(SYS1) UACC(NONE)
PERMIT BBGZDFLT.com.ibm.ws.management.security.resource.Administrator CLASS(EJBROLE) ID(ZCEEUSRS) ACCESS(READ)
PERMIT BBGZDFLT.com.ibm.ws.management.security.resource.Reader CLASS(EJBROLE) ID(ZCEEUSRS) ACCESS(READ)
PERMIT BBGZDFLT.com.ibm.ws.management.security.resource.allAuthenticatedUsers CLASS(EJBROLE) ID(ZCEEUSRS) ACCESS(READ)
SETR RACLIST(EJBROLE) REFRESH
```



Liberty feature: restConnector-2.0 – featureManager example

https://wg31.washington.ibm.com:9443/ibm/api/config/featureManager

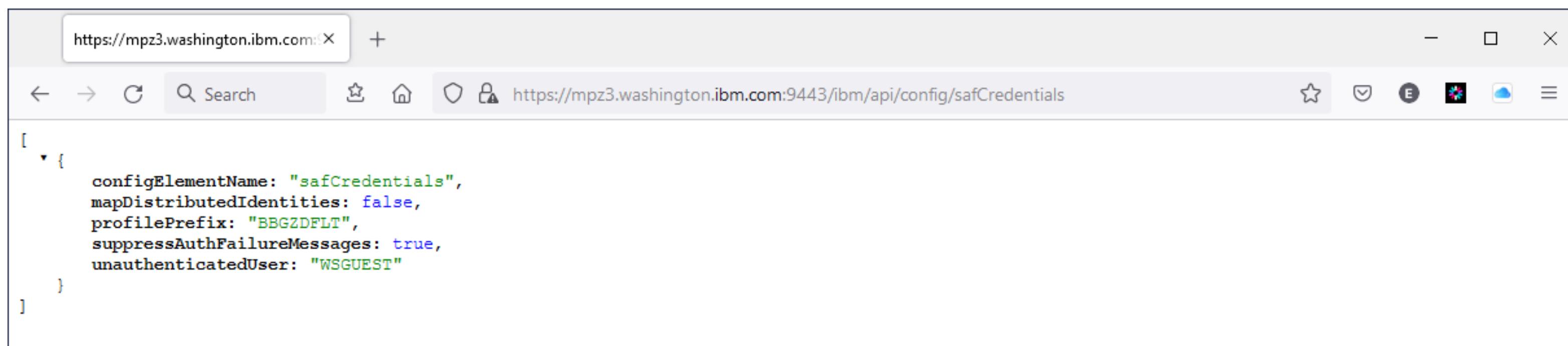
The screenshot shows a browser window with the URL <https://wg31.washington.ibm.com:9443/ibm/api/config/featureManager>. The page displays a JSON configuration for the featureManager. The configuration includes a list of features such as appSecurity-2.0, zosSecurity-1.0, zosconnect:cicsService-1.0, transportSecurity-1.0, zosconnect:apiRequester-1.0, zosconnect:apiRequester-1.0, zosconnect:mqService-1.0, zosWlm-1.0, restConnector-2.0, monitor-1.0, zosRequestLogging-1.0, adminCenter-1.0, apiDiscovery-1.0, zosconnect:zosConnect-2.0, zosconnect:zosConnectCommands-1.0, and imsmobile:imsmobile-2.0. The configuration also specifies an onError value of "WARN".

```
[{"configElementName": "featureManager", "feature": ["appSecurity-2.0", "zosSecurity-1.0", "zosconnect:cicsService-1.0", "transportSecurity-1.0", "zosconnect:apiRequester-1.0", "zosconnect:apiRequester-1.0", "zosconnect:mqService-1.0", "zosWlm-1.0", "restConnector-2.0", "monitor-1.0", "zosRequestLogging-1.0", "adminCenter-1.0", "apiDiscovery-1.0", "zosconnect:zosConnect-2.0", "zosconnect:zosConnectCommands-1.0", "imsmobile:imsmobile-2.0"], "onError": "WARN"}]
```

Liberty feature: restConnector-2.0 – safCredentials/safAuthorization examples

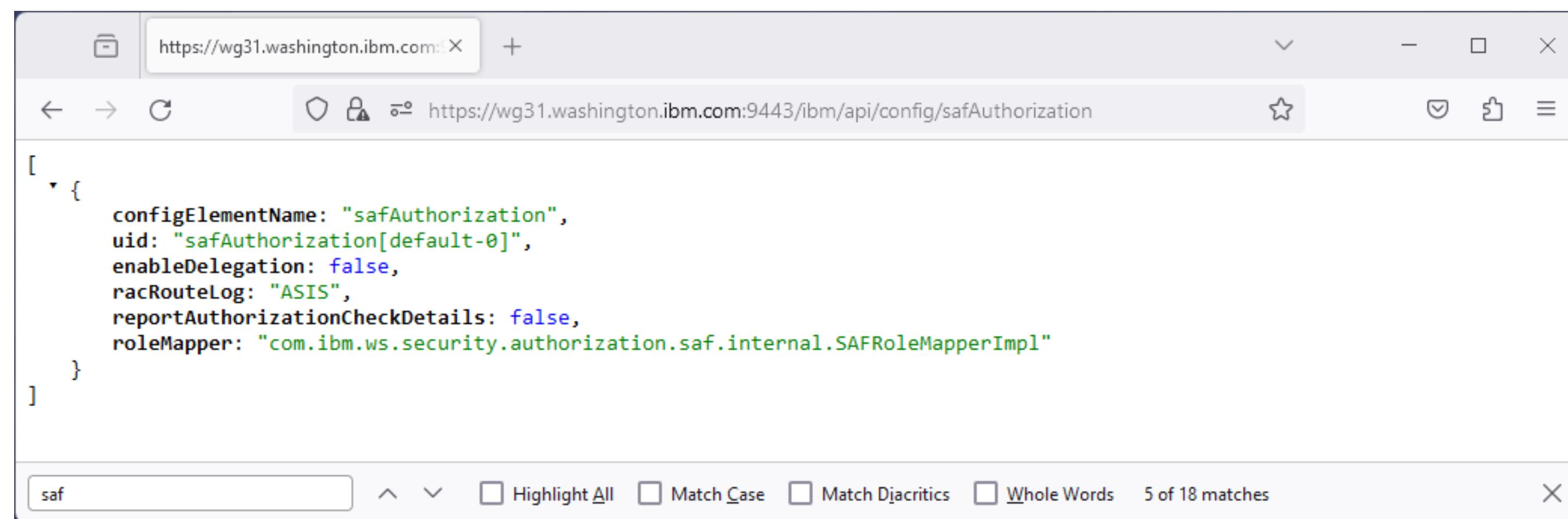


https://wg31.washington.ibm.com:9443/ibm/api/config/safCredentials



```
[{"configElementName": "safCredentials", "mapDistributedIdentities": false, "profilePrefix": "BBGZDFLT", "suppressAuthFailureMessages": true, "unauthenticatedUser": "WSGUEST"}]
```

https://wg31.washington.ibm.com:9443/ibm/api/config/safAuthorization



```
[{"configElementName": "safAuthorization", "uid": "safAuthorization[default-0]", "enableDelegation": false, "racRouteLog": "ASIS", "reportAuthorizationCheckDetails": false, "roleMapper": "com.ibm.ws.security.authorization.saf.internal.SAFAuthorizationRoleMapperImpl"}]
```

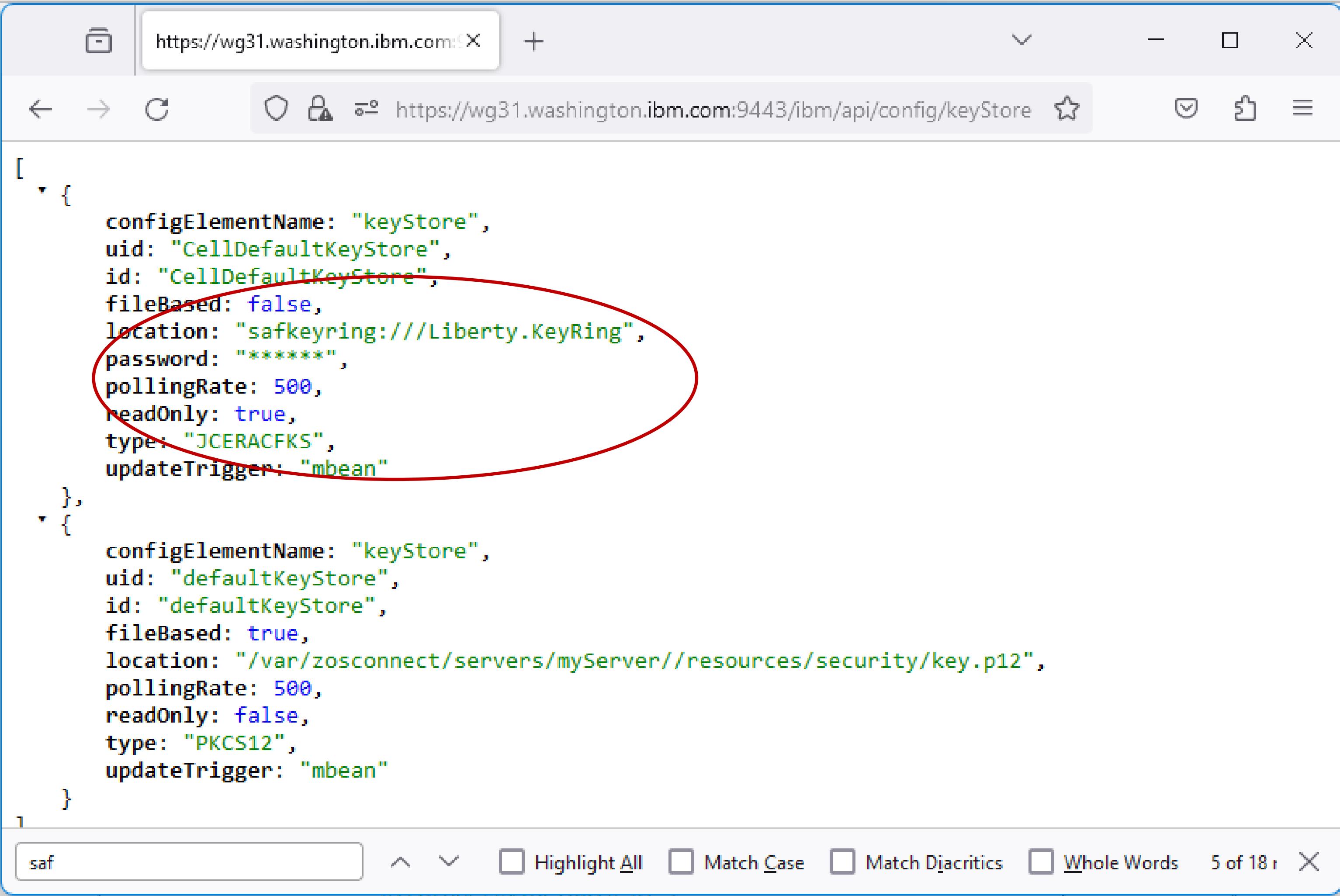
saf

Highlight All Match Case Match Diacritics Whole Words 5 of 18 matches



Liberty feature: restConnector-2.0 – keystore example

https://wg31.washington.ibm.com:9443/ibm/api/config/keyStore

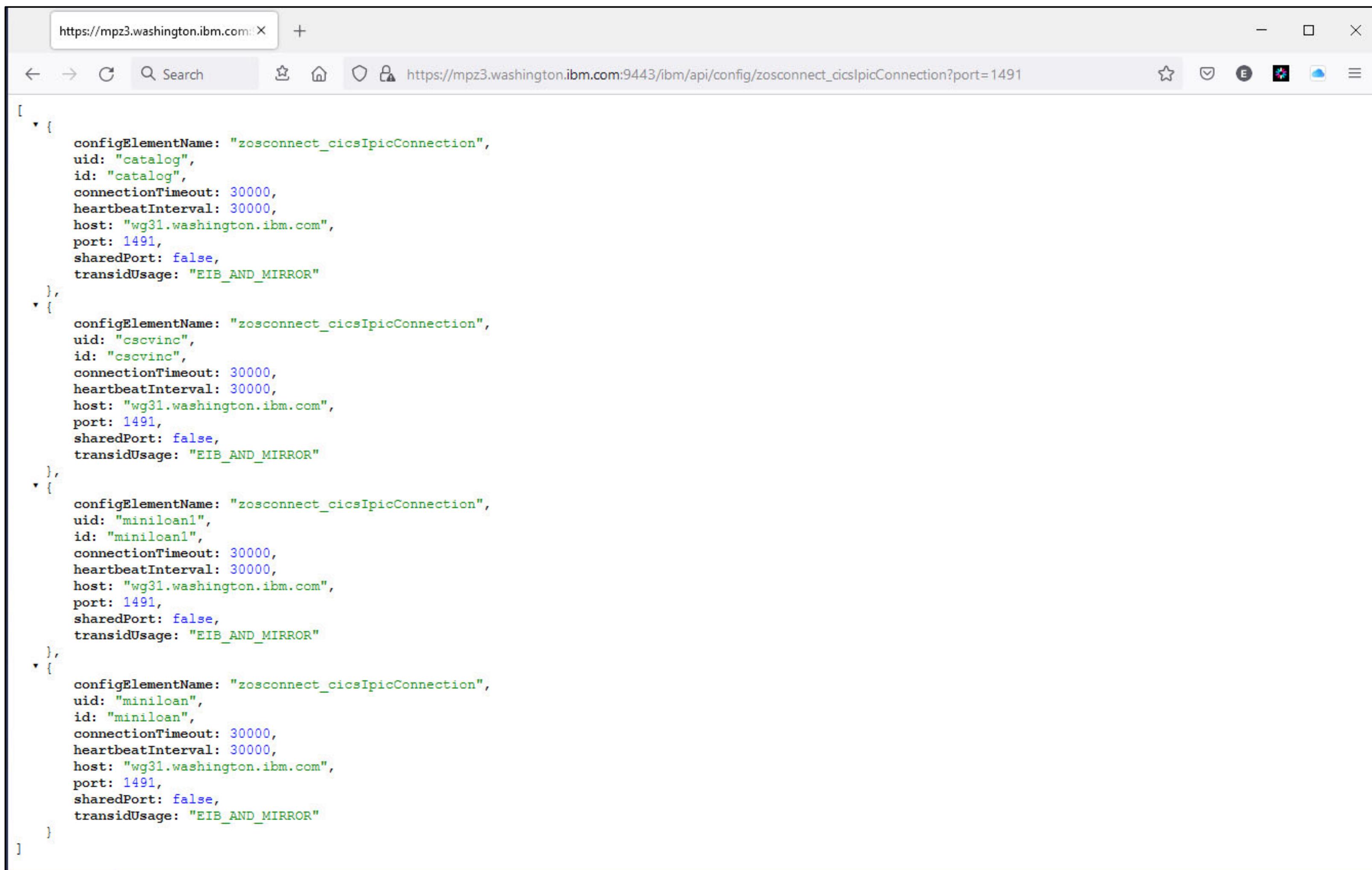


```
[  
  {  
    configElementName: "keyStore",  
    uid: "CellDefaultKeyStore",  
    id: "CellDefaultKeyStore",  
    fileBased: false,  
    location: "safkeyring:///Liberty.KeyRing",  
    password: "*****",  
    pollingRate: 500,  
    readOnly: true,  
    type: "JCERACFKS",  
    updateTrigger: "mbean"  
  },  
  {  
    configElementName: "keyStore",  
    uid: "defaultKeyStore",  
    id: "defaultKeyStore",  
    fileBased: true,  
    location: "/var/zosconnect/servers/myServer//resources/security/key.p12",  
    pollingRate: 500,  
    readOnly: false,  
    type: "PKCS12",  
    updateTrigger: "mbean"  
  }  
]
```



Liberty feature: restConnector-2.0 – zosconnect_cicsIpicConnection example

https://wg31.washington.ibm.com:9443/ibm/api/config/zosconnect_cicsIpicConnection?port=1491



```
[{"configElementName": "zosconnect_cicsIpicConnection", "uid": "catalog", "id": "catalog", "connectionTimeout": 30000, "heartbeatInterval": 30000, "host": "wg31.washington.ibm.com", "port": 1491, "sharedPort": false, "transidUsage": "EIB_AND_MIRROR"}, {"configElementName": "zosconnect_cicsIpicConnection", "uid": "cscvinc", "id": "cscvinc", "connectionTimeout": 30000, "heartbeatInterval": 30000, "host": "wg31.washington.ibm.com", "port": 1491, "sharedPort": false, "transidUsage": "EIB_AND_MIRROR"}, {"configElementName": "zosconnect_cicsIpicConnection", "uid": "minilcan1", "id": "minilcan1", "connectionTimeout": 30000, "heartbeatInterval": 30000, "host": "wg31.washington.ibm.com", "port": 1491, "sharedPort": false, "transidUsage": "EIB_AND_MIRROR"}, {"configElementName": "zosconnect_cicsIpicConnection", "uid": "minilcan", "id": "minilcan", "connectionTimeout": 30000, "heartbeatInterval": 30000, "host": "wg31.washington.ibm.com", "port": 1491, "sharedPort": false, "transidUsage": "EIB_AND_MIRROR"}]
```



Liberty feature: restConnector-2.0 – CICS ECI connection factory example

https://wg31.washington.ibm.com:9443/ibm/api/config/connectionFactory

The screenshot shows a web browser window with the URL https://wg31.washington.ibm.com:9443/ibm/api/config/connectionFactory. The page displays a JSON object representing a connection factory configuration. A red box highlights the 'properties.eciResourceAdapter' section, which contains various properties for the ECI resource adapter. The JSON structure is as follows:

```
[{"configElementName": "connectionFactory", "uid": "ECI", "id": "ECI", "jndiName": "ECI", "properties.eciResourceAdapter": {"TPNName": "", "applid": "", "applidQualifier": "", "cipherSuites": "", "clientSecurity": "", "connectionURL": "tcp://wg31.washington.ibm.com", "keyRingClass": "", "keyRingPassword": "*****", "password": "*****", "portNumber": "2006", "requestExits": "", "serverName": "CICS62", "serverSecurity": "", "socketConnectTimeout": "0", "traceLevel": 3, "tranName": "", "userName": ""}, "api": ["/ibm/api/validation/connectionFactory/ECI"]}]
```

Liberty feature: restConnector-2.0 – IMS connection factory example

https://wg31.washington.ibm.com:9453/ibm/api/config/imsmobile_imsConnection

The image shows two side-by-side browser windows displaying JSON configuration data for IMS connection factories.

Left Browser Window: The URL is https://wg31.washington.ibm.com:9453/ibm/api/config/imsmobile_imsConnection. The JSON content includes a red box highlighting the "properties.gmoa" section, which contains various connection parameters like hostName, portNumber, and traceLevel. The "api" section lists the endpoint `/ibm/api/validation/connectionFactory/IVP1`.

```
[{"configElementName": "imsmobile_imsConnection", "uid": "IMSCONN", "id": "IMSCONN", "comment": "", "connectionFactoryRef": {"configElementName": "connectionFactory", "uid": "IVP1", "id": "IVP1", "containerAuthDataRef": {"configElementName": "authData", "uid": "Connection1_Auth", "id": "Connection1_Auth", "password": "*****", "user": "USER1"}, "properties.gmoa": {"CMODedicated": false, "IMSConnectName": "", "SSLEnabled": false, "SSLEncryptionType": "Weak", "SSLKeyStoreName": "", "SSLKeyStorePassword": "*****", "SSLProtocol": "TLSv1.0", "SSLTrustStoreName": "", "SSLTrustStorePassword": "*****", "applicationName": "", "dataStoreName": "myDStrNm", "groupName": "", "hostName": "wg31.washington.ibm.com", "password": "*****", "passwordPhrase": "*****", "portNumber": 4000, "traceLevel": 1, "userName": ""}, "api": ["/ibm/api/validation/connectionFactory/IVP1"]}, "connectionTimeout": "-1", "connectionType": "IMSCONNECT", "pingIMSConnectionInvoke": false}]
```

Right Browser Window: The URL is <https://wg31.washington.ibm.com:9453/>. It displays the configuration for the "imsmobile_interaction" connection factory, which includes parameters like imsConnectCodepage, imsConnectTimeout, and imsConnectUserMessageExitIdentifier.

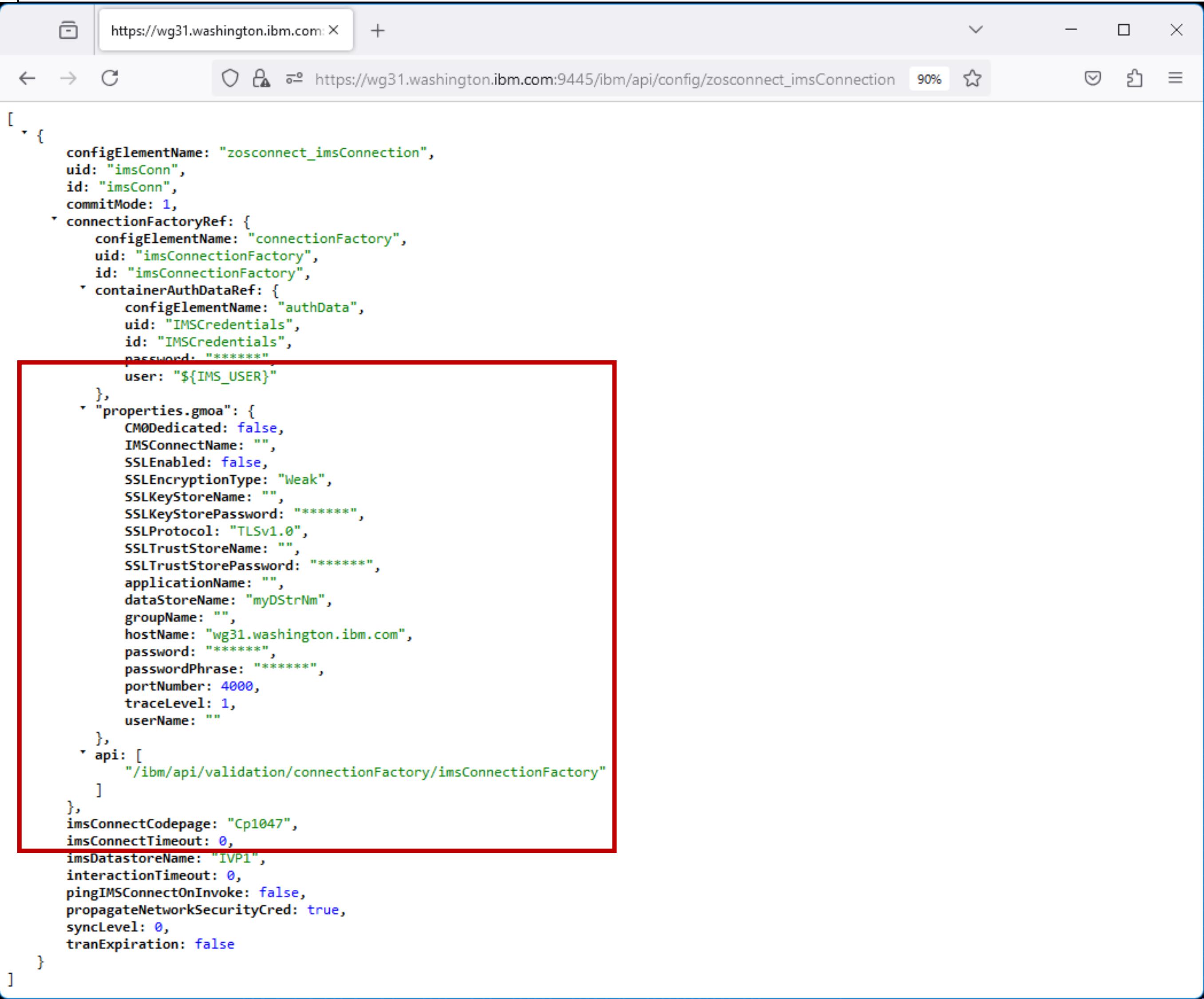
```
[{"configElementName": "imsmobile_interaction", "uid": "IMSINTER", "id": "IMSINTER", "ackNakProvider": 0, "comment": "", "commitMode": 1, "configSchemaVersion": 1, "imsConnectCodepage": "Cp1047", "imsConnectTimeout": 30000, "imsConnectUserMessageExitIdentifier": "*SAMPL1*", "imsDatastoreName": "IVP1", "inputMessageDataSegmentsIncludeLlzzAndTrancode": true, "interactionTimeout": -1, "interactionTypeDescription": "SENDRECV", "ltermOverrideName": "", "outputMessageDataSegmentsIncludeLlzz": true, "propagateNetworkSecurityCred": true, "propertyType": "TRAN", "purgeUndeliverableOutput": true, "rerouteUndeliverableOutput": false, "resumeTpipeProcessing": 16, "returnMfsModname": true, "syncLevel": 0, "useCM0AckNoWait": true}]
```

A search bar at the bottom of the right window shows the term "imsinter".

Liberty feature: restConnector-2.0 – IMS connection factory example



https://wg31.washington.ibm.com:9453/ibm/api/config/zosconnect_imsConnection



```
[{"configElementName": "zosconnect_imsConnection", "uid": "imsConn", "id": "imsConn", "commitMode": 1, "connectionFactoryRef": {"configElementName": "connectionFactory", "uid": "imsConnectionFactory", "id": "imsConnectionFactory", "containerAuthDataRef": {"configElementName": "authData", "uid": "IMSCredentials", "id": "IMSCredentials", "password": "*****", "user": "${IMS_USER}"}, "properties.gmoa": {"CMODedicated": false, "IMSConnectName": "", "SSLEnabled": false, "SSLEncryptionType": "Weak", "SSLKeyStoreName": "", "SSLKeyStorePassword": "*****", "SSLProtocol": "TLSv1.0", "SSLTrustStoreName": "", "SSLTrustStorePassword": "*****", "applicationName": "", "dataStoreName": "myDStrNm", "groupName": "", "hostName": "wg31.washington.ibm.com", "password": "*****", "passwordPhrase": "*****", "portNumber": 4000, "traceLevel": 1, "userName": ""}, "api": ["/ibm/api/validation/connectionFactory/imsConnectionFactory"]}, "imsConnectCodepage": "Cp1047", "imsConnectTimeout": 0, "imsDatastoreName": "IVP1", "interactionTimeout": 0, "pingIMSConnectOnInvoke": false, "propagateNetworkSecurityCred": true, "syncLevel": 0, "tranExpiration": false}]
```

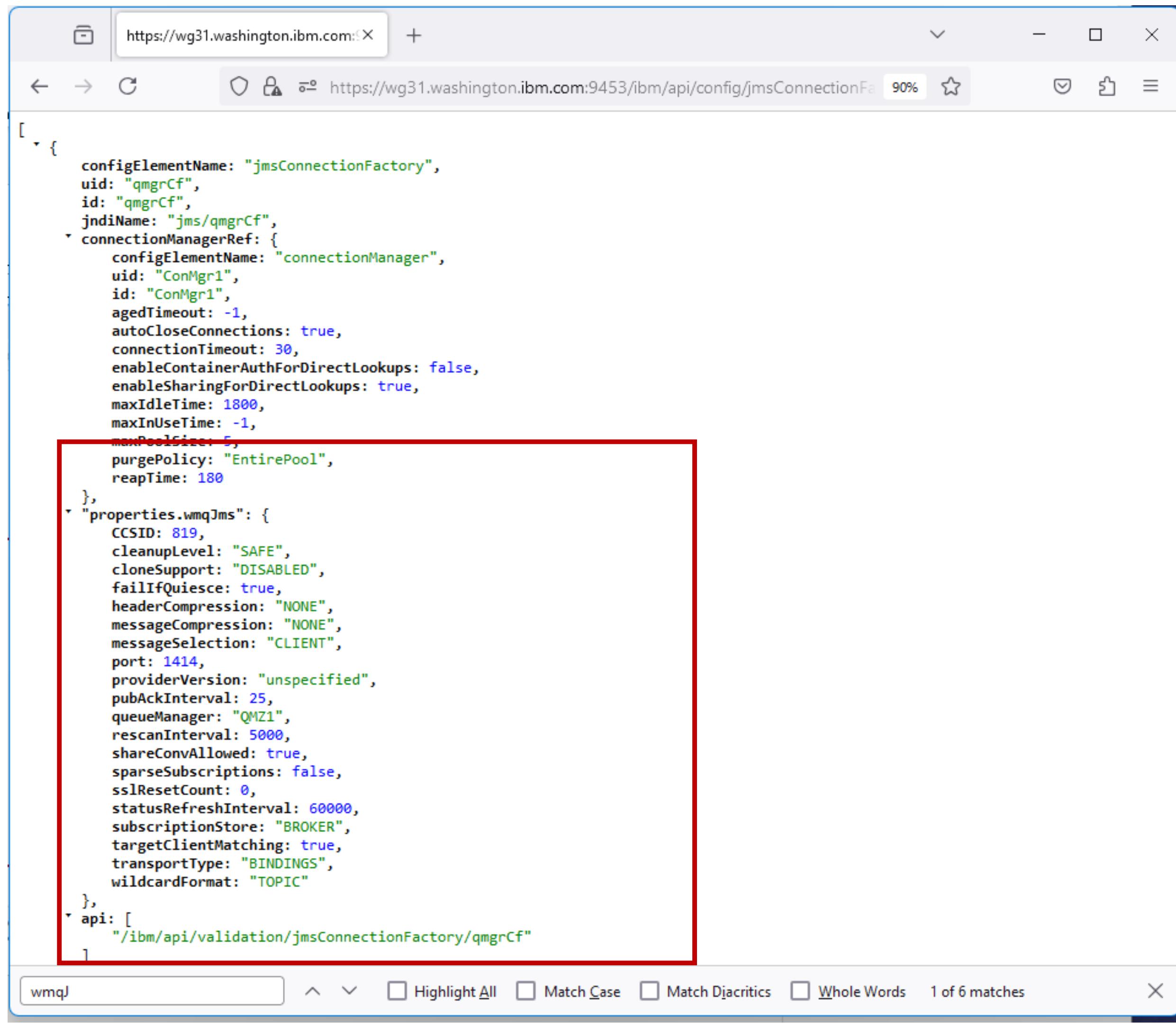
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Liberty feature: restConnector-2.0 – jmsConnectionFactory example



https://wg31.washington.ibm.com:9453/ibm/api/config/jmsConnectionFactory



```
[{"configElementName": "jmsConnectionFactory", "uid": "qmgrCf", "id": "qmgrCf", "jndiName": "jms/qmgrCf", "connectionManagerRef": {"configElementName": "connectionManager", "uid": "ConMgr1", "id": "ConMgr1", "agedTimeout": -1, "autoCloseConnections": true, "connectionTimeout": 30, "enableContainerAuthForDirectLookups": false, "enableSharingForDirectLookups": true, "maxIdleTime": 1800, "maxInUseTime": -1, "maxPoolSize": 5, "purgePolicy": "EntirePool", "reapTime": 180}, "properties.wmqJms": {"CCSID": 819, "cleanupLevel": "SAFE", "cloneSupport": "DISABLED", "failIfQuiesce": true, "headerCompression": "NONE", "messageCompression": "NONE", "messageSelection": "CLIENT", "port": 1414, "providerVersion": "unspecified", "pubAckInterval": 25, "queueManager": "QM1", "rescanInterval": 5000, "shareConvAllowed": true, "sparseSubscriptions": false, "sslResetCount": 0, "statusRefreshInterval": 60000, "subscriptionStore": "BROKER", "targetClientMatching": true, "transportType": "BINDINGS", "wildcardFormat": "TOPIC"}, "api": ["/ibm/api/validation/jmsConnectionFactory/qmgrCf"]}]
```

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Liberty feature: apiDiscovery-1.0 or OpenAPI-3.0 to display/execute APIs

The screenshot shows a browser window titled "IBM REST API Documentation" with the URL <https://mpz3.washington.ibm.com:9443/api/explorer/#/cscvinc>. The page displays the "Liberty REST APIs" section, which lists various API endpoints under categories like "cscvinc", "db2employee", "filemgr", "imsPhoneBook", "jwtlvpDemoApi", "miniloancics", "mqapi", and "phonebook". Each endpoint is shown with its method (e.g., POST, GET, PUT, DELETE) and path. A search bar at the top right contains the text "all" and a "Filter" button.

cscvinc		Show/Hide List Operations Expand Operations
POST	/cscvinc/employee	
DELETE	/cscvinc/employee/{employee}	
GET	/cscvinc/employee/{employee}	
PUT	/cscvinc/employee/{employee}	
db2employee		Show/Hide List Operations Expand Operations
filemgr		Show/Hide List Operations Expand Operations
imsPhoneBook		Show/Hide List Operations Expand Operations
jwtlvpDemoApi		Show/Hide List Operations Expand Operations
miniloancics		Show/Hide List Operations Expand Operations
mqapi		Show/Hide List Operations Expand Operations
phonebook		Show/Hide List Operations Expand Operations

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IBM MQ Administrative REST API

qmgr		Show/Hide List Operations Expand Operations
GET	/ibmmq/rest/v1/admin/qmgr	Retrieves details of all queue managers in the IBM MQ installation.
GET	/ibmmq/rest/v1/admin/qmgr/{qmgr}	Retrieves details of a specific queue manager in the IBM MQ installation.
*	GET /ibmmq/rest/v2/admin/qmgr	Retrieves details of all queue managers in the IBM MQ installation.
*	GET /ibmmq/rest/v2/admin/qmgr/{qmgr}	Retrieves details of a specific queue manager in the IBM MQ installation.
qmgr : action		Show/Hide List Operations Expand Operations
POST	/ibmmq/rest/v1/admin/action/qmgr/{qmgrName}/mqsc	Runs an MQSC command.
*	POST /ibmmq/rest/v2/admin/action/qmgr/{qmgrName}/mqsc	Runs an MQSC command.
queue		Show/Hide List Operations Expand Operations
GET	/ibmmq/rest/v1/admin/qmgr/{qmgrName}/queue	Retrieves details of all queues.
POST	/ibmmq/rest/v1/admin/qmgr/{qmgrName}/queue	Creates a queue.
DELETE	/ibmmq/rest/v1/admin/qmgr/{qmgrName}/queue/{qName}	Deletes a queue.
GET	/ibmmq/rest/v1/admin/qmgr/{qmgrName}/queue/{qName}	Retrieves details of a specific queue.
PATCH	/ibmmq/rest/v1/admin/qmgr/{qmgrName}/queue/{qName}	Modifies a queue.
subscription		Show/Hide List Operations Expand Operations
GET	/ibmmq/rest/v1/admin/qmgr/{qmgrName}/subscription	Retrieves details of all subscriptions.
GET	/ibmmq/rest/v1/admin/qmgr/{qmgrName}/subscription/{name}	Retrieves details of a specific subscription.



IBM MQ Messaging REST API Support

messaging

Show/Hide | List Operations | Expand Operations

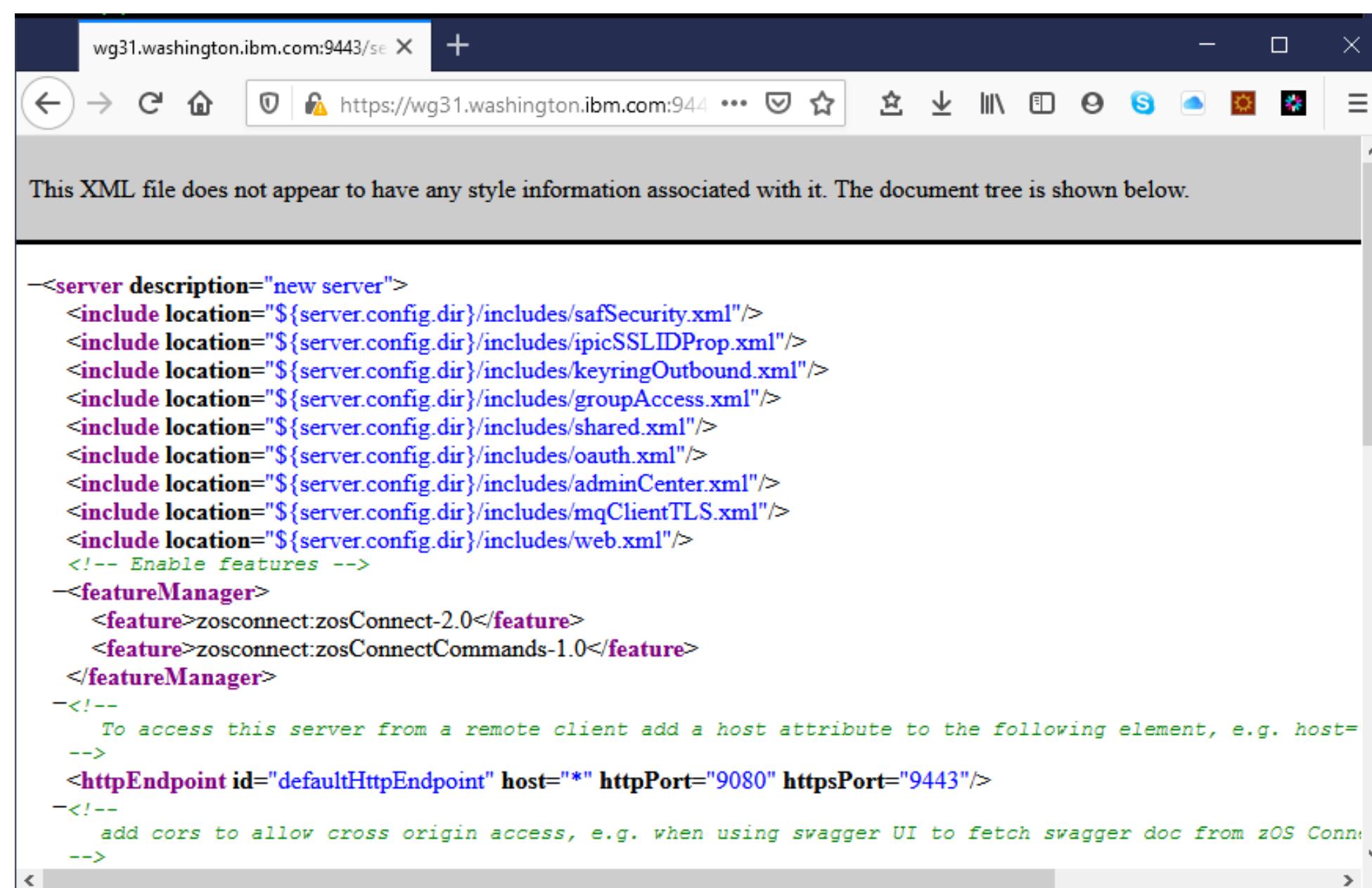
DELETE	/ibmmq/rest/v1/messaging/qmgr/{qmgrName}/queue/{qName}/message	Retrieves the next message from a specified queue.
GET	/ibmmq/rest/v1/messaging/qmgr/{qmgrName}/queue/{qName}/message	Browses the next message from a specified queue.
POST	/ibmmq/rest/v1/messaging/qmgr/{qmgrName}/queue/{qName}/message	Sends a message to a specified queue.
GET	/ibmmq/rest/v1/messaging/qmgr/{qmgrName}/queue/{qName}/messagelist	Browses messages from a specified queue.
* DELETE	/ibmmq/rest/v2/messaging/qmgr/{qmgrName}/queue/{qName}/message	Retrieves the next message from a specified queue.
* GET	/ibmmq/rest/v2/messaging/qmgr/{qmgrName}/queue/{qName}/message	Browses the next message from a specified queue.
* POST	/ibmmq/rest/v2/messaging/qmgr/{qmgrName}/queue/{qName}/message	Sends a message to a specified queue.
* GET	/ibmmq/rest/v2/messaging/qmgr/{qmgrName}/queue/{qName}/messagelist	Browses messages from a specified queue.
* POST	/ibmmq/rest/v2/messaging/qmgr/{qmgrName}/topic/{topicString}/message	Publishes a message to a specified topic.

* If you are accessing a version earlier than V9.1.5 you must use v1 rather than v2



Liberty: Enable as a file server to provide remote access to configuration/logs

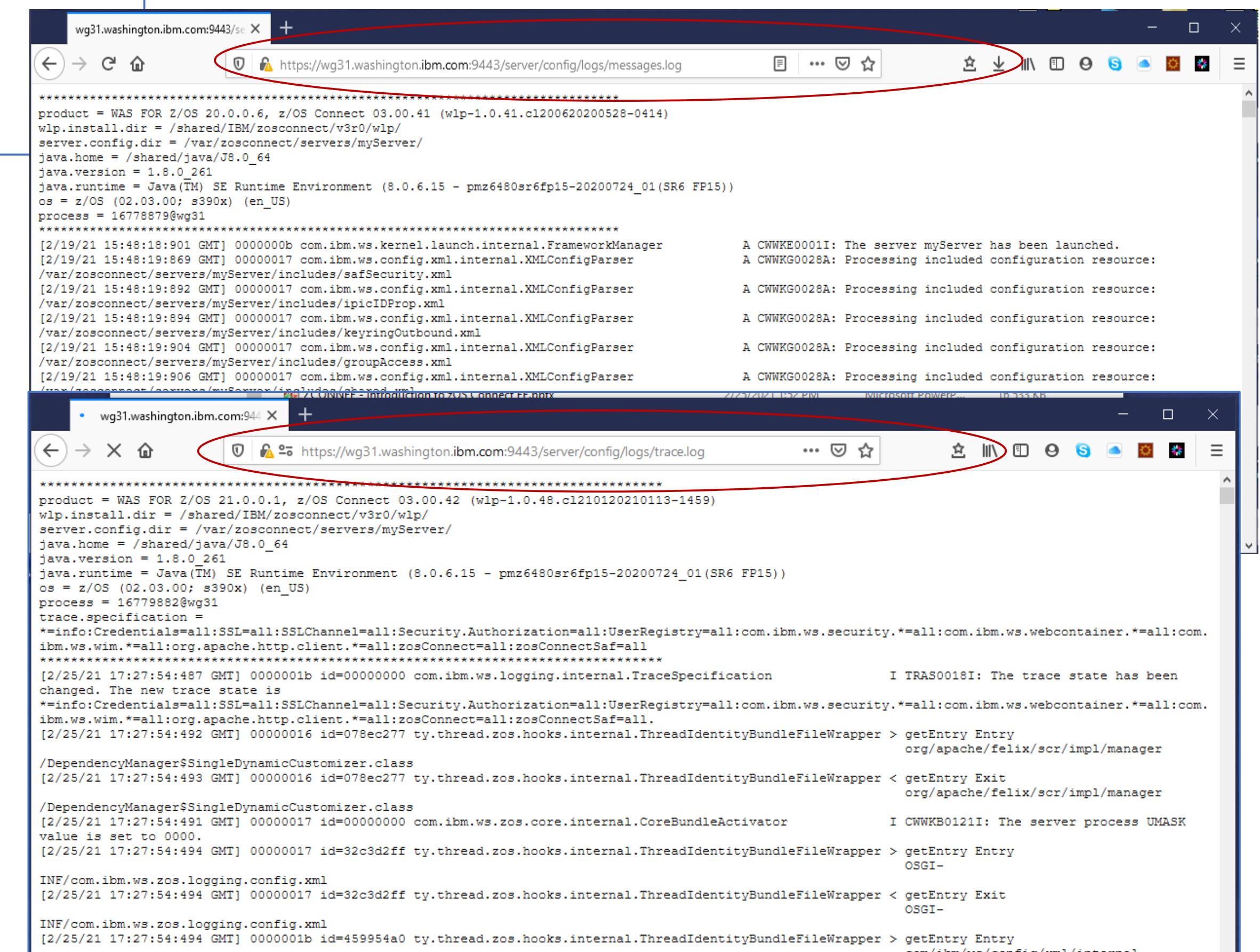
```
<webApplication id="serverConfig-location" name="serverConfig"
  location="${server.config.dir}">
  <web-ext context-root="/server/config"
    enable-file-serving="true" enable-directory-browsing="true">
    <file-serving-attribute name="extendedDocumentRoot"
      value="${server.config.dir}" />
  </web-ext>
</webApplication>
```



This XML file does not appear to have any style information associated with it. The document tree is shown below.

```
<server description="new server">
  <include location="${server.config.dir}/includes/safSecurity.xml"/>
  <include location="${server.config.dir}/includes/ipcSSLIDProp.xml"/>
  <include location="${server.config.dir}/includes/keyringOutbound.xml"/>
  <include location="${server.config.dir}/includes/groupAccess.xml"/>
  <include location="${server.config.dir}/includes/shared.xml"/>
  <include location="${server.config.dir}/includes/oauth.xml"/>
  <include location="${server.config.dir}/includes/adminCenter.xml"/>
  <include location="${server.config.dir}/includes/mqClientTLS.xml"/>
  <include location="${server.config.dir}/includes/web.xml"/>
  <!-- Enable features -->
  <featureManager>
    <feature>zosconnect:zosConnect-2.0</feature>
    <feature>zosconnect:zosConnectCommands-1.0</feature>
  </featureManager>
  <!--
    To access this server from a remote client add a host attribute to the following element, e.g. host=...
  -->
  <httpEndpoint id="defaultHttpEndpoint" host="*" httpPort="9080" httpsPort="9443"/>
  <!--
    add cors to allow cross origin access, e.g. when using swagger UI to fetch swagger doc from zOS Connect
  -->

```



wg31.washington.ibm.com:9443/server/config/logs/messages.log

```
*****
product = WAS FOR Z/OS 20.0.0.6, z/OS Connect 03.00.41 (wlp-1.0.41.c1200620200528-0414)
wlp.install.dir = /shared/IBM/zosconnect/v3r0/wlp/
server.config.dir = /var/zosconnect/servers/myServer/
java.home = /shared/java/J8_0_64
java.version = 1.8.0_261
java.runtime = Java(TM) SE Runtime Environment (8.0.6.15 - pmz6480sr6fp15-20200724_01(SR6 FP15))
os = z/OS (02.03.00; s390x) (en_US)
process = 16778879@wg31
*****
[2/19/21 15:48:18:901 GMT] 0000000b com.ibm.ws.kernel.launch.internal.FrameworkManager
[2/19/21 15:48:18:869 GMT] 00000017 com.ibm.ws.config.xml.internal.XMLConfigParser
/var/zosconnect/servers/myServer/includes/safSecurity.xml
[2/19/21 15:48:18:892 GMT] 00000017 com.ibm.ws.config.xml.internal.XMLConfigParser
/var/zosconnect/servers/myServer/includes/ipcIDProp.xml
[2/19/21 15:48:18:894 GMT] 00000017 com.ibm.ws.config.xml.internal.XMLConfigParser
/var/zosconnect/servers/myServer/includes/keyringOutbound.xml
[2/19/21 15:48:19:904 GMT] 00000017 com.ibm.ws.config.xml.internal.XMLConfigParser
/var/zosconnect/servers/myServer/includes/groupAccess.xml
[2/19/21 15:48:19:906 GMT] 00000017 com.ibm.ws.config.xml.internal.XMLConfigParser
/var/zosconnect/servers/myServer/includes/web.xml
*****
```

wg31.washington.ibm.com:9443/server/config/logs/trace.log

```
*****
product = WAS FOR Z/OS 21.0.0.1, z/OS Connect 03.00.42 (wlp-1.0.48.c12101201013-1459)
wlp.install.dir = /shared/IBM/zosconnect/v3r0/wlp/
server.config.dir = /var/zosconnect/servers/myServer/
java.home = /shared/java/J8_0_64
java.version = 1.8.0_261
java.runtime = Java(TM) SE Runtime Environment (8.0.6.15 - pmz6480sr6fp15-20200724_01(SR6 FP15))
os = z/OS (02.03.00; s390x) (en_US)
process = 16779882@wg31
trace.specification =
*=info:Credentials=all:SSL=all:SSLChannel=all:Security.Authorization=all:UserRegistry=all:com.ibm.ws.security.*=all:com.ibm.ws.wim.*=all:org.apache.http.client.*=all:zosConnect=all:zosConnectSaf=all
*****
[2/25/21 17:27:54:487 GMT] 0000001b id=00000000 com.ibm.ws.logging.internal.TraceSpecification
I TRAS0018I: The trace state has been changed. The new trace state is
*=info:Credentials=all:SSL=all:SSLChannel=all:Security.Authorization=all:UserRegistry=all:com.ibm.ws.security.*=all:com.ibm.ws.wim.*=all:org.apache.http.client.*=all:zosConnect=all:zosConnectSaf=all.
[2/25/21 17:27:54:492 GMT] 00000016 id=078ec277 ty.thread.zos.hooks.internal.ThreadIdentityBundleFileWrapper > getEntry Entry org/apache/felix/scr/impl/manager
/DependencyManager$SingleDynamicCustomizer.class
[2/25/21 17:27:54:493 GMT] 00000016 id=078ec277 ty.thread.zos.hooks.internal.ThreadIdentityBundleFileWrapper < getEntry Exit org/apache/felix/scr/impl/manager
/DependencyManager$SingleDynamicCustomizer.class
[2/25/21 17:27:54:491 GMT] 00000017 id=00000000 com.ibm.ws.zos.core.internal.CoreBundleActivator
I CWWKB0121I: The server process UMASK value is set to 0000.
[2/25/21 17:27:54:494 GMT] 00000017 id=32c3d2ff ty.thread.zos.hooks.internal.ThreadIdentityBundleFileWrapper > getEntry Entry OSGI-
INF/com.ibm.ws.zos.logging.config.xml
[2/25/21 17:27:54:494 GMT] 00000017 id=32c3d2ff ty.thread.zos.hooks.internal.ThreadIdentityBundleFileWrapper < getEntry Exit OSGI-
INF/com.ibm.ws.zos.logging.config.xml
[2/25/21 17:27:54:494 GMT] 0000001b id=459954a0 ty.thread.zos.hooks.internal.ThreadIdentityBundleFileWrapper > getEntry Entry com/ibm/ws/config/xml/internal
```

wg31.washington.ibm.com:9443/server/config/logs/internal.log

```
*****
[2/25/21 17:27:54:494 GMT] 0000001b id=459954a0 ty.thread.zos.hooks.internal.ThreadIdentityBundleFileWrapper < getEntry Exit com/ibm/ws/config/xml/internal
```

Liberty MVS Commands

F BAQSTRT,CACHE,CLEAR,AUTH

Clears all users that are cached in the Liberty authentication cache

F BAQSTRT,REFRESH,CONFIG

Process pending configuration updates. Configuration processing applies to the server.xml file, any files it includes

F BAQSTRT,REFRESH,APPS

Process pending application updates. (Not applicable to z/OS Connect OpenAPI 2 servers)

F BAQSTRT,REFRESH,KEYSTORE

Use the command to refresh the keystore instorage profiles for the server.

F BAQSTRT,REFRESH,KEYSTORE, ID=*OutboundKeyRing*

To refresh a specific keystore defined in the server XML with ID=OutboundKeyRing.

F BAQSTRT,CACHE,CLEAR,AUTH

Clears all users that are cached in the Liberty authentication cache.

F BAQSTRT,PAUSE

To pause the server

F BAQSTRT,STATUS

To display the current status of a server

F BAQSTRT,RESUME

To resume the server

For more details, see URL <https://www.ibm.com/docs/en/was-liberty/zos?topic=zos-modify-commands>

Liberty MVS Angel Commands

F BAQZANGL,DISPLAY,SERVERS

Displays a list of servers currently connected to the angel

F BAQZANGL,DISPLAY,SERVERS,PID

Displays a list of servers currently connected to the angel code along with the server's PIDs.

```
CWWKB0067I ANGEL DISPLAY OF ACTIVE SERVERS
CWWKB0080I ACTIVE SERVER ASID 4d JOBNAME ZCEEAPIR PID 16777398
CWWKB0080I ACTIVE SERVER ASID 4b JOBNAME ZCEEDVM PID 50331780
CWWKB0080I ACTIVE SERVER ASID 4f JOBNAME WLPRPSRV PID 138
CWWKB0080I ACTIVE SERVER ASID 4a JOBNAME ZCEESRVR PID 50331815
CWWKB0080I ACTIVE SERVER ASID 50 JOBNAME ZCEEOPID PID 33554605
CWWKB0080I ACTIVE SERVER ASID 4c JOBNAME ZCEEHATS PID 143
CWWKB0080I ACTIVE SERVER ASID 4e JOBNAME WLPOPSRV PID 33554565
CWWKB0080I ACTIVE SERVER ASID 58 JOBNAME MQWEBS PID 152
```

F BAQZANGL,VERSION

Displays the version level of the angel

z/OS Connect MVS Commands (OpenAPI 2)

```
<feature>zosconnect:zosConnectCommands-1.0</feature>
```

F BAQSTRT,ZCON,REFRESH

All updated z/OS Connect artifacts (APIs, services, and API Requesters) are reloaded.

F BAQSTRT,ZCON,CLEARTOKENCACHE

Clears all OAuth 2.0 access tokens and JWTs from the cache. The token cache is only applicable for OAuth 2.0 access tokens and JWTs that were generated either locally or by an external authentication server, when invoking API requesters.

F BAQSTRT,ZCON,CLEARSAFCACHE

Clears the SAF cache. The SAF cache contains SAF user IDs and any associated RACF groups in which the user ID resides. The SAF cache is only applicable to API requester, and only when ID assertion is enabled.

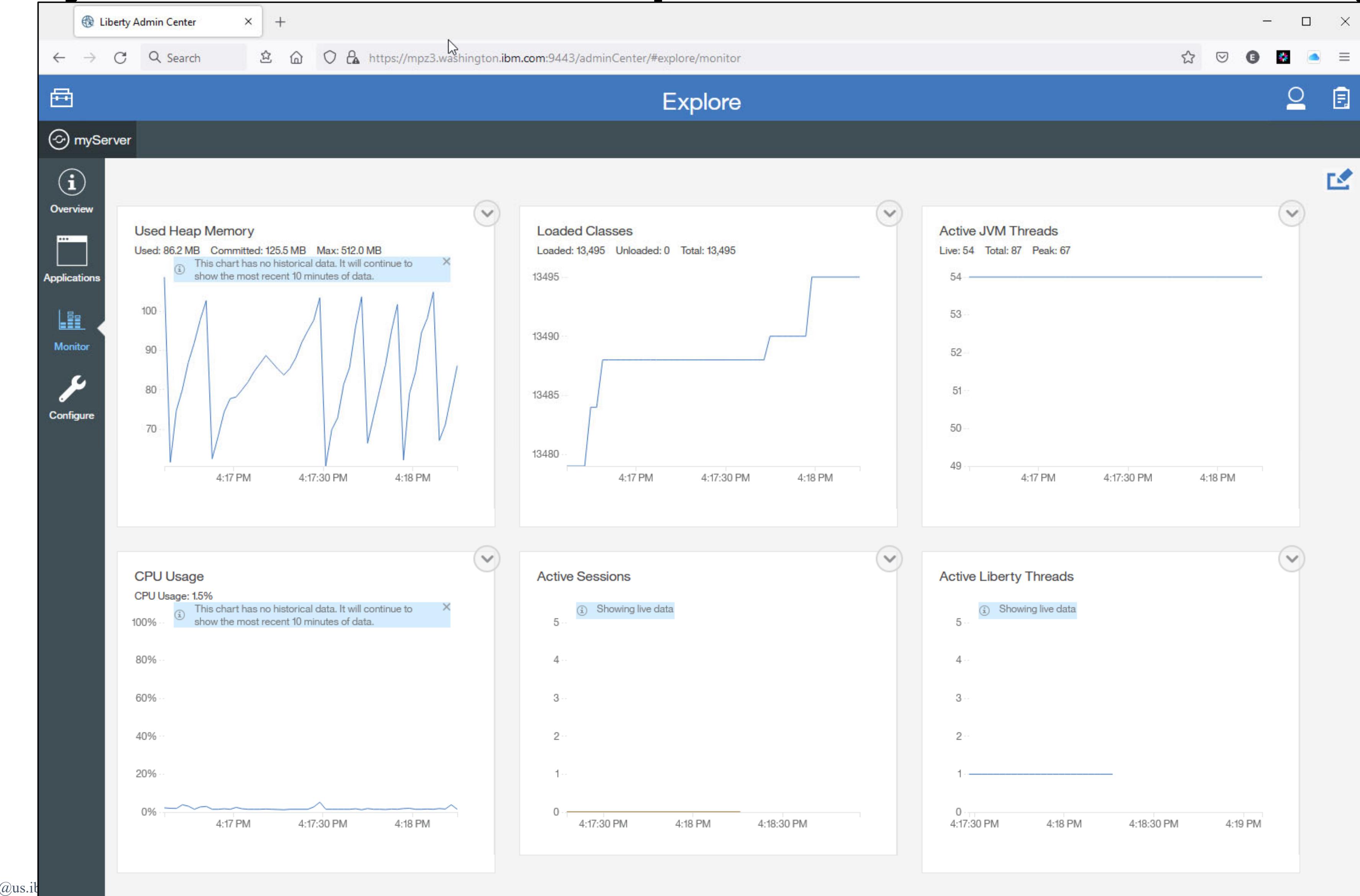
F BAQSTRT,REFRESH,APPS

Monitoring Liberty Servers

Monitoring Liberty, Java Virtual Machines and z/OS



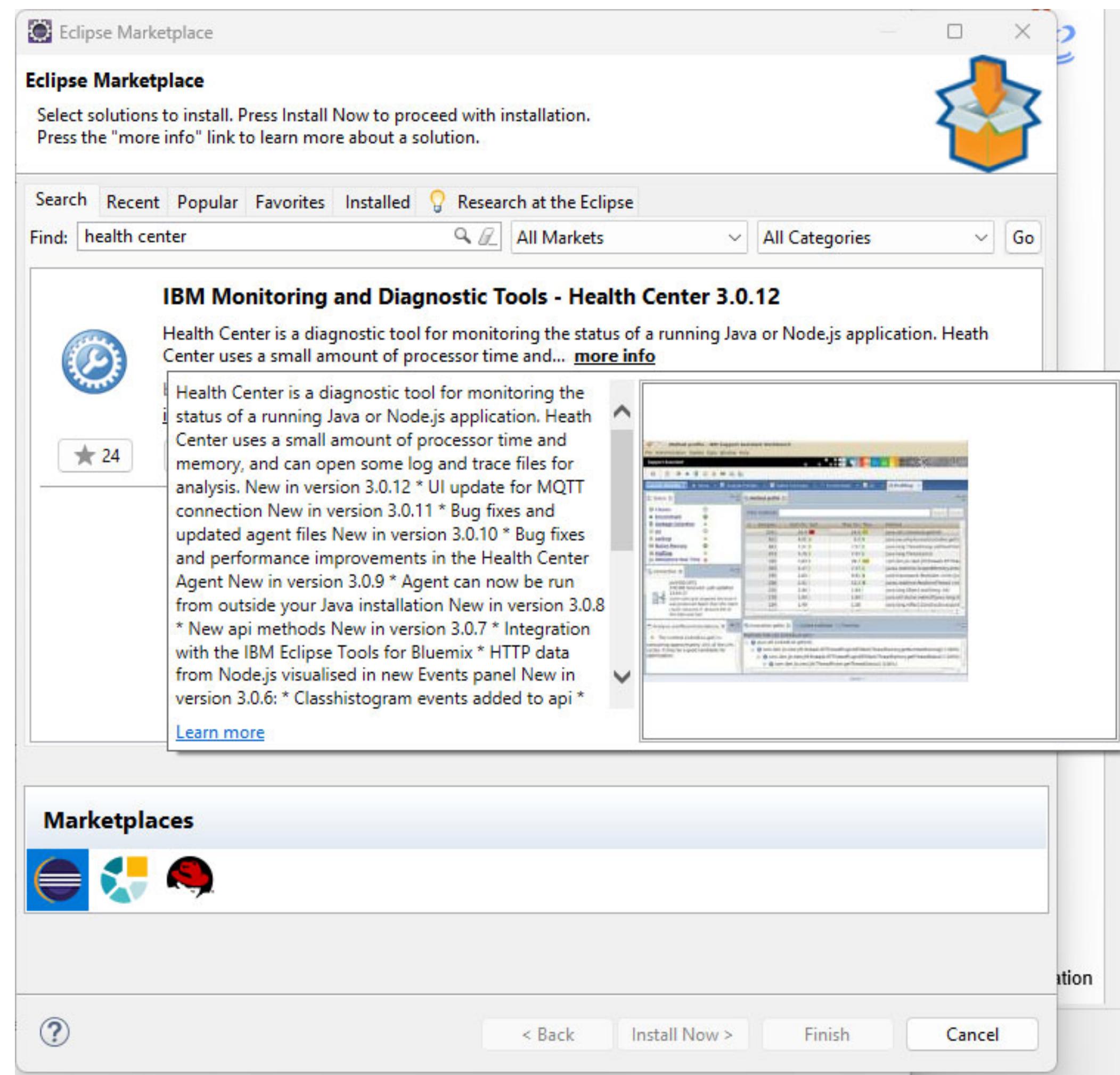
Liberty Admin Center feature provides real time monitoring



Java Health Center – Client Configuration



The Java health center client is available on the Eclipse Marketplace can be installed in most Eclipse workspace, e.g., IBM z/OS Explorer, etc.





Java Health Center – Monitors the Java environment

Configuring the Monitoring Agent using JVM directives

Java Health Center Directives

- healthcenter:level=headless *run without a client*
- com.ibm.java.diagnostics.healthcenter.headless.output.directory=/var/zcee/hcd *directory where HCD will be stored*
- com.ibm.java.diagnostics.healthcenter.socket.readwrite=on *collect socket sent/receive data*
- com.ibm.java.diagnostics.healthcenter.headless.files.to.keep=2 *number of HCD files to retain*
- com.ibm.java.diagnostics.healthcenter.headless.delay.start=value=0 *delay start value in minutes*
- com.ibm.java.diagnostics.healthcenter.headless.run.pause.duration=0 *pause between runs, in minutes*
- com.ibm.java.diagnostics.healthcenter.headless.run.duration=0 *run duration, in minutes*
- com.ibm.java.diagnostics.healthcenter.headless.run.number.of.runs=0 *number of runs*
- com.ibm.diagnostics.healthcenter.readonly=on *no client connections allowed*

Add directives to `bootstrap.properties` or a `JVM properties file`, e.g.,

`/var/zcee/properties/zceeHCD.properties` (see next page)

```
-Dcom.ibm.tools.attach.enable=yes  
-Xhealthcenter:level=headless  
-Dcom.ibm.java.diagnostics.healthcenter.headless.output.directory=/var/zcee/hcd  
-Dcom.ibm.java.diagnostics.healthcenter.socket.readwrite=on -Dcom.ibm.diagnostics.healthcenter.readonly=on  
-Dcom.ibm.java.diagnostics.healthcenter.headless.run.duration=5  
-Dcom.ibm.java.diagnostics.healthcenter.headless.run.number.of.runs=1 #
```

All the health center directives should be on one line.

For details on these and other Health Center configuration properties, see URL

<https://www.ibm.com/docs/en/mon-diag-tools?topic=agent-health-center-configuration-properties>

Java Health Center – Monitoring Agent Configuration



Set the `JVM_OPTIONS` environment variable to the properties file containing the health center directives

```
SYS1.PROCLIB(BAQSTRT)
//BAQSTRT PROC PARMS='myServer --clean'
//*
// SET ZCONHOME='/usr/lpp/IBM/zosconnect/v3r0'
//*
//ZCON      EXEC PGM=BPXBATSL,REGION=0M,MEMLIMIT=8G,
//              PARM='PGM &ZCONHOME./bin/zosconnect run &PARMS.'
//STEPLIB   DD DISP=SHR,DSN=MQ91#.SCSQAUTH
//          DD DISP=SHR,DSN=MQ91#.SCSQANLE
//STDERR    DD SYSOUT=*,FREE=CLOSE,SPIN=(UNALLOC,1M)
//STDOUT    DD SYSOUT=*
//STDIN     DD DUMMY
//STDENV    DD *
_BPX_SHAREAS=YES
JAVA_HOME=/usr/lpp/java/J8.0_64/
WLP_USER_DIR=/var/zosconnect
JVM_OPTIONS=-Xoptionsfile=/var/zcee/properties/zceeHCD.properties
```

Java Health Center – HEAP analysis example



The screenshot shows the IBM Java Health Center interface within the Eclipse IDE. The main window displays a graph of heap usage and pause times over time, with three data series: Used heap (after collection) in purple, Heap size in green, and Pause time in blue. The graph spans from 0:00 to 0:36 minutes. Below the graph is a summary table of garbage collection metrics. To the right, a help panel provides information on using the garbage collection perspective.

Summary Table Metrics:

Concurrent collection count	10
GC Mode	Default (gencon)
Global collections - Mean garbage collection pause	6.29 ms
Global collections - Mean interval between collections	2110 ms
Global collections - Number of collections	12
Largest memory request	199 KB
Mean garbage collection pause	3.5 ms
Mean interval between collections	129 ms
Minor collections - Mean garbage collection pause	3.39 ms
Minor collections - Mean interval between collections	134 ms
Minor collections - Number of collections	310
Minor collections - Total amount flipped	338073 KB
Minor collections - Total amount tenured	52.64 MB
Number of collections	322
Number of collections triggered by allocation failure	312
Proportion of time spent in garbage collection pauses (%)	2.71%
Proportion of time spent unpause (%)	97.29%
Rate of garbage collection	2643 MB/minute
Total amount flipped	338073 KB

Help Panel Content:

- Tool: IBM Monitoring and Diagnostic Tools - Health Center > IBM Monitoring and Diagnostic Tools - Health Center > Viewing the data collected > Garbage collection perspective
- Using the garbage collection perspective**
 - View data such as heap usage, pause times, summary table, object allocations, and tuning recommendation sections in the Health Center garbage collection perspective. Some data is not available for non-Java™ applications.
- The Health Center garbage collection perspective has the following views:
 - Views for basic garbage collection information**: These views are available for all application types:
 - Heap and pause times: A graph of [heap usage](#) and [pause times](#).
 - Summary: A [summary table](#) of important garbage collection metrics.
 - Views for detailed garbage collection information**: These views are available only for Java applications, and only if you enable detailed garbage collection information according to the instructions in [Controlling the collection of garbage collection information \(Java applications only\)](#).
 - Object allocations: A table that shows the [allocation of objects](#) within a specified size range.
 - Samples by request site: A profile of sampled object allocations, grouped by the call site of the allocation request.
 - Samples by object: A profile of sampled object allocations, grouped by the type of object allocated.
 - Call hierarchy: This view shows data when you select a row in the Object allocations, Samples by request site, or Samples by object views. For example, if you select a row in the Samples by object view, this view shows the hierarchy of calls to allocations of that object.
 - Timeline: A visual indication of when object allocations were requested. This view shows data when you select a row in the Object allocations or Samples by request site views.

Java Health Center – Network analysis example



smf - Eclipse

File Edit Navigate Search Project Data Run Monitored System Window Help

Status Connection Sockets

CPU Classes Environment Events Garbage Collection I/O Locking Method Profiling Method Trace Native Memory Network Threads WebSphere Real Time

Socket ID filter: Apply Clear

ID	Type	IP Address	Port	Data sent	Data received	State	Thread [ID] Name
102	Client	0:0:0:ffff:c0a8:11c9	1491	116043 bytes	42284 bytes	Closed	[0x29d2fa00] Equino...
103	Client	0:0:0:ffff:c0a8:11c9	1491	116043 bytes	42284 bytes	Open	[0x2a00aa00] Default...
112	Server	0:0:0:ffff:c0a8:3c	65470	32953 bytes	38334 bytes	Open	[0x2a253d00] Shared...
127	Server	0:0:0:ffff:c0a8:3c	59411	87343 bytes	98768 bytes	Closed	[0x2a019f00] Default...
136	Server	0:0:0:ffff:c0a8:11c9	2446	87343 bytes	98768 bytes	Open	[0x2b38c800] Default...
138	ServerS...	0:0:0:0:0:0	9080	8818 bytes	8818 bytes	Open	[0x2a253d00] Shared...
144	Server	0:0:0:ffff:c0a8:3c	59412	4248 bytes	8818 bytes	Open	[0x2a019f00] Default...
164	ServerS...	0:0:0:0:0:0	9443	8818 bytes	8818 bytes	Open	[0x2a253d00] Shared...
176	Client	0:0:0:ffff:c0a8:11c9	4000	182558 bytes	186691 bytes	Closed	[0x2a00aa00] Default...
183	Client	0:0:0:ffff:c0a8:11c9	4000	182558 bytes	186691 bytes	Open	[0x2a14f400] Default...
186	Server	0:0:0:0:ffff:c0a8:11f3	7883	62048 bytes	116825 bytes	Open	[0x2a253d00] Shared...
196	Server	0:0:0:0:ffff:c0a8:3c	61723	1428 bytes	602 bytes	Closed	[0x29fcbb00] Default...
204	Server	0:0:0:0:ffff:c0a8:11f3	7880	1428 bytes	602 bytes	Open	[0x2a253d00] Shared...
215	Client	0:0:0:0:ffff:c0a8:11c9	1491	116825 bytes	62048 bytes	Open	[0x2b38c800] Default...
226	Server	0:0:0:0:ffff:c0a8:11f3	7863	2447 bytes	1059 bytes	Closed	[0x2a00aa00] Default...
227	Server	0:0:0:0:ffff:c0a8:11f3	9463	9892 bytes	8675 bytes	Open	[0x2aa3c100] Default...
228	Server	0:0:0:0:ffff:c0a8:11f3	7849	1059 bytes	9892 bytes	Closed	[0x29fcbb00] Default...
230	Server	0:0:0:0:ffff:c0a8:11f3	7850	39936 bytes	54048 bytes	Open	[0x2a00aa00] Default...
231	Server	0:0:0:0:ffff:c0a8:11f3	9463	10868 bytes	7460 bytes	Open	[0x2a14f400] Default...
233	Server	0:0:0:0:ffff:c0a8:11f3	9463	22059 bytes	11436 bytes	Open	[0x2a00aa00] Default...
234	Server	0:0:0:0:ffff:c0a8:11f3	7010	11436 bytes	22059 bytes	Closed	[0x2b20-0001] Default...

Sockets open Network I/O

mitchj@us.ibm.com

c0a8:11c9 = 192.168.17.201

Java Health Center – Method Profiling



The screenshot shows the Eclipse Java Health Center interface, specifically the Method Profiling section. The left sidebar lists various monitoring categories: CPU, Classes, Environment, Events, Garbage Collection, I/O, Locking, Method Profiling (selected), Method Trace, Native Memory, Network, Threads, and WebSphere Real Time. The Analysis and Recommendations panel indicates that the method `MD5.a()` is consuming approximately 27% of the CPU cycles.

The main area displays two tables of sampled methods and their performance metrics. A red circle highlights the first row of the top table, which shows 2806 samples, 27.17% self time, and 27.28% tree time for the method `com.ibm.crypto.provider.MD5.a(byte[], int, int, byte[], int)`.

Samples	Self (%)	Self	Tree (%)	Tree	Method
2806	27.17	■	27.28	■	<code>com.ibm.crypto.provider.MD5.a(byte[], int, int, byte[], int)</code>
562	5.44	■	7.26	■	<code>com.ibm.ws.logging.utils.FileLogHolder.writeRecord(java.lang.String)</code>
440	4.26	■	21.36	■	<code>com.ibm.ws.logging.internal.impl.BaseTraceService.publishTraceLogRecord(com.ibm.ws.logging...)</code>
264	2.56	■	2.56	■	<code>java.math.Division.monReduction(int[], java.math.BigInteger, int)</code>
183	1.77	■	1.79	■	<code>java.math.Multiplication.square(int[], int, int[])</code>
172	1.67	■	2.32	■	<code>javax.security.auth.Subject.toString(boolean)</code>
150	1.45	■	1.47	■	<code>java.math.DivisionLong.monReduceSq(long[], long[], long, int, long[])</code>
130	1.26	■	1.83	■	<code>com.ibm.crypto.provider.MD5.a(byte[], int, int, byte[], int)</code>
128	1.24	■	1.55	■	<code>com.ibm.crypto.provider.MD5.a(byte[], int, int, byte[], int)</code>
115	1.11	■	1.14	■	<code>java.math.DivisionLong.monMulSq(long[], int, long[])</code>
102	0.99	■	5.32	■	<code>com.ibm.ws.logging.utils.FileLogHolder.writeRecord(java.lang.String)</code>
97	0.94	■	1.91	■	<code>com.ibm.ws.logging.utils.FileLogHolder.writeRecord(java.lang.String)</code>
92	0.89	■	1.31	■	<code>org.eclipse.osni.interceptor.Interceptor</code>

Samples	Self (%)	Self	Tree (%)	Tree	Method
1768	45.63	■	45.78	■	<code>com.ibm.crypto.provider.MD5.a(byte[], int, int, byte[], int)</code>
173	4.46	■	6.3	■	<code>com.ibm.ws.logging.utils.FileLogHolder.writeRecord(java.lang.String)</code>
152	3.92	■	18.68	■	<code>com.ibm.ws.logging.internal.impl.BaseTraceService.publishTraceLogRecord(com.ibm.ws.logging...)</code>
111	2.86	■	2.86	■	<code>java.math.Division.monReduction(int[], java.math.BigInteger, int)</code>
96	2.48	■	2.48	■	<code>java.math.Multiplication.square(int[], int, int[])</code>
56	1.45	■	2.04	■	<code>com.ibm.crypto.provider.x.add(com.ibm.crypto.provider.EllipticPoint)</code>
54	1.39	■	1.45	■	<code>java.math.DivisionLong.monReduceSq(long[], long[], long, int, long[])</code>
54	1.39	■	1.94	■	<code>javax.security.auth.Subject.toString(boolean)</code>
53	1.37	■	1.45	■	<code>java.math.DivisionLong.monMulSq(long[], int, long[])</code>
51	1.32	■	1.63	■	<code>com.ibm.crypto.provider.P256PrimeField.a(int[])</code>
43	1.11	■	3.59	■	<code>java.math.Multiplication.multPAP(int[], int[], int[], int, int)</code>
39	1.01	■	5.01	■	<code>com.ibm.ws.logging.internal.impl.BaseTraceFormatter.formatObj(java.lang.Object)</code>
27	0.7	■	1.42	■	<code>com.ibm.ws.logging.internal.impl.BaseTraceFormatter.createFormattedMessage(java.util.LoggingEvent)</code>

The bottom section contains two timeline graphs showing sample counts over time. The left graph spans from 2:30 to 5:00, and the right graph spans from 1:48 to 2:24. Both graphs show a significant drop in sample count starting around 2:00/2:06.



Tech-Tip: Sample JCL - Restarting the Java Health Center collection

SDSF PROCESS DISPLAY wg31 ALL		LINE 1-5 (5) SCROLL ===> CSR									IBM Washington Systems Center	
NP	JOBNAME	Status	Owner	State	CPU-Time	PID	PPID	ASID	ASIDX	LatchWaitPID	Command	
BAQSTRT	WAITING FOR CHILD	LIBSERV	LIBSERV	1W	40.01	69050	83955129	42	002A		/bin/sh /usr/lpp/IBM/zosconnect/v3r0/bin	
BAQSTRT	OTHER KERNEL WAIT	LIBSERV	LIBSERV	HK	40.01	16846267	69050	42	002A		/usr/lpp/java/J8.0_64/bin/java -javagen	
BAQZANGL	SWAPPED, RUNNING	LIBANGE	LIBANGE	1RI	0.01	50399398	83953829	77	004D		/usr/lpp/IBM/zosconnect/v3r0/wplib/nat	
BAQZANGL	SWAPPED, FILE SYS KERNEL WAIT	LIBANGE	LIBANGE	1FI	0.01	83953829	1	77	004D		BPXBATA2	
BAQSTRT	FILE SYS KERNEL WAIT	LIBSERV	LIBSERV	1F	40.01	83955129	1	42	002A		BPXBATSL	

```
*****  
product = WAS FOR Z/OS 21.0.0.9, z/OS Connect 03.00.52 (wlp-1.0.56.c1210920210909-1618)  
wlp.install.dir = /shared/IBM/zosconnect/v3r0/wlp/  
server.config.dir = /var/zosconnect/servers/myServer/  
java.home = /shared/java/J8.0_64  
java.version = 1.8.0_301  
java.runtime = Java(TM) SE Runtime Environment (8.0.6.36 - pmz6480sr6fp36-20210913_01(SR6 FP36))  
os = z/OS (02.03.00; s390x) (en_US)  
process = 16846267@wg31  
*****
```

```
//JOHNONS JOB (ACCOUNT), NOTIFY=&SYSUID,REGION=0M,  
// CLASS=A,MSGCLASS=H,MSGLEVEL=(1,1),USER=LIBSERV  
//JAVA EXEC PGM=IKJEFT01,REGION=0M  
//SYSERR DD SYSOUT=*  
//STDOUT DD SYSOUT=*  
//SYSTSPRT DD SYSOUT=*  
//SYSTSIN DD *  
BPXBATCH SH +  
java -jar /usr/lpp/java/J8.0_64/lib/ext/healthcenter.jar +  
ID=16846267 level=headless +  
-Dcom.ibm.java.diagnostics.healthcenter.headless.run.number.of.runs=1
```

The job must be executed under the same identity under which the server is running.

z/OS Connect

Liberty Features

Liberty

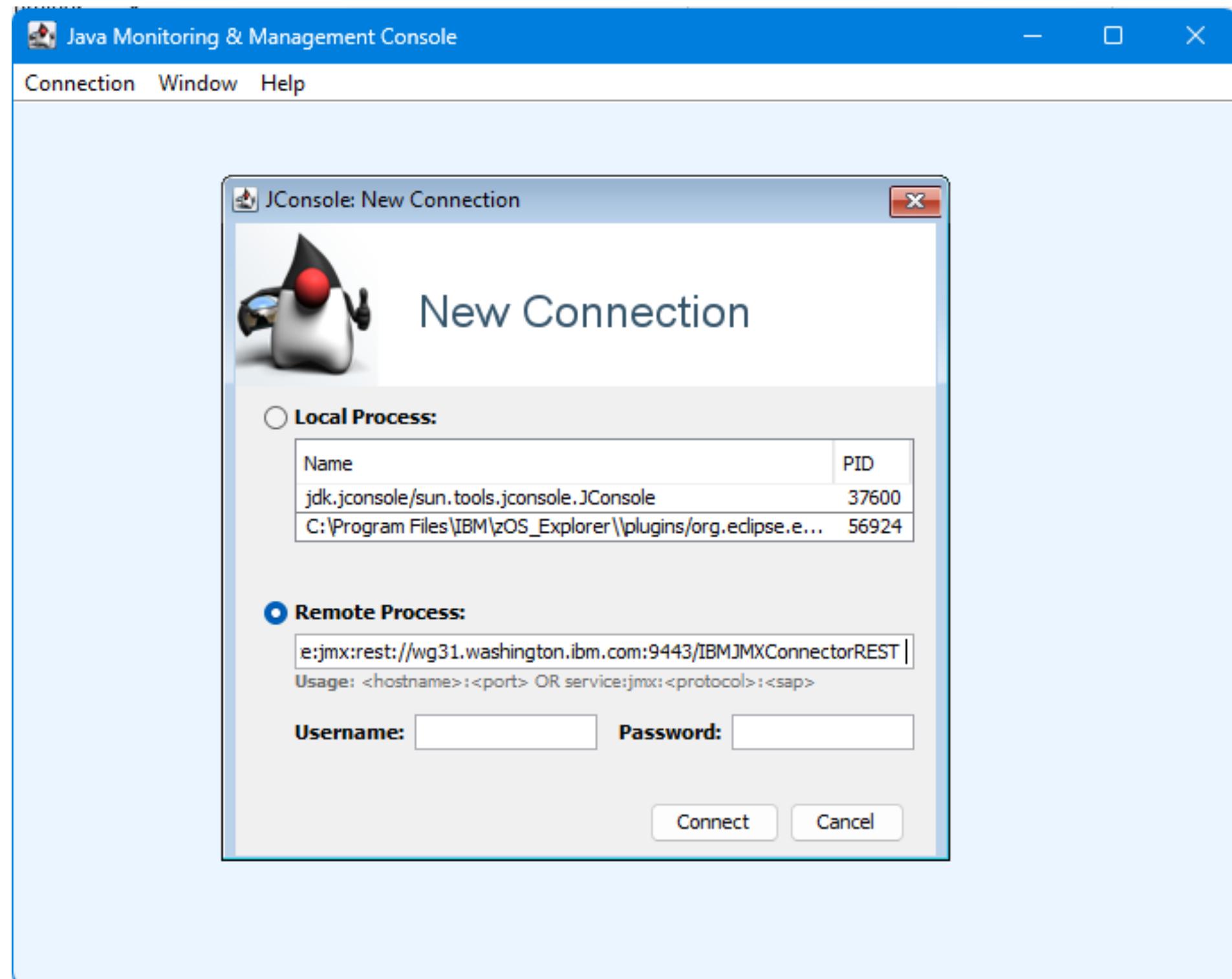


z/OS Connect





Using Java's jConsole with Liberty features restConnector-2.0 and monitor-1.0

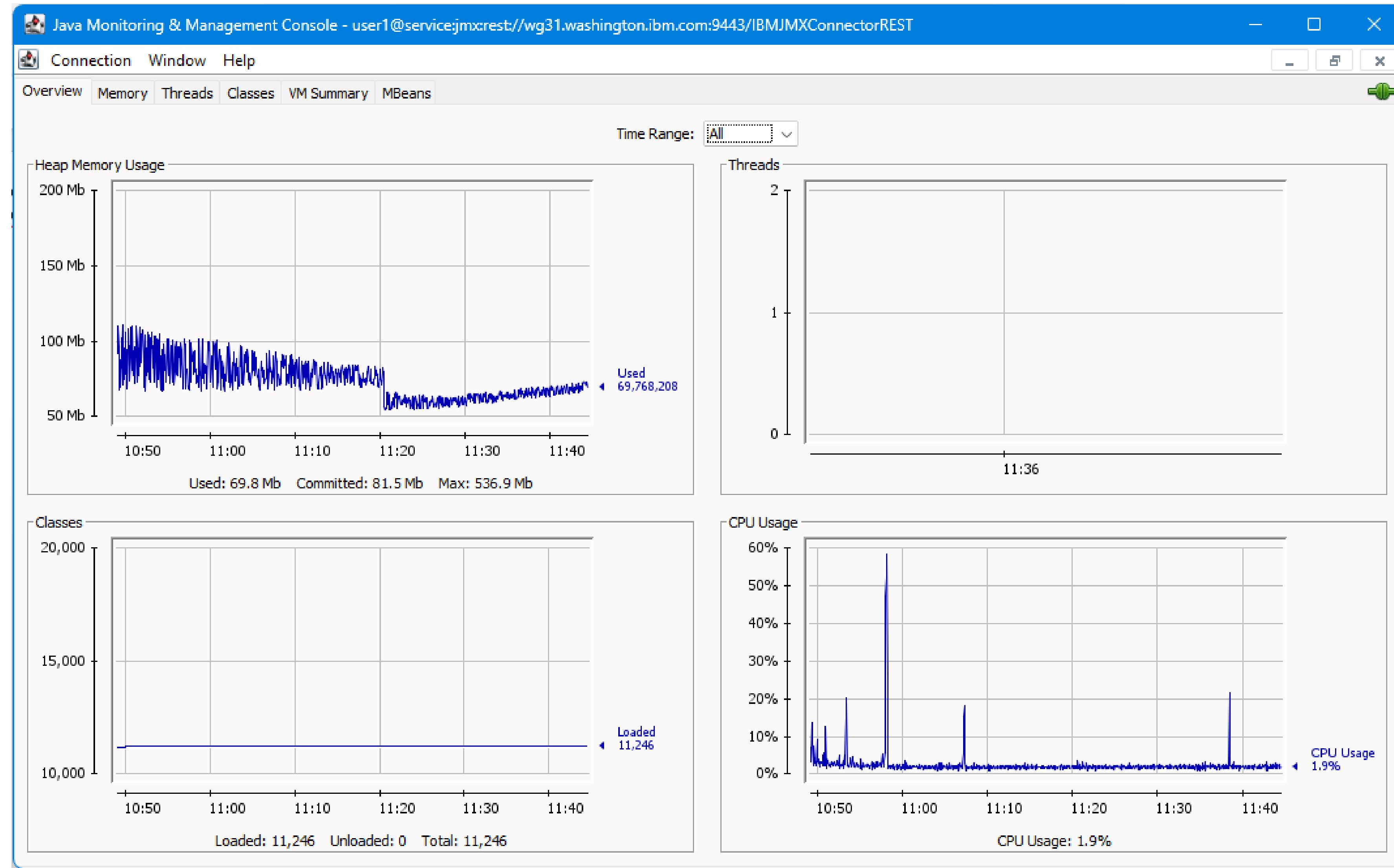


```
<server description="Additional Features">  
    <!-- Enable features -->  
    <featureManager>  
        <feature>adminCenter-1.0</feature>  
        <feature>restConnector-2.0</feature>  
        <feature>monitor-1.0</feature>  
    </featureManager>  
  
    <remoteFileAccess>  
        <readDir>/var/zcee/includes</readDir>  
        <readDir>/global/zosconnect/includes</readDir>  
        <writeDir>${server.config.dir}</writeDir>  
    </remoteFileAccess>  
  
</server>
```

Monitoring a z/OS Liberty server using JMX and REST Clients: <https://ibm.biz/BdahXK>

```
RDEFINE EJBROLE BBGZDFLT.com.ibm.ws.management.security.resource.Administrator OWNER(SYS1) UACC(NONE)  
RDEFINE EJBROLE BBGZDFLT.com.ibm.ws.management.security.resource.Reader OWNER(SYS1) UACC(NONE)  
RDEFINE EJBROLE BBGZDFLT.com.ibm.ws.management.security.resource.allAuthenticatedUsers OWNER(SYS1) UACC(NONE)  
PERMIT BBGZDFLT.com.ibm.ws.management.security.resource.Administrator CLASS(EJBROLE) ID(ZCEEUSRS) ACCESS(READ)  
PERMIT BBGZDFLT.com.ibm.ws.management.security.resource.Reader CLASS(EJBROLE) ID(ZCEEUSRS) ACCESS(READ)  
PERMIT BBGZDFLT.com.ibm.ws.management.security.resource.allAuthenticatedUsers CLASS(EJBROLE) ID(ZCEEUSRS) ACCESS(READ)  
SETR RACLIST(EJBROLE) REFRESH
```

Using Java's jConsole with Liberty features restConnector-2.0 and monitor-1.0



Using Java's jConsole with Liberty features restConnector-2.0 and monitor-1.0



Server XML files

Memory usage

Details

Time:	2024-05-03 11:45:19
Used:	69,028 kbytes
Committed:	79,616 kbytes
Max:	524,288 kbytes
GC time:	0.118 seconds on global (13 collections) 5.454 seconds on scavenge (7,293 collections)

Using Java's jConsole with Liberty features restConnector-2.0 and monitor-1.0



Display connection pool utilization

The screenshot shows the Java Monitoring & Management Console interface. The title bar reads "Java Monitoring & Management Console - Fred@servicejmx:rest://wg31.washington.ibm.com:9443/IBMJMXConnectorREST". The menu bar includes Connection, Window, Help, Overview, Memory, Threads, Classes, VM Summary, and MBeans. A red circle highlights the "MBeans" tab. The left pane displays a tree view of MBeans, including IBM MQ, JImplementation, WebSphere (with sub-folders like ConnectionPoolStats, DynaCache, FileService, FileTransfer, JvmStats, PluginUtility, ServletStats, SessionStats, ThreadPoolStats, apiDiscovery, and various com.ibm.websphere.* and com.ibm.ws.* packages). The right pane shows the "Operation invocation" section with "java.lang.String showPoolContents ()". Below it is the "MBeanOperationInfo" table:

Name	Value
Operation:	
Name	showPoolContents

A modal dialog titled "Operation return value" is open, displaying the following information:

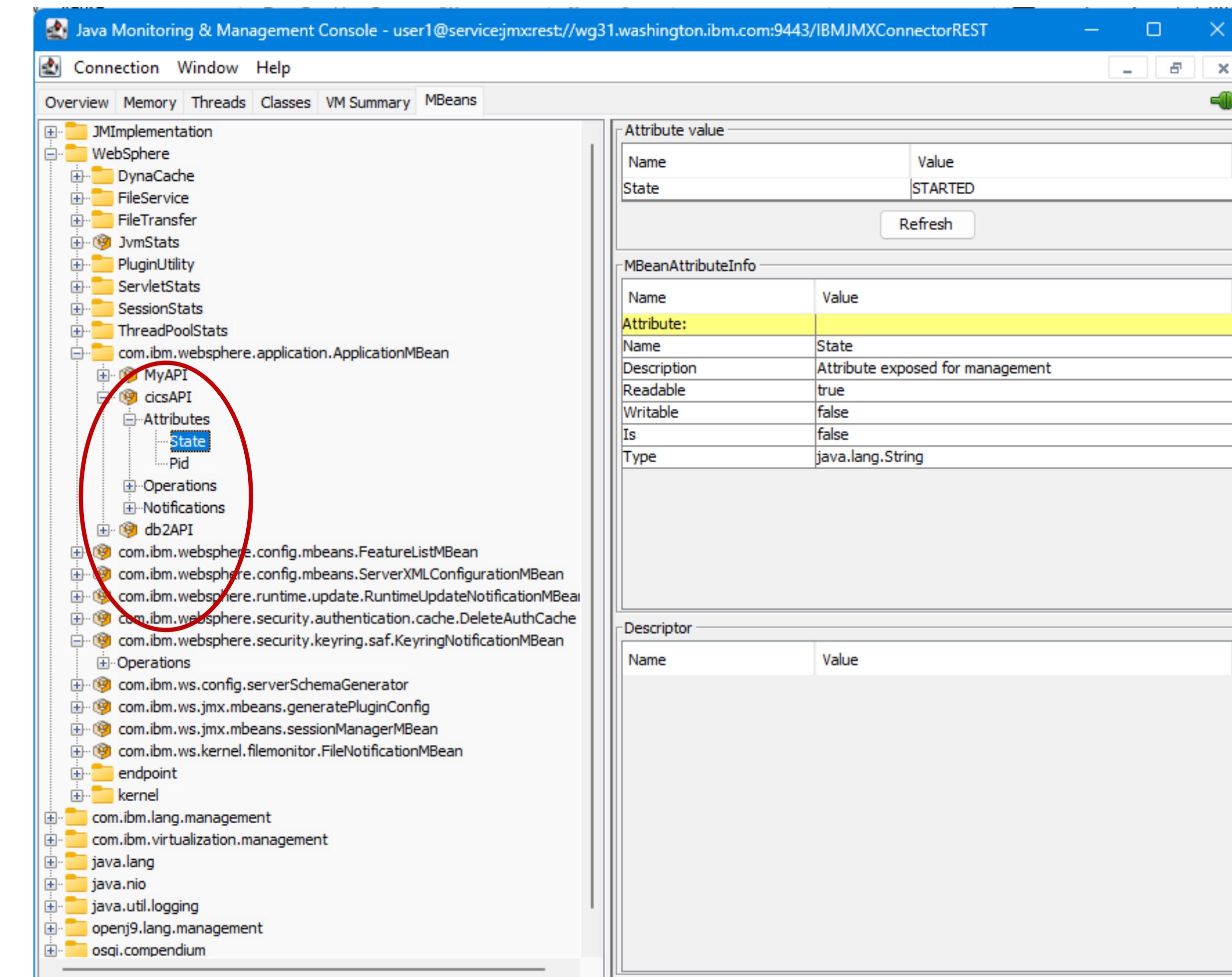
```
PoolManager@1badcb0
name=WebSphere:type=com.ibm.ws.jca.cm.mbean.ConnectionPoolManager
jndiName=none
maxPoolSize=555
size=2
waiting=0
unshared=0
shared=0
available=2
ManagedConnection@475ca2d6=Reusable
ManagedConnection@92aa45f3=Reusable
```

The "OK" button is visible at the bottom of the dialog.



Using Java's jConsole with Liberty features restConnector-2.0 and monitor-1.0

Display and manage z/OS Connect OpenAPI3 APIs



<https://github.com/ibm-wsc/zCONNEE-Wildfire-Workshop/blob/master/misc/Monitoring%20a%20zOS%20Liberty%20server%20using%20IMM%20and%20DECT%20clients.pdf>

Workload Manager - Definitions

WLM Report Classes

mpz3

Report-Class View Notes Options Help

Report Class Selection List Row 1 to 12 of 12

Command ==> _____

Action Codes: 1=Create, 2=Copy, 3=Modify, 4=Browse, 5=Print, 6=Delete, /=Menu Bar

-- Last Change --

Action	Name	Description	User	Date
	BAQSTC		JOHNSON	2021/09/04
	WMQFTE		JOHNSON	2011/08/31
	WMQFTER		JOHNSON	2011/08/31
	WMQFTEZ		JOHNSON	2011/08/31
	ZCEEADM		JOHNSON	2021/08/02
	ZCEEAPIR		JOHNSON	2021/08/05
	ZEECICS		JOHNSON	2021/08/05
	ZCEEDB2		JOHNSON	2021/08/05
	ZCEEIMS		JOHNSON	2021/08/05
	ZCEEMQ		JOHNSON	2021/08/05
	ZCEEOTHR		JOHNSON	2021/08/02
	ZCEESTC		JOHNSON	2021/09/02

***** Bottom of data *****

10/004

Connected to remote server/host mpz3 using lu/pool MPZ30008 and port 23

WLM Service Classes

mpz3

Service-Class Xref Notes Options Help

Modify a Service Class Row 1 to 2 of 2

Command ==> _____

Service Class Name : OPS_HIGH

Description System Tasks Velocity 70

Workload Name STC_WKL (name or ?)

Base Resource Group (name or ?)

Cpu Critical NO (YES or NO)

I/O Priority Group NORMAL (NORMAL or HIGH)

Honor Priority DEFAULT (DEFAULT or NO)

Specify BASE GOAL information. Action Codes: I=Insert new period, E>Edit period, D=Delete period.

-- Period -- Goal --

Action # Duration Imp. Description

1 1 Execution velocity of 70

***** Bottom of data *****

19/004

Connected to remote server/host mpz3 using lu/pool MPZ30008 and port 23

mitchj@us.ibm.com

WLM "CB" Classification Rules

mpz3

File Edit Settings View Communication Actions Window Help

Subsystem-Type Xref Notes Options Help

Modify Rules for the Subsystem Type Row 1 to 8 of 16

Command ==> _____

Subsystem Type . . . CB Fold qualifier names? N (Y or N)

Description WLP/zCEE Transactions

Action codes: A=After C=Copy M=Move I=Insert rule
B=Before D=Delete row R=Repeat IS=Insert Sub-rule
More ==>

Action	Type	Name	Start	Class
1	CN	myServer	_____	Service Report
2	TC	TCADM	_____	OPS_HIGH BAQSTC
2	TC	TCAPIR	_____	OPS_HIGH ZCEEADM
2	TC	TCCICS	_____	OPS_HIGH ZCEEAPIR
2	TC	TCDB2	_____	OPS_HIGH ZCEEDB2
2	TC	TCIMS	_____	OPS_HILO ZCEEIMS
2	TC	TCMQ	_____	OPS_MED ZCEEMQ
2	TC	TCOTHR	_____	OPS_LOW ZCEEOTHR

07/021

Connected to remote server/host mpz3 using lu/pool MPZ30008 and port 23

mpz3

File Edit Settings View Communication Actions Window Help

Subsystem-Type Xref Notes Options Help

Modify Rules for the Subsystem Type Row 9 to 16 of 16

Command ==> _____

Subsystem Type . . . CB Fold qualifier names? N (Y or N)

Description WLP/zCEE Transactions

Action codes: A=After C=Copy M=Move I=Insert rule
B=Before D=Delete row R=Repeat IS=Insert Sub-rule
More ==>

Action	Type	Name	Start	Class
1	CN	zceex	_____	Service Report
2	TC	TCADM	_____	OPS_HIGH ZCEEOTHR
2	TC	TCAPIR	_____	OPS_HIGH ZCEESTC
2	TC	TCDB2	_____	OPS_HIGH ZCEEADM
2	TC	TCCICS	_____	OPS_HIGH ZCEEAPIR
2	TC	TCIMS	_____	OPS_HILO ZCEEDB2
2	TC	TCMQ	_____	OPS_MED ZCEEIMS
2	TC	TCOTHR	_____	OPS_HILO ZCEEMQ

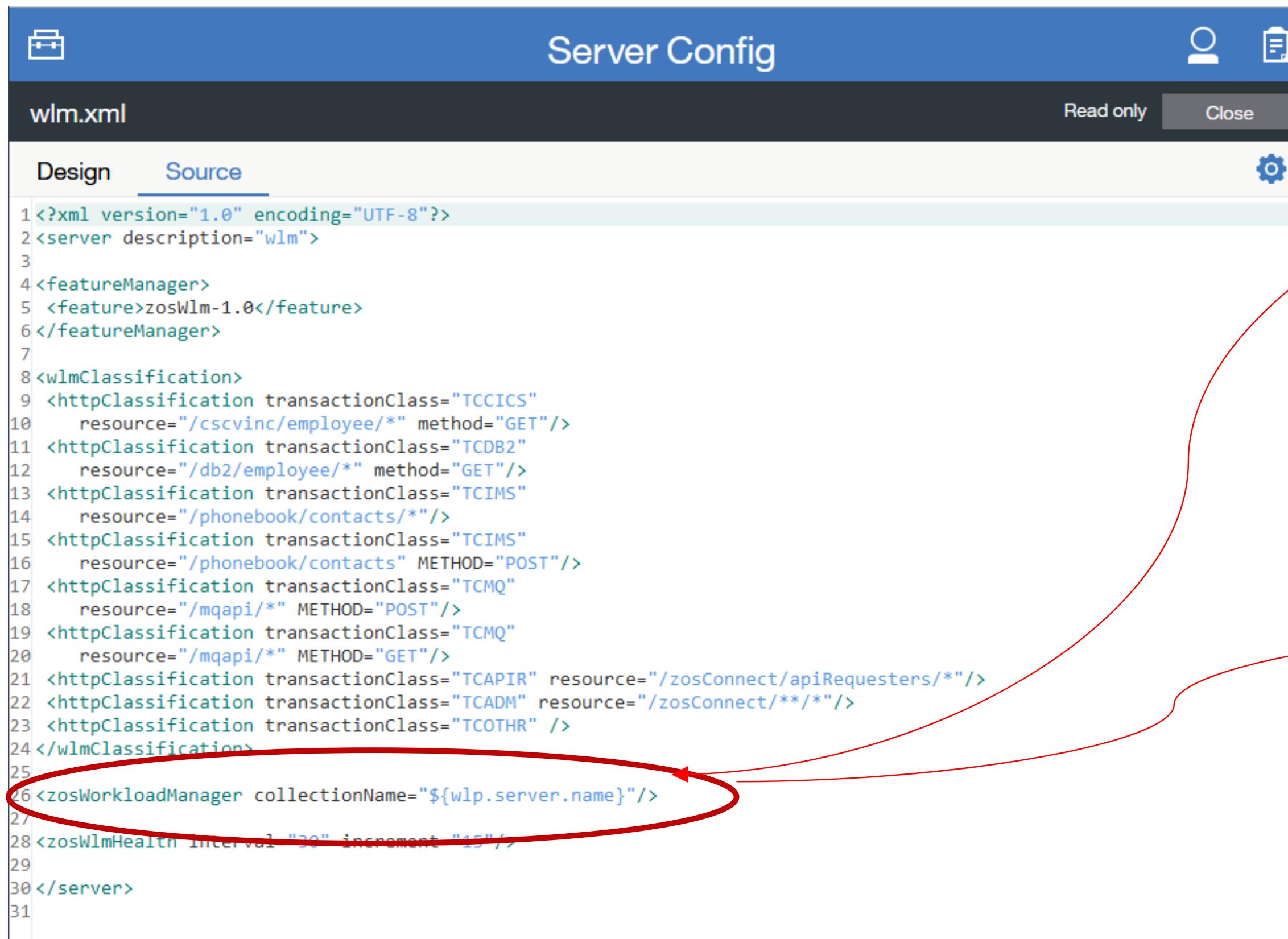
07/021

Connected to remote server/host mpz3 using lu/pool MPZ30008 and port 23

Workload Manager – WLM Classification server XML

The corresponding required server XML configuration

- Based on HTTP path matching (port and/or method can also be specified)
- The default value for the *wlmClassification* name is the name of the server
- See URL <https://www.ibm.com/docs/en/was-liberty/zos?topic=zos-wlm-classification> for more information
- The *transactionClass* attribute is required to ensure an enclave is created.

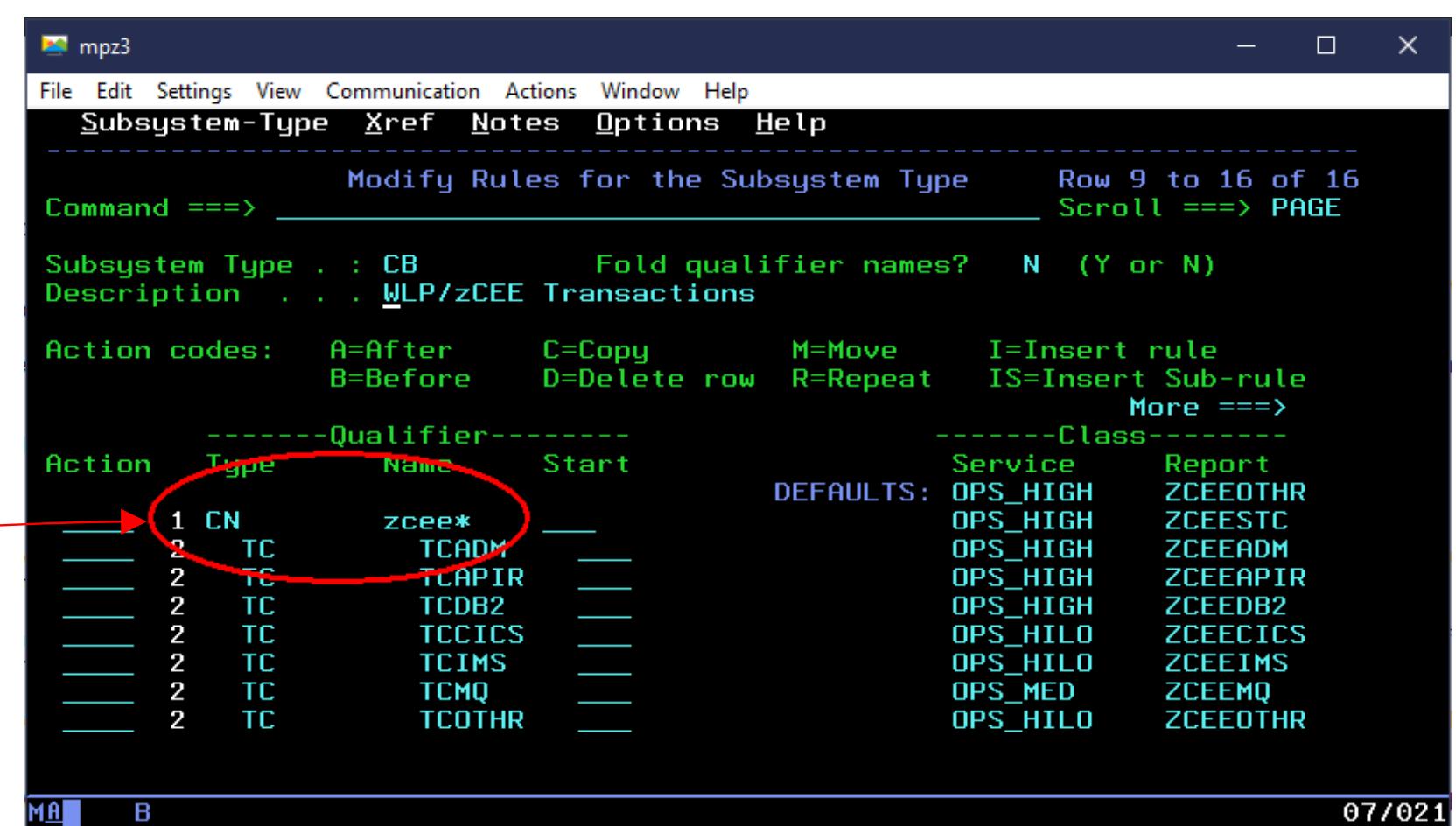


```

<?xml version="1.0" encoding="UTF-8"?>
<server description="wlm">
  <featureManager>
    <feature>zosWlm-1.0</feature>
  </featureManager>
  <wlmClassification>
    <httpClassification transactionClass="TCCICS"
      resource="/cscvinc/employee/*" method="GET"/>
    <httpClassification transactionClass="TCDB2"
      resource="/db2/employee/*" method="GET"/>
    <httpClassification transactionClass="TCIMS"
      resource="/phonebook/contacts/*"/>
    <httpClassification transactionClass="TCIMS"
      resource="/phonebook/contacts" METHOD="POST"/>
    <httpClassification transactionClass="TCMQ"
      resource="/mqapi/*" METHOD="POST"/>
    <httpClassification transactionClass="TCMQ"
      resource="/mqapi/*" METHOD="GET"/>
    <httpClassification transactionClass="TCAPIR" resource="/zosConnect/apiRequesters/*"/>
    <httpClassification transactionClass="TCADM" resource="/zosConnect/**/*"/>
    <httpClassification transactionClass="TCOTHR" />
  </wlmClassification>
  <zosWorkloadManager collectionName="${wlp.server.name}"/>
  <zosWlmHealth interval "30" increment "15"/>
</server>

```

Related to WLM CN name.



Action	Type	Name	Start	Service	Report
1	CN	zceex*		OPS_HIGH	ZCEEOTHR
2	TC	TCADM		OPS_HIGH	ZCEEESTC
2	TC	TCDB2		OPS_HIGH	ZCEEADM
2	TC	TCCICS		OPS_HILO	ZCEEAPIR
2	TC	TCIMS		OPS_HILO	ZCEEIMS
2	TC	TCMQ		OPS_MED	ZCEEMQ
2	TC	TCOTHR		OPS_HILO	ZCEEOTHR



Workload Manager – Active HTTP Classification

https://wg31.washington.ibm.com:9443/ibm/api/config/httpClassification

The screenshot shows a web browser window displaying a JSON array of configuration elements for "httpClassification". Each element is defined by the following fields:

- configElementName: "httpClassification"
- uid: "wlmClassification[default-0]/httpClassification[default-4]", "wlmClassification[default-0]/httpClassification[default-5]", "wlmClassification[default-0]/httpClassification[default-6]", "wlmClassification[default-0]/httpClassification[default-7]", or "wlmClassification[default-0]/httpClassification[default-8]"
- host: "*" (wildcard)
- method: "POST", "GET", "*", or "*/*"
- port: "*" (wildcard)
- resource: "/mqapi/*", "/zosConnect/apiRequesters/*", "/zosConnect/**/*", or "/*"
- transactionClass: "TCMQ", "TCAPIR", "TCADM", or "TCOTHR"

```
[{"configElementName": "httpClassification", "uid": "wlmClassification[default-0]/httpClassification[default-4]", "host": "*", "method": "POST", "port": "*", "resource": "/mqapi/*", "transactionClass": "TCMQ"}, {"configElementName": "httpClassification", "uid": "wlmClassification[default-0]/httpClassification[default-5]", "host": "*", "method": "GET", "port": "*", "resource": "/mqapi/*", "transactionClass": "TCMQ"}, {"configElementName": "httpClassification", "uid": "wlmClassification[default-0]/httpClassification[default-6]", "host": "*", "method": "*", "port": "*", "resource": "/zosConnect/apiRequesters/*", "transactionClass": "TCAPIR"}, {"configElementName": "httpClassification", "uid": "wlmClassification[default-0]/httpClassification[default-7]", "host": "*", "method": "*", "port": "*", "resource": "/zosConnect/**/*", "transactionClass": "TCADM"}, {"configElementName": "httpClassification", "uid": "wlmClassification[default-0]/httpClassification[default-8]", "host": "*", "method": "*", "port": "*", "resource": "/*", "transactionClass": "TCOTHR"}]
```

RMF SMF Type 72 Service Class Reports

mpz3

File Edit Settings View Communication Actions Window Help
Display Filter View Print Options Search Help

SDSF OUTPUT DISPLAY JOHNSONR JOB12740 DSID 112 LINE CHARS 'CICS' FOUND
COMMAND INPUT ===>
POLICY=WSCPOL

REPORT CLAS

- TRANSACTIONS --		TRANS-TIME	HHH.MM.SS.FFFFFFF	TRA
Avg	0.02	ACTUAL	108891	TOT
MPL	0.02	EXECUTION	108856	MOB
ENDED	96	QUEUED	34	CAT
END/S	0.16	R/S AFFIN	0	CAT
#SWAPS	0	INELIGIBLE	0	
EXCTD	0	CONVERSION	0	
		STD DEV	762583	
----SERVICE----	SERVICE TIME	--APPL %--	--P	
IOC	0 CPU	1.967 CP	0.02 AAP	BLK
CPU	1739K SRB	0.000 IIPCP	0.02 ENQ	
MSO	0 RCT	0.000 IIP	0.31 CRM	
SRB	0 IIT	0.000 AAPCP	0.00 LCK	
TOT	1739K HST	0.000 AAP	N/A SUP	
/SEC	2898 IIP	1.844		
ABSRPTN	166K AAP	N/A		
TRX SERV	166K			

MA A
Connected to remote server/host mpz3 using lu/pool MPZ30008 and port 23

mpz3

File Edit Settings View Communication Actions Window Help
Display Filter View Print Options Search Help

SDSF OUTPUT DISPLAY JOHNSONR JOB12740 DSID 112 LINE CHARS 'APIR' FOUND
COMMAND INPUT ===>
SCROLL ==> PAGE
POLICY=WSCPOL

REPORT CLASS=ZCEEAPIR PERIOD=1

- TRANSACTIONS --		TRANS-TIME	HHH.MM.SS.FFFFFFF	TRANS-APPL%-----CP-IIPCP/AAPCP-IIP/AAP	---ENCLAVES---	
Avg	0.14	ACTUAL	424835	TOTAL 0.12	0.12 0.73	
MPL	0.14	EXECUTION	424707	MOBILE 0.00	0.00 0.00	
ENDED	200	QUEUED	126	CATEGORYA 0.00	0.00 0.00	
END/S	0.33	R/S AFFIN	0	CATEGORYB 0.00	0.00 0.00	
#SWAPS	0	INELIGIBLE	0			
EXCTD	0	CONVERSION	0			
		STD DEV	1.381943			
----SERVICE----	SERVICE TIME	--APPL %--	--PROMOTED--	--DASD I/O--	----STORAGE----	-PAGE-IN RATES-
IOC	0 CPU	5.073 CP	0.12	BLK 0.000	SSCHRT 2.4	AVG 0.00
CPU	4485K SRB	0.000 IIPCP	0.12	ENQ 0.000	RESP 0.4	TOTAL 0.00
MSO	0 RCT	0.000 IIP	0.73	CRM 0.000	CONN 0.3	SHARED 0.00
SRB	0 IIT	0.000 AAPCP	0.00	LCK 0.000	DISC 0.0	
TOT	4485K HST	0.000 AAP	N/A SUP	0.000 Q+PEND	0.0	
/SEC	7474 IIP	4.363		IOSQ 0.0		
ABSRPTN	53K AAP	N/A				
TRX SERV	53K					

MA A
Connected to remote server/host mpz3 using lu/pool MPZ30008 and port 23



Liberty SMF 120 Subtype 11

WebSphere Liberty Profile (WLP) can generate various types of SMF 120 records. Support for a SMF 120 record relevant for z/OS Connect was added in WLP V16.0.0.2. This record, a SMF 120 Subtype 11, is generated for each HTTP request received by the Liberty server. For more details and a description of the contents of this record, see URL <https://www.ibm.com/support/pages/liberty-zos-smf-120-11-version-2>



The screenshot shows the 'Server Config' interface with a blue header bar. On the left is a briefcase icon, in the center is the title 'Server Config', and on the right are user and save icons. Below the header is a dark navigation bar with the text 'smf.xml' on the left and 'Read only' and 'Close' buttons on the right. The main area has tabs for 'Design' and 'Source'. The 'Source' tab is selected, showing XML code. The code is as follows:

```
1<?xml version="1.0" encoding="UTF-8"?>
2
3<server description="SMF">
4    <featureManager>
5        <feature>monitor-1.0</feature>
6        <feature>zosRequestLogging-1.0</feature>
7    </featureManager>
8
9</server>
10
```

Useful Plug-ins for WAS z/OS SMF 120.9 Browser

<https://www.ibm.com/support/pages/node/6355403>



Liberty SMF 120 Subtype 11 – WP102312 Plugin

AutoSave (Off) Mitch Johnson MJ

File Home Insert Page Layout Formulas Data Review View Help ACROBAT

Cut Copy Format Painter Share Comments

Font Alignment Number Styles Cells Editing Ideas Sensitivity

AS9 : 166

LibertyExport.csv

Search

Clipboard Sort & Filter Select Ideas Sensitivity

Font Alignment Number Styles Cells Editing Ideas Sensitivity

AS9 : 166

1 SystemName SysplexName JobName StartTime StartTime EndTime EndTime ResponseTime TranClass TotalCPUStart TotalCPUEnd TotalGP(ms) TotalOffload(ms) UserId MappedUser requestUser host port uri response targetPort remotePort RemoteAddr

2 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 6080 TCAPIR 3314772936 4.92E+09 245.5195 5.0110927 240.508381 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4283 192.168.17.243

3 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 7030 TCAPIR 178821759 471750165 71.51572 2.334169 69.181561 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4286 192.168.17.243

4 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 374 TCAPIR 4327455460 4.469E+09 34.44008 0.10757129 34.3325041 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4301 192.168.17.243

5 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 495 TCAPIR 2762287407 2.9E+09 33.65053 0.057430662 33.59311 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4304 192.168.17.243

6 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 500 TCAPIR 4484655211 4.629E+09 35.15451 0.12540185 35.0200041 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4303 192.168.17.243

7 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 262 TCAPIR 4637789017 4.777E+09 34.10823 0.42818993 33.6800421 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4305 192.168.17.243

8 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 293 TCAPIR 542458283 668050357 30.66213 0.053870115 30.6082571 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4306 192.168.17.243

9 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 10493 TCAPIR 3802597962 5.38E+09 385.0374 5.576215 379.461151 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4285 192.168.17.243

10 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 185 TCAPIR 5384541333 5.446E+09 15.04486 0.15656103 14.8883031 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4308 192.168.17.243

11 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 282 TCAPIR 1028119195 1.153E+09 30.38298 0.04661279 30.3363631 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4309 192.168.17.243

12 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 163 TCAPIR 901260513 962209631 14.88016 0 14.88015651 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4310 192.168.17.243

13 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 5126 TCAPIR 3137255105 3.284E+09 35.92899 0.33009765 35.5988921 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4313 192.168.17.243

14 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 5122 TCAPIR 4890213483 5.128E+09 58.01673 0.61064285 57.406091 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4314 192.168.17.243

15 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 24315 TCAPIR 13036032356 1.393E+10 217.4406 4.0119 213.42871 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4282 192.168.17.243

16 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 24338 TCAPIR 1463812131 2.41E+09 230.9845 3.1036336 227.88091 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4284 192.168.17.243

17 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 12587 TCAPIR 1160912461 1.967E+09 196.8579 0.7669092 196.090961 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4315 192.168.17.243

18 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 6599 TCAPIR 5303866625 5.467E+09 39.78177 0.020269532 39.7614941 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4316 192.168.17.243

19 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 6565 TCAPIR 6143860672 6.315E+09 41.86705 0.16208105 41.7049671 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4317 192.168.17.243

20 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 25052 TCAPIR 2622790027 3.928E+09 318.7149 5.489483 313.225461 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4281 192.168.17.243

21 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 7709 TCAPIR 4477460136 4.615E+09 33.52233 0.35891944 33.1634061 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4322 192.168.17.243

22 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 7682 TCAPIR 1973032107 2.112E+09 33.81701 0.19548193 33.6215251 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4321 192.168.17.243

23 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 14950 TCAPIR 458083508 590213570 32.25832 0.0489917 32.2093241 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4323 192.168.17.243

24 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 14016 TCAPIR 61401222 178390269 28.56178 0.2347461 28.3270321 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4325 192.168.17.243

25 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 14088 TCAPIR 86069826 148846164 15.32625 0.0541626 15.2720911 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4326 192.168.17.243

26 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 14097 TCAPIR 5471350509 5.535E+09 15.43587 0.21740967 15.2184591 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4324 192.168.17.243

27 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 7051 TCAPIR 5358173556 5.482E+09 30.16547 0.001757324 30.1637151 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4328 192.168.17.243

28 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 7029 TCAPIR 2281578411 2.336E+09 13.27289 0 13.2728891 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4327 192.168.17.243

29 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 379 TCAPIR 1054429318 1.188E+09 32.66632 0.067269534 32.5990521 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4329 192.168.17.243

30 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 347 TCAPIR 644045567 759168227 28.10612 0.16462207 27.9414961 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4330 192.168.17.243

31 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 18550 TCAPIR 764059849 891747729 31.1738 0.4028291 30.7709711 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4336 192.168.17.243

32 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 18551 TCAPIR 5678912186 5.811E+09 32.35731 0.39294335 31.9643651 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4332 192.168.17.243

33 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 18557 TCAPIR 260836676 390012335 31.53703 0.6369346 30.9000911 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4331 192.168.17.243

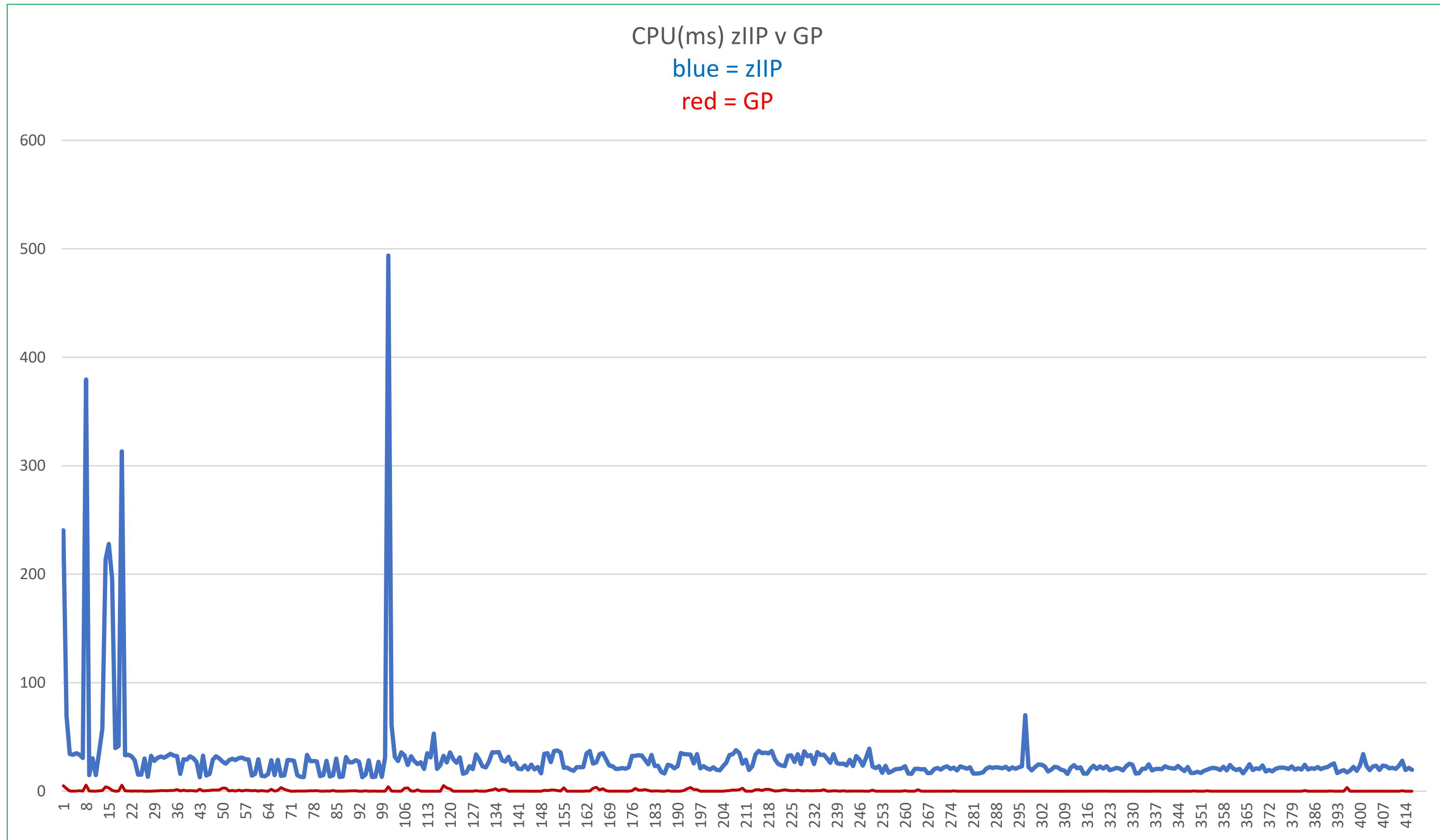
34 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 18568 TCAPIR 252264630 387487083 33.01329 0.4126411 32.6006551 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4333 192.168.17.243

35 MPZ3 MPZPLEX BAQSTRT Friday Au 3.84E+12 Friday Au 3.84E+12 18571 TCAPIR 6167008451 6.311E+09 35.09796 0.69125974 34.4066961 USER1 /zosConn(mpz3.was 9080 /zosConnect/apiRequeste 166 9080 4334 192.168.17.243

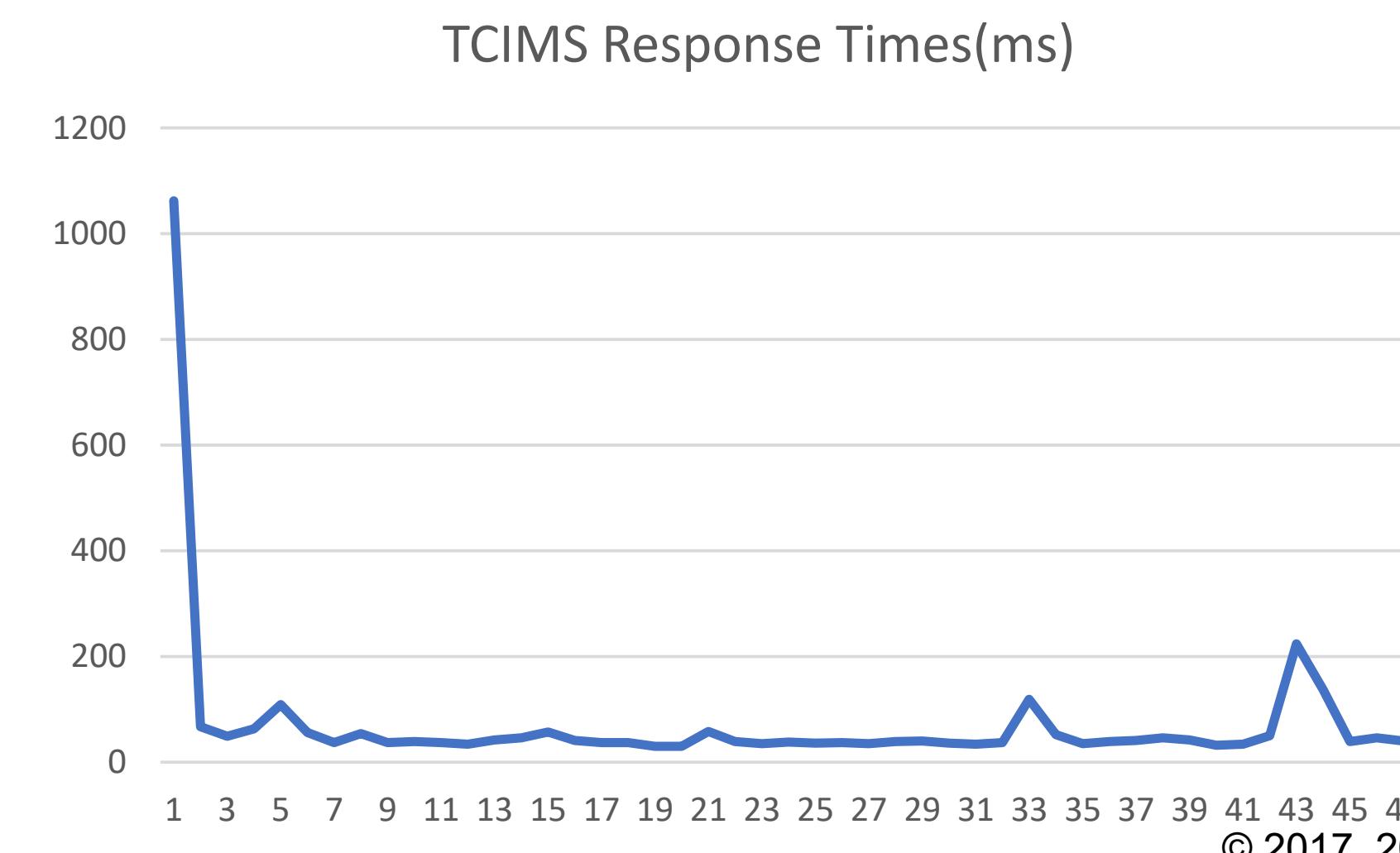
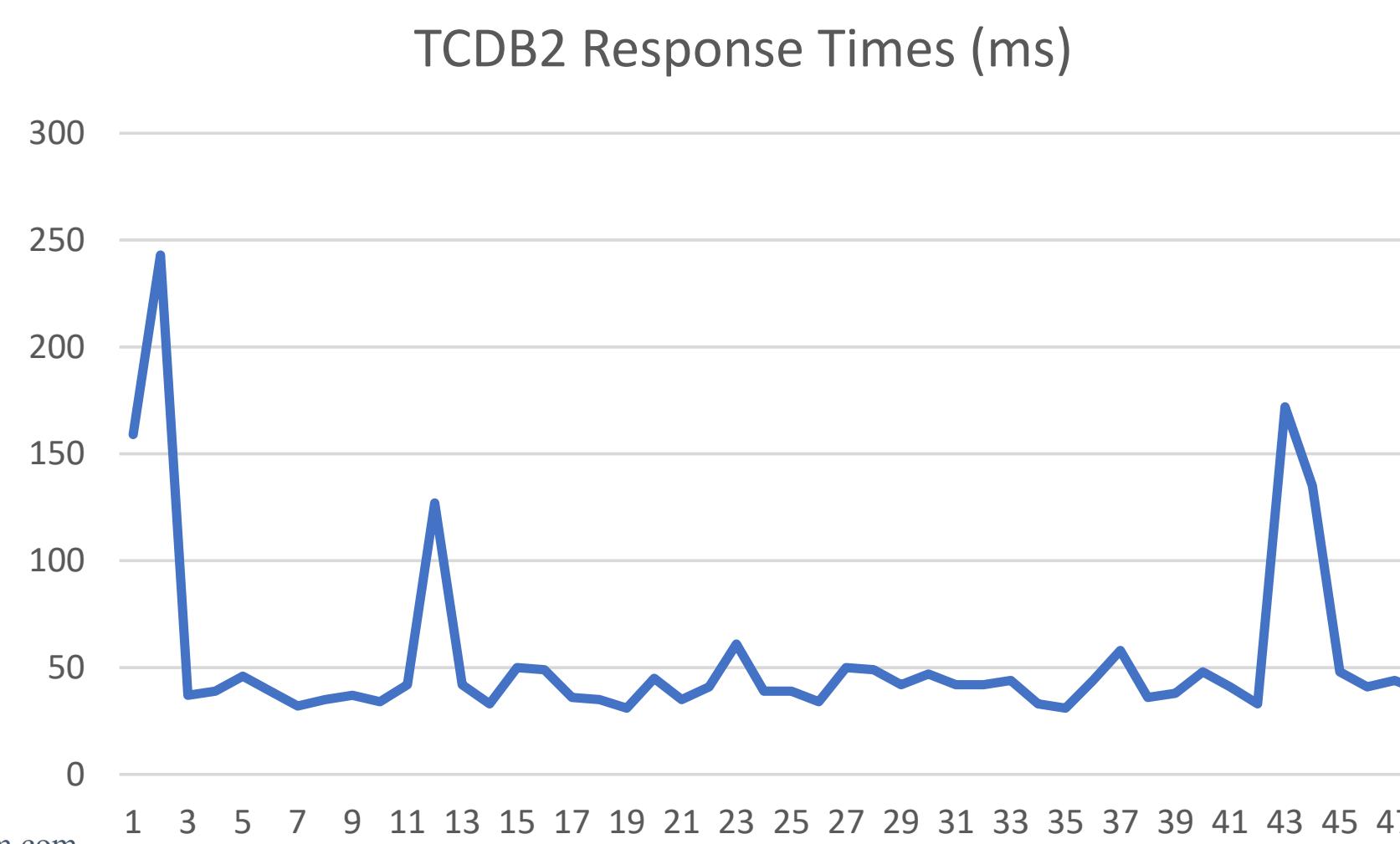
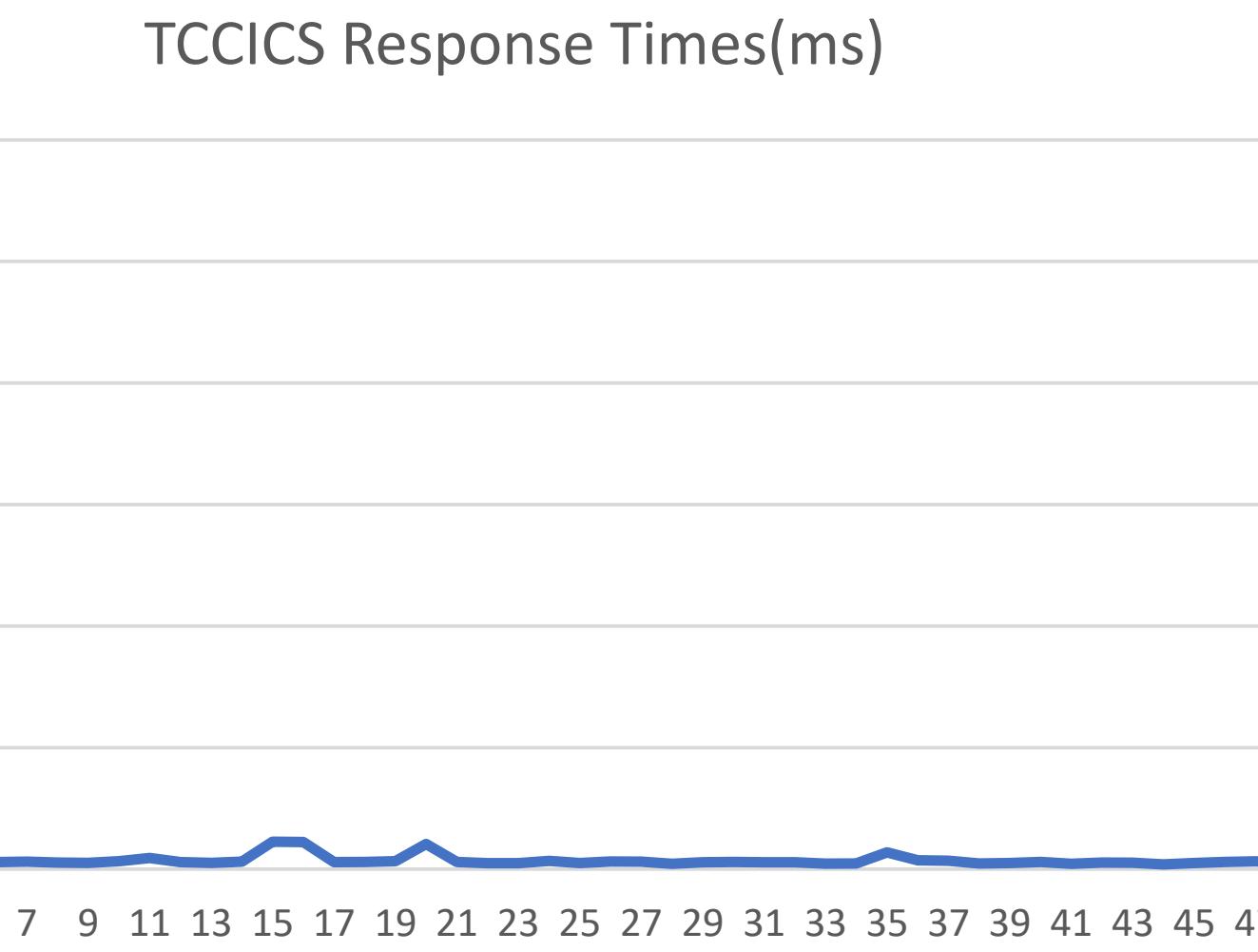
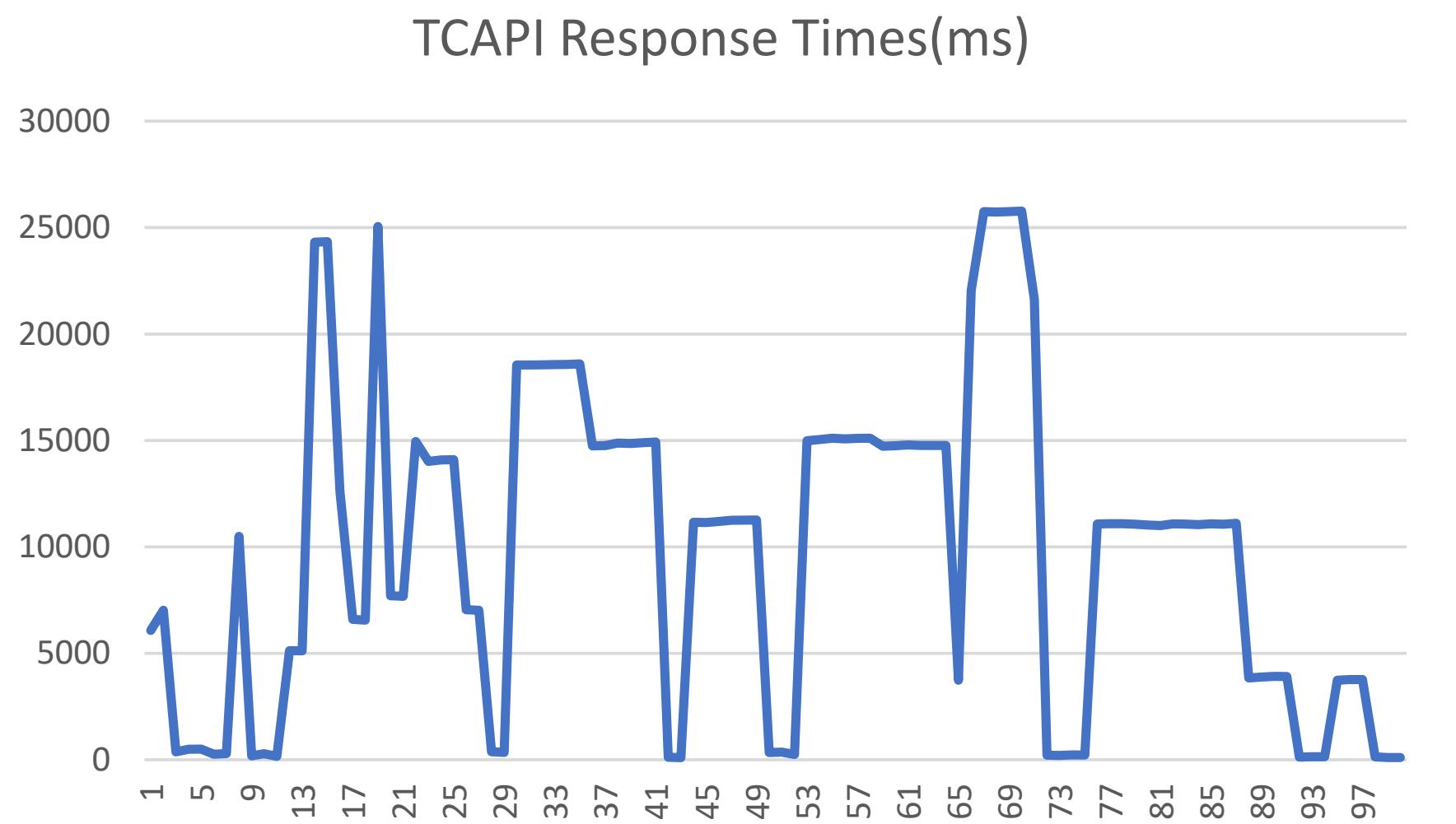
Some fields have been hidden



Liberty SMF 120 type 11 – GP v zIIP comparison example



Liberty SMF 120 type 11 – Response times comparisons example



z/OS Connect SMF 123 server XML configuration (OpenAPI 2)



SMF 123 records have two subtypes, and each subtype can have different versions.

- SMF type 123 subtype 1 records - Version 1 contains some basic information about both API provider and API requester requests. Version 2 supersedes version 1 and contains more detailed information about each API provider request, including information about to which system of record (SOR) the request was sent
- SMF type 123 subtype 2 records - Version 2 supersedes subtype 1 version 1 and contains more detailed information about each API requester request, including information about to what HTTP endpoint the request was sent.*

Server Config

audit.xml

Read only Close

Design Source

```
1 <?xml version="1.0" encoding="UTF-8"?>
2 <server description="SMF reporting">
3
4   <zosconnect_zosConnectManager
5     globalInterceptorsRef="interceptorList_g"/>
6
7   <zosconnect_authorizationInterceptor id="auth"
8     safCacheTimeout="600"/>
9
10  <zosconnect_auditInterceptor id="audit"
11    apiRequesterSmfVersion="2"
12    apiProviderSmfVersion="2"/>
13
14  <zosconnect_zosConnectInterceptors id="interceptorList_g"
15    interceptorRef="audit"/>
16
17</server>
18
```

Server Config

audit.xml

Read only Close

Design Source

Server

- z/OS Connect Manager
- z/OS Connect Authorization Interceptor auth
- z/OS Connect EE SMF Audit Interceptor audit

z/OS Connect Interceptors interceptorList_g

Sequence
0 (default)
The sequence in which this interceptor should be processed with respect to other configured interceptors implementing z/OS Connect's com.ibm.wsspi.zos.connect.Interceptor Service Provider Interface (SPI).

API provider SMF Version
2
The version of SMF 123 subtype 1 records to be written.

auditApiProviderRequestHeaders.name
(no value)
auditApiProviderRequestHeaders.desc

auditApiProviderResponseHeaders.name
(no value)
auditApiProviderResponseHeaders.desc

API requester SMF Version
2
The version of SMF 123 subtype 1 or subtype 2 records to be written.

z/OS Connect SMF 123 subtype 1 version 2 (OpenAPI 2) *



smfout.csv

Search

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AM1

A B C D U V X Y Z AA A AJ AK AL AM AN AO AP AQ AR AS AT AU AV

REC_TYPE SUBTYPE SUBTYPE_VERSION

123 1 2

1

2

3

4

5 SID SSI TRIPLET_C TRIPLET_C HTTP_RES REQ_TIME USER_NAM USER_NA CLIENT_IP API_NAM API_VERS TIME_ZC_EN TIME_ZC TIME_SO TIME_ZCinboundTime(us) SORTTime(us) ZCOutboundTime(us) TotalTime(us) TotalTime(s) SP_NAME SOR_REFESOR_IDEN SOR_RESOURCE REQ_I

6 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/21 1 2021/08/2021/0 41355 913 9306 51575 0.0516 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

7 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/21 1 2021/08/2021/0 25471 756 3442 29669 0.0297 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

8 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 33757 1072 7176 42007 0.042 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

9 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 22424 1683 3430 27538 0.0275 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

10 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 24569 835 6861 32266 0.0323 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

11 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 23687 894 6740 31321 0.0313 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

12 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 39183 813 5873 45869 0.0459 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

13 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 28666 442 3328 32437 0.0324 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

14 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 62785 1454 14099 78338 0.0783 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

15 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 63645 720 10646 75013 0.075 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

16 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 32949 956 7546 41452 0.0415 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

17 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 35064 774 7185 43023 0.043 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

18 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 29211 577 3953 33743 0.0337 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

19 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 19984 764 7056 27805 0.0278 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

20 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 70534 834 18331 89700 0.0897 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

21 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 59928 1413 8672 70014 0.07 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

22 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 34807 561 5141 40510 0.0405 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

23 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 103793 5375 15872 125041 0.125 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

24 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 103356 1792 12380 117530 0.1175 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

25 MPZ3 ZCON 2 40 200 NO distuser1 USER1 192.168.17 cscvinc 1.0.0 2021/08/23 1 2021/08/2021/0 97134 987 14433 112554 0.1126 CICS-1.0 cscvinc USIBMWZ CSMI,CSCVINC

26

smfout

Average: 3260805.85 Count: 210 Sum: 326080585

100%

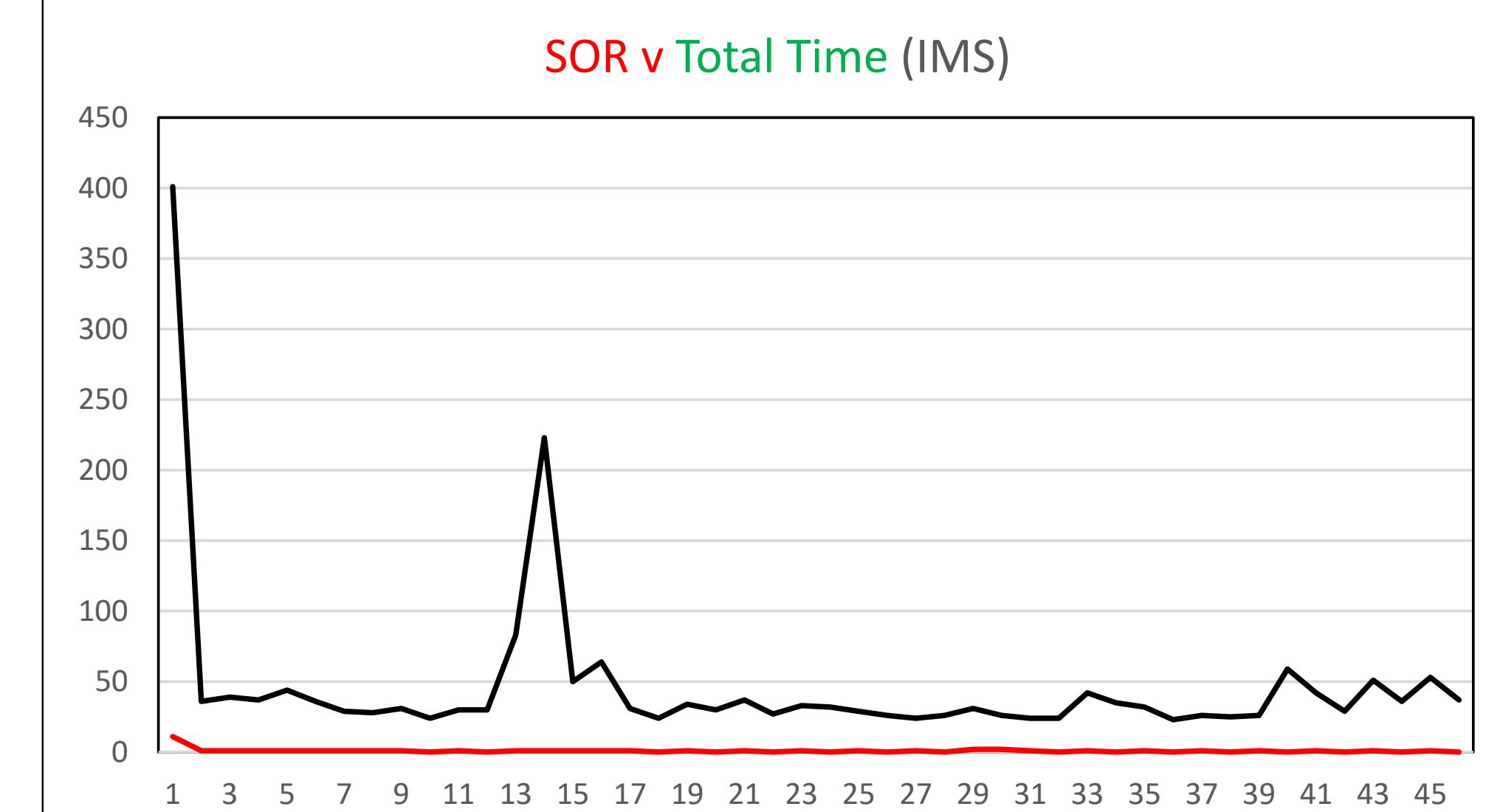
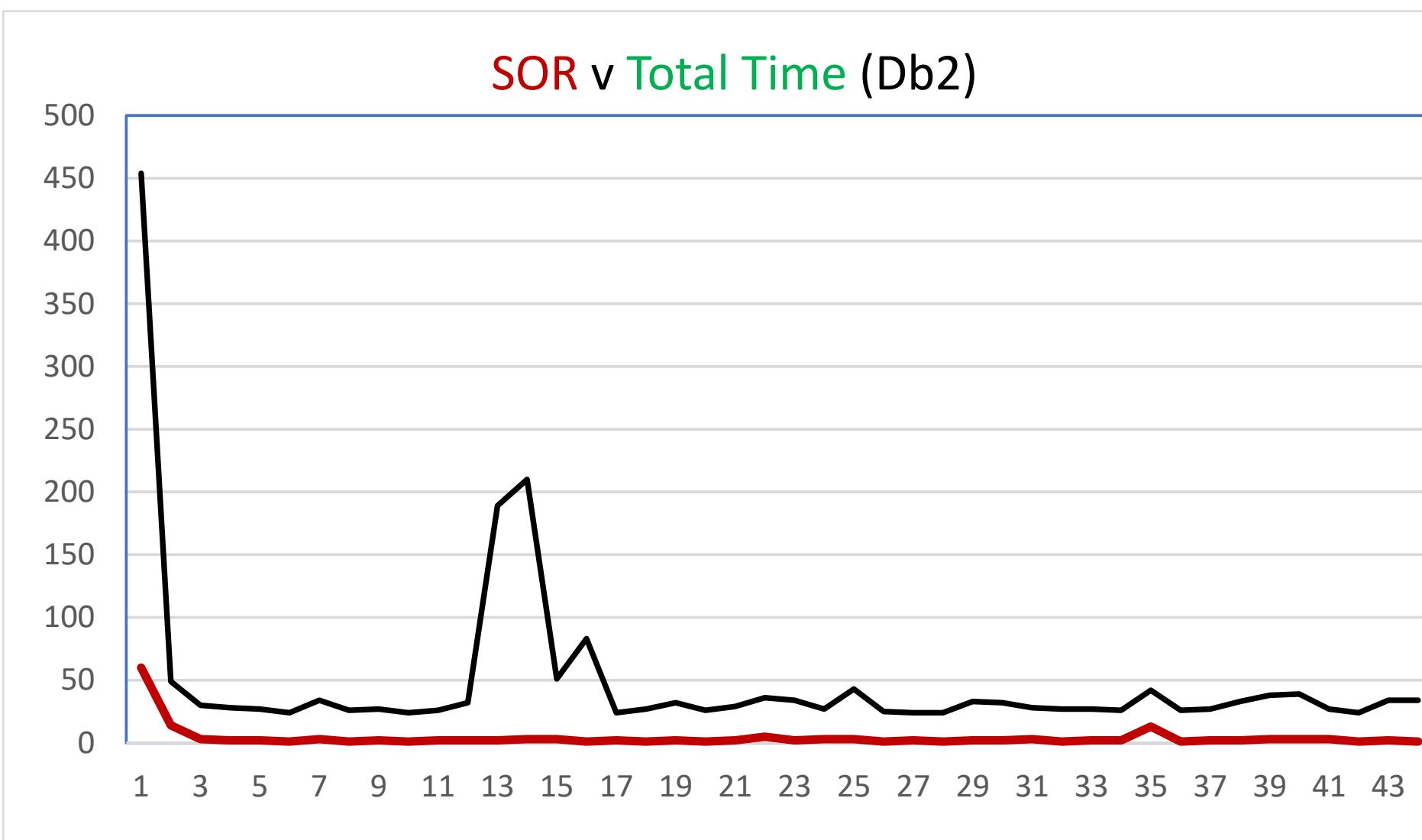
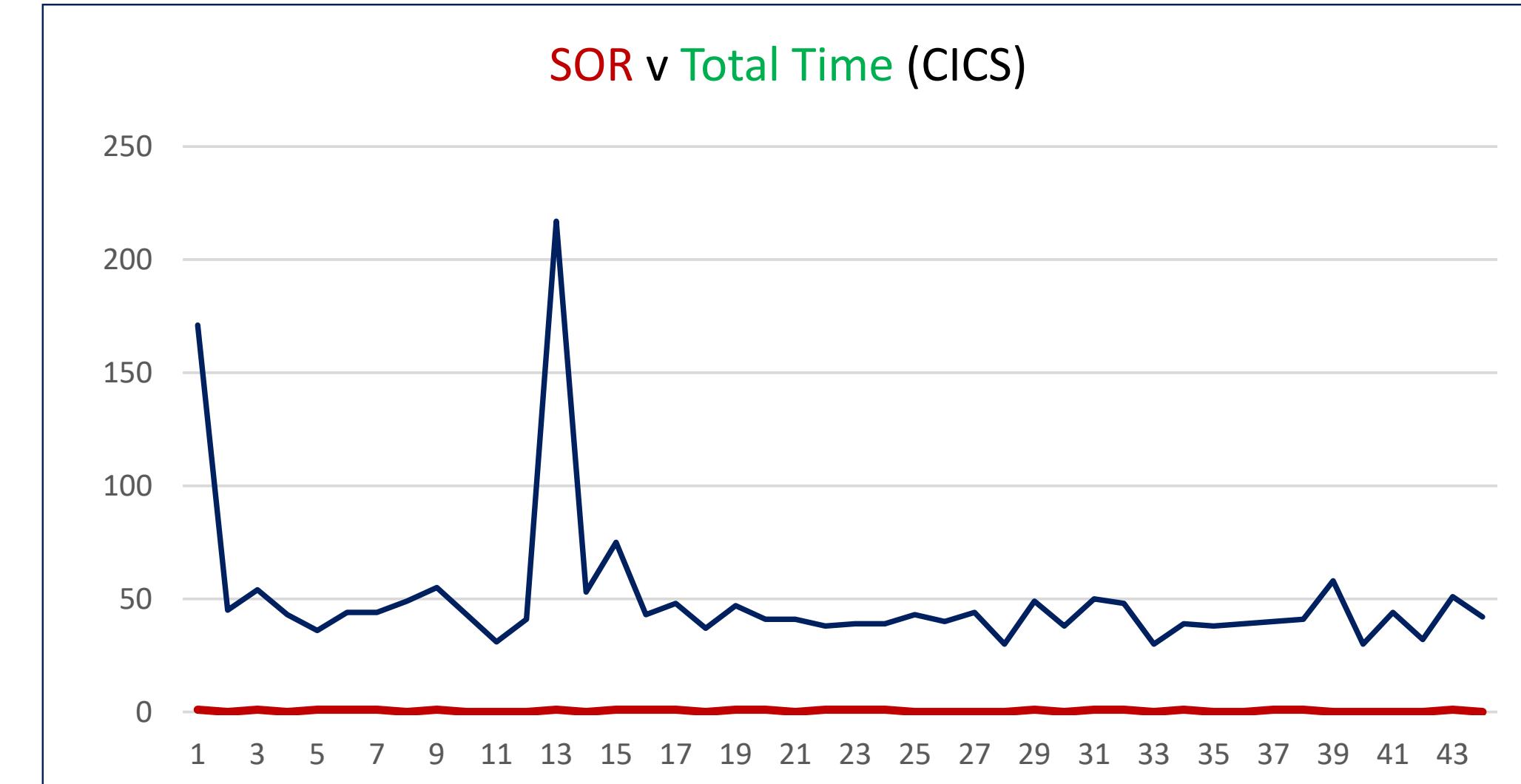
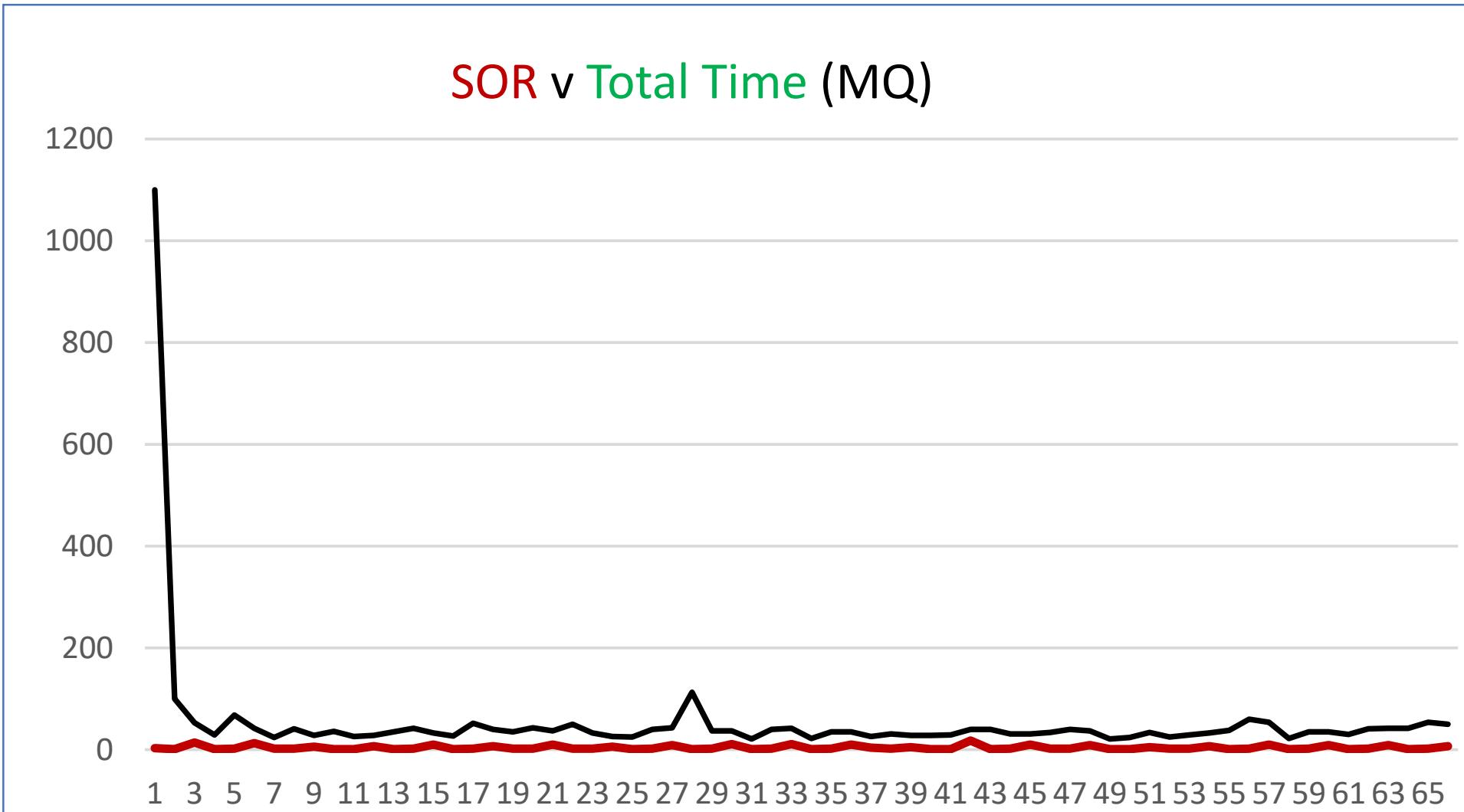
mitchj@us.ibm.com

Some fields have been hidden

* Generated by using a modified version
of the BAQSMFX sample program.

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z/OS Connect SMF 123 subtype 1 version 2 graph examples (OpenAPI 2)



z/OS Connect SMF 123 subtype 2 version 2 (OpenAPI 2) *



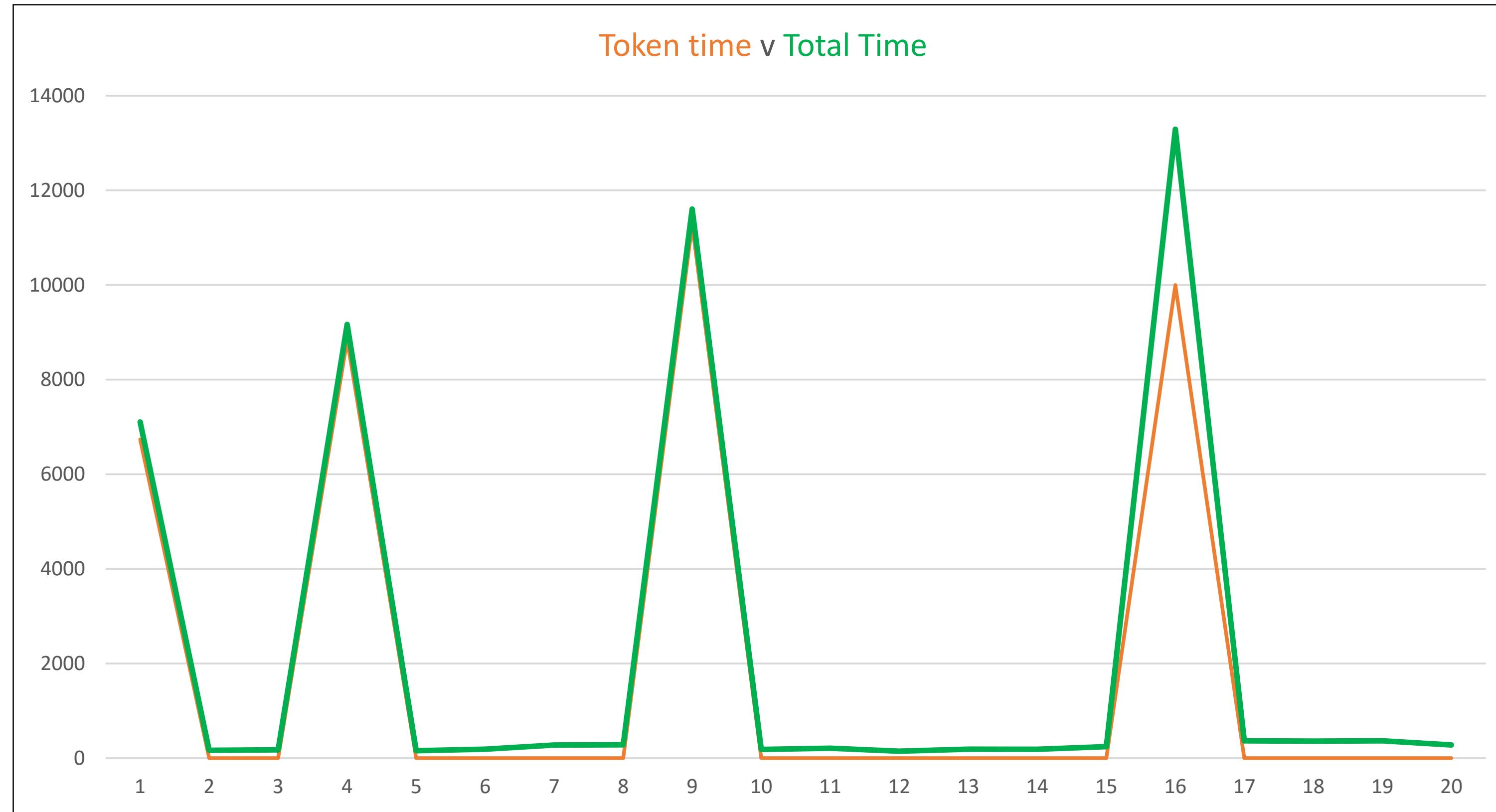
Some fields have been hidden

mitchj@us.ibm.com

* Generated by using a modified version of the BAQSMFX sample program.

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z/OS Connect SMF 123 subtype 2 version 2 graph example (OpenAPI 2)



Connection Management



Inbound persistent connections

- Persistent connections can be used to avoid too many handshakes
- Configured by setting the `keepAliveEnabled` attribute on the `httpOptions` element to **true**
- Example setting `server.xml` file

```
<httpEndpoint host="*" httpPort="80" httpsPort="443" id="defaultHttpEndpoint"  
httpOptionsRef="httpOpts"/>  
  
<httpOptions id="httpOpts" keepAliveEnabled="true" maxKeepAliveRequests="500"  
persistTimeout="1m"/>
```

- This sets the connection timeout to **1 minute** (default is 30 seconds) and sets the maximum number of persistent requests that are allowed on a single HTTP connection to **500**
- It is recommended to set a maximum number of persistent requests when connection workload balancing is configured
- It is also necessary to configure the client to support persistent connections



Liberty Connection Management

Liberty default connection pool management <connectionManager>

- agedTimeout The number of seconds before a physical connection can be discarded by the pool maintenance thread. The default value of -1 disables this timeout.
- connectionTimeout Amount of time after which a connection request will time out with an exception when no connections are available.
- maxIdleTime Amount of time a connection can be unused or idle until it can be discarded during pool maintenance.
- maxPoolSize Maximum number of physical connections for a pool.
- minPoolSize Minimum number of physical connections to maintain in the pool.
- purgePolicy Specifies which connections to destroy when a “stale” connection is detected in a pool (EntirePool, FailingConnectionOnly or ValidateAllConnections)
- reapTime Amount of time between runs of the pool maintenance thread. Should be less than agedTimeout and maxIdleTime.

```
<connectionManager id="ConMgr1">  
    agedTimeout=-1  
    connectionTimeout=30s  
    maxIdleTime=1800s  
    maxPoolSize=50  
    minPoolSize=0  
    purgePolicy= "EntirePool"  
    reapTime=180/>
```



IMS Connect TCPIP configuration parameters

In the IMS Connect **TCPIP** configuration statement, you can set the following limits on the amount of time IMS Connect waits in the following stages of communication:

- The *TIMEOUT* parameter determines how long IMS Connect keeps a connection open if the client does not send any input after the connection is **first** established.
- The *IDLETO* parameter determines how long IMS Connect keeps a connection that is in RECV state open **after** the prior client interaction completes.
- The *TIMEOUT* parameter also determines how long IMS Connect waits for a response from IMS before IMS Connect notifies the client of the timeout and returning the socket connection to a RECV state.

```
HWS=(ID=IMS15HWS,XIBAREA=100,RACF=Y,RRS=Y)
TCPIP=(HOSTNAME=TCPIP,
       ECB=Y,           This allows TCP/IP to post an ECB into IMS Connect to improve performance
       PORT=(ID=4000, IDLETO=4500), Idle timeout value set to 4500 hundredths of a second
       PORT=(ID=4001),           Idle timeout value is set to global default
       PORT=(ID=4002, IDLETO=3600), Idle timeout value set to 3600 hundredths of a second
       PORTID=(4003),           Idle timeout value is set to global default
       IDLETO=5500,             Global idle timeout value set to 5500 hundredths of a second
       RACFID=JOHNSON,
       TIMEOUT=5000)
```



IMS Connection Management Attributes

IMS connection profiles (imsmobile_imsConnection)

- **connectionFactoryRef** – Set this file to the name (ID) of the ConnectionFactory configuration element

IMS interaction profiles (imsmobile_interaction)

- **imsConnectTimeout** - Specify the time in milliseconds to wait for a reply after sending a message to IMS Connect.
General guidelines for setting the imsConnectTimeout value:
 - This value should be equal or larger than the value for interactionTimeout.
 - This value should be at least 5 seconds shorter than the value for the *asyncRequestTimeout* attribute of the *zosconnect_zosConnectManager* element in server.xml.
- **interactionTimeout** - Specify the time in milliseconds for the transaction to be processed by IMS. After sending a message to IMS, IMS Connect waits for a reply from IMS until this timeout value is reached..
 - Valid values are -1, 0, or between 1 and 3600000 (one hour), inclusively.
 - A value of 0 means that the timeout value is determined by IMS Connect.
 - A value of -1 (the default) means to wait indefinitely.
- **transExpiration** - Indicates to IMS OTMA, when the execution timeout value is reached, whether the transaction is considered expired, and OTMA no longer needs to process it. When this property is set to true, the IMS TM resource adapter client application indicates to OTMA that the transaction can be discarded after the execution times out. This function relieves OTMA from having to process unnecessary messages. The default is false.

Tip: The imsConnectTimeout value should be equal or larger than the value for interactionTimeout.



Connection Management for IMS TM

Use the connectionManagerRef attribute in an IMS ConnectionFactory to provide a connection pool for connections to IMS Connect.

```
<connectionManager id="IMSTMConnMgr1" agedTimeout=-1 connectionTimeout=30 maxIdleTime=1800 maxPoolSize=50  
minPoolSize=0 purgePolicy="EntirePool" reaptTime=180/>  
<connectionManager id="IMSTMConnMgr2" agedTimeout=-1 connectionTimeout=30 maxIdleTime=1800 maxPoolSize=200  
minPoolSize=0 purgePolicy="EntirePool" reaptTime=180/>  
  
<imsmobile_imsConnection id="IMSCONN1" connectionFactoryRef="IMSCF1"/>  
<connectionFactory id="IMSCF1" connectionManagerRef="IMSTMConnMgr1" containerAuthDataRef="Connection1_Auth" >  
    <properties.gmoa hostName="wg31.washington.ibm.com" portNumber="4000" applicationName="IMSTMPL"/>  
</connectionFactory>  
  
<imsmobile_imsConnection id="IMSCONN2" connectionFactoryRef="IMSCF2"/>  
<connectionFactory id="IMSCF2" connectionManagerRef="IMSTMConnMgr2" containerAuthDataRef="Connection1_Auth" >  
    <properties.gmoa hostName="wg31.washington.ibm.com" portNumber="4000" applicationName="IMSTMPL"/>  
</connectionFactory>  
  
<imsmobile_interaction id="IMSINTER1" imsConnectTimeout="30000"  
                      interactionTimeout="20000" ... />  
<imsmobile_interaction id="IMSINTER2" imsConnectTimeout="20000"  
                      interactionTimeout="15000" ... />
```

The total of *maxPoolSize* in the *connectionManager* configuration elements should not exceed the value of the IMS Connect *MAXSOC* attribute – 1,

- The imsConnectTimeout value is the time the service provider waits for a reply after sending a message to IMS Connect
- The interactionTimeout value is passed to IMS Connect. IMS Connect sends the message to IMS and then waits that long for a reply. If there is none there is a timeout in IMS Connect and IMS Connect sends a timeout to the service provider.



TCP/IP considerations with IMS Connect

On the Liberty TCP/IP environment, ensure:

- **TCPNODELAY=DISABLE**. This allows optimization of transmission but depends on the client environment. Allows for multiple writes and waits for the buffer to be filled before sending.
- **SO_Linger=Y,VALUE=10** ensures no loss of data. The close of the socket is blocked until ACK is received or 10 seconds, whichever comes first.

In PROFILE.TCPIP configuration on the IMS Connect endpoint, ensure:

- IMS Connect PORT set to NODELAYACKS. This allows ACKS to be sent immediately.
- Specify SHAREPORT, which allows IMS Connect PORTS to be shared by multiple IMS Connect instances on the same stack.
- TCPCONFIG INTERVAL or KEEPALIVEOPTIONS INTERVAL allows TCP/IP to maintain a connection that can be inactive for long periods of time.
- SOMAXCONN must be defined large enough for maximum concurrent connections.

From Redbook *IMS Performance and Tuning Guide*, SG24-7324-00



Connection Management for IMS DB

Use the `connectionManagerRef` attribute in an IMS ConnectionFactory to provide a connection pool for connections to IMS Connect.

```
<connectionFactory id="DFSIVPACConn" connectionManagerRef="IMSDBConnMgr" >
<properties.imsudbJLocal
  databaseName="DFSIVPA"
  datastoreName="IVP1"
  datastoreServer="wg31.washington.ibm.com"
  driverType="4"
  portNumber="5555"
  user="USER1"
  password="USER1"
  flattenTables="True"/>
</connectionFactory>

<connectionManager id="IMSDBConnMgr" agedTimout=-1 connectionTimeout=30
maxIdleTime=1800 maxPoolSize=50 minPoolSize=0 purgePolicy="EntirePool"
reapTime=180/>
```

The `maxPoolSize` in the `connectionManager` configuration element should not exceed the value of the IMS Connect `MAXSOC` attribute.



Connection Management for MQ

Use the connectionManagerRef attribute in a JMS ConnectionFactory to provide a connection pool for connections to a queue manager.

```
<jmsConnectionFactory id="qmgrCf" jndiName="jms/qmgrCf"  
connectionManagerRef="MQConnMgr">  
  <properties.wmqJMS transportType="CLIENT"  
    queueManager="ZMQ1"  
    channel="LIBERTY.DEF.SVRCONN"  
    hostName="wg31.washington.ibm.com"  
    port="1422" />  
</jmsConnectionFactory>  
  
<connectionManager id="MQConnMgr" agedTimout=-1 connectionTimeout=30  
  maxIdleTIme=1800 maxPoolSize=50 minPoolSize=0 purgePolicy="EntirePool"  
reapTIme=180/>
```

The *maxPoolSize* in the *connectionManager* configuration element should not exceed the value of the *MAXINST* or *MAXINSTC* attributes of the queue manager's server-connection channel.



Connection Management for outbound HTTP request, e.g., Db2, etc.

Outbound connections to Db2, authorization servers, API requesters servers are managed by z/OS Connect code (as is any endpoint configured by the use of a z/OS Connection configuration element).

Connections are managed and/or configured by the use of Java system parameters (-D) *http.maxConnections* and *http.keepAlive*.

- Dhttp.maxConnections=5
- Dhttp.keepAlive=true



TLS sessions

- When connections timeout, it is still possible to avoid the impact of full handshakes by reusing the TLS session id
- Configured by setting the `sslSessionTimeout` attribute on the `sslOptions` element to an amount of time
- Example setting `server.xml` file

```
<httpEndpoint host="*" httpPort="80" httpsPort="443" id="defaultHttpEndpoint"  
httpOptionsRef="httpOpts" sslOptionsRef="mySSLOptions"/>  
  
<httpOptions id="httpOpts" keepAliveEnabled="true" maxKeepAliveRequests="100"  
persistTimeout="1m"/>  
  
<sslOptions id="mySSLOptions" sslRef="DefaultSSLSettings"  
sslSessionTimeout="10m"/>
```

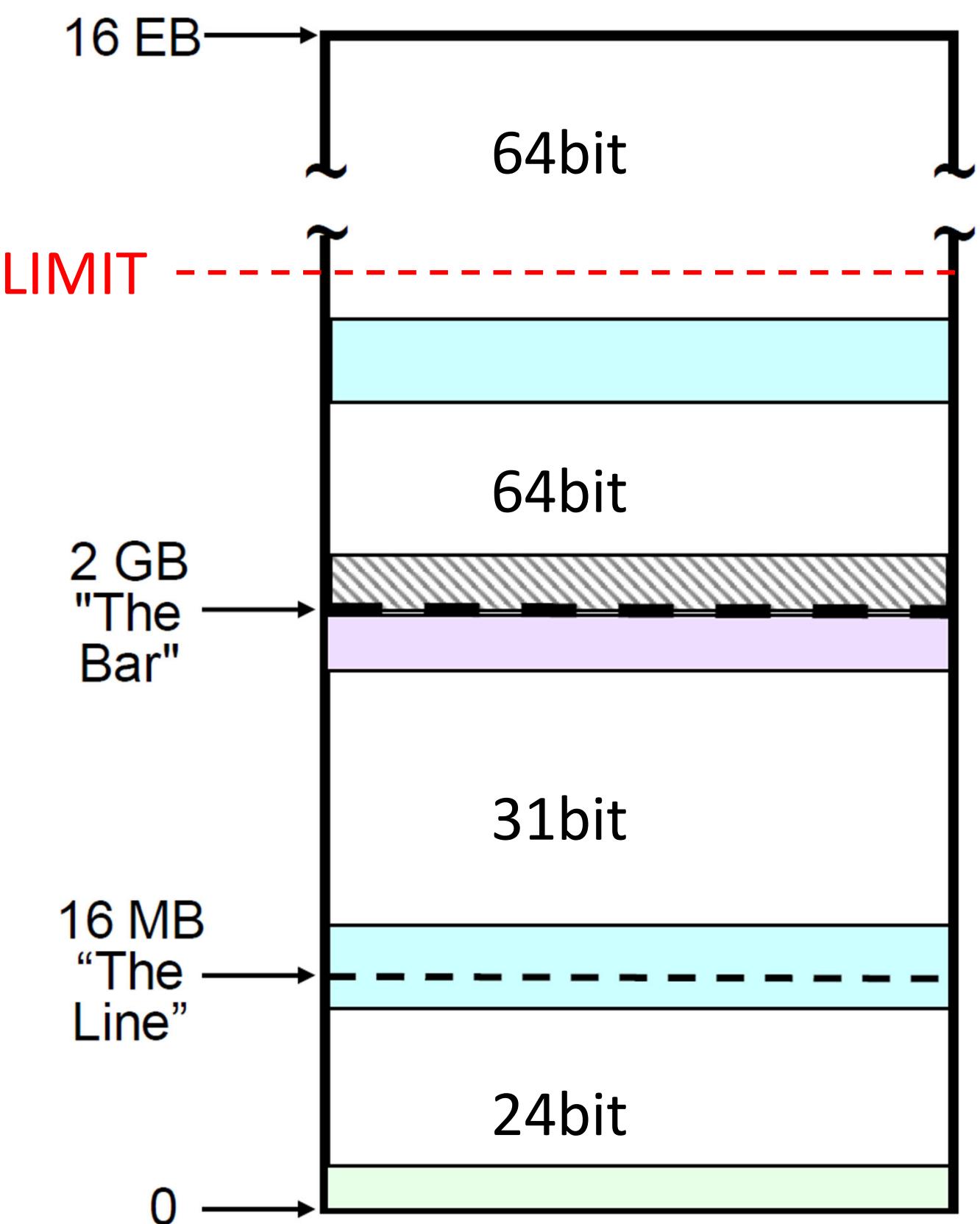
- This sets the timeout limit of an TLS session to **10 minutes** (default is 8640ms)

Memory and Storage

MEMLIMIT - memory storage above-the-bar

```
//ZCON EXEC PGM=BPXBATSL,REGION=0M,MEMLIMIT=4G,  
//      PARM='PGM &ZCONHOME./bin/zosconnect run &PARMS.'
```

- Limits the amount of 64-bit storage
 - Only a limit, not pre-allocated
- z/OS uses above the bar storage for:
 - Native thread stack storage
- Java uses above the bar storage for:
 - Heap storage
 - Caches
 - Java thread

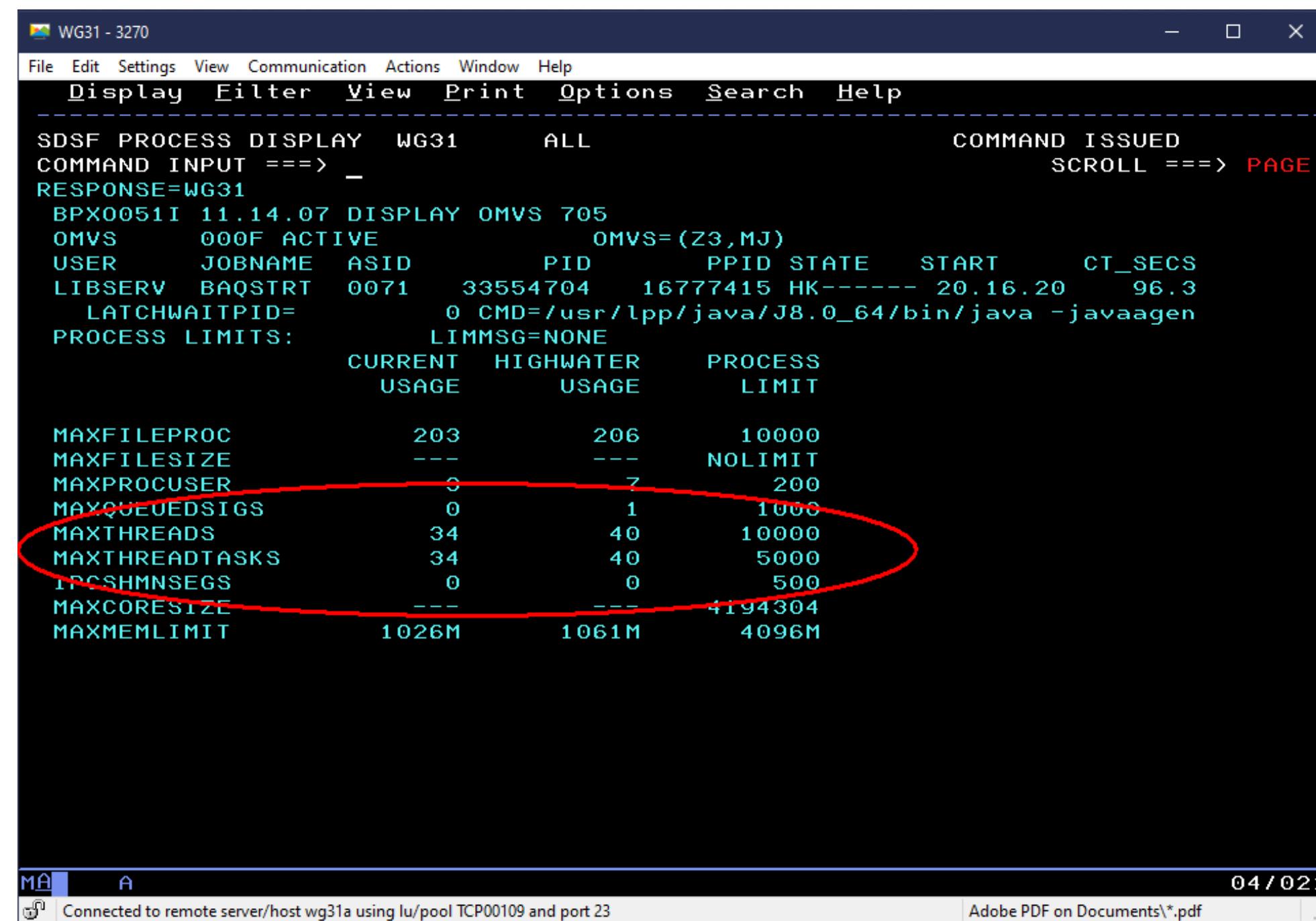


messages.log

CWWKB0125I: This server requested a REGION size of 0KB. The below-the-line storage limit is 8MB and the above-the-line storage limit is 1725MB.
 CWWKB0126I: MEMLIMIT=1000. MEMLIMIT CONFIGURATION SOURCE=JCL.

Native threads

- Native threads require 3Mb of above the bar storage (2Mb for LE and 1Mb for the JVM)
 - Monitor thread usage for the address space
 - *D OMVS,LIMITS,PID=<server pid>*



```

WG31 - 3270
File Edit Settings View Communication Actions Window Help
Display Filter View Print Options Search Help
SDSF PROCESS DISPLAY WG31 ALL
COMMAND INPUT ==> -
RESPONSE=WG31
BPX0051I 11.14.07 DISPLAY OMVS 705
OMVS 000F ACTIVE OMVS=(Z3,MJ)
USER JOBNAME ASID PID PPID STATE START CT_SECS
LIBSERV BAQSTRT 0071 33554704 16777415 HK----- 20.16.20 96.3
LATCHWAITPID= 0 CMD=/usr/lpp/java/J8.0_64/bin/java -javaagen
PROCESS LIMITS: LIMMSG=NONE
CURRENT HIGHWATER PROCESS
USAGE USAGE LIMIT
MAXFILEPROC 203 206 10000
MAXFILESIZE --- --- NOLIMIT
MAXPROCUSER 0 7 200
MAXQUEUEDSIGS 0 1 1000
MAXTHREADS 34 40 10000
MAXTHREADTASKS 34 40 5000
ITC_SHMNSEGS 0 0 500
MAXCORESIZE --- --- 4194304
MAXMEMLIMIT 1026M 1061M 4096M

```

Connected to remote server/host wg31a using lu/pool TCP00109 and port 23 04 / 021

- MAXTHREADS must be greater than or equal to MAXTHREADTASK
- Take action when USAGE comes within 80-90% of maxThreads



Tech-Tip: Java heap storage

- Java heap is the area of memory managed by the Java Virtual Machine (JVM) where Java class objects and other objects instantiated by Java applications running in the JVM are stored and resides above the bar. The JVM obtains storage in the heap storage on behalf of the Java applications.
- A process known as garbage collection reclaims the storage when the object is no longer, for more information see URL https://docs.oracle.com/cd/E15289_01/JRSDK/garbage_collect.htm

Non-standard Java options related to garbage collection and heap storage*

- Xgcpolicy:gencon Garbage collection policy, the default is *gencon* and is the recommended garbage collection policy
- Xms<size> Initial heap size, defaults to *8MB* on z/OS
- Xmx<size> Maximum heap size, defaults to half the available memory with a minimum of *16 MB* and a maximum of *512 MB*

<https://www.ibm.com/docs/en/sdk-java-technology/8?topic=reference-default-settings>

Standard Java options related garbage collection reporting*

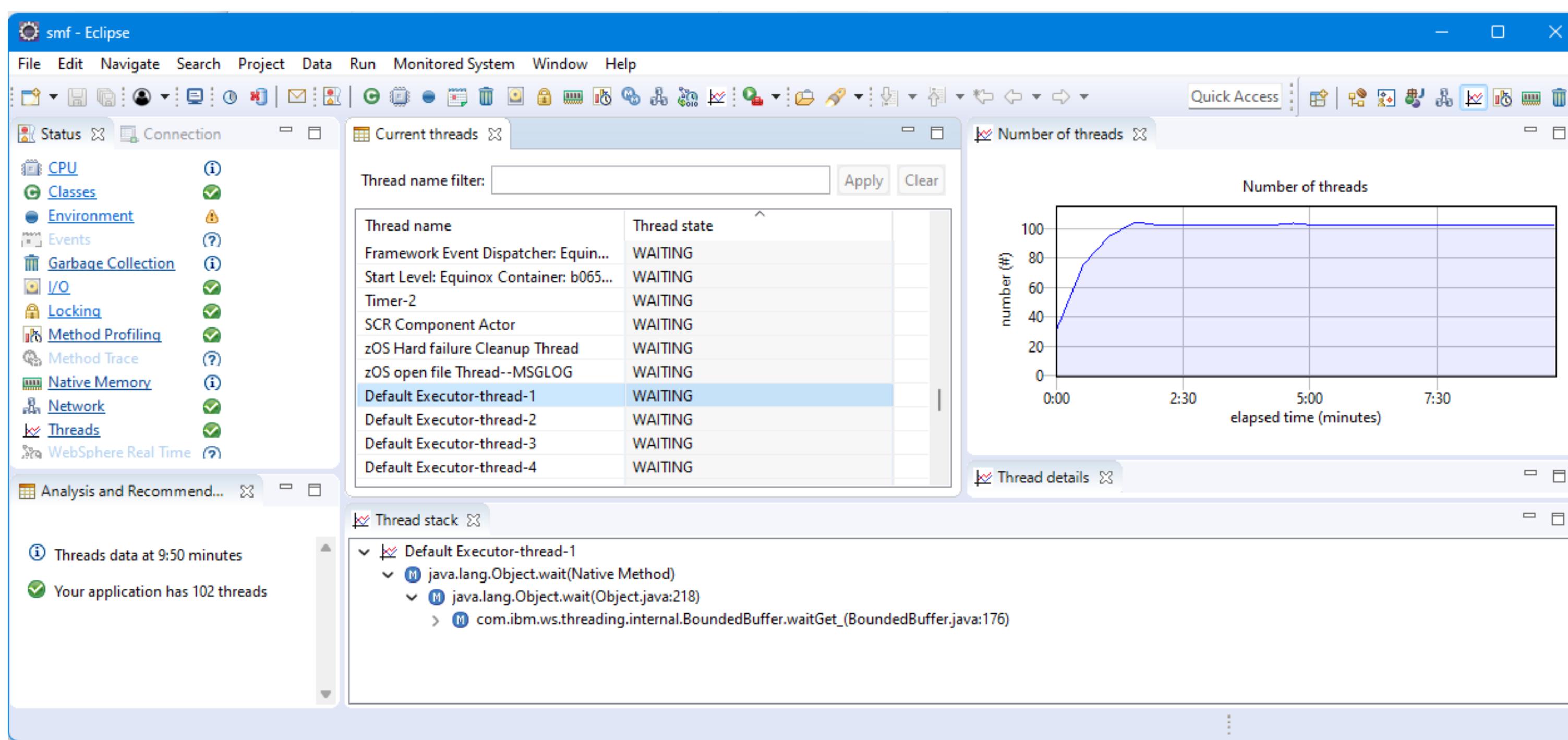
- verbose:gc Writes verbose garbage collection information.
- verbose:sizes Writes information to stderr describing the active memory usage settings.

<https://www.ibm.com/docs/en/sdk-java-technology/8?topic=options-standard>



Java threads

- Java threads handle application requests (executor threads), garbage collection and other Java housekeeping functions.
 - Each Java thread require 1.6Kb of Java heap storage
 - The maximum number of executor threads defaults to unlimited.
 - The maximum number of executor threads can be limited with configuration element `<executor maxThreads="300"/>`
 - The attribute *maxOpenConnections* attribute in the *tcpOptions* configuration element should be set to less than or equal to the value of the maximum number of executor threads.





MEMLIMIT Recommendations

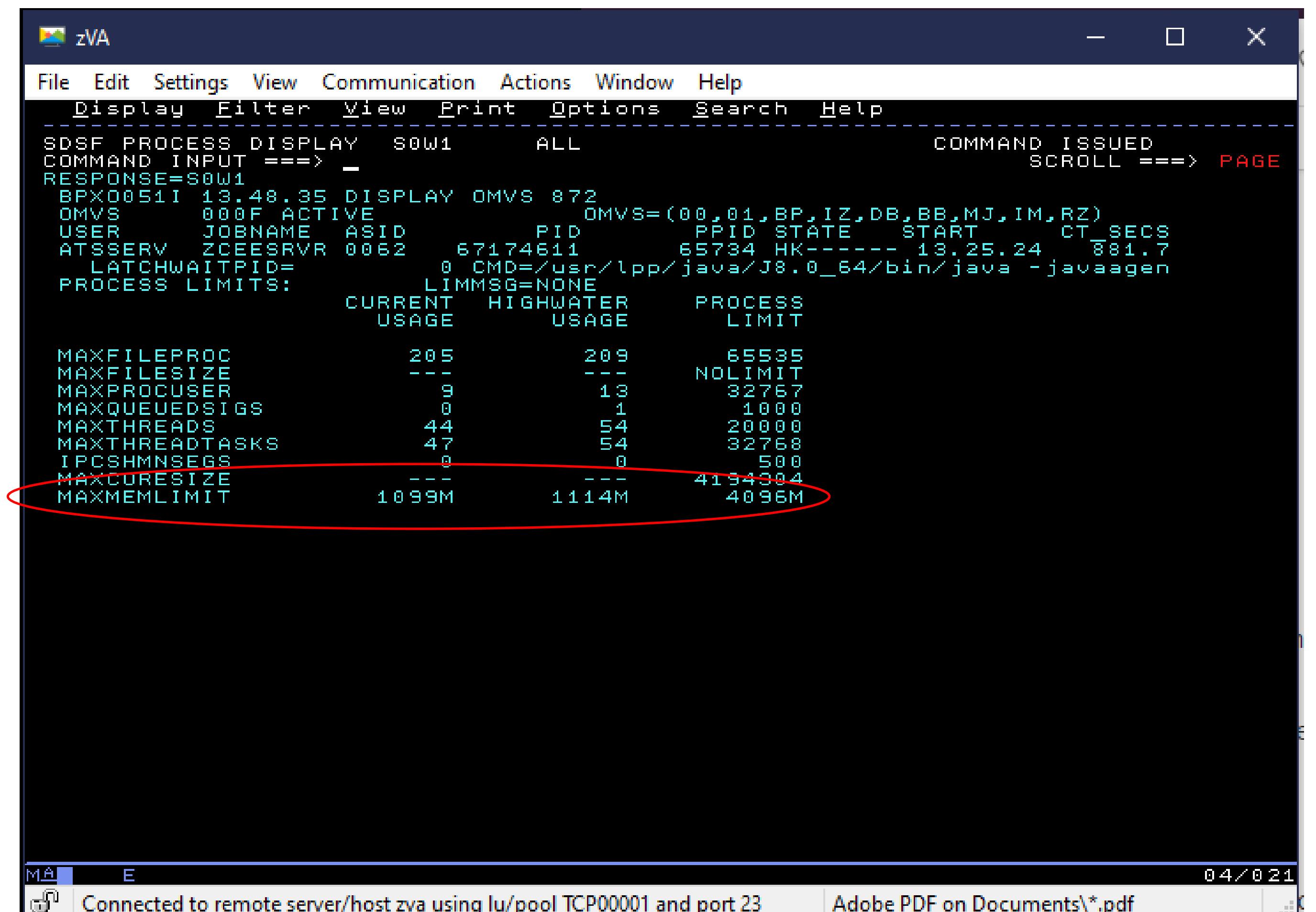
- Don't reach the maximum!
 - Results in Java Out Of Memory errors and system abends
 - z/OS Connect EE will stop processing API requests
- Ensure this doesn't happen
 - Limit the Liberty Default Executor thread pool
 - `maxThreads` default value is `-1` No Limit!
 - **MEMLIMIT** =
 - Maximum JVM Heap Size (`-Xmx`)
 - + 20% of the Maximum Heap Size (for JIT caches and other JVM requirements)
 - + Default Executor pool `maxThreads` * 3MB

`<executor maxThreads="300"/>`

Maximum JVM Heap Size – half the available memory with a minimum of 16 MB and a maximum of 512 MB

MEMLIMIT – management

- MEMLIMIT values
 - MEMLIMIT = maximum Java heap size + 50% of maximum heap size
 - or
 - MEMLIMIT = maximum Java heap size + 20% of Java heap size + (number of executor threads * 3Mb)
- Monitor periodically
 - To track high water mark with MVS command
D OMVS,LIMITS,PID=<server pid>
- Don't reach the maximum!
 - Results in Java Out Of Memory errors and system abends
 - Liberty will stop processing requests



```

zVA
File Edit Settings View Communication Actions Window Help
Display Filter View Print Options Search Help
SDSF PROCESS DISPLAY S0W1 ALL COMMAND ISSUED
COMMAND INPUT ===> -
RESPONSE=S0W1 SCROLL ===> PAGE
BPX0051I 13.48.35 DISPLAY OMVS 872
OMVS 000F ACTIVE OMVS=(00,01,BP,IZ,DB,BB,MJ,IM,RZ)
USER JOBNAM ASID PID PPID STATE START CT_SECS
ATSSERV ZCEESRVR 0062 67174611 65734 HK----- 13.25.24 881.7
LATCHWAITPID= 0 CMD=/usr/lpp/java/J8.0_64/bin/java -javaagen
PROCESS LIMITS: LIMMSG=NONE
                CURRENT HIGHWATER PROCES
                USAGE USAGE LIMIT
MAXFILEPROC    205    209    65535
MAXFILESIZE   ---   --- NOLIMIT
MAXPROCUSER     9    13    32767
MAXQUEUEDSIGS   0     1    1000
MAXTHREADS     44    54    20000
MAXTHREADTASKS  47    54    32768
IPCSHMNSEGS    0     0    500
MAXCORESIZE   ---   --- 4194304
MAXMEMLIMIT   1099M  1114M 4096M

```

The screenshot shows the zVA interface with the DISPLAY OMVS command running. The output displays various system parameters and process limits. A red oval highlights the 'MAXMEMLIMIT' row in the 'PROCESS LIMITS:' section, which shows a current usage of 1099M, a high watermark of 1114M, and a limit of 4096M.

Where do I look when things go wrong?

Where to find information when a problem occurs.



messages.log

```
mpz3
File Edit Settings View Communication Actions Window Help
File Edit Settings Menu Utilities Compilers Test Help
VIEW /MPZ3/var/zosconnect/servers/myServer/logs/messages.log
Command ==>
000228 System Property com.ibm.zos.jdbcnvironment set to 'WAS'.
000229 J2CA7001I: Resource adapter imsudsJLocal installed in 5.665 seconds.
000230 CUWKZ0014U: The application resources could not be started as it could not be found at location /var/zosconnect/servers/myServer/server/config.
000231 CUWKZ0018I: Starting application serverConfig.
000232 CUWKZ0018I: The myServer application is using the expanded directory at the /var/zosconnect/servers/myServer location.
000233 SRVE0169I: Loading Web Module myServer has been bound to default_host.
000235 CUWKZ0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/server/config/
000236 SESN0176I: A new session context will be created for application key default_host/server/config
000237 CUWKZ0018I: The session context uses the java defaultSecureRandom implementation for session ID generation.
000238 SRVE0193I: A configuration file for a web server plugin was automatically generated for this server at /var/zosconnect/server
000239 CUWKZ0011I: Application serverConfig started in 0.036 seconds.
000240 SRVE0105I: A configuration file for a web server plugin was automatically generated for this server at /var/zosconnect/server
000241 CUWKZ00219I: TCP Channel defaultHTTPEndpoint has been started and is now listening for requests on host * (IPv6) port 9080.
000242 CUWKZ00219I: TCP Channel defaultHTTPEndpoint has been started and is now listening for requests on host * (IPv6) port 94
000243 CUWKZ00219I: TCP Channel defaultHTTPEndpoint has been started and is now listening for requests on host * (IPv6) port 94
000244 CUWKZ0008I: Feature Update completed in 17.519 seconds.
000245 CUWKZ0011I: The myServer server is ready to run a smarter planet. The myServer server started in 17.991 seconds.
000246 CUWKZ0032I: The authorized version of the SAF user registry is activated. Authentication will proceed using authorized native
000247 CUWKS1100A: Authentication did not succeed for user ID user1. An invalid user ID or Password was specified.
000248 CUWKS1100A: Authentication did not succeed for user ID user1. An invalid user ID or Password was specified.
***** Bottom of Data *****
```

04/015
Connected to remote server/host mpz3 using lu/pool MPZ30030 and port 23

SYSLOG/STC JESMSGGL DD

```
mpz3
File Edit Settings View Communication Actions Window Help
Display Filter View Options Search Help
SDSF OERLOG MPZ3 08/30/2021 0W COLUMNS 02- 133
COMMAND INPUT ==> SCROLL ==> CSR
M 0020000 MPZ3 21242 13:20:25.35 STC1077I 00000290 +CUWL80161I: Resource manager BBG.DEFAULT.DA38C9E1985D6C0IBM with 337
D 0020000 MPZ3 337 00000290 D tokens successfully registered with Resource Recovery Services (RRS). Number
E 0020000 MPZ3 337 00000290 of unresolved units of recovery: 0
M 0000000 MPZ3 21242 13:20:25.36 00000290 ATR1691 RRS HAS UNSET EXITS FOR RESOURCE MANAGER 338
H 0020000 MPZ3 21242 13:20:25.36 STC1077I 00000290 BBG.DEFAULT.DA38C9E1985D6C0IBM with 337
D 0020000 MPZ3 339 00000290 tokens successfully registered with Resource Recovery Services (RRS). Number
E 0020000 MPZ3 339 00000290 of unresolved units of recovery: 0
N 8000000 MPZ2 21242 13:20:25.41 STC0416T 0000090 DSNU133I -DSNE DSNUVSMF - TRACE DATA LOST, SMF NOT ACCESSIBLE RC=24
N 0020000 MPZ2 21242 13:20:25.44 STC1077I 0000090 +CUWKZ0011I: Application serverConfig started in 0.036 seconds.
M 4000000 MPZ3 21242 13:20:25.92 STC1077I 0000090 +CUWKZ0011I: The myServer server is ready to run a smarter Planet. The
E 4000000 MPZ3 341 0000090 myServer server started in 17.991 seconds.
M 0000000 MPZ3 21242 13:20:30.98 STC1077I 0000090 ICH4081 USER(USER1 ) GROUP(SYS1 ) NAME( ) 342
E 0000000 MPZ3 342 0000090 LOGON/JOB INITIATION - PASS PHRASE IS NOT VALID
M 0000000 MPZ3 21242 13:20:30.98 STC1077I 0000090 ICH4081 USER(USER1 ) GROUP(SYS1 ) NAME( ) 343
E 0000000 MPZ3 343 0000090 LOGON/JOB INITIATION - PASS PHRASE IS NOT VALID
N 8000000 MPZ2 21242 13:20:35.53 STC0406T 0000090 DSNU123I -DSNE DSNUVSMF - TRACE DATA LOSS, SMF NOT ACCESSIBLE RC=24
N 8000000 MPZ2 21242 13:21:00.13 STC0416T 0000090 DSNU123I -DSNE DSNUVSMF - TRACE RECORDING HAS BEEN RESUMED ON SMF
N 4000000 MPZ1 21242 13:21:00.56 STC0419O 0000090 +CSQX251I ZMQA CSQXSTR Listener started, TRPTYPE=TCP INDISP=QMGR
M 4000000 MPZ1 21242 13:21:00.56 STC0419O 0000090 +CSQX218E ZMQA CSQXLSTT Listener not started - unable to bind, 245
```

21/099
Connected to remote server/host mpz3 using lu/pool MPZ30030 and port 23

STC STDOUT DD

```
mpz3
File Edit Settings View Communication Actions Window Help
Display Filter View Options Search Help
SDSF OUTPUT DISPLAY BAQSTRT STC1077I DSID 103 LINE 84 COLUMNS 02- 133
COMMAND INPUT ==> SCROLL ==> CSR
YAUDIT " BAQR7130I: z/OS Connect EE API minilancies was registered successfully for API Discovery.
YAUDIT " CUWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/api/explorer/
YAUDIT " CUWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/api/docs/
YAUDIT " CUWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/api/v1/
YAUDIT " CUWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/ibm/tpConnectorREST/
YAUDIT " CUWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/ibm/adminCenter/serverConfig-
YAUDIT " CUWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/jwt/
YAUDIT " CUWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/adminCenter/explore-1.0/
YAUDIT " CUWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/adminCenter/
YAUDIT " CUWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/zosConnect/apiRequesters/
YAUDIT " J2CA70011I: Resource adapter imsudsJLocal installed in 4.765 seconds.
YAUDIT " CUWKT0014W: The application resources could not be started as it could not be found at location /var/zosconnect/servers/m
YWARNING " CUWKT0014W: The application resources could not be started as it could not be found at location /var/zosconnect/servers/m
YAUDIT " CUWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/server/config/
YAUDIT " CUWKT0016I: Application serverConfig started in 0.036 seconds.
YAUDIT " CUWKT0011I: The myServer server is ready to run a smarter planet. The myServer server started in 17.991 seconds.
YAUDIT " CUWKS1100A: Authentication did not succeed for user ID user1. An invalid user ID or Password was specified.
YAUDIT " CUWKS1100A: Authentication did not succeed for user ID user1. An invalid user ID or Password was specified.
***** Bottom of Data *****
```

04/021
Connected to remote server/host mpz3 using lu/pool MPZ30030 and port 23

trace.out

```
mpz3
File Edit Settings View Communication Actions Window Help
File Edit Settings Menu Utilities Compilers Test Help
VIEW /MPZ3/var/zosconnect/servers/myServer/logs/trace.log
Command ==>
***** ***** Top of Data *****
==MSG: -Warning- The UNDO command is not available until you change
==MSG: your edit profile using the command RECOVERY ON.
000001 **** FOR Z/OS 2.0 15:34:58:201 Z/OS selected @ 00.48 (IP-1.0.53.c1210620210527-1900)
000003 WLP_INSTALL_DIR=/var/zosconnect/zosconnect/v10.15
000004 server.config.dir = /var/zosconnect/servers/myServer/
000005 Java.home = /MA4RS1/usr/lpp/java/J8.0.64
000006 Java.version = 1.8.0_301
Java.runtime.version = 02.04.00.9990x (en_US)
000008 process = 168430938MpZ3
000010 trace.specification = ==info:com.ibm.zosconnect,wv==FINEST:zosConnect=all:zosConnectServiceCics=all
000011 **** ****
000012 [8/30/21 15:34:58:201 GMT] 00000064 id=0000000 connect.service.cics.internal.conn.isc.Connection > getVersion Ent
000013 [8/30/21 15:34:58:203 GMT] 00000064 id=e8994258 com.ibm.zosconnect.service.cics.internal.conn.isc.Connection > getVersion Ex
000014
000015 [8/30/21 15:34:58:203 GMT] 00000064 id=0000000 connect.service.cics.internal.conn.isc.headers.ISCHTTPHeader > getHeader Ent
000016
000017 [8/30/21 15:34:58:203 GMT] 00000064 id=e8994258 connect.service.cics.internal.conn.isc.headers.Iscv2HTTPHeader > <init> Entry
000018 [8/30/21 15:34:58:203 GMT] 00000064 id=438687cd connect.service.cics.internal.conn.isc.headers.Iscv2HTTPHeader < init> Exit
000019
***** Bottom of Data *****
```

04/015
Connected to remote server/host mpz3 using lu/pool MPZ30030 and port 23

mitchj@us.ibm.com

Issues and problems can be categorized

- First realize that actual products problems do occur, but they are rare. In my experience most problems and issues can be resolved with a little investigation and some analysis. I have found that most problems and issues will fall in these categories.

- **Basic Security issues**
 - Insufficient access to local SAF resources, e.g., APPL, EJBCROLE, SERVER resources
 - Security issues related to XML configuration elements, safCredentials, sslDefault, keystore, etc.
- **Advanced Security issues**
 - Key ring access, e.g., FACILITY resources IRR.DIGTCERT or RDATALIB or IDIDMAP resources.
 - Key ring contents, e.g., missing certificates, key usage, personal and certificate authorities, private keys versus public keys.
 - Incorrect use of certificates in a TLS handshakes versus certificates used for token validation.
- **z/OS Connect XML Configuration issues**
 - Missing or misspelled configuration attributes (remember the Liberty XML parser is too forgiving)
- **External resource Issues**
 - Service provider configuration issues.
 - Timeouts
 - Network Firewalls
 - Resource Security
 - Other resource errors

Remember external symptoms will overlap. But the use of rigor in setting configuration standards and following a process in problem isolation/determination process will help reduce the impact of problems and issues.



messages.log - The anatomy of a message in the messages.log file

```
*****
product = WAS FOR z/OS 21.0.0.6, z/OS Connect 03.00.48 (wlp-1.0.53.cl210620210527-1900)
wlp.install.dir = /shared/IBM/zosconnect/v3r0/wlp/
server.config.dir = /var/zosconnect/servers/zceepid/
java.home = /MA4RS1/usr/lpp/java/J8.0_64
java.version = 1.8.0_301
java.runtime = Java(TM) SE Runtime Environment (8.0.6.35 - pmz6480sr6fp35-20210714_01(SR6 FP35))
os = z/OS (02.04.00; s390x) (en_US)
process = 16843186@wg31
*****
[9/3/21 13:38:02:831 GMT] 00000013 com.ibm.ws.kernel.launch.internal.FrameworkManager
[9/3/21 13:38:04:439 GMT] 0000001f com.ibm.ws.config.xml.internal.XMLConfigParser
[9/3/21 13:38:04:466 GMT] 0000001f com.ibm.ws.config.xml.internal.XMLConfigParser
[9/3/21 13:38:04:470 GMT] 0000001f com.ibm.ws.config.xml.internal.XMLConfigParser
[9/3/21 13:38:04:473 GMT] 0000001f com.ibm.ws.config.xml.internal.XMLConfigParser
[9/3/21 13:38:04:476 GMT] 0000001f com.ibm.ws.config.xml.internal.XMLConfigParser
[9/3/21 13:38:04:481 GMT] 0000001f com.ibm.ws.config.xml.internal.XMLConfigParser
[9/3/21 13:38:04:610 GMT] 00000021 com.ibm.ws.zos.core.internal.NativeServiceTracker
[9/3/21 13:38:04:612 GMT] 00000021 com.ibm.ws.zos.core.internal.NativeServiceTracker
[9/3/21 13:38:04:628 GMT] 00000021 com.ibm.ws.zos.core.internal.NativeServiceTracker
[9/3/21 13:38:04:679 GMT] 00000021 com.ibm.ws.zos.core.internal.NativeServiceTracker
[9/3/21 13:38:04:680 GMT] 00000021 com.ibm.ws.zos.core.internal.NativeServiceTracker
[9/3/21 13:38:04:680 GMT] 00000021 com.ibm.ws.zos.core.internal.NativeServiceTracker
- - - - -
[9/3/21 13:38:42:347 GMT] 00000040 om.ibm.ws.app.manager.rar.internal.RARApplicationHandlerImpl
[9/3/21 13:38:42:419 GMT] 0000003e com.ibm.ws.jmx.connector.server.rest.RESTAppListener
[9/3/21 13:38:42:422 GMT] 0000003e com.ibm.ws.jmx.connector.server.rest.RESTAppListener
[9/3/21 13:38:42:428 GMT] 0000002c com.ibm.ws.tcpchannel.internal.TCPEndpoint
[9/3/21 13:38:42:431 GMT] 0000002c com.ibm.ws.tcpchannel.internal.TCPEndpoint
[9/3/21 13:38:42:437 GMT] 00000042 com.ibm.ws.webcontainer.osgi.mbeans.PluginGenerator
[9/3/21 13:38:42:489 GMT] 0000002c com.ibm.ws.kernel.feature.internal.FeatureManager
[9/3/21 13:38:42:490 GMT] 0000002c com.ibm.ws.kernel.feature.internal.FeatureManager
[9/3/21 13:38:42:490 GMT] 0000002c com.ibm.ws.kernel.feature.internal.FeatureManager
[9/3/21 13:41:31:640 GMT] 00000045 .security.openidconnect.client.internal.OidcClientConfigImpl
[9/3/21 13:41:31:691 GMT] 00000045 liberty.authentication.filter.internal.AuthenticationFilterImpl
[9/3/21 13:41:32:824 GMT] 00000053 com.ibm.zosconnect.service.cics.internal.conn.isc.Connection
*****
A CWWKE0001I: The server zceepid has been launched.
A CWWKG0028A: Processing included configuration resource
A CWWKB0125I: This server requested a REGION size of 0KB
I CWWKB0126I: MEMLIMIT=2000. MEMLIMIT CONFIGURATION SOUR
I CWWKB0122I: This server is connected to the default an
I CWWKB0103I: Authorized service group KERNEL is availab
I CWWKB0103I: Authorized service group LOCALCOM is avail
I CWWKB0103I: Authorized service group PRODMGR is availa
- - - - - 148 Line(s) not Displayed
A J2CA7001I: Resource adapter imsudbJLocal installed in
I CWWKX0103I: The JMX REST connector is running and is a
I CWWKX0103I: The JMX REST connector is running and is a
I CWWKO0219I: TCP Channel defaultHttpEndpoint has been s
I CWWKO0219I: TCP Channel defaultHttpEndpoint-ssl has be
I SRVE9103I: A configuration file for a web server plugi
A CWWKF0012I: The server installed the following feature
I CWWKF0008I: Feature update completed in 37.484 seconds
A CWWKF0011I: The zceepid server is ready to run a smar
I CWWKS1700I: OpenID Connect client ATS configuration su
I CWWKS4358I: The authentication filter ATSAuthFilter co
I BAQR0680I: CICS connection cscvinc established with 10
```

- **WLP_LOGGING_CONSOLE_FORMAT - SIMPLE** - Use the simple logging format. As of Liberty release 20.0.0.6 (z/OS Connect V3.034), this format writes the messages to STDOUT and STDERR with time stamps included.



Basic security issues – Sometimes the problem is easy to find

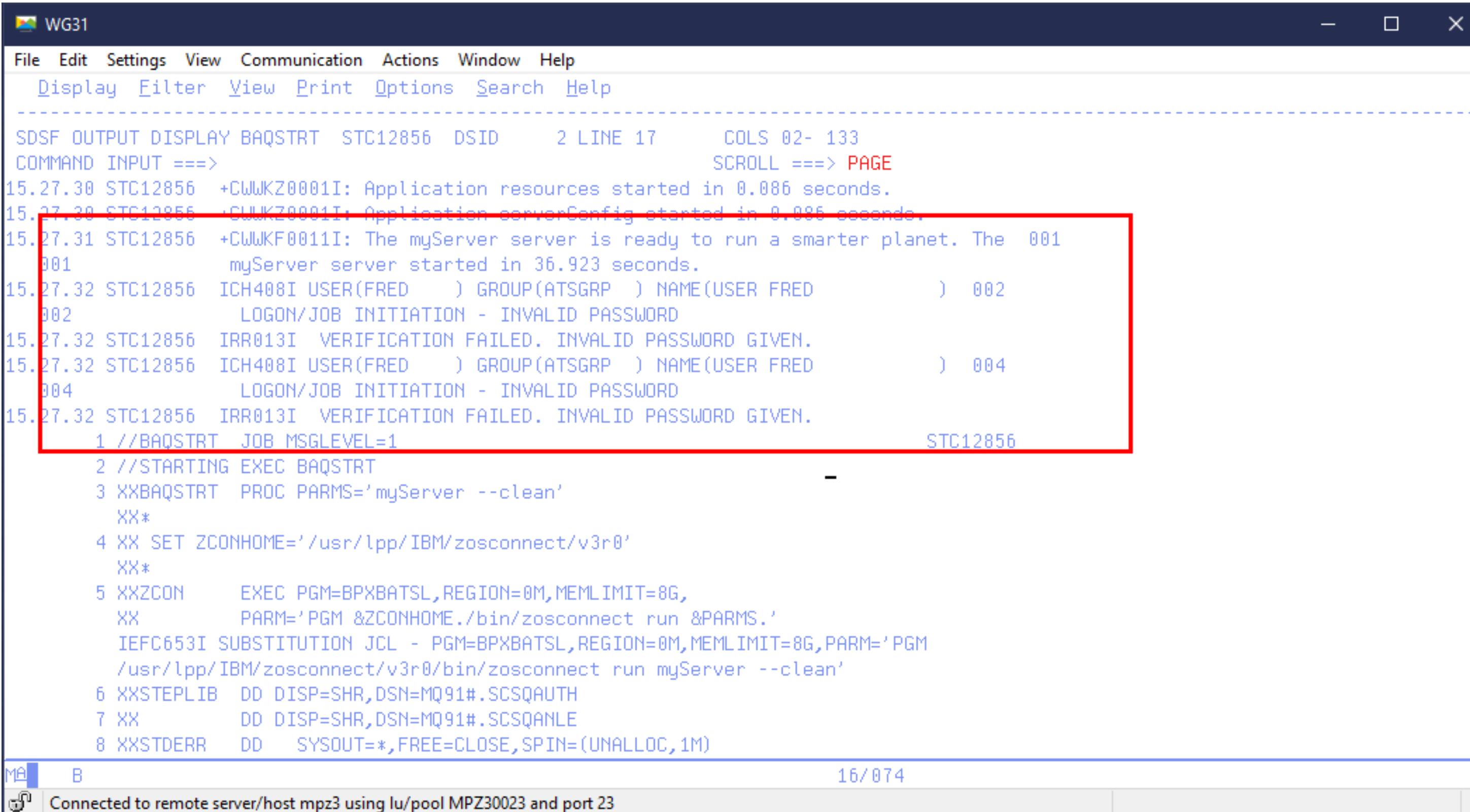
The STDOUT may show:

```
ÝAUDIT    " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified  
ÝAUDIT    " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified
```

And the messages.log displays:

```
CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.  
CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
```

But the JESMSGLOG and SYSLOG displays:



```
WG31  
File Edit Settings View Communication Actions Window Help  
Display Filter View Print Options Search Help  
-----  
SDFS OUTPUT DISPLAY BAQSTRT STC12856 DSID 2 LINE 17 COLS 02- 133  
COMMAND INPUT ==> SCROLL ==> PAGE  
15.27.30 STC12856 +CWWKZ0001I: Application resources started in 0.086 seconds.  
15.27.30 STC12856 +CWWKZ0001I: Application serverConfig started in 0.086 seconds.  
15.27.31 STC12856 +CWWJKF0011I: The myServer server is ready to run a smarter planet. The 001  
001 myServer server started in 36.923 seconds.  
15.27.32 STC12856 ICH408I USER(FRED ) GROUP(ATSGRP ) NAME(USER FRED ) 002  
002 LOGON/JOB INITIATION - INVALID PASSWORD  
15.27.32 STC12856 IRR013I VERIFICATION FAILED. INVALID PASSWORD GIVEN.  
15.27.32 STC12856 ICH408I USER(FRED ) GROUP(ATSGRP ) NAME(USER FRED ) 004  
004 LOGON/JOB INITIATION - INVALID PASSWORD  
15.27.32 STC12856 IRR013I VERIFICATION FAILED. INVALID PASSWORD GIVEN.  
1 //BAQSTRT JOB MSGLEVEL=1 STC12856  
2 //STARTING EXEC BAQSTRT  
3 XXBAQSTRT PROC PARMs='myServer --clean'  
XX*  
4 XX SET ZCONHOME='/usr/lpp/IBM/zosconnect/v3r0'  
XX*  
5 XXZCON EXEC PGM=BPXBATSL,REGION=0M,MEMLIMIT=8G,  
XX PARM='PGM &ZCONHOME./bin/zosconnect run &PARMS.'  
IEFC653I SUBSTITUTION JCL - PGM=BPXBATSL,REGION=0M,MEMLIMIT=8G,PARM='PGM  
'/usr/lpp/IBM/zosconnect/v3r0/bin/zosconnect run myServer --clean'  
6 XXSTEPLIB DD DISP=SHR,DSN=MQ91#.SCSQAUTH  
7 XX DD DISP=SHR,DSN=MQ91#.SCSQANLE  
8 XXSTDERR DD SYSOUT=*,FREE=CLOSE,SPIN=(UNALLOC,1M)  
16/074  
Connected to remote server/host mpz3 using lu/pool MPZ30023 and port 23
```

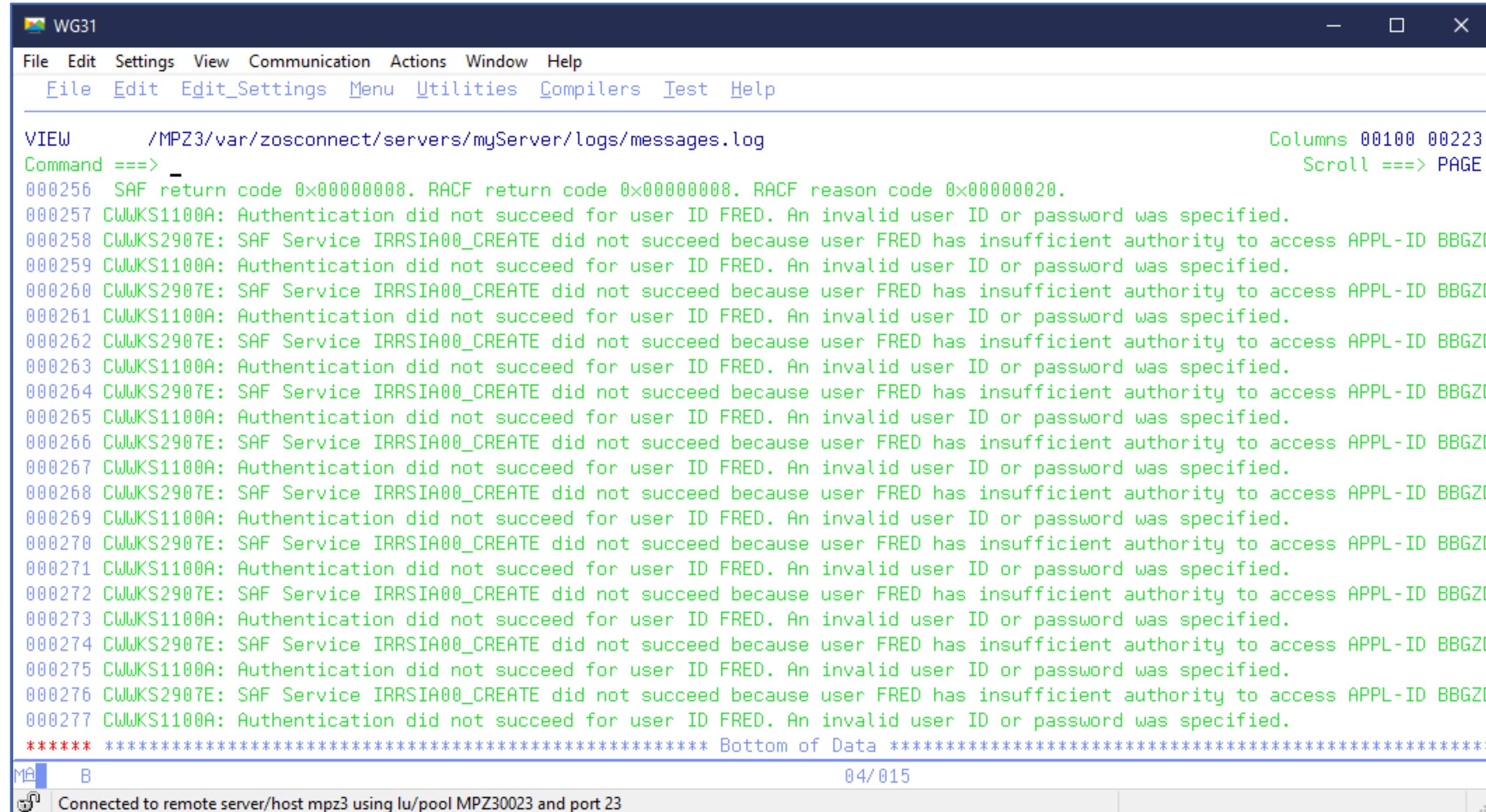
Basic security issues – Sometimes you must dig a little more

The STDOUT may show:

```
ÝAUDIT    " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified
ÝAUDIT    " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified
```

But there are no SAF messages in the SYSLOG:

While the messages.log displays a SAF return code and reason code:



```
VIEW      /MPZ3/var/zosconnect/servers/myServer/logs/messages.log
Command ==> -
000256  SAF return code 0x00000008. RACF return code 0x00000008. RACF reason code 0x00000020.
000257  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
000258  CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZD
000259  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
000260  CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZD
000261  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
000262  CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZD
000263  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
000264  CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZD
000265  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
000266  CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZD
000267  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
000268  CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZD
000269  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
000270  CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZD
000271  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
000272  CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZD
000273  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
000274  CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZD
000275  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
000276  CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZD
000277  CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.

***** ***** Bottom of Data *****
```

CWWKS2907E: SAF Service IRRSIA00_CREATE did not succeed because user FRED has insufficient authority to access APPL-ID BBGZDFLT. SAF return code 0x00000008. RACF return code 0x00000008. RACF reason code 0x00000020.

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Tech-Tip: And be aware of hex v. decimal in return and reason codes

RACF return code 0x00000008. RACF reason code 0x00000020.



Table 1. initACEE create return codes

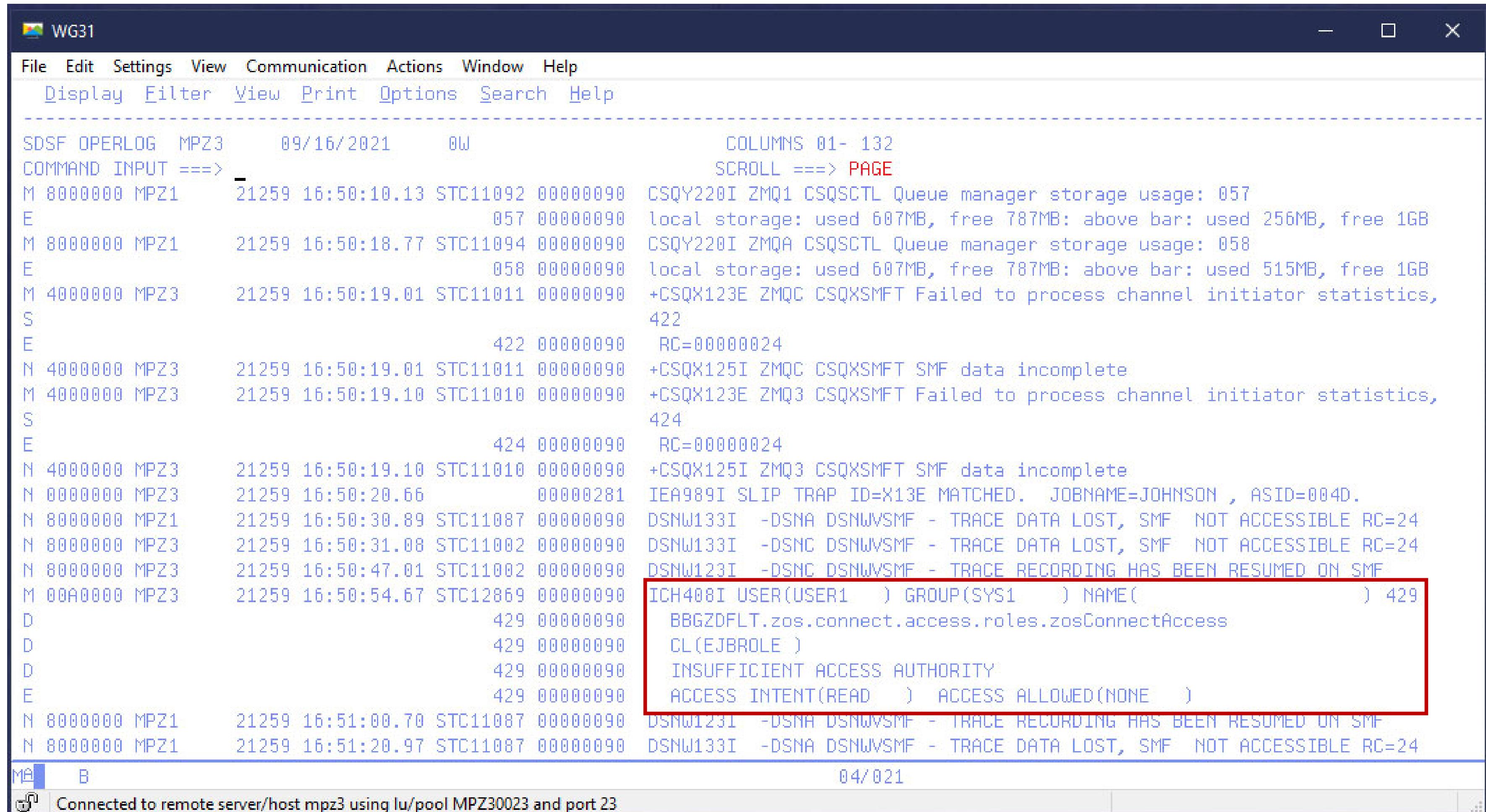
SAF return code	RACF® return code	RACF reason code	Explanation
0	0	0	The service was successful.
4	0	0	RACF is not installed.
8	8	4	Parameter list error occurred.
8	8	8	An internal error occurred during RACF processing.
8	8	12	Recovery environment could not be established.
8	8	16	User ID is not defined to RACF.
8	8	20	Password, Password Phrase or Pass Ticket is not valid.
8	8	24	Password or Password Phrase is expired.
8	8	28	User ID is revoked or user access to group is revoked.
8	8	32	The user does not have appropriate RACF access to either the SECLABEL, SERVAUTH profile, or APPL specified in the parmlist.
8	8	36	Certificate is not valid.
8	8	40	▷ No user ID is defined for this certificate. See Usage Note number 37. ▷
8	8	44	The client security label is not equivalent to the server's security label.
8	8	48	A managed ACEE is requested with a nested RACO in the Envir_In parameter.
8	12	InitUSP reason code	initUSP failed. See initUSP reason codes in Return and reason codes .

Hex '20' = Dec '32'

Root cause – No READ access to APPL resource BBGZDFLT

Basis security issues - Use the SYSLOG/JESMSGLG output

The SYSLOG shows a ICH408I message:



```

WG31

File Edit Settings View Communication Actions Window Help
Display Filter View Print Options Search Help

SDSF OPERLOG MPZ3      09/16/2021     0W          COLUMNS 01- 132
COMMAND INPUT ==> -
M 8000000 MPZ1      21259 16:50:10.13 STC11092 00000090 CSQY220I ZMQ1 CSQSCTL Queue manager storage usage: 057
E                               057 00000090 local storage: used 607MB, free 787MB; above bar: used 256MB, free 1GB
M 8000000 MPZ1      21259 16:50:18.77 STC11094 00000090 CSQY220I ZMQA CSQSCTL Queue manager storage usage: 058
E                               058 00000090 local storage: used 607MB, free 787MB; above bar: used 515MB, free 1GB
M 4000000 MPZ3      21259 16:50:19.01 STC11011 00000090 +CSQX123E ZMQC CSQXSMFT Failed to process channel initiator statistics,
S                                         422
E                               422 00000090 RC=00000024
N 4000000 MPZ3      21259 16:50:19.01 STC11011 00000090 +CSQX125I ZMQC CSQXSMFT SMF data incomplete
M 4000000 MPZ3      21259 16:50:19.10 STC11010 00000090 +CSQX123E ZMQ3 CSQXSMFT Failed to process channel initiator statistics,
S                                         424
E                               424 00000090 RC=00000024
N 4000000 MPZ3      21259 16:50:19.10 STC11010 00000090 +CSQX125I ZMQ3 CSQXSMFT SMF data incomplete
N 0000000 MPZ3      21259 16:50:20.66      00000281 IEA989I SLIP TRAP ID=X13E MATCHED.  JOBNAME=JOHNSON , ASID=004D.
N 8000000 MPZ1      21259 16:50:30.89 STC11087 00000090 DSNW133I -DSNA DSNWVSMF - TRACE DATA LOST, SMF NOT ACCESSIBLE RC=24
N 8000000 MPZ3      21259 16:50:31.08 STC11002 00000090 DSNW133I -DSNC DSNWVSMF - TRACE DATA LOST, SMF NOT ACCESSIBLE RC=24
N 8000000 MPZ3      21259 16:50:47.01 STC11002 00000090 DSNW123I -DSNC DSNWVSMF - TRACE RECORDING HAS BEEN RESUMED ON SMF
M 00A0000 MPZ3      21259 16:50:54.67 STC12869 00000090 ICH408I USER(USER1 ) GROUP(SYS1 ) NAME(          ) 429
D                               429 00000090 BBGZDFLT.zos.connect.access.roles.zosConnectAccess
D                               429 00000090 CL(EJBROLE )
D                               429 00000090 INSUFFICIENT ACCESS AUTHORITY
E                               429 00000090 ACCESS INTENT(READ ) ACCESS ALLOWED(NONE )
N 8000000 MPZ1      21259 16:51:00.70 STC11087 00000090 DSNW123I -DSNA DSNWVSMF - TRACE RECORDING HAS BEEN RESUMED ON SMF
N 8000000 MPZ1      21259 16:51:20.97 STC11087 00000090 DSNW133I -DSNA DSNWVSMF - TRACE DATA LOST, SMF NOT ACCESSIBLE RC=24

MA B
Connected to remote server/host mpz3 using lu/pool MPZ30023 and port 23
04/021

```

Symptom: client see HTTP 403 – Authorization Failed. There were no messages in STDOUT or messages.log locations. Root cause – No READ access to EJBROLE BBGZDFLT.zos.connect.access.roles.zosConnectAccess.



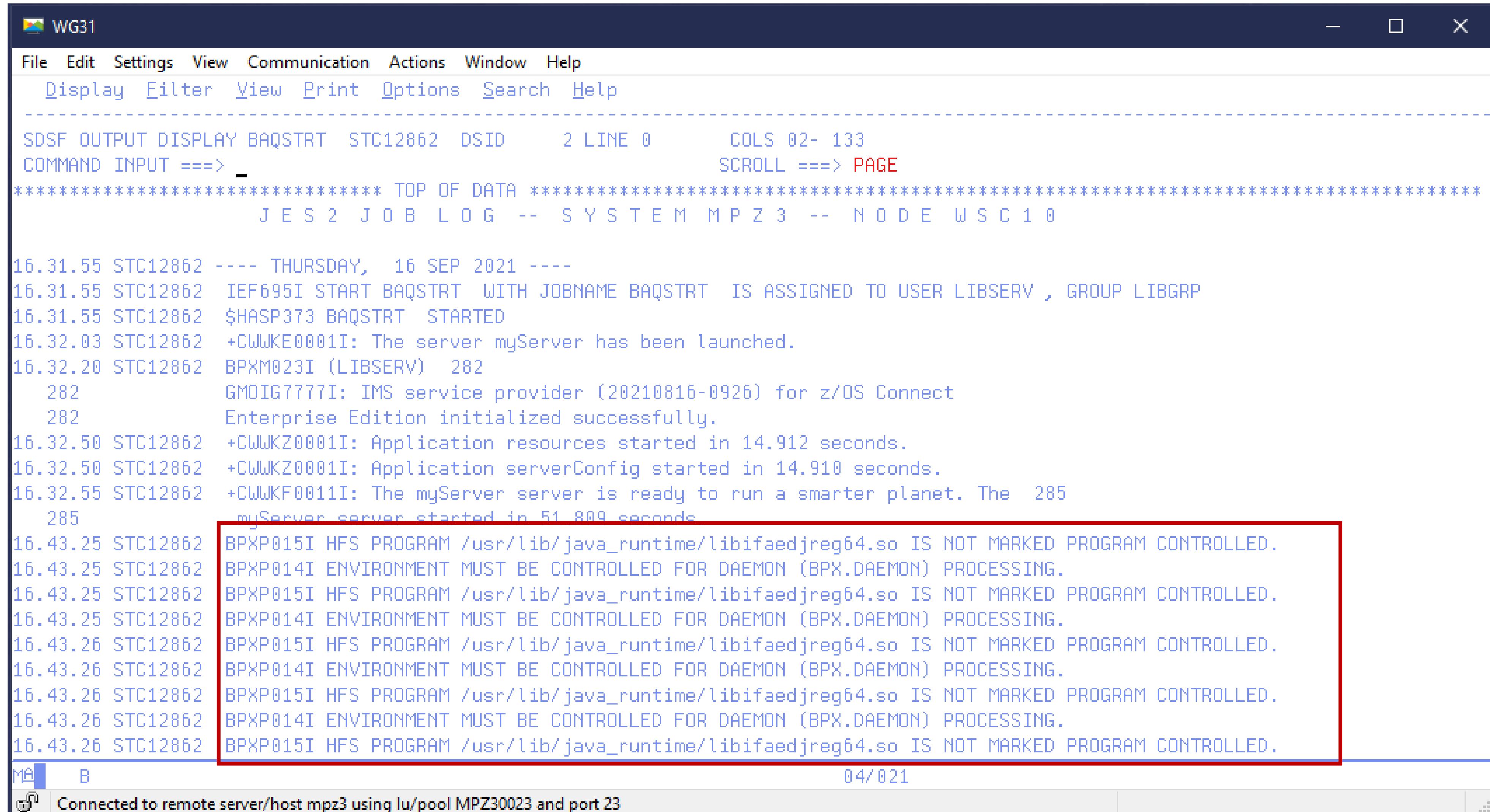
Basic security issues – Sometimes there is misdirection

The STDOUT may show:

```
WG31
File Edit Settings View Communication Actions Window Help
Display Filter View Print Options Search Help
-----
SDSF OUTPUT DISPLAY BAQSTRT STC12844 DSID 103 LINE 98      COLS 02- 133
COMMAND INPUT ==> SCROLL ==> PAGE
AUDIT  " CWWKZ0001I: Application serverConfig started in 4.006 seconds.
AUDIT  " CWWKZ0001I: Application resources started in 4.007 seconds.
AUDIT  " CWWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/zosConnect/apiRequesters/
AUDIT  " CWWKT0016I: Web application available (default_host): http://dvipa.washington.ibm.com:9080/
AUDIT  " CWWKF0012I: The server installed the following features: YadminCenter-1.0, apiDiscovery-1.0, appSecurity-2.0, distributed
AUDIT  " CWWKF0011I: The myServer server is ready to run a smarter planet. The myServer server started in 66.646 seconds.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
AUDIT  " CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.
***** BOTTOM OF DATA *****
```

MA B
Connected to remote server/host mpz3 using lu/pool MPZ30019 and port 23 04/021

Basic security issues - SYSLOG/JESMSGGLG output (even more misdirection)



```

WG31
File Edit Settings View Communication Actions Window Help
Display Filter View Print Options Search Help
SDSF OUTPUT DISPLAY BAQSTRT STC12862 DSID 2 LINE 0 COLS 02- 133
COMMAND INPUT ===> SCROLL ===> PAGE
***** TOP OF DATA *****
J E S 2 J O B L O G -- S Y S T E M M P Z 3 -- N O D E W S C 1 0

16.31.55 STC12862 ---- THURSDAY, 16 SEP 2021 ----
16.31.55 STC12862 IEF695I START BAQSTRT WITH JOBNM BAQSTRT IS ASSIGNED TO USER LIBSERV , GROUP LIBGRP
16.31.55 STC12862 $HASP373 BAQSTRT STARTED
16.32.03 STC12862 +CWUJKE0001I: The server myServer has been launched.
16.32.20 STC12862 BPXM023I (LIBSERV) 282
282 GMDIG7777I: IMS service provider (20210816-0926) for z/OS Connect
282 Enterprise Edition initialized successfully.
16.32.50 STC12862 +CWUWKZ0001I: Application resources started in 14.912 seconds.
16.32.50 STC12862 +CWUWKZ0001I: Application serverConfig started in 14.910 seconds.
16.32.55 STC12862 +CWUWKF0011I: The myServer server is ready to run a smarter planet. The 285
285 myServer server started in 51.809 seconds
16.43.25 STC12862 BPXP015I HFS PROGRAM /usr/lib/java_runtime/libifaedjreg64.so IS NOT MARKED PROGRAM CONTROLLED.
16.43.25 STC12862 BPXP014I ENVIRONMENT MUST BE CONTROLLED FOR DAEMON (BPX.DAEMON) PROCESSING.
16.43.25 STC12862 BPXP015I HFS PROGRAM /usr/lib/java_runtime/libifaedjreg64.so IS NOT MARKED PROGRAM CONTROLLED.
16.43.25 STC12862 BPXP014I ENVIRONMENT MUST BE CONTROLLED FOR DAEMON (BPX.DAEMON) PROCESSING.
16.43.26 STC12862 BPXP015I HFS PROGRAM /usr/lib/java_runtime/libifaedjreg64.so IS NOT MARKED PROGRAM CONTROLLED.
16.43.26 STC12862 BPXP014I ENVIRONMENT MUST BE CONTROLLED FOR DAEMON (BPX.DAEMON) PROCESSING.
16.43.26 STC12862 BPXP015I HFS PROGRAM /usr/lib/java_runtime/libifaedjreg64.so IS NOT MARKED PROGRAM CONTROLLED.
16.43.26 STC12862 BPXP014I ENVIRONMENT MUST BE CONTROLLED FOR DAEMON (BPX.DAEMON) PROCESSING.
16.43.26 STC12862 BPXP015I HFS PROGRAM /usr/lib/java_runtime/libifaedjreg64.so IS NOT MARKED PROGRAM CONTROLLED.

MA B 04/021
Connected to remote server/host mpz3 using lu/pool MPZ30023 and port 23

```

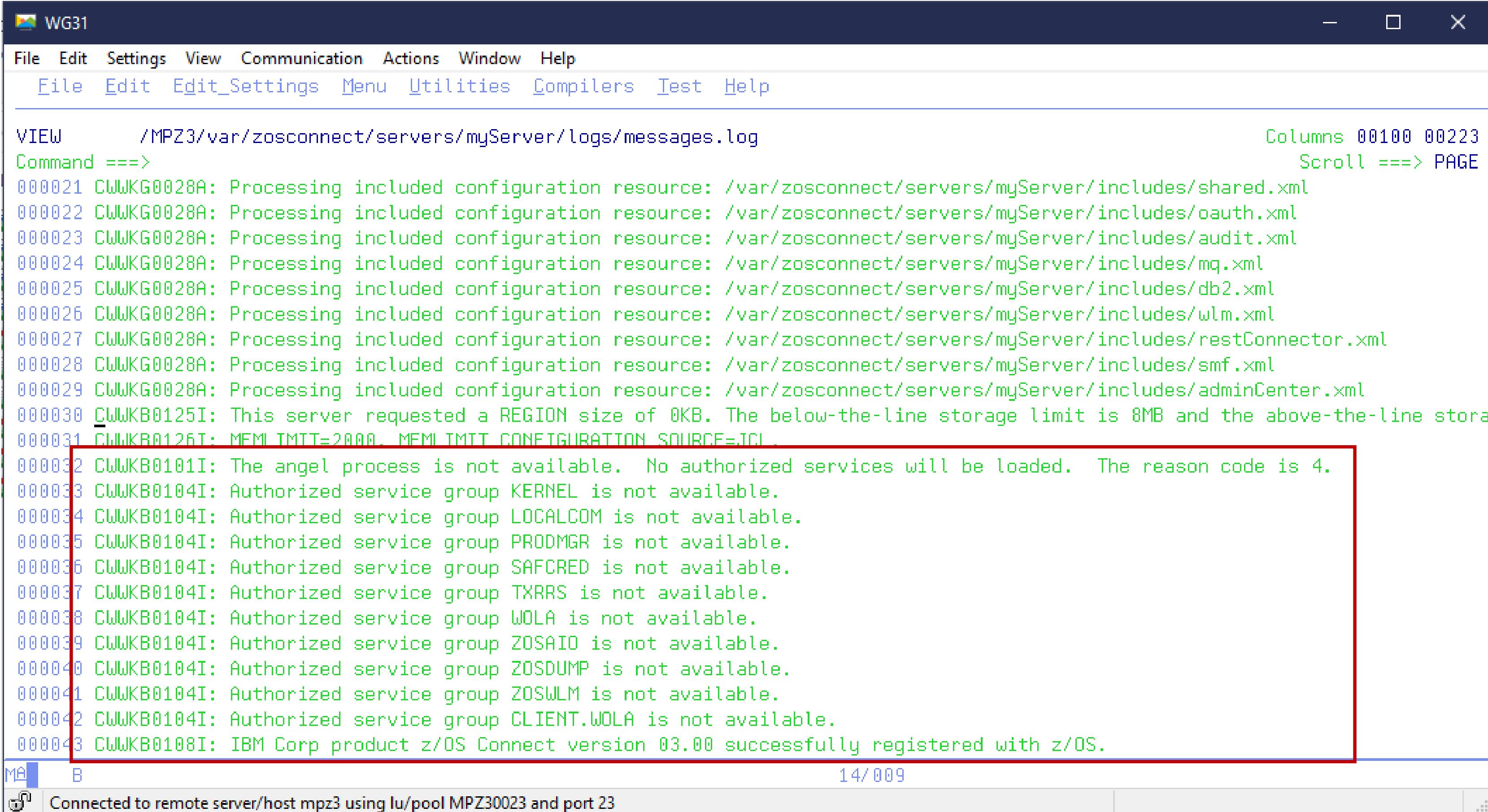
Symptom: Client unable to connect. STDOUT contains message *CWWKS1100A: Authentication did not succeed for user ID user1. An invalid user ID or password was specified.*

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Basic security issues - SYSLOG/JESMSGGLG output (even more misdirection)

There is no need to set the extended protection attribute for this Java shared object executable.
The root cause was that the angel was not active.



```
VIEW      /MPZ3/var/zosconnect/servers/myServer/logs/messages.log          Columns 00100 00223
Command ==>
000021 CWUKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/shared.xml
000022 CWUKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/oauth.xml
000023 CWUKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/audit.xml
000024 CWUKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/mq.xml
000025 CWUKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/db2.xml
000026 CWUKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/wlm.xml
000027 CWUKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/restConnector.xml
000028 CWUKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/smf.xml
000029 CWUKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/adminCenter.xml
000030 CWWKB0125I: This server requested a REGION size of 0KB. The below-the-line storage limit is 8MB and the above-the-line stor
000031 CWWKB0126I: MFML TMFT=20000. MFML TMFT CONFIGURATION SOURCE=TCI
000032 CWWKB0101I: The angel process is not available. No authorized services will be loaded. The reason code is 4.
000033 CWWKB0104I: Authorized service group KERNEL is not available.
000034 CWWKB0104I: Authorized service group LOCALCOM is not available.
000035 CWWKB0104I: Authorized service group PRODMGR is not available.
000036 CWWKB0104I: Authorized service group SAFCREC is not available.
000037 CWWKB0104I: Authorized service group TXRRS is not available.
000038 CWWKB0104I: Authorized service group WOLA is not available.
000039 CWWKB0104I: Authorized service group ZOSAIO is not available.
000040 CWWKB0104I: Authorized service group ZOSDUMP is not available.
000041 CWWKB0104I: Authorized service group ZOSWLM is not available.
000042 CWWKB0104I: Authorized service group CLIENT.WOLA is not available.
000043 CWWKB0108I: IBM Corp product z/OS Connect version 03.00 successfully registered with z/OS.
M8 B 14/009
Connected to remote server/host mpz3 using lu/pool MPZ30023 and port 23
```



External resource issues (HTTP 500)

The client sees:

```
HTTP/1.1 500 Internal Server Error
```

The STDOUT may show:

```
ÝWARNING `` BAQR0429W: API db2employee encountered an error while processing a request under URL  
https://wg31.washington.ibm.com:9443/db2/employee/948478.
```

While the messages.log display

```
[9/16/21 21:00:55:811 GMT] 00000051 com.ibm.zosconnect.service.cics.internal.conn.ISCECIRequest E BAQR0657E: Transaction abend MIJO occurred in CICS while using CICS connection cscvinc and service cscvincDeleteService.  
[9/16/21 21:00:55:815 GMT] 00000051 com.ibm.zosconnect.internal.web.ServiceProxyServlet W BAQR0429W: API cscvinc encountered an error while processing a request under URL https://wg31.washington.ibm.com:9443/cscvinc/employee/948478.
```

The STDOUT may show:

```
ÝWARNING `` BAQR0429W: API db2employee encountered an error while processing a request under URL  
https://wg31.washington.ibm.com:9443/db2/employee/948478.
```

The messages.log displays:

```
[9/14/21 20:04:59:776 GMT] 00000048 osconnect.service.client.rest.internal.RestClientServiceImpl E BAQR0558E: The remote service invocation failed with [9/14/21 20:04:59:776 GMT] 00000048  
osconnect.service.client.rest.internal.RestClientServiceImpl E BAQR0558E: The remote service invocation failed with failed due to SQLCODE=-204 SQLSTATE=42704, USER1.EMPLOYEE IS AN UNDEFINED NAME. Error Location:DSNLJACC:35"
```

Tech-Tip: An HTTP 500 shortcut – look elsewhere

A HTTP status code 500 occurs when a failure occurred at an external endpoint. It does not matter if the external endpoint is a z/OS resources or a REST API provider, or an authorization server, etc.

The details of the failure may not be provided **directly** to z/OS Connect, just the fact that a failure has occurred. The failure could be a security issue, an abend or something entirely. z/OS Connect may or may not have directly access to any details of the failure (it depends on the service provider). It does not mean the details do not exist; the details are just readily available.

The shortcut to identify the issue is review the messages in the messages.log and check to see if there is corresponding FFDC (first failure data collection) dump.



What is a Java stack trace?

```
[9/6/21 22:51:19:981 GMT] 00000039 com.ibm.ejs.j2c.ConnectionEventListener
A J2CA0056I: The Connection Manager received
a fatal connection error from the Resource Adapter for resource null. The exception is: javax.resource.spi.EISSystemException: ICO0001E:
com.ibm.connector2.ims.ico.IMSTCPIPManagedConnection@c341a0aa.processOutputOTMAMsg(Connection, InteractionSpec, Record, Record) error. IMS
Connect returned an error: RETCODE=[4], REASONCODE=[NFNDDST] [Datastore not found.]
at com.ibm.connector2.ims.ico.IMSManagedConnection.processOutputOTMAMsg(IMSManagedConnection.java:4042)
at com.ibm.connector2.ims.ico.IMSTCPIPManagedConnection.callSendRecv(IMSTCPIPManagedConnection.java:241)
at com.ibm.connector2.ims.ico.IMSManagedConnection.call(IMSManagedConnection.java:1625)
at com.ibm.connector2.ims.ico.IMSConnection.call(IMSConnection.java:213)
at com.ibm.connector2.ims.ico.IMSInteraction.execute(IMSInteraction.java:586)
at com.ibm.ims.gateway.services.IMSGatewayServiceImpl.executeTranServiceInputTMRA(Unknown Source)
at com.ibm.ims.gateway.services.IMSGatewayServiceImpl.invokeTransactionService(Unknown Source)
at com.ibm.ims.gateway.services.IMSGatewayServiceImpl.invoke(Unknown Source)
at com.ibm.ims.zconnect.provider.clients.GatewayServiceClient.doPost(Unknown Source)
at com.ibm.ims.zconnect.provider.clients.IMSClient.doInvoke(Unknown Source)
at com.ibm.ims.gateway.config.services.IMSZServiceHandlerImpl.invoke(Unknown Source)
at com.ibm.ims.gateway.config.services.IMSZServiceImpl.invoke(Unknown Source)
at com.ibm.zosconnect.internal.ZosConnectServiceImpl.apiInvoke(Unknown Source)
at com.ibm.zosconnect.internal.ServiceManagerImpl.invoke(Unknown Source)
at com.ibm.zosconnect.internal.ApiManagerImpl.invokeApi(Unknown Source)
at com.ibm.zosconnect.internal.web.ServiceProxyServlet$3.run(Unknown Source)
at com.ibm.ws.webcontainer.async.ServiceWrapper.wrapAndRun(ServiceWrapper.java:236)
at com.ibm.ws.webcontainer.async.ContextWrapper.run(ContextWrapper.java:28)
at com.ibm.ws.webcontainer.async.WrapperRunnableImpl.run(WrapperRunnableImpl.java:89)
at com.ibm.ws.threading.internal.ExecutorServiceImpl$RunnableWrapper.run(ExecutorServiceImpl.java:238)
at java.util.concurrent.ThreadPoolExecutor.runWorker(ThreadPoolExecutor.java:1160)
at java.util.concurrent.ThreadPoolExecutor$Worker.run(ThreadPoolExecutor.java:635)
at java.lang.Thread.run(Thread.java:825)
```

A J2CA0056I: The Connection Manager received
a fatal connection error from the Resource Adapter for resource null. The exception is: javax.resource.spi.EISSystemException: ICO0001E:
com.ibm.connector2.ims.ico.IMSTCPIPManagedConnection@c341a0aa.processOutputOTMAMsg(Connection, InteractionSpec, Record, Record) error. IMS
Connect returned an error: RETCODE=[4], REASONCODE=[NFNDDST] [Datastore not found.]

IMS service provider classes
z/OS Connect Java classes

A Google search of ICO00001E returned an explanation at URL: <https://www.ibm.com/docs/en/ims/13.1.0?topic=exceptions-ico0001e>

Root cause – Datastore mistyped in the interaction configuration

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First Failure Data Collection (FFDC)

```
-----Start of DE processing----- = [9/7/21 14:19:29:291 GMT]
Exception = com.ibm.msg.client.jms.DetailedIllegalStateException
Source = com.ibm.zosconnect.service.mq.OneWayMQServiceInvocation
probeid = 0004
Stack Dump = com.ibm.msg.client.jms.DetailedIllegalStateException: JMSWMQ2002: Failed to get a message from destination 'ZCONN2.DEFAULT.MQZCEE.QUEUE'.
IBM MQ classes for JMS attempted to perform an MQGET; however IBM MQ reported an error.
Use the linked exception to determine the cause of this error.
at com.ibm.msg.client.wmq.common.internal.Reason.reasonToException(Reason.java:489)
at com.ibm.msg.client.wmq.common.internal.Reason.createException(Reason.java:215)
.
.
.
at com.ibm.zosconnect.service.mq.MQService.invoke(Unknown Source)
at com.ibm.zosconnect.internal.ZosConnectServiceImpl.apiInvoke(Unknown Source)
at com.ibm.zosconnect.internal.ServiceManagerImpl.invoke(Unknown Source)
at com.ibm.zosconnect.internal.ApiManagerImpl.invokeApi(Unknown Source)
at com.ibm.zosconnect.internal.web.ServiceProxyServlet$3.run(Unknown Source)
at com.ibm.ws.webcontainer.async.ServiceWrapper.wrapAndRun(ServiceWrapper.java:236)
at com.ibm.ws.webcontainer.async.ContextWrapper.run(ContextWrapper.java:28)
at com.ibm.ws.webcontainer.async.WrapperRunnableImpl.run(WrapperRunnableImpl.java:89)
at com.ibm.ws.threading.internal.ExecutorServiceImpl$RunnableWrapper.run(ExecutorServiceImpl.java:238)
at java.util.concurrent.ThreadPoolExecutor.runWorker(ThreadPoolExecutor.java:1160)
at java.util.concurrent.ThreadPoolExecutor$Worker.run(ThreadPoolExecutor.java:635)
at java.lang.Thread.run(Thread.java:825)
Caused by: com.ibm.mq.MQException: JMSCMQ0001: IBM MQ call failed with compcode '2' ('MQCC_FAILED') reason '2016' ('MQRC_GET_INHIBITED').
at com.ibm.msg.client.wmq.common.internal.Reason.createException(Reason.java:203)
... 25 more
```

MQ service provider classes

Root cause – Queue was configured to disable the MQPUT request



The FFDC dump is more than just a Java stack trace

```
-----Start of DE processing----- = [9/7/21 20:26:12:394 GMT]
Exception = com.ibm.zosconnect.endpoint.connection.TokenConfigException
Source = com.ibm.zosconnect.endpoint.connection.internal.OAuthConfigImpl
probeid = 265
Stack Dump = com.ibm.zosconnect.endpoint.connection.TokenConfigException: BAQR1006E: An error occurred when z/OS Connect EE attempted to
access the authentication/authorization server. Error: javax.net.ssl.SSLHandshakeException: SSLHandshakeException invoking
https://wg31.washington.ibm.com:26213/oidc/endpoint/OP/token: com.ibm.jsse2.util.j: PKIX path building failed:
com.ibm.security.cert.IBMCertPathBuilderException: unable to find valid certification path to requested target
at com.ibm.zosconnect.endpoint.connection.internal.OAuthConfigImpl.requestAuthorizationServer(Unknown Source)
at com.ibm.zosconnect.endpoint.connection.internal.OAuthConfigImpl.getAuthData(Unknown Source)
at com.ibm.zosconnect.apirequester.internal.restclient.RestClientImpl.handleAuthConfig(Unknown Source)
at com.ibm.zosconnect.apirequester.internal.restclient.RestClientImpl.invoke(Unknown Source)
at com.ibm.zosconnect.apirequester.internal.ARInvokeHandler.handle(Unknown Source)
at com.ibm.zosconnect.apirequester.internal.ApiRequesterManagerImpl.invoke(Unknown Source)
at com.ibm.zosconnect.apirequester.internal.proxy.ApiRequesterManagerProxyImpl$1.run(Unknown Source)

.
.

Dump of callerThis
Object type = com.ibm.zosconnect.endpoint.connection.internal.OAuthConfigImpl
copyright_notice = "Licensed Materials - Property of IBM 5655-CE3 (c) Copyright IBM Corp. 2017, 2021 All Rights Reserved
tc = class com.ibm.websphere.ras.TraceComponent@2d85bcc
    strings[0] = "TraceComponent[com.ibm.zosconnect.endpoint.connection.internal.OAuthConfigImpl, class
com.ibm.zosconnect.endpoint.connection.internal.OAuthConfigImpl, [zosConnectApiRequesterToken], com.ibm.zosconnect.endpoint
.connection.internal.resources.ZosConnectEndpointConnection, null]"
CFG_ELEMENT_ID = "id"
CFG_GRANTTYPE = "grantType"
id = "myoAuthConfig"
grantType = "password"
authServer = class com.ibm.zosconnect.endpoint.connection.internal.AuthorizationServerImpl@ed6c1e8c

.
.

sslCertsRef = "OutboundSSLSettings"
connectionTimeout = 30000
receiveTimeout = 60000
id = "myoAuthServer"
```

z/OS Connect Java classes



The FFDC dump for a network issue

```
-----Start of DE processing----- = [6/6/21 14:56:01:242 GMT]
Exception = java.net.UnknownHostException
Source = com.ibm.zosconnect.service.cics.internal.conn.isc.ConnectionManager
probeid = 131
Stack Dump = java.net.UnknownHostException: wg31.washington.ibm.com
at java.net.InetAddress.getAllByName0(InetAddress.java:1419)
at java.net.InetAddress.getAllByName(InetAddress.java:1323)
at java.net.InetAddress.getAllByName(InetAddress.java:1246)
at java.net.InetAddress.getByName(InetAddress.java:1196)
at com.ibm.zosconnect.service.cics.internal.conn.isc.ConnectionManager.createConnection(Unknown Source)
at com.ibm.zosconnect.service.cics.internal.conn.isc.ConnectionManager.getConnection(Unknown Source)
at com.ibm.zosconnect.service.cics.internal.conn.isc.SessionManager.getNewConversation(Unknown Source)
at com.ibm.zosconnect.service.cics.ServerECIRequest.executeISC(Unknown Source)
at com.ibm.zosconnect.service.cics.ServerECIRequest.execute(Unknown Source)
at com.ibm.zosconnect.service.cics.internal.CicsIpicConnection.flow(Unknown Source)
at com.ibm.zosconnect.service.cics.internal.CicsServiceImpl.flowRequest(Unknown Source)
at com.ibm.zosconnect.service.cics.internal.CicsServiceImpl.invoke(Unknown Source)
at com.ibm.zosconnect.internal.ZosConnectServiceImpl.apiInvoke(Unknown Source)
at com.ibm.zosconnect.internal.ServiceManagerImpl.invoke(Unknown Source)
at com.ibm.zosconnect.internal.ApiManagerImpl.invokeApi(Unknown Source)
```

Base Java classes
z/OS Connect Java classes

Root cause – Host wg31.washington.ibm.com was not configured in the DNS server

Use the messages.log and FFDC log together



The messages.log states a First Failure Data Collection dump of the issues has been created.

```
[9/12/21 14:56:45:613 GMT] 00000045 com.ibm.ws.logging.internal.impl.IncidentImpl           I FFDC1015I: An FFDC Incident has been  
created: "com.ibm.connector.DetailedResourceException: MQJCA1011: Failed to allocate a JMS connection., error code: MQJCA1011 An  
internal error caused an attempt to allocate a connection to fail. See the linked exception for details of the failure.  
com.ibm.ejs.j2c.poolmanager.FreePool.createManagedConnectionWithMCWrapper 199" at ffdc_21.09.12_14.56.45.0.log
```

```
[9/12/21 14:56:45:652 GMT] 00000045 com.ibm.ws.logging.internal.impl.IncidentImpl           I FFDC1015I: An FFDC Incident has been  
created: "com.ibm.msg.client.jms.DetailedJMSEException: MQJCA1011: Failed to allocate a JMS connection.
```

An internal error caused an attempt to allocate a connection to fail.

See the linked exception for details of the failure. com.ibm.zosconnect.service.mq.OneWayMQServiceInvocation 0004" at
ffdc_21.09.12_14.56.45.1.log

```
[9/12/21 14:56:45:652 GMT] 00000045 com.ibm.zosconnect.service.mq.MQServiceInvocation          E BAQM0056E: An unexpectedJMSEException  
occurred while processing a request for service 'mqGetService'. The exception message was 'MQJCA1011: Failed to allocate a JMS  
connection.'
```



The FFDC dump showing additional JMS information

```
-----Start of DE processing----- = [9/12/21 14:56:45:567 GMT]
Exception = com.ibm.mq.connector.DetailedResourceException
Source = com.ibm.ejs.j2c.poolmanager.FreePool.createManagedConnectionWithMCWrapper
probeid = 004
Stack Dump = com.ibm.mq.connector.DetailedResourceException: MQJCA1011: Failed to allocate a JMS connection., error code: MQJCA1011 An
internal error caused an attempt to allocate a connection to fail. See the linked exception for details of the failure.
at com.ibm.mq.connector.services.JCAExceptionBuilder.buildException(JCAExceptionBuilder.java:169)
at com.ibm.mq.connector.services.JCAExceptionBuilder.buildException(JCAExceptionBuilder.java:135)
at com.ibm.mq.connector.ConnectionBuilder.createConnection(ConnectionBuilder.java:162)
at com.ibm.mq.connector.outbound.ManagedConnectionFactoryImpl.createConnection(ManagedConnectionFactoryImpl.java:655)
at com.ibm.mq.connector.outbound.ManagedConnectionImpl.<init>(ManagedConnectionImpl.java:200)
at com.ibm.mq.connector.outbound.ManagedConnectionFactoryImpl.createManagedConnection(ManagedConnectionFactoryImpl.java:248)
at com.ibm.ejs.j2c.FreePool.createManagedConnectionWithMCWrapper(FreePool.java:1376)
at com.ibm.ejs.j2c.FreePool.createOrWaitForConnection(FreePool.java:1246)
at com.ibm.ejs.j2c.PoolManager.reserve(PoolManager.java:1438)
at com.ibm.ejs.j2c.ConnectionManager.allocateMCWrapper(ConnectionManager.java:574)
at com.ibm.ejs.j2c.ConnectionManager.allocateConnection(ConnectionManager.java:306)
at com.ibm.mq.connector.outbound.ConnectionFactoryImpl.createManagedJMSConnection(ConnectionFactoryImpl.java:309)
at com.ibm.mq.connector.outbound.ConnectionFactoryImpl.createConnectionInternal(ConnectionFactoryImpl.java:252)
at com.ibm.mq.connector.outbound.ConnectionFactoryImpl.createConnection(ConnectionFactoryImpl.java:225)
. . .
at java.lang.Thread.run(Thread.java:818)
Caused by: com.ibm.msg.client.jms.DetailedJMSEException: JMSFMQ6312: An exception occurred in the Java(tm) MQI.
The Java(tm) MQI has thrown an exception describing the problem.
See the linked exception for further information.
at sun.reflect.NativeConstructorAccessorImpl.newInstance0(Native Method)
. . .
... 27 more
Caused by: com.ibm.mq.jmqi.JmqiException: CC=2;RC=2495;AMQ8568: The native JNI library 'mqjrrs64' was not found. For a client installation
this is expected. [3=mqjrrs64]
at com.ibm.mq.jmqi.local.LocalMQ.loadLib(LocalMQ.java:1178)
Caused by: java.lang.UnsatisfiedLinkError: /usr/lpp/mqm/V9R1M0/java/lib/libmqjrrs64.so (EDC5205S DLL module not found.)
```

Root cause – configuration issue in the MQ resource adapter configuration, e.g., nativeLibraryPath.

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A FFDC dump showing an SSL Handshake issue

```
. . . -----Start of DE processing----- = [6/16/21 17:59:45:534 GMT]
Exception = java.security.cert.CertPathValidatorException
Source = com.ibm.ws.ssl.core.WSX509TrustManager
probeid = checkServerTrusted
Stack Dump = java.security.cert.CertPathValidatorException: The certificate issued by CN=OpenIdProv, OU=CertAuth is not trusted; internal cause is: java.security.cert.CertPathValidatorException: Certificate chaining error
at com.ibm.security.cert.BasicChecker.<init>(BasicChecker.java:111)
at com.ibm.security.cert.PKIXCertPathValidatorImpl.engineValidate(PKIXCertPathValidatorImpl.java:220)
at java.security.cert.CertPathValidator.validate(CertPathValidator.java:278)
at com.ibm.jsse2.util.f.a(f.java:40)
at com.ibm.jsse2.util.f.b(f.java:143)
. .
e = class com.ibm.jsse2.util.f@5728f8dd
f = null
z = class java.lang.String[37]
tsCfgAlias = "OutboundKeyRing"
tsFile = "safkeyring:///zCEE.KeyRing"
extendedInfo = class java.util.HashMap@5ebd51b
serialVersionUID = 362498820763181265
```

Root cause – CA used to sign server certificate was not present in outbound key ring.

Tech-Tip: Use the Java JSSE debugging utility to enable SSL tracing at the Java level.

Use the Java runtime directive `-Djavax.net.debug` to enable this tracing by setting this directive value to `ssl`, e.g. **`-Djavax.net.debug=ssl`**. For more options regarding additional trace options SSL tracing available, see URL <https://www.ibm.com/docs/en/sdk-java-technology/8?topic=troubleshooting-debugging-utilities>

Using this directive requires the Java SDK be at Version 8, service release 6, fix pack 36 or later release level.

Tech/Tip: Details of the flow with mutual authentication (TLS 1.2)



1. A Client sends a request to server for a protected session in a ***ClientHello*** message. Included in the request is the TLS capabilities of the client (e.g., TLS 1.2 or 1.3) and a list of supported ciphers in preference order.
2. The server selects the TLS version and selects cipher from the list sent by the client and returns this information in a ***ServerHello*** message.
3. The server's certificate public information (including the **public key**) is sent to the client in a ***Certificate*** message.
4. The server sends cryptographic information for the client to use for encrypting a pre-master key in a ***Server key exchange*** message.
5. **For mutual authentication, the server sends a *CertificateRequest* message requesting a client's personal certificate.**
6. The server concludes by sending a ***ServerHelloDone*** message.
7. The client verifies the server's certificate with its trust store.
8. **If mutual authentication is requested, the client sends its public personal certificate information in a *Certificate* message**
9. The client then uses the **server's public key** to generate and encrypt a 48 byte “premaster secret” message which is sent to the server in a ***ClientKeyExchange*** message.
10. **When mutual authentication is requested, a digitally signature (hashed) of the concatenation of all previous handshake messages is encrypted with the client's private key sent in a *CertificateVerify* message.**
11. The ***Change Cipher*** message is used to change the cipher used during the handshake so all subsequent messages will be encrypted using a different cipher.
12. The server uses its **private key** to decrypt the “premaster secret” message (**only the private key can be used to decrypt the message**).
13. **If mutual authentication is requested, the server verifies the client's personal certificate with its key ring and uses the client's public key to decrypt and verify the message sent in the *CertificateVerify* message.**
14. Both the Client and Server use the “premaster secret” to compute a ‘master secret’, also known as “shared secret” or “session key” (symmetric encryption)
15. Client and server will use this “shared secret” or “session key” to encrypt messages sent between the endpoints.



Tech/Tip: Use the Java directive javax.net.debug to enable Java SSL tracing

Add this directive to the JVM properties -Djavax.net.debug=ssl,handshake

```
.java:1168|JsseJCE: Using cipher DES/CBC/NoPadding from provider TBD via init
.java:1168|JsseJCE: Using cipher RC4 from provider TBD via init
.java:1168|JsseJCE: Using cipher DES/CBC/NoPadding from provider TBD via init
.java:1168|JsseJCE: Using cipher DESEde/CBC/NoPadding from provider TBD via init
-
-
-
.java:1168|JsseJCE: Using cipher AES/GCM/NoPadding from provider TBD via init
.java:1168|JsseJCE: Using cipher ChaCha20-Poly1305 from provider TBD via init
-
-
-
.java:1168|JsseJCE: Using KeyGenerator IbmTlsExtendedMasterSecret from provider TBD via init
.java:1168|JsseJCE: Using signature SHA1withECDSA from provider TBD via init
.java:1168|JsseJCE: Using signature NONEwithECDSA from provider TBD via init
-
-
-
.java:1168|Consuming ClientHello handshake message (
-
-
-
.java:1168|Consumed extension: supported_versions
.java:1168|Negotiated protocol version: TLSv1.2
-
-
-
.java:1168|Produced ServerHello handshake message (
-
-
-
.java:1168|Produced server Certificate handshake message (
-
-
-
.java:1168|Produced ECDH ServerKeyExchange handshake message (
-
-
-
.java:1168|Produced ServerHelloDone handshake message (
-
-
-
.java:1168|Consuming ECDHE ClientKeyExchange handshake message (
-
-
-
.java:1168|Consuming ChangeCipherSpec message
-
-
-
.java:1168|Consuming client Finished handshake message (
-
-
-
.java:1168|Produced ChangeCipherSpec message
.java:1168|Produced server Finished handshake message (
-
-
-
```

For more details, see URL <https://www.ibm.com/docs/en/sdk-java-technology/8?topic=troubleshooting-debugging-utilities>

Common TLS handshake issues

With a few exceptions, most of TLS errors may require a review of a trace.

I use the *traceSpecification* as shown below:

```
<logging traceSpecification="com.ibm.ws.security.*=all:SSLChannel=all:SSL=all:zosConnectSaf=all"/>
```

This will generate a *trace.out* file in the *logs* subdirectory. This trace will provide details about the key ring and certificates involved in the handshake. There is a wealth of information about the flow between the client and server endpoints. Review this trace for exceptions. The following exceptions are some of the most commonly experienced.

- ***Error occurred during a read, exception:javax.net.ssl.SSLHandshakeException: null cert chain***

This exception occurs when the server configuration set to require client certificates (*clientAuthentication="true"*) and the client had no certificate to provide, and no alternative authentication method was available.

- ***Error occurred during a read, exception:javax.net.ssl.SSLException: Received fatal alert: bad_certificate error (handshake), vc=1083934466***

Caught exception during unwrap, javax.net.ssl.SSLException: Received fatal alert: bad_certificate

This is usually caused when the client certificate presented to the server did not have a valid CA certificate for the client's personal certificate in the server's trust store key ring.

Common TLS handshake issues

- ***FFDC1015I: An FFDC Incident has been created: "java.io.IOException: Failed validating certificate paths com.ibm.ws.ssl.config.WSKeyStore\$1 do_getKeyStore" at ffdc_19.12.04_20.51.47.0.log***

This can occur when the CA certificate used to sign the server's personal certificate was not connected to the server's local trust store (key ring on z/OS).

- ***java.io.IOException: IOException invoking https://132.25.33.351:9443/employees/John?validated=true: HTTPS hostname wrong: should be <132.25.33.351>***

In this situation the endpoint for the outbound API request was configured to use an IP address rather than a hostname. This should not be an issue unless an exchange of digital certificates is required.

The trace showed that during the handshake process the outbound API provider server's certificate had a common name (CN) which specified the hostname of the TCPIP stack where the API resided. This hostname was not known (e.g., DNS-resolvable) on the TCPIP stack where the z/OS Connect server was executing. This meant that communications back to the API requester's TCPIP stack based on the hostname was not possible which caused the IO exception. The best solution would be to use the host name in the server.xml configuration rather than the IP address and either add an entry to the local TCPIP stack's hostname (e.g., hosts) file for the IP address and hostname or add an entry to the DNS servers used by this TCPIP stack.

Common TLS handshake issues



- **CWPKI0022E: SSL HANDSHAKE FAILURE:** A signer with SubjectDN CN=USER3 D. Client, OU=LIBERTY, O=IBM was sent from the target host. The signer might need to be added to local trust store `safkeyring://Liberty.KeyRing`, located in SSL configuration alias `DefaultSSLSettings`. The extended error message from the SSL handshake exception is: PKIX path building failed: `com.ibm.security.cert.IBMCertPathBuilderException: unable to find valid certification path to requested target`

This message is indicating a personal certificate was presented in a TLS handshake and there was no corresponding certificate authority certificate connect to the local trust store (e.g., key ring). This can occur either for client connecting to the server or an API requester request going to an API provider.

Identify the certificate authority which signed this personal certificate and connect it to the keyring with usage CERTAUTH.

Common TLS handshake issues

- *CWWKO0801E: Unable to initialize SSL connection. Unauthorized access was denied or security settings have expired. Exception is javax.net.ssl.SSLHandshakeException: no cipher suites in common*

- There may be many causes for this issue but first confirm the RACF identity under which the server is running has either READ access to FACILITY resources IRR.DIGTCERT.LISTRING and IRR.DIGTCERT.LIST or access to RDATALIB resources if virtual keyrings are being used.

The first FACILITY resource gives the identity access to their own key ring and the second allows access to the certificates. If virtual keyrings are in use, then the identity needs READ or UPDATE authority to the <ringOwner>.<ringName>.LST resource in the RDATALIB class. READ access enables retrieving one's own private key, UPDATE access enables retrieving another's private key.

An alternative cause: For a TLS handshake to occur, the server must first have access to a private or site certificate that has a private key and the server must have access to that certificate's private key and no certificate with a private key is available.

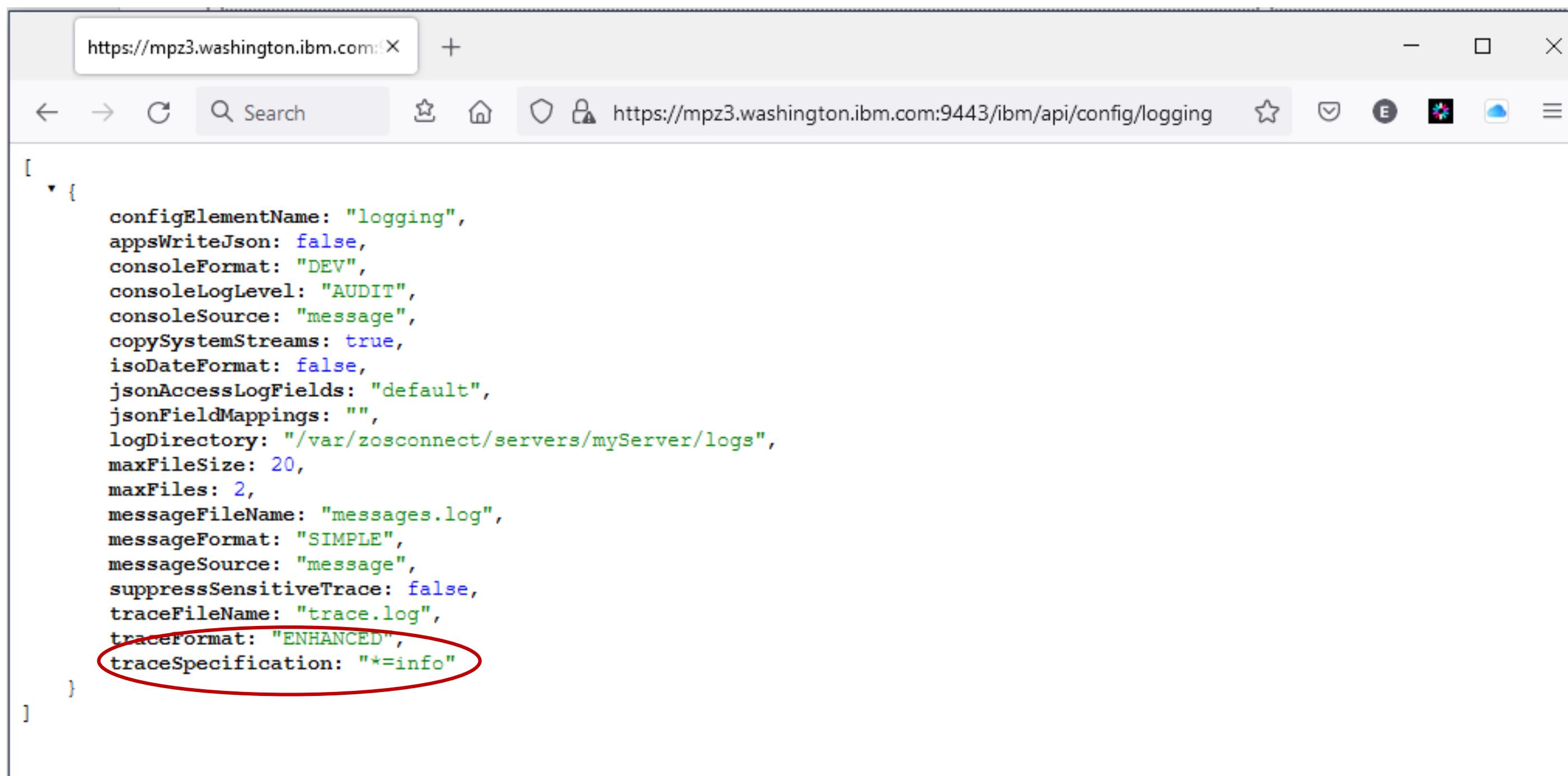
- Another possibility is that the TLS handshake the negotiations between the client and server failed, e.g.,
javax.net.ssl.SSLHandshakeException: Client requested protocol SSLv3 is not enabled or supported in server context



trace.out – use as a last resort or at the request of Level 2

First, the current active trace specification settings can be display using the *restConnector* feature.

`https://wg31.washington.ibm.com:9443/ibm/api/config/logging`



```
[{"configElementName": "logging", "appsWriteJson": false, "consoleFormat": "DEV", "consoleLogLevel": "AUDIT", "consoleSource": "message", "copySystemStreams": true, "isoDateFormat": false, "jsonAccessLogFields": "default", "jsonFieldMappings": "", "logDirectory": "/var/zosconnect/servers/myServer/logs", "maxFileSize": 20, "maxFiles": 2, "messageFileName": "messages.log", "messageFormat": "SIMPLE", "messageSource": "message", "suppressSensitiveTrace": false, "traceFileName": "trace.log", "traceFormat": "ENHANCED", "traceSpecification": "*=info"}]
```

Enabling trace in z/OS Connect EE server

<https://www.ibm.com/docs/en/zosconnect/3.0?topic=problems-enabling-trace-in-zos-connect-ee>



Managing trace specifications

- Use “include” file to save commonly used trace specifications.
- Add the “include” after the sever has started to avoid tracing the startup activity.

server.xml

```
<include location="${server.config.dir}/includes/safTrace.xml"/>
```

safTrace.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<server description="security trace">
<logging traceSpecification="com.ibm.ws.security.*=all:
    SSLChannel=all:SSL=all:zosConnectSaf=all:zosConnect=all"/>
</server>
```

cicsTrace.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<server description="CICS trace">
<logging traceSpecification="zosConnectServiceCics=all:
    com.ibm.zosconnect.wv*=FINEST:zosConnect=all"/>
</server>
```

imsTrace.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<server description="IMS trace">
<logging traceSpecification="com.ibm.ims.*=all:
    com.ibm.j2ca.RAIMSTM=all:com.ibm.zosconnect.wv*=FINEST:
    zosConnect=all"/>
</server>
```

Enables enhanced tracing

(after adding an “include” file)
F BAQSTART,REFRESH,CONFIG

Disable enhanced tracing

F BAQSTART,LOGGING='*=INFO'

Or

F BAQSTART,REFRESH,CONFIG
(after removing the “include” file)



trace.out file

```
mpz3
File Edit Settings View Communication Actions Window Help
File Edit Edit_Settings Menu Utilities Compilers Test Help
EDIT /MPZ3/var/zosconnect/servers/myServer/logs/trace.log Columns 00101 00252
Command ==> Scroll ==> PAGE
003697 > getSSLConfig: DefaultSSLSettings Entry 4 Line(s) not Displayed
003698 < getSSLConfig Exit
003699 SSLConfig.toString() {
003700
003701 > determineIfCSIV2SettingsApply Entry
003702 {com.ibm.ssl.remoteHost=*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl}
003703 < determineIfCSIV2SettingsApply (original settings) Exit
003704
003705 3 keyStoreType: JCERACFKS
003706 3 trustStoreType: JCERACFKS
003707
003708 3 keyStore: safkeyring://Liberty.KeyRing
003709 3 keyStoreName: CellDefaultKeyStore
003710 3 keyStorePassword: *****
003711 3 trustStore: safkeyring://Liberty.KeyRing
003712 3 trustStoreName: CellDefaultKeyStore
003713 3 trustStorePassword: *****
003714
003715 (com.ibm.ssl.remoteHost=*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl)
003716
004117 k 3 Error occurred during a read, exception:javax.net.ssl.SSLHandshakeException: Empty server certificate chain 375 Line(s) not Displayed
004119 3 Caught exception during unwrap, javax.net.ssl.SSLHandshakeException: Empty server certificate chain 1 Line(s) not Displayed
004120 22 Line(s) not Displayed
004121 (com.ibm.ssl.remoteHost=*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl)
004122
004144 > isTransportSecurityEnabled Entry 1 Line(s) not Displayed
004145 < isTransportSecurityEnabled true Exit
004150
004151 > getSSLConfig: DefaultSSLSettings Entry 4 Line(s) not Displayed
004152 < getSSLConfig Exit
004153 SSLConfig.toString() {
004154
004155 > determineIfCSIV2SettingsApply Entry
004156 {com.ibm.ssl.remoteHost=*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl}
004157 < determineIfCSIV2SettingsApply (original settings) Exit
004158
004243 3 keyStoreType: JCERACFKS
004244 3 trustStoreType: JCEPKEK
004245
004246 3 keyStore: safkeyring://Liberty.KeyRing
004247 3 keyStoreName: CellDefaultKeyStore
004248 3 keyStorePassword: *****
004249 3 trustStore: safkeyring://Liberty.KeyRing
004250 3 trustStoreName: CellDefaultKeyStore
004251 3 trustStorePassword: *****
004252
004253 (com.ibm.ssl.remoteHost=*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl)
004254
004630 k 3 Error occurred during a read, exception:javax.net.ssl.SSLHandshakeException: Empty server certificate chain 375 Line(s) not Displayed
004632 3 Caught exception during unwrap, javax.net.ssl.SSLHandshakeException: Empty server certificate chain 1 Line(s) not Displayed
004633 22 Line(s) not Displayed
004655 (com.ibm.ssl.remoteHost=*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl)
004656
004657 > isTransportSecurityEnabled Entry 1 Line(s) not Displayed
004658 < isTransportSecurityEnabled true Exit
03/019
MA A
Connected to remote server/host mpz3 using lu/pool MPZ30006 and port 23
```

z/OS Connect Wildfire Github Site

<https://ibm.biz/BdPRGD>



The screenshot shows a GitHub repository page with a red box highlighting several recent file uploads. The repository name is "ibm-wsc/zCONNEE-Wildfire-Workshop".

File	Action	Time Ago
README.md	Update README.md	3 years ago
WebSphere Liberty on zOS Managi...	Add files via upload	25 minutes ago
WebSphere Liberty on zOS Configu...	Add files via upload	25 minutes ago
WebSphere Liberty on zOS Introduc...	Add files via upload	25 minutes ago
zOS Connect EE V3 Advanced Topic...	Add files via upload	3 years ago
ZOS Connect EE v3 Getting Started....	Add files via upload	3 years ago

Contributors 2

- emitchj
- Jbrefach John J Brefach

Deployments 1

- github-pages 3 years ago

Languages

COBOL 100.0%

README

This repository contains material from the z/OS Connect EE Wildfire workshops run by the IBM Washington Systems Center. It is should be referenced frequently for updates to the presentations, exercises, samples and other material.

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mitchj@us.ibm.com

Thank you for listening and your questions.

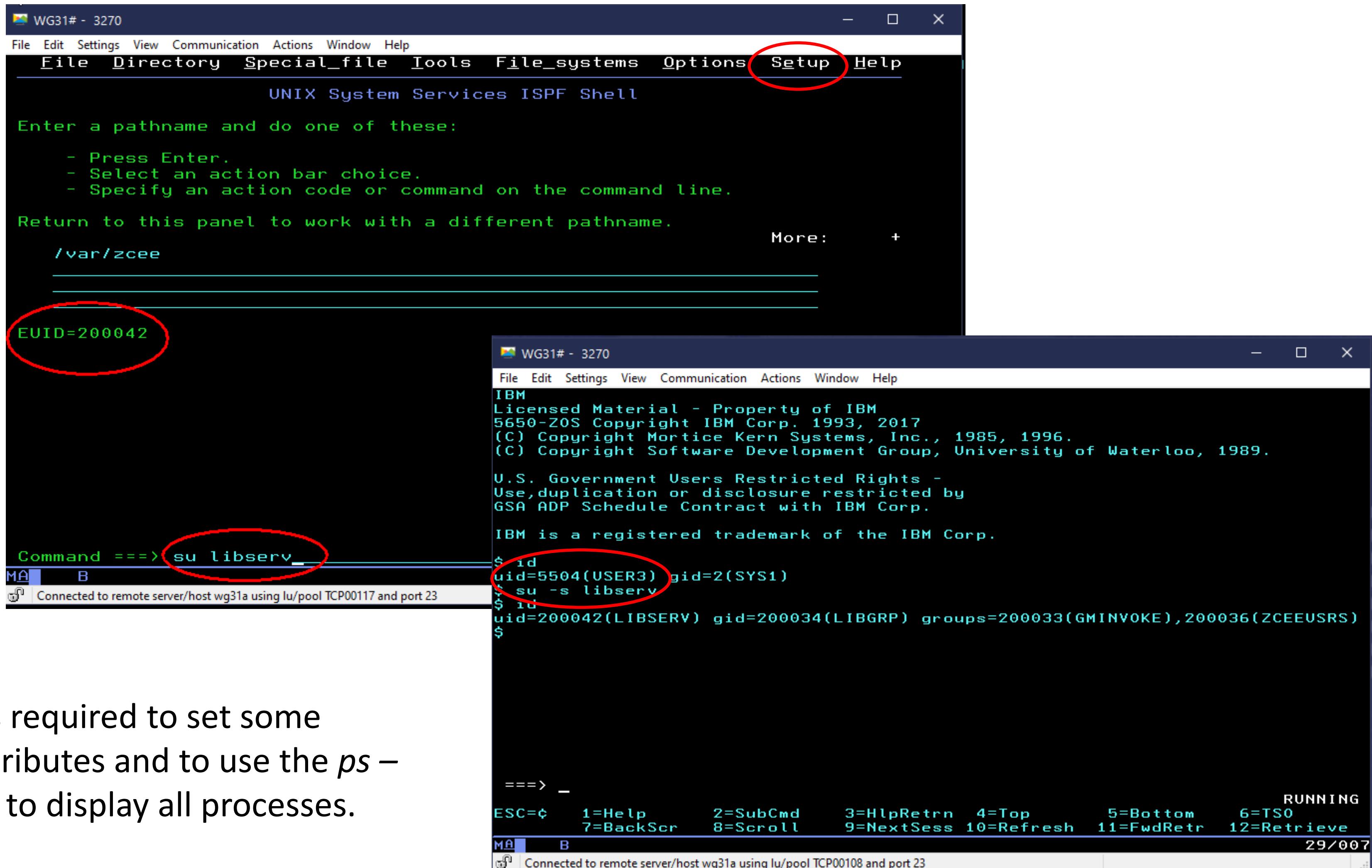
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Thank you for listening and your questions.

Miscellaneous Odds and Ends

Tech/Tip: z/OS : ISPF/OMVS examples of using SURROGAT access



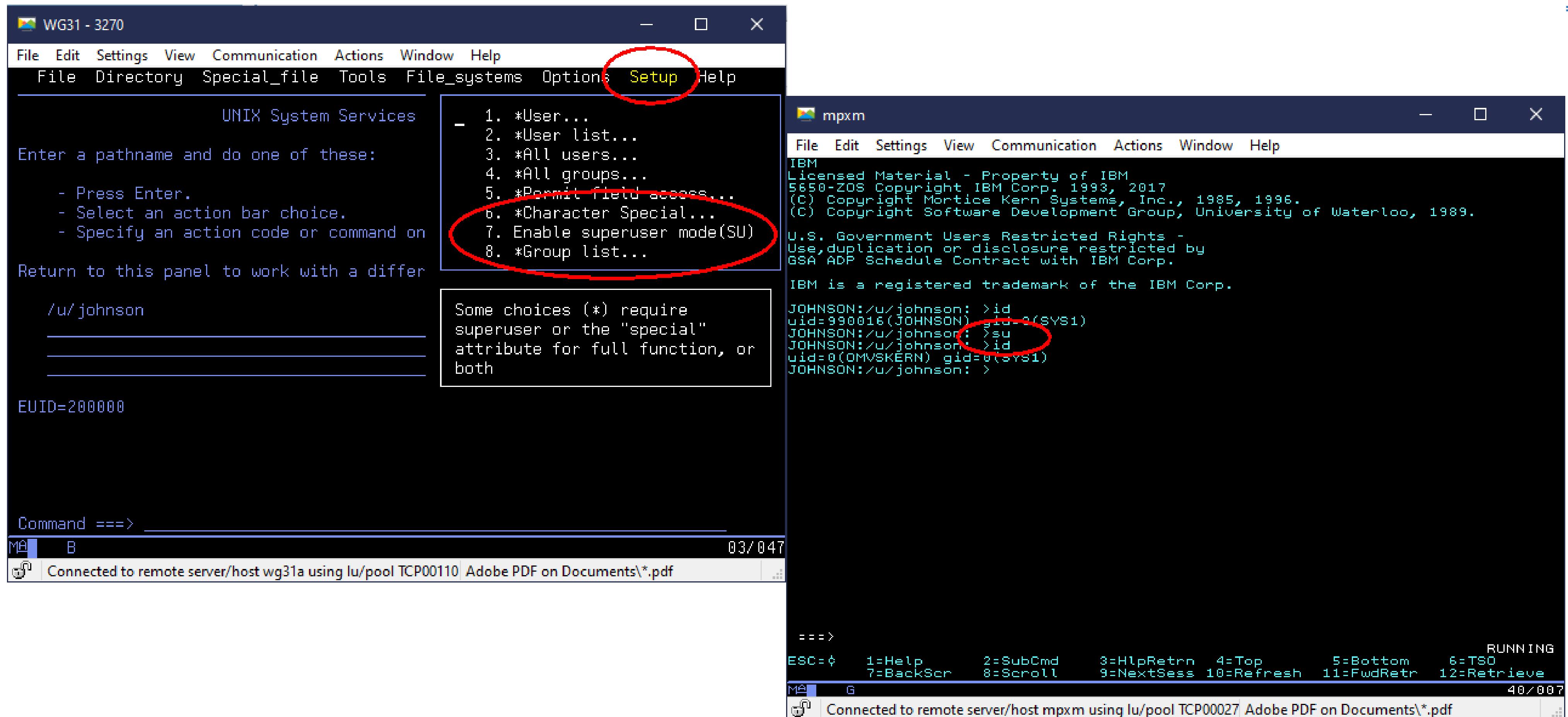
The image contains two side-by-side screenshots of the ISPF/OMVS interface.

Screenshot 1: This screenshot shows the ISPF Shell. The menu bar is visible with options like File, Directory, Special_file, Tools, File_systems, Options, Setup, and Help. The 'Setup' option is circled in red. Below the menu, it says "UNIX System Services ISPF Shell". It prompts the user to "Enter a pathname and do one of these:" with three options: Press Enter, Select an action bar choice, or Specify an action code or command on the command line. It also says "Return to this panel to work with a different pathname." The command line shows "/var/zcee". A red circle highlights the text "EUID=200042" which appears to be a placeholder for a user ID.

Screenshot 2: This screenshot shows a terminal window with the following text:
 IBM
 Licensed Material - Property of IBM
 5650-ZOS Copyright IBM Corp. 1993, 2017
 (C) Copyright Mortice Kern Systems, Inc., 1985, 1996.
 (C) Copyright Software Development Group, University of Waterloo, 1989.
 U.S. Government Users Restricted Rights -
 Use, duplication or disclosure restricted by
 GSA ADP Schedule Contract with IBM Corp.
 IBM is a registered trademark of the IBM Corp.
 Command ==> su libserv
 MA B
 Connected to remote server/host wg31a using lu/pool TCP00117 and port 23
 \$ id
 uid=5504(USER3) gid=2(SYS1)
 \$ su -s libserv
 \$ id
 uid=200042(LIBSERV) gid=200034(LIBGRP) groups=200033(GMINVOKE),200036(ZCEEUSRS)
 \$
 ==> _
 ESC=< 1=Help 2=SubCmd 3=HlpRetrn 4=Top 5=Bottom 6=TSO
 7=BackScr 8=Scroll 9=NextSess 10=Refresh 11=FwdRetr 12=Retrieve
 MA B
 Connected to remote server/host wg31a using lu/pool TCP00108 and port 23 29/007

Super user is required to set some extended attributes and to use the *ps -ef* command to display all processes.

Tech/Tip: z/OS : Switching to root authority



Tech-Tip: Super user is required to set the program control extended attribute (`extattr +p`) bit for the Java shared object ***ifaedjreg64.so***. This extended attribute must be set for identity assertion in certain situations.

Tech-Tip: Identity assertion and/or JWT generation Extended Attribute Requirement

As root or superuser, set the *libifaedjreg64.so* program control extended attribute bit

- *Permit the server's identity to the required FACILITY resource*

**PERMIT BPX.SERVER CLASS(FACILITY) ID(*LIBSERV*) ACCESS(READ)
SETROPTS RACLIST(FACILITY) REFRESH**

- *Define a SURROGAT profile for the asserted identity and permit access to connection identity*

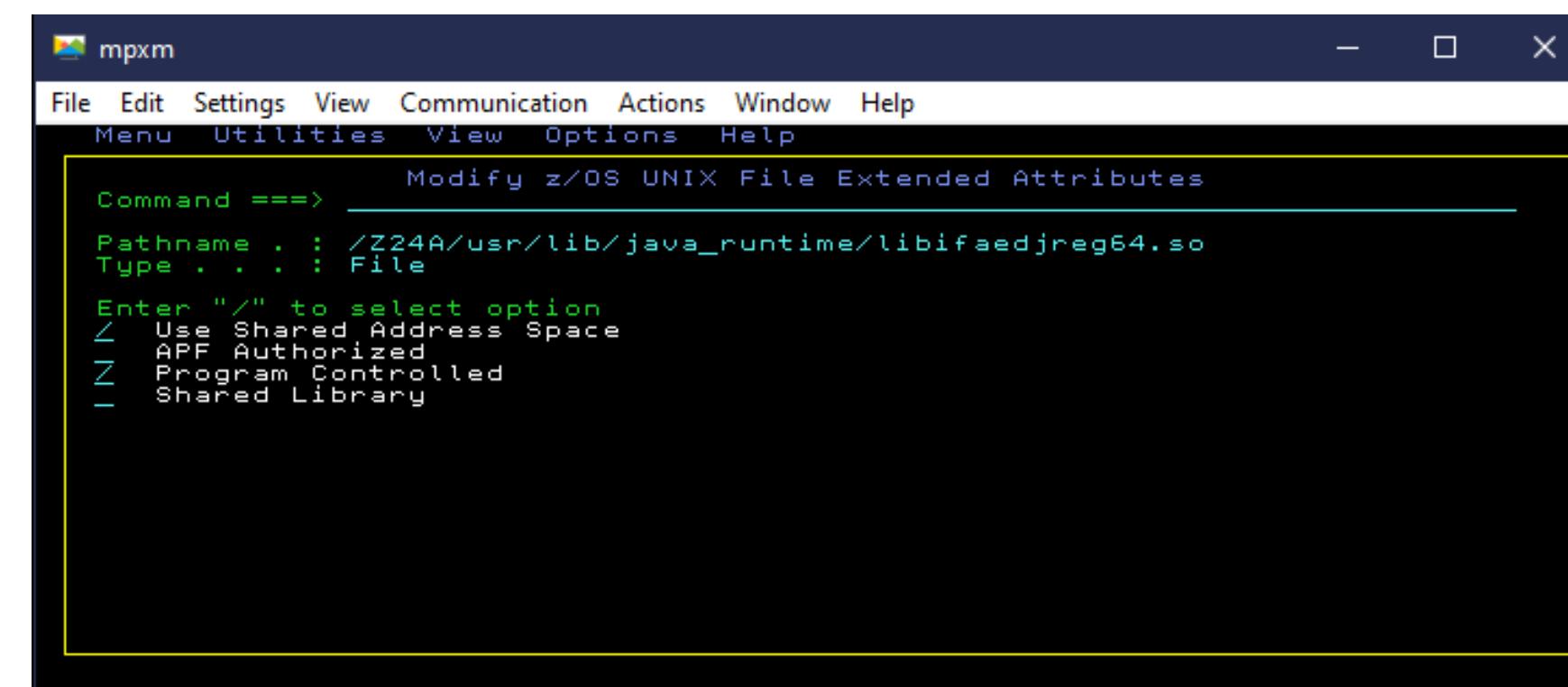
**RDEFINE SURROGAT *clientID.BAQASSRT* UACC(NONE) OWNER(SYS1)
PERMIT *clientID.BAQASSRT* CLASS(SURROGAT) ACCESS(READ) ID(*zCEEID*)**

OR

**RDEFINE SURROGAT *.BAQASSRT UACC(NONE) OWNER(SYS1)
PERMIT *.BAQASSRT CLASS(SURROGAT) ACCESS(READ) ID(*zCEEID*)
SETROPTS RACLIST(SURROGAT) REFRESH**

- *Enable the program control bit for Java shared object *ifaedjreg64**

```
su
cd /usr/lib/java_runtime
extattr +p libifaedjreg64.so
```





Tech-Tip: Displaying Liberty messages on the console and/or STDERR spool

server.xml

```
<zosLogging wtoMessage=
  "BAQR0657E,BAQR0658E,BAQR0660E,BAQR0686E,BAQR0687E"
  hardCopyMessage=
  "BAQR0657E,BAQR0658E,BAQR0660E,BAQR0686E,BAQR0687E"/>
```

MVS Console

```
18.12.02 STC00137 +BAQR0686E: Program CSCVINC is not available in the CICS region with
  811           connection ID cscvinc; service cscvincService failed.
18.12.02 STC00137 +BAQR0686E: Program CSCVINC is not available in the CICS region with
  812           connection ID cscvinc; service cscvincService failed.
19.07.12 STC00137 +BAQR0657E: Transaction abend MIJO occurred in CICS while using
  745           connection cscvinc and service cscvincService.
```

STDERR

```
ÝERROR  .. BAQR0686E: Program CSCVINC is not available in the CICS region with connection cscvinc and service cscvincService.
ÝERROR  .. BAQR0686E: Program CSCVINC is not available in the CICS region with connection cscvinc and service cscvincService.
ÝERROR  .. BAQR0657E: Transaction abend MIJO occurred in CICS while using CICS connection cscvinc and service cscvincService.
```

Tech-Tip: Use Symbolic links to simplify commands used in OMVS and JCL

Performing commands:

```
ln -s /global/zosconnect/includes /var/zcee/includes
ln -s /var/zosconnect/servers/zceesrv1 /var/zcee/zceesrv1
ln -s /var/zosconnect/servers/zceesrv2 /var/zcee/zceesrv2
```

Will change these OMVS commands from:

```
ln -s /global/zosconnect/includes /var/zosconnect/servers/zceesrv1/includes
ln -s /global/zosconnect/includes /var/zosconnect/servers/zceesrv2/includes
```

To simpler (and shorter) OMVS commands:

```
ln -s /var/zcee/includes /var/zcee/zceesrv1/includes
ln -s /var/zcee/includes /var/zcee/zceesrv2/includes
```

Directory Shortcuts

- Create a shortcut from the shared administrative *include* directory to the Sysplex or LPAR shared directory
- Create shortcuts from the server's administrative directories to each server's configuration directory.

N.B. These are symbolic links to symbolic links.

ln -s oldname newname

These symbolic links can be used as JCL symbols

```
//EXPORT EXPORT SYMLIST=(*)
// SET SERVER= 'zceesrv1'
// SET SHARED=' /var/zcee/includes '
// SET WLPUSER=' /var/zosconnect '
//ZCEELN EXEC PGM=IKJEFT01,REGION=0M
//SYSTSPRT DD SYSOUT=*
//SYSERR DD SYSOUT=*
//STDOUT DD SYSOUT=*
//SYSTSIN DD *,SYMBOLS=EXECSYS
BPXBATCH SH +
ln -s &SHARED /var/zcee/&SERVER/includes
 instead of entering the full directory names as in
ln -s /global/zosconnect/includes +
 &WLPUSER/servers/&SERVER/includes
```

And added as exports to /u/home/.profile or /etc/profile files

```
export serverName=zceesrv1
export shared=/var/zcee/includes
export WLP_USER_DIR=/var/zosconnect
```

```
//ZCEELN EXEC PGM=IKJEFT01,REGION=0M
//SYSTSPRT DD SYSOUT=*
//SYSERR DD SYSOUT=*
//STDOUT DD SYSOUT=*
//SYSTSIN DD *
BPXBATCH SH +
ln -s $shared /var/zcee/$serverName/includes
 instead of entering the full directory names as in
ln -s /global/zosconnect/includes +
 $WLPUSER/servers/$serverName/includes
```



Tech-Tip: Copying WOLA executables from OMVS to a PDSE

```
//JOHNSONS JOB (ACCOUNT),JOHNSON,NOTIFY=JOHNSON,REGION=0M,  
// CLASS=A,MSGCLASS=H,MSGLEVEL=(1,1)  
//*****  
///* SET SYMBOLS  
//*****  
//EXPORT EXPORT SYMLIST=(*)  
// SET DSNAME='USER1.WOLA2106.LOADLIB'  
// SET ZCEEPATH='/usr/lpp/IBM/zosconnect/v3r0'  
// SET JAVAHOME='/usr/lpp/java/J8.0_64'  
//*****  
///* Step ALLOC - Allocate a PDSE load library  
//*****  
//ALLOC EXEC PGM=IDCAMS  
//SYSPRINT DD SYSOUT=*  
//SYSIN DD *,SYMBOLS=EXECSYS  
DELETE '&DSNAME'  
SET MAXCC=0  
ALLOC DSNAME('&DSNAME') -  
    NEW CATALOG SPACE(2,1) DSORG(PO) CYLINDERS -  
    RECFM(U) DSNTYPE(LIBRARY)  
//*****  
///* Step WOLACOPY - copy the WOLA executables to the PDSE  
//*****  
//WOLACOPY EXEC PGM=IKJEFT01,REGION=0M  
//SYSTSPRT DD SYSOUT=*  
//SYSERR DD SYSOUT=*  
//STDOUT DD SYSOUT=*  
//SYSTSIN DD *,SYMBOLS=EXECSYS  
BPXBATCH SH +  
    export JAVA_HOME=&JAVAHOME; +  
    export DSNAME=&DSNAME; +  
    cp -Xv &ZCEEPATH/wlp/clients/zos/* "//$DSNAME"
```

Tech-Tip: Sample JCL - Executing the Liberty *securityUtility* command



```
//*****  
/* Use securityUtility to encrypt a password using an  
/* encryption key of a certificate  
//*****  
//IKJEFT01 EXEC PGM=IKJEFT01,REGION=0M  
//SYSTSPRT DD SYSOUT=*  
//SYSERR DD SYSOUT=*  
//STDOUT DD SYSOUT=*  
//SYSTSIN DD *  
BPXBATCH SH +  
/usr/lpp/IBM/zosconnect/v3r0/wlp/bin/securityUtility encode +  
--encoding=aes +  
--keyring=safkeyring://JOHNSON/Liberty.KeyRing +  
--keyringType=JCERACFKS --keyLabel="Johnson Client Cert" +  
passwordToEncrypt
```

```
<featureManager>  
  <feature>zosPasswordEncryptionKey-1.0</feature>  
</featureManager>  
  
<zosPasswordEncryptionKey  
keyring="safkeyring://JOHNSON/Liberty.KeyRing"  
label="Johnson Client Cert" type="JCERACFKS"/>
```

```
//*****  
/* Use securityUtility to encrypt a password using an  
/* encryption key string  
//*****  
//IKJEFT01 EXEC PGM=IKJEFT01,REGION=0M  
//SYSTSPRT DD SYSOUT=*  
//SYSERR DD SYSOUT=*  
//STDOUT DD SYSOUT=*  
//SYSTSIN DD *  
BPXBATCH SH +  
/usr/lpp/IBM/zosconnect/v3r0/wlp/bin/securityUtility encode +  
--encoding=aes -key myEncryptionKey +  
passwordToEncrypt
```

```
wlp.password.encryption.key=myEncryptionKey
```

Tech-Tip: Sample Sysplex DVIPAs Configuration

SYS1.TCPIP.TCPPARMS (IPNODES)

```
192.168.17.241 MPZ1.DMZ MPZ1 mpz1.washington.ibm.com
192.168.17.242 MPZ2.DMZ MPZ2 mpz2.washington.ibm.com
192.168.17.243 MPZ3.DMZ MPZ3 mpz3.washington.ibm.com
192.168.17.240 dvipa dvipa.washington.ibm.com
```

SYS1.TCPIP.TCPPARMS (PROFMPZ3)

```
IPCONFIG SYSPLEXROUTING
DYNAMICXCF 172.1.1.243 255.255.255.0 3
VIPADYNAMIC
VIPADEFINE 255.255.255.0 192.168.17.240
VIPADISTRIBUTE DEFINE DISTM ROUNDROBIN|BASEWLM 192.168.17.240
PORT 23 1416 1491 2446 9443 9453 9463
DESTIP
172.1.1.241
172.1.1.242
172.1.1.243
ENDVIPADYNAMIC
```

SERVERWLM is not an option

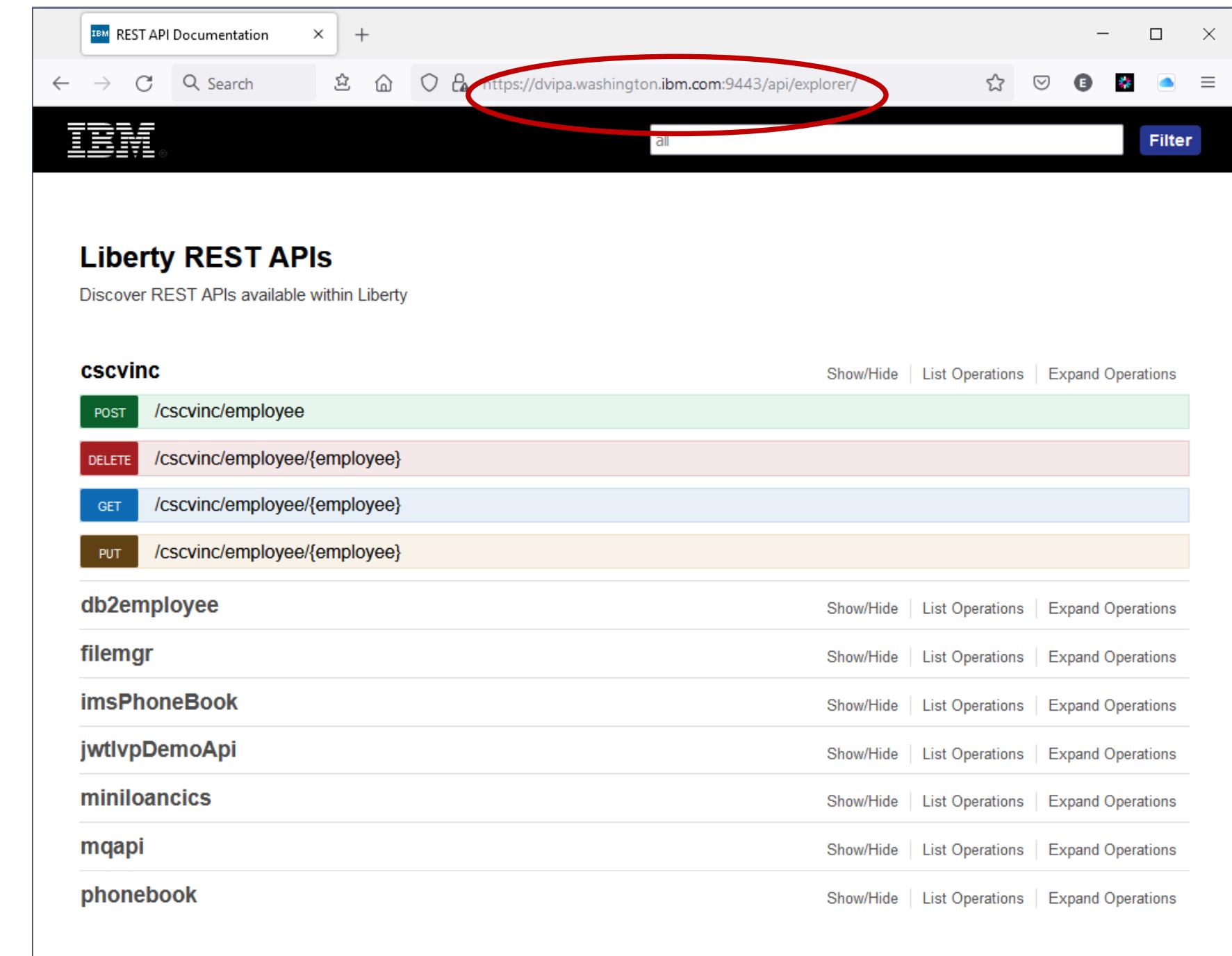
HOMETEST

```
EZA0619I Running IBM MVS TCP/IP CS V2R4 TCP/IP Configuration Tester
EZA0602I TCP Host Name is: MPZ3

EZA0605I Using Name Server to Resolve MPZ3
EZA0611I The following IP addresses correspond to TCP Host Name: MPZ3
EZA0612I 192.168.17.243
EZA0614I The following IP addresses are the HOME IP addresses defined in PROFILE.TCPIP:
EZA0615I 192.168.17.243
EZA0615I 172.1.1.243
EZA0615I 192.168.17.240
EZA0615I 127.0.0.1

EZA0618I All IP addresses for MPZ3 are in the HOME list!
EZA0622I Hometest was successful - all Tests Passed!
```

```
<zosconnect_cicsIpicConnection id="cscvinc"
host="dvipa.washington.ibm.com"
port="1491"/>
<zosconnect_endpointConnection id="mqapi"
host="http://dvipa.washington.ibm.com"
port="9453"
basicAuthRef="myBasicAuth"
connectionTimeout="10s"
receiveTimeout="20s" />
```



cscvinc	
POST	/cscvinc/employee
DELETE	/cscvinc/employee/{employee}
GET	/cscvinc/employee/{employee}
PUT	/cscvinc/employee/{employee}
db2employee	
filemgr	
imsPhoneBook	
jwtlvpDemoApi	
miniloancics	
mqapi	
phonebook	

Tech/Tip: Use the TCPIP resolver trace to display name resolution information

```

ALLOC FILE(SYSTCPT) DA(*)
ping wg31.washington.ibm.com
Resolver Trace Initialization Complete -> 2021/09/12 12:54:37.36

res_init Resolver values:
Setup file warning messages = No
CTRACE TRACERES option = No
Global Tcp/Ip Dataset = SYS1.TCPIP.TCPPARMS(TCPDAT3)
Default Tcp/Ip Dataset = SYS1.TCPIP.TCPPARMS(TCPDAT3)
Local Tcp/Ip Dataset = //DD:SYSTCPD
                         ==> SYS1.TCPIP.TCPPARMS(TCPDAT3)
Translation Table = SYS1.TCPIP.STANDARD.TCPXLBIN
UserId/JobName = JOHNSON
Caller API = TCP/IP Sockets Extended
Caller Mode = EBCDIC
System Name = WSC13 (from VMCF)
UnresponsiveThreshold = 25
(G) DataSetPrefix = SYS1.TCPIP
(G) HostName = wg31
. . .
res_query Failed: RetVal = -1, RC = 1, Reason = 0x78981005
res_querydomain Failed: RetVal = -1, RC = 1, Reason = 0x78981005
res_search Failed: RetVal = -1, RC = 1, Reason = 0x78981005
GetAddrInfo Closing IOCTL Socket 0x00000000
BPX1CLO: RetVal = 0, RC = 0, Reason = 0x00000000
GetAddrInfo Failed: RetVal = -1, RC = 1, Reason = 0x78AE1004
GetAddrInfo Ended: 2021/09/12 12:55:32.364732
*****
EZ2311I Unknown host 'WG31.WASHINGTON.IBM.COM'

```

Root cause – Host wg31.washington.ibm.com was missing from SYS1.TCPIP.TCPPARMS(IPNODES)

Tech/Tip: Details of the flow with mutual authentication (TLS 1.2)



1. A Client sends a request to server for a protected session in a ***ClientHello*** message. Included in the request is the TLS capabilities of the client (e.g., TLS 1.2 or 1.3) and a list of supported ciphers in preference order.
2. The server selects the TLS version and selects cipher from the list sent by the client and returns this information in a ***ServerHello*** message.
3. The server's certificate public information (including the **public key**) is sent to the client in a ***Certificate*** message.
4. The server sends cryptographic information for the client to use for encrypting a pre-master key in a ***Server key exchange*** message.
5. **For mutual authentication, the server sends a *CertificateRequest* message requesting a client's personal certificate.**
6. The server concludes by sending a ***ServerHelloDone*** message.
7. The client verifies the server's certificate with its trust store.
8. **If mutual authentication is requested, the client sends its public personal certificate information in a *Certificate* message**
9. The client then uses the **server's public key** to generate and encrypt a 48 byte “premaster secret” message which is sent to the server in a ***ClientKeyExchange*** message.
10. **When mutual authentication is requested, a digitally signature (hashed) of the concatenation of all previous handshake messages is encrypted with the client's private key sent in a *CertificateVerify* message.**
11. The ***Change Cipher*** message is used to change the cipher used during the handshake so all subsequent messages will be encrypted using a different cipher.
12. The server uses its **private key** to decrypt the “premaster secret” message (**only the private key can be used to decrypt the message**).
13. **If mutual authentication is requested, the server verifies the client's personal certificate with its key ring and uses the client's public key to decrypt and verify the message sent in the *CertificateVerify* message.**
14. Both the Client and Server use the “premaster secret” to compute a ‘master secret’, also known as “shared secret” or “session key” (symmetric encryption)
15. Client and server will use this “shared secret” or “session key” to encrypt messages sent between the endpoints.

Tech/Tip: Using a cURL trace to show the flow with mutual authentication



- * successfully set certificate verify locations:
- * TLSv1.3 (OUT), TLS handshake, Client hello (01):
- * TLSv1.3 (IN), TLS handshake, Server hello (02):
- * TLSv1.2 (IN), TLS handshake, Certificate (11):
- * TLSv1.2 (IN), TLS handshake, Server key exchange (12):
- * **TLSv1.2 (IN), TLS handshake, Request CERT (13):**
- * TLSv1.2 (IN), TLS handshake, Server finished (14):
- * **TLSv1.2 (OUT), TLS handshake, Certificate (11):**
- * **TLSv1.2 (OUT), TLS handshake, Client key exchange (16):**
- * **TLSv1.2 (OUT), TLS handshake, CERT verify (15):**
- * TLSv1.2 (OUT), TLS change cipher, Change cipher spec (01):
- * TLSv1.2 (OUT), TLS handshake, Finished (20):
- * TLSv1.2 (IN), TLS handshake, Finished (20):
- * SSL connection using TLSv1.2 / ECDHE-RSA-AES256-GCM-SHA384
- * Server certificate:
- * subject: O=IBM; OU=LIBERTY; CN=wg31.washington.ibm.com
- * start date: Jan 4 04:00:00 2021 GMT
- * expire date: Jan 1 03:59:59 2023 GMT
- * common name: wg31.washington.ibm.com (matched)
- * issuer: OU=LIBERTY; CN=CA for Liberty
- * SSL certificate verify ok.

```
enum {
    hello_request(0),
    client_hello(1),
    server_hello(2),
    certificate(11),
    server_key_exchange (12),
    certificate_request(13),
    server_hello_done(14),
    certificate_verify(15),
    client_key_exchange(16),
    finished(20),
    (255) }
HandshakeType;
```

* TLS 1.2 <https://tools.ietf.org/html/rfc5246>
TLS 1.3 <https://tools.ietf.org/html/rfc8446>



Tech-Tip: CICS IPCONN and TCPIPSERVICE resources for HA

CICS Specific TCPIPSERVICE - IPIC

```
TCpipservice : IPIC1
GROup       : SYSPGRP
Urm          ==> DFHISAIP
POrtnumber   ==> 01492
SStatus      ==> Open
PROtocol     ==> IPic
TRansaction  ==> CISS
Host         ==> ANY
Ipaddress    ==> ANY
SPeciftcp    ==>
```

CICS Generic TCPIPSERVICE - IPICG

```
TCpipservice : IPICG1
GROup       : SYSPGRP
Urm          ==> DFHISAIP
POrtnumber   ==> 01491
SStatus      ==> Open
PROtocol     ==> IPic
TRansaction  ==> CISS
Host         ==> ANY
Ipaddress    ==> ANY
SPeciftcp    ==> IPIC
```

A client connects first to the CICS region's generic port (1491) and then the CICS region redirects the client to the region's specific port (1492).

I IPCONN ACQ

```
STATUS: RESULTS - OVERTYPE TO MODIFY
Ipc(BAQSVR1 ) App(BAQSVR1) Net(BAQSVR1) Ins Acq Nos
        Rece(001) Sen(000) Tcp(IPIC)
Ipc(BAQSVR1C) App(BAQSVR1C) Net(BAQSVR1C) Ins Acq Nos
        Rece(001) Sen(000) Tcp(IPIC)
Ipc(BAQSVR1M) App(BAQSVR1M) Net(BAQSVR1M) Ins Acq Nos
        Rece(001) Sen(000) Tcp(IPIC)
Ipc(BAQSVR2 ) App(BAQSVR2) Net(BAQSVR2) Ins Acq Nos
        Rece(001) Sen(000) Tcp(IPIC)
Ipc(BAQSVR2C) App(BAQSVR2C) Net(BAQSVR2C) Ins Acq Nos
        Rece(001) Sen(000) Tcp(IPIC)
Ipc(BAQSVR2M) App(BAQSVR2M) Net(BAQSVR2M) Ins Acq Nos
        Rece(001) Sen(000) Tcp(IPIC)
```

Number of
IPCONN resources
equals the number
of zCEE server
times the number of
unique connection
references

¹CICS requires the specific TCPIPSERVICE be installed before the corresponding generic TCPIPSERVICE resource. TCPIPServices are installed in alphabetically order, so the name of specific service must be alphabetically prior to the name of the generic TCPIPSERVICE.



Tech-Tip" CICS IPIC connection processing for high availability load balancing*

If the *reconnectInterval* attribute is set, at the specified time interval, a check is made to see if a new connection attempt should be attempted

A new connection is established if the current connection properties are not the preferred connection properties:

- If *reconnectInterval*, *preferredSpecificHost* and *preferredSpecificPort* are not set,
 - New connection attempts are disabled (this is the default behavior).
- If *reconnectInterval* is set and *preferredSpecificHost* and *preferredSpecificPort* are not set,
 - A new connection is attempted at the interval specified by the *reconnectInterval* time. Use this to enable regular connection rebalancing.
- If *reconnectInterval* and *preferredSpecificPort* are set and *preferredSpecificHost* is not set,
 - A new connection is attempted at the expiration time interval and if the current connected port in use does not match the preferred port
 - Relevant when shared port is for a single LPAR
 - Specific CICS region is preferred
- If *reconnectInterval* and *preferredSpecificHost* are set and *preferredSpecificPort* is not set
 - A new connection is attempted at the expiration time interval and if the current host in use does not match the preferred port
 - Relevant when shared port is across Sysplex
 - Any CICS region on a specific LPAR is preferred
- If *reconnectInterval*, *preferredSpecificHost* and *preferredSpecificPort* are all set
 - A new connection is attempted at the expiration time interval time and if both the current host and port in use do not match the preferred host and port
 - Relevant when shared port is on a single LPAR or across a Sysplex
 - Specific CICS region is preferred.

When the reconnection attempt results in a new connection to a CICS region, new requests are sent over the new connection. Previous connections will continue and when all requests have completed processing, the previous or old connection will be closed.



Tech-Tip: Executing the z/OS Connect *zconsetup* script using JCL

```
//JOHNSONS JOB (ACCOUNT),JOHNSON,NOTIFY=JOHNSON,REGION=0M,  
// CLASS=A,MSGCLASS=H,MSGLEVEL=(1,1)  
//*****  
//* Set symbols  
//*****  
//EXPORT EXPORT SYMLIST=(*)  
// SET JAVAHOME='/usr/lpp/java/J8.0_64'  
// SET ZCEEPATH='/usr/lpp/IBM/zosconnect/v3r0'  
//*****  
//* Step ZCSETUP - Invoke the zconsetup script  
//*****  
//ZCSETUP EXEC PGM=IKJEFT01,REGION=0M  
//SYSTSPRT DD SYSOUT=*  
//SYSERR DD SYSOUT=*  
//STDOUT DD SYSOUT=*  
//SYSTSIN DD *,SYMBOLS=EXECSYS  
BPXBATCH SH +  
  export JAVA_HOME=&JAVAHOME; +  
  &ZCEEPATH/bin/zconsetup install
```

Tech-Tip: Differences between z/OS Connect OpenAPI2 and OpenAPI3 server.xml files



```
default template - OpenAPI 2 server.xml configuration file
<?xml version="1.0" encoding="UTF-8"?>
<server description="new server">
    <!-- Enable features -->
    <featureManager>
        <feature>zosconnect:zosConnect-2.0</feature>
        <feature>zosconnect:zosConnectCommands-1.0</feature>
        <feature>apiDiscovery-1.0</feature> *
    </featureManager>

    <!-- To access this server from a remote client add a host attribute
    <httpEndpoint id="defaultHttpEndpoint"
        host="*"
        httpPort="9080"
        httpsPort="9443" />
    <!-- add cors to allow cross origin access, e.g. when using swagger UI
    to fetch swagger doc from zOS Connect Enterprise Edition -->
    <cors id="defaultCORSConfig"
    - - - - - 24 Line(s) not Displayed

    <!-- config requires updateTrigger="mbean" for REFRESH command support
-->
    <config updateTrigger="mbean" monitorInterval="500"/>

    <zosconnect_zosConnectManager setUTF8ResponseEncoding="true"/>

    <!-- zosConnect APIs -->
    <zosconnect_zosConnectAPIs updateTrigger="disabled" pollingRate="5s"
        <!-- zosConnect Services -->
    <zosconnect_services updateTrigger="disabled" pollingRate="5s"/>

    <!-- applicationMonitor is not applicable for z/OS Connect EE servers --
->
    <applicationMonitor updateTrigger="disabled" dropinsEnabled="false"/>

</server>
```

* Include these features if not already present.

```
openApi3 template - OpenAPI 3 server.xml configuration file
<?xml version="1.0" encoding="UTF-8"?>
<server description="new server">
    <!-- Enable features -->
    <featureManager>
        <feature>zosconnect:zosConnect-3.0</feature>
        <feature>openapi-3.0</feature>
    </featureManager>

    <!-- To access this server from a remote client add a host attribute
    <httpEndpoint id="defaultHttpEndpoint"
        host="*"
        httpPort="9080"
        httpsPort="9443" />
    - - - - - 12 Line(s) not Displayed
    <!-- config requires updateTrigger="mbean" for REFRESH command support
    config updateTrigger="mbean"/>

    <!-- applicationMonitor requires updateTrigger="mbean" for REFRESH command
    support -->
    <applicationMonitor updateTrigger="mbean" dropinsEnabled="false"/>

    <!-- Automatic expansion of WAR files is required for z/OS Connect native
    servers running the zosConnect-3.0 feature -->
    <applicationManager autoExpand="true" />

    <!-- APIs are deployed as WAR files and a webApplication element must be
    used to specify the location of the API WAR and optionally the name of the API
    -->
    <webApplication id="My API" location="${server.config.dir}/apps/api.war"
        name="MyAPI"/>

</server>
```

Note there are no *zosconnect* or *cors* configuration elements present with Open API 3.

Tech-TIP: Contrast a Liberty JCL procedure versus a z/OS Connect JCL procedure

```
//ZCEESRVR PROC PARMs='serverName'
//*
// SET ZCONHOME='/usr/lpp/IBM/zosconnect/v3r0'
// SET INSTDIR='/usr/lpp/liberty_zos/21.0.0.9'
//*
//ZCON      EXEC PGM=BPXBATSL,REGION=0M,MEMLIMIT=8G,
//  PARM='PGM &ZCONHOME./bin/zosconnect run &PARMS. --clean'
//  PARM='PGM &INSTDIR./lib/native/zos/s390x/bbgzsrv &PARMS'
//STDOUT    DD   SYSOUT=*
//STDERR    DD   SYSOUT=*
//STDIN     DD   DUMMY
//MSGLOG    DD   SYSOUT=*
//STDENV    DD   *
_BPX_SHAREAS=YES
_CEE_RUNOPTS=HEAPPOOLS (ON) ,HEAPPOOLS64 (ON)
JAVA_HOME=/usr/lpp/java/J8.0_64
WLP_USER_DIR=/var/zosconnect
JVM_OPTIONS=-Dcom.ibm.ws.zos.core.angelName=zCEEAngel -Xmx512m
OPENJ9_JAVA_OPTIONS=-Xoptionsfile=/var/zcee/properties/myServer.property
```

OMVS
LE
JAVA
LIBERTY
z/OS Connect

Tech-Tip: Executing Gradle build commands in JCL



```
//JOHNSONS JOB (ACCOUNT),JOHNSON,NOTIFY=&SYSUID,REGION=0M,  
// CLASS=A,MSGCLASS=H,MSGLEVEL=(1,1)  
//*****  
//* SET SYMBOLS  
//*****  
//EXPORT EXPORT SYMLIST=(*)  
// SET JAVAHOME='/usr/lpp/java/J8.0_64'  
// SET GRADLSRC='/u/johnson/gradle'  
// SET GRADLE='/usr/lpp/gradle/gradle-7.6.1'  
//*****  
//* Step GRADLE - Invoke the gradle build command  
//*****  
//CSCVINC EXEC PGM=IKJEFT01,REGION=0M  
//SYSTSPRT DD SYSOUT=*  
//SYSERR DD SYSOUT=*  
//STDOUT DD SYSOUT=*  
//SYSTSIN DD *,SYMBOLS=EXECSYS  
BPXBATCH SH +  
export JAVA_HOME=&JAVAHOME; +  
cd &GRADLSRC./cscvinc; +  
&GRADLE./bin/gradle build -i
```

settings.gradle

```
pluginManagement {  
    repositories {  
        maven {  
            url '/u/johnson/gradle/gradleLibs'  
        }  
    }  
}
```

build.gradle

```
plugins {  
    id 'com.ibm.zosconnect.requester' version '1.1.7'  
}
```

This assumes the z/OS Connect provided *dependencies.zip* files was expanded into directory */u/johnson/gradle/gradleLibs* using command *jar -tf dependencies.zip* and that the gradle files *settings.gradle* and *build.gradle* are encoded in ASCII in directory */u/johnson/gradle/cscvinc*

Tech-Tip: - Executing the z/OS Connect Build Toolkit in JCL



```
//JOHNSONS JOB (ACCOUNT),JOHNSON,NOTIFY=&SYSUID,REGION=0M,  
// CLASS=A,MSGCLASS=H,MSGLEVEL=(1,1)  
//*****  
///* SET SYMBOLS  
//*****  
//EXPORT EXPORT SYMLIST=(*)  
// SET WORKDIR='/u/johnson/zconbt'  
// SET ZCONDIR='/usr/lpp/IBM/zosconnect/v3r0/zconbt/bin'  
//ZCONBT EXEC PGM=IKJEFT01,REGION=0M,MEMLIMIT=4G  
//SYSTSPRT DD SYSOUT=*  
//SYSERR DD SYSOUT=*  
//STDOUT DD SYSOUT=*  
//SYSTSIN DD *,SYMBOLS=EXECSYS  
BPXBATCH SH +  
  export WORKDIR=&WORKDIR; +  
  export ZCONDIR=&ZCONDIR; +  
  cd $WORKDIR; +  
  $ZCONDIR/zconbt.zos -p cscvinc.properties -f=cscvinc.ara; +  
  cp -v $WORKDIR/syslib/* //'JOHNSON.ZCONBT.COPYLIB'"
```

cscvinc.properties

```
apiDescriptionFile=./cscvinc.json  
dataStructuresLocation=./syslib  
apiInfoFileLocation=./syslib  
logFileDirectory./logs  
language=COBOL  
connectionRef=cscvincAPI  
requesterPrefix=csc
```

This assumes the zconbt.zip files was expanded into directory /usr/lpp/IBM/zosconnect/v3r0/zconbt using command *jar -tf zconbt.zip* and that the property file and Swagger JSON document are encoded in ASCII in directory /u/johnson/zconbt.

Tech-Tip: Executing multiple OMVS commands in one step



```
*****  
/* SET SYMBOLS  
*****  
//EXPORT EXPORT SYMLIST=(*)  
// SET CURL= '/usr/lpp/rocket/curl'  
*****  
/* CURL Procedure  
*****  
//CURL PROC  
//CURL EXEC PGM=IKJEFT01,REGION=0M  
//SYSTSPRT DD SYSOUT=*  
//SYSERR DD SYSOUT=*  
//STDOUT DD SYSOUT=*  
// PEND  
*****  
/* STEP CURL - use curl to deploy API cscvinc  
*****  
//DEPLOY EXEC CURL  
BPXBATCH SH export CURL=&CURL; +  
$CURL/bin/curl -X PUT -s +  
--cacert /u/johnson/CERTAUTH.PEM --user FRED:FRED +  
https://wg31.washington.ibm.com:9445/zosConnect/apis/cscvinc?status=stop+  
pped > null; +  
$CURL/bin/curl -X DELETE -s +  
--cacert /u/johnson/CERTAUTH.PEM --user FRED:FRED +  
https://wg31.washington.ibm.com:9445/zosConnect/apis/cscvinc > null; +  
$CURL/bin/curl -X POST -s +  
--cacert /u/johnson/CERTAUTH.PEM --user FRED:FRED +  
--data-binary @/u/johnson/cscvinc.aar +  
--header "Content-Type: application/zip" +  
https://wg31.washington.ibm.com:9445/zosConnect/apis  
*****  
/* STEP CURL - use curl to invoke the API cscvinc  
*****  
//INVOKE EXEC CURL  
//SYSTSIN DD *,SYMBOLS=EXECSYS  
BPXBATCH SH export CURL=&CURL; $CURL/bin/curl -X GET -s +  
--cacert /u/johnson/CERTAUTH.PEM --user FRED:FRED +  
https://wg31.washington.ibm.com:9445/cscvinc/employee/000100
```

Always be aware of the beginning and trailing spaces.

[https://www.rocketsoftware.com/
platforms/ibm-z/curl-for-zos](https://www.rocketsoftware.com/platforms/ibm-z/curl-for-zos)



Tech-Tip: Copy WOLA executables from OMVS to a PDSE

```
//JOHNSONS JOB (ACCOUNT),JOHNSON,NOTIFY=JOHNSON,REGION=0M,  
// CLASS=A,MSGCLASS=H,MSGLEVEL=(1,1)  
//*****  
///* SET SYMBOLS  
//*****  
//EXPORT EXPORT SYMLIST=(*)  
// SET DSNAME='USER1.WOLA2106.LOADLIB'  
// SET ZCEEPATH='/usr/lpp/IBM/zosconnect/v3r0'  
// SET JAVAHOME='/usr/lpp/java/J8.0_64'  
//*****  
///* Step ALLOC - Allocate a PDSE load library  
//*****  
//ALLOC EXEC PGM=IDCAMS  
//SYSPRINT DD SYSOUT=*  
//SYSIN DD *,SYMBOLS=EXECSYS  
DELETE '&DSNAME'  
SET MAXCC=0  
ALLOC DSNAME('&DSNAME') -  
    NEW CATALOG SPACE(2,1) DSORG(PO) CYLINDERS -  
    RECFM(U) DSNTYPE(LIBRARY)  
//*****  
///* Step WOLACOPY - copy the WOLA executables to the PDSE  
//*****  
//WOLACOPY EXEC PGM=IKJEFT01,REGION=0M  
//SYSTSPRT DD SYSOUT=*  
//SYSERR DD SYSOUT=*  
//STDOUT DD SYSOUT=*  
//SYSTSIN DD *,SYMBOLS=EXECSYS  
BPXBATCH SH +  
    export JAVA_HOME=&JAVAHOME; +  
    export DSNAME=&DSNAME; +  
    cp -Xv &ZCEEPATH/wlp/clients/zos/* "/* '$DSNAME'"
```

Tech-Tip: BBOSMFV (Extract Liberty SMF 120 Subtype 11 records)

```
//JOHNSONS JOB (ACCOUNT),JOHNSON,NOTIFY=JOHNSON,REGION=0M,
// CLASS=A,MSGCLASS=H,MSGLEVEL=(1, 1)
//EXPORT EXPORT SYMLIST=(*)
// SET REPORT='LibertyExport'
//JAVA EXEC PROC=JVMPRC86,
// JAVAACL= 'com.ibm.ws390.sm.smfview.JclSmf'
//STDENV DD DISP=SHR,DSN=JOHNSON.JCLLIB.CNTL(STDENV)
//SMFDATA DD DISP=SHR,DSN=MPZ3.DUMPSPMF
//SMFENV DD *,SYMBOLS=EXEC SYS
# Specify the plugin to use
plugin=&REPORT
# Specify where the output goes
output=/u/johnson/&REPORT..csv
# Uncomment (and change the value as appropriate) to filter
#matchServer=BAQSTRT
```

JOHNSON.JCLLIB.CNTL(STDENV)

```
. /etc/profile
export JAVA_HOME=/usr/lpp/java/J8.0_64
export PATH=/bin:"${JAVA_HOME}"/bin
LIBPATH=/lib:/usr/lib:"${JAVA_HOME}"/bin
LIBPATH="$LIBPATH":"${JAVA_HOME}"/lib/s390x
LIBPATH="$LIBPATH":"${JAVA_HOME}"/lib/s390x/j9vm
LIBPATH="$LIBPATH":"${JAVA_HOME}"/bin/classic
export LIBPATH="$LIBPATH":

# Customize your CLASSPATH here
APP_HOME=$JAVA_HOME
CLASSPATH=$APP_HOME:"${JAVA_HOME}"/lib:"${JAVA_HOME}"/lib/ext
CLASSPATH=/u/johnson/lib/bbosmfv.jar:$CLASSPATH
CLASSPATH=/u/johnson/lib/WP102312_Plugins.jar:$CLASSPATH

# Add Application required jars to end of CLASSPATH
for i in "${APP_HOME}"/*.jar; do
    CLASSPATH="$CLASSPATH":$i"
done
export CLASSPATH="$CLASSPATH":

# Configure JVM options
IJO="-Xms16m -Xmx128m"
export IBM_JAVA_OPTIONS="$IJO "
```

Tech-Tip: Using ADRDSSU to dump/restore MVS data sets

ZCEEDUMP

```
//EXPORT EXEC SYMLIST=(*)
// SET ZCEELVL=349
//DELETE EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=*
//SYSIN    DD *,SYMBOLS=EXECSYS
      DELETE IBM.ZCEE30.BKUP&ZCEELVL.
      SET MAXCC=0
//DUMP      EXEC PGM=ADRDSSU,REGION=2048K
//SYSPRINT DD SYSOUT=*
//DUMPDD DD DSN=IBM.ZCEE30.BKUP&ZCEELVL.,
//          DISP=(NEW,CATLG),
//          UNIT=SYSDA,SPACE=(CYL,(3000,2000,0),RLSE)
//SYSIN    DD *,SYMBOLS=EXECSYS
      DUMP DATASET(INCLUDE(
      ZCEE30.SBAQ* -
      ZCEE30.WOLA*.** -
      OMVS.ZCEE*.** -
      )) OPTIMIZE(4) OUTDDNAME(DUMPDD) TOLERATE(ENQF)
```

ZCEERSTR

```
//RESTORE EXEC PGM=ADRDSSU,REGION=2048K
//SYSPRINT DD SYSOUT=*
//DUMPDD DD DISP=SHR,DSN=JOHNSON.ZCEE30.BKUP349
//SYSIN    DD *
      RESTORE DATASET(INCLUDE(**)) -
      INDDNAME(DUMPDD) OUTDYNAM(WAS004) -
      NULLSTORCLAS -
      REPLACE CATALOG TOLERATE(ENQF)
```

Tech-Tip: Define and format a ZFS data set using IOEAGFMT

ZFS

```
//DEFINE EXEC PGM=IDCAMS
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
//AMSDUMP DD SYSOUT=*
//SYSIN    DD *
      SET MAXCC=0
      DEFINE CLUSTER (NAME(OMVS.ZCEE.GROUP1.ZFS) -
                      LINEAR CYLINDERS(100 100) SHAREOPTIONS(3))
//CREATE EXEC PGM=IOEAGFMT,REGION=0M,
//  PARM=( '-aggregate OMVS.ZCEE.GROUP1.ZFS -compat' )
//SYSPRINT DD SYSOUT=*
//STDOUT   DD SYSOUT=*
//STDERR   DD SYSOUT=*
//SYSUDUMP DD SYSOUT=*
//CEEDUMP  DD SYSOUT=*
```

Tech-Tip: Generate WLM Workload Activity Reports

```
//JOHNSONS JOB (ACCOUNT),NOTIFY=&SYSUID,REGION=0M,  
// CLASS=A,MSGCLASS=H,MSGLEVEL=(1,1)  
//DELETE EXEC PGM=IDCAMS  
//SYSPRINT DD SYSOUT=*  
//SYSIN DD *  
    DELETE JOHNSON.DUMPSMF.SORT  
//RMFSORT EXEC PGM=SORT,REGION=0M  
//SORTIN DD DISP=SHR,DSN=MPZ3.DUMPSMF  
//SORTOUT DD DISP=(,CATLG),DSN=JOHNSON.DUMPSMF.SORT,  
//           SPACE=(CYL,(100,50),RLSE),UNIT=SYSDA  
//SORTWK01 DD DISP=(NEW,DELETE),UNIT=SYSDA,SPACE=(CYL,(100))  
//SORTWK02 DD DISP=(NEW,DELETE),UNIT=SYSDA,SPACE=(CYL,(100))  
//SORTWK03 DD DISP=(NEW,DELETE),UNIT=SYSDA,SPACE=(CYL,(100))  
//SORTWK04 DD DISP=(NEW,DELETE),UNIT=SYSDA,SPACE=(CYL,(100))  
//SORTWK05 DD DISP=(NEW,DELETE),UNIT=SYSDA,SPACE=(CYL,(100))  
//SORTWK06 DD DISP=(NEW,DELETE),UNIT=SYSDA,SPACE=(CYL,(100))  
//SORTWK07 DD DISP=(NEW,DELETE),UNIT=SYSDA,SPACE=(CYL,(100))  
//SYSPRINT DD SYSOUT=(,)  
//SYSOUT DD SYSOUT=(,)  
//SYSIN DD *  
    SORT FIELDS=(11,4,CH,A,7,4,CH,A),EQUALS  
    MODS E15=(ERBPPE15,36000,,N),E35=(ERBPPE35,3000,,N)  
//RMFPP EXEC PGM=ERBRMFPP,REGION=0M  
//SYSUDUMP DD SYSOUT=*  
//STEPLIB DD DSN=SYS1.COMBINED.LINKLIB,DISP=SHR  
//MFPIINPUT DD DISP=SHR,DSN=JOHNSON.DUMPSMF.SORT  
//MFPMMSGDS DD SYSOUT=*  
//SYSIN DD *  
    SYSOUT(O)  
    SYSRPTS(WLMGL(RCPER)) /*WORKLOAD ACTIVITY REPORT */
```