

zCEEADM – IBM z/OS Connect Administration

A dive into Liberty and z/OS Connect
Administration

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Disclaimer

- The information in this presentation was derived from various product Knowledge Centers (KC).
- Additional information included in this presentation was distilled from years of 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 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  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 and are not necessarily sanctioned by Liberty or z/OS Connect development.



Agenda

- OMVS, Liberty, z/OS Connect and RACF security configuration
- Connecting z/OS Connect servers to other z/OS subsystems
- Useful Liberty features and MVS commands
- Where do I look when things go wrong?
- Managing and Monitoring Liberty and z/OS Connect
- Miscellaneous Odds and Ends
- Additional Material - sample administrative JCL

**Let's start by reviewing some of the basic
Liberty and z/OS Connect
OMVS, Liberty and RACF
security/configuration details and options**



Important, verify the Java and OMVS environments are ready*

- Prevent out-of-memory or other storage issues:
 - Verify the Java runtime is not being limited by system parameters, e.g., *MAXASSIZE* (2 147 483 647), *MAXTHREADS*, etc., for details see *BPXPRM setting* at URL https://www.ibm.com/docs/en/sdk-java-technology/8?topic=SSYKE2_8.0.0/com.ibm.java.vm.80.doc/docs/j9_configure_zos_bpxprm.html
 - Check the value of *ASSIZEMAX* in the OMVS segments of the identities involved and ensure it is adequate, see *MAXASSIZE* above.
 - Exclude OMVS from any IEFUSI exit, SUBSYS(OMVS,NOEXITS) in PARMLIB member *SMFRPMxx*.
 - Verify the JCL *MEMLIMIT* parameter is within reason for your system.
- Start an OMVS shell session and verify that Java is fully operational by entering command *java -version*, you see should results like this:

```
java version "1.8.0_301"
Java(TM) SE Runtime Environment (build 8.0.6.35 - pmz6480sr6fp35-20210714_01(SR6 FP35))
IBM J9 VM (build 2.9, JRE 1.8.0 z/OS s390x-64-Bit Compressed References 20210622_7763 (JIT enabled, AOT
enabled)
OpenJ9   - b1f3adb
OMR      - c2f4a18
IBM      - c24a144)
JCL     - 20210625_01 based on Oracle jdk8u301-b09
```

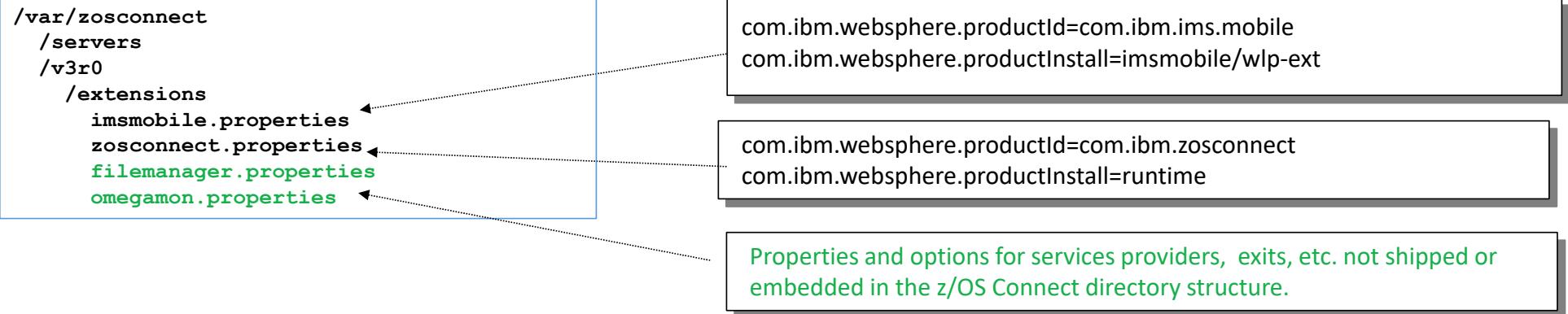
- Verify that RACF identities associated with started tasks have OMVS segments with UIDs and GIDs and valid HOME directories and that the identities can invoke Java commands.
- Verify the *zconsetup* script has been executed. My recommendation is to execute this script in the SMP/E target environment, otherwise it will be lost when service is applied and propagated to other images.



The purpose for invoking the zconsetup command

The `zconsetup` script creates a symbolic link from the WLP `..v3r0/wlp/etc` directory (normally R/O) to a local R/W directory (creating a default configuration and local extension directories).

```
JOHNSON:/usr/lpp/IBM/zosconnect/v3r0/wlp/etc: ls -al
total 32
drwxrwxr-x  2 OMVSKERN 0          8192 Jun 24 10:24 .
drwxrwxr-x 10 OMVSKERN 0          8192 Jun 24 10:24 ..
lrwxrwxrwx  1 990023 0          31 Jul 27 2020 extensions -> /var/zosconnect/v3r0/extensions
```



- This directory structure and contents is created by invoking the `zconsetup` script and **must be created on each LPAR** on which z/OS Connect will execute. This is how the z/OS Connect Liberty server locates service provider executables. Note: the `com.ibm.websphere.productInstall` directive value that is relative to directory `/usr/lpp/IBM/zosconnect/v3r0`.
- Not creating this link will cause messages `CWWKF0001E: A feature definition could not be found for zosconnect:....` or `CWWKE0054E: Unable to open /usr/lpp/IBM/zosconnect/v3r0/wlp/etc/extensions/zosconnect.properties`



Using the `zosconnect` command to create a z/OS Connect Liberty Server

To create a server, use the `zosconnect` command:

```
zosconnect create serverName --template=templateName
```

Where *templateName* can be:

- `zosconnect:apiRequester` for an API requester enabled z/OS Connect server
- `zosconnect:default` template for base z/OS Connect servers

- `zosconnect:sampleCicsIpicCatalogManager` for a sample CICS enabled z/OS Connect server
- `zosconnect:sampleDb2Project` for a sample Db2 enabled z/OS Connect server
- `zosconnect:sampleDatabase` for a sample IMS database enabled z/OS Connect server
- `zosconnect:samplePhonebook` for a sample IMS transaction enabled z/OS Connect server
- `zosconnect:sampleMQStockManager` for a sample MQ enabled z/OS Connect server
- `zosconnect:sampleWolaCatalogManager` for a sample WOLA enabled z/OS Connect server

`zosconnect create zceesrvr --template=zosconnect:apiRequester`

- Where *serverName* is any value you wish, such as `zceesrvr` or `zCEEServer`, and this value will be the name of the server instance. The templates can be found in directory `/usr/lpp/IBM/zosconnect/v3r0/runtime/templates/servers`.
- Environment variable `WLP_USER_DIR` will be used to set the location of the configuration directory and files created by this command, default location is `/var/zosconnect/servers` where `/var/zosconnect` is default value for `WLP_USER_DIR`.

Issues with permission bits and ownership and group access for directories and files is a common problem.

Tec-Tip: OMVS security - A quick review of Unix permissions bits

| Owner | Group | Other | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|--|----------|----------|----------|---------|---|----------|----------|----------|--------------|-----|-----|-----|--|---|---|---|--|---|---|---|---|---|---|--|-----|------|-------|---------|--|----------|----------|----------|--------------|-----|-----|-----|--|---|---|---|--|---|---|---|---|---|---|--|-----|------|-------|---------|--|----------|----------|----------|--------------|-----|-----|-----|--|---|---|---|--|---|---|---|---|---|---|
| <table border="1"> <thead> <tr> <th>Bit</th> <th>Read</th> <th>Write</th> <th>Execute</th> </tr> </thead> <tbody> <tr> <td></td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>Base-2 Value</td> <td>[4]</td> <td>[2]</td> <td>[1]</td> </tr> <tr> <td></td> <td>↓</td> <td>↓</td> <td>↓</td> </tr> <tr> <td></td> <td>4</td> <td>+</td> <td>2</td> <td>+</td> <td>1</td> <td>=</td> </tr> </tbody> </table> <p>7 The owner has READ, WRITE and EXECUTE</p>  <p>The owner of the file or directory</p> <pre>chmod -R * u+rwx zceesrv1</pre> | Bit | Read | Write | Execute | | 1 | 1 | 1 | Base-2 Value | [4] | [2] | [1] | | ↓ | ↓ | ↓ | | 4 | + | 2 | + | 1 | = | <table border="1"> <thead> <tr> <th>Bit</th> <th>Read</th> <th>Write</th> <th>Execute</th> </tr> </thead> <tbody> <tr> <td></td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>Base-2 Value</td> <td>[4]</td> <td>[2]</td> <td>[1]</td> </tr> <tr> <td></td> <td>↓</td> <td>↓</td> <td>↓</td> </tr> <tr> <td></td> <td>4</td> <td>+</td> <td>0</td> <td>+</td> <td>1</td> <td>=</td> </tr> </tbody> </table> <p>5 The group has READ and EXECUTE, but not WRITE</p>  <p>IDs that are part of the group for the file or directory</p> <pre>chmod g+rwx server.xml</pre> | Bit | Read | Write | Execute | | 1 | 0 | 1 | Base-2 Value | [4] | [2] | [1] | | ↓ | ↓ | ↓ | | 4 | + | 0 | + | 1 | = | <table border="1"> <thead> <tr> <th>Bit</th> <th>Read</th> <th>Write</th> <th>Execute</th> </tr> </thead> <tbody> <tr> <td></td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>Base-2 Value</td> <td>[4]</td> <td>[2]</td> <td>[1]</td> </tr> <tr> <td></td> <td>↓</td> <td>↓</td> <td>↓</td> </tr> <tr> <td></td> <td>0</td> <td>+</td> <td>0</td> <td>+</td> <td>0</td> <td>=</td> </tr> </tbody> </table> <p>0 Others have nothing</p>  <p>IDs that are not the owner and not part of the group; that is, other</p> <pre>chmod -R * o+rx resources chmod -R * o-w resources/security</pre> | Bit | Read | Write | Execute | | 0 | 0 | 0 | Base-2 Value | [4] | [2] | [1] | | ↓ | ↓ | ↓ | | 0 | + | 0 | + | 0 | = |
| Bit | Read | Write | Execute | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Base-2 Value | [4] | [2] | [1] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ↓ | ↓ | ↓ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | + | 2 | + | 1 | = | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bit | Read | Write | Execute | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 1 | 0 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Base-2 Value | [4] | [2] | [1] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ↓ | ↓ | ↓ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 4 | + | 0 | + | 1 | = | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bit | Read | Write | Execute | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0 | 0 | 0 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Base-2 Value | [4] | [2] | [1] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | ↓ | ↓ | ↓ | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 0 | + | 0 | + | 0 | = | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

-R* indicates recursion



The default server configuration directories and files



ID=**LIBSERV**
Group=**LIBGRP**

```
export JAVA_HOME=<path_to_64_bit_Java>
export WLP_USER_DIR=/var/zosconnect
./zosconnect create zceesrvr
--template= zosconnect:apiRequester
```

```
/var/zosconnect          750 LIBSERV LIBGRP
  /servers               750 LIBSERV LIBGRP
    /zceesrvr            750 LIBSERV LIBGRP
      /logs                777 LIBSERV LIBGRP
        messages.log       666 LIBSERV LIBGRP
      /resources            750 LIBSERV LIBGRP
        /zosconnect         750 LIBSERV LIBGRP
          /apis              750 LIBSERV LIBGRP
            /apiRequesters   750 LIBSERV LIBGRP*
          /rules              750 LIBSERV LIBGRP
          /services           750 LIBSERV LIBGRP
        /security             777 LIBSERV LIBGRP
        server.xml            640 LIBSERV LIBGRP
        server.env            640 LIBSERV LIBGRP
      /workarea             750 LIBSERV LIBGRP*
```

The create command will create the directories and files under the <WLP_USER_DIR> and assign ownership based on the ID and Group that created the server

There are a few potential issues with this in a production setting:

- If you have multiple people with a need to change configuration files, do you share the password of LIBSERV?
(answer: **no**)
Sharing passwords is a bad practice. Better to take advantage SAF SURROGAT so permitted users can switch to the owning ID so they can make changes. In fact, LIBSERV should be a PROTECTED identity with no password in the first place.
- If you have multiple people with a need to read or update configuration files, do you simply connect them to LIBGRP?
(answer: **no**)
The owner group may be granted access to other resources (on z/OS SAF profiles notably: SERVER) and you do not want others inheriting that. Better to make the configuration group be something different from the owner group and grant READ/WRITE through that group.

* Only created when using the apiRequester template.

One suggestion for settings of the server configuration permission bits



ID=**LIBSERV**
Group=**LIBGRP**

```
export JAVA_HOME=<path_to_64_bit_Java>
export WLP_USER_DIR=/var/zosconnect
./server create zceesrvr
```

| | | |
|-----------------|-----|----------------|
| /var/zosconnect | 751 | LIBSERV LIBGRP |
| /servers | 751 | LIBSERV LIBGRP |
| /zceesrv1 | 751 | LIBSERV LIBGRP |
| /logs | 771 | LIBSERV LIBGRP |
| messages.log | 644 | LIBSERV LIBGRP |
| /resources | 751 | LIBSERV ADMGRP |
| /security | 777 | LIBSERV LIBGRP |
| /zosconnect | 751 | LIBSERV ADMGRP |
| /apis | 761 | LIBSERV ADMGRP |
| /apiRequesters | 761 | LIBSERV ADMGRP |
| /rules | 761 | LIBSERV ADMGRP |
| /services | 761 | LIBSERV ADMGRP |
| /server.xml | 460 | LIBSERV ADMGRP |
| /server.env | 460 | LIBSERV ADMGRP |
| /workarea | 750 | LIBSERV LIBGRP |

```
export WLP_USER_DIR=/var/zosconnect
cd $WLP_USER_DIR
chmod o+x $WLP_USER_DIR/servers
chmod o+x $WLP_USER_DIR/servers/zceesrvr/resources
chmod -R o+x $WLP_USER_DIR/servers/zceesrvr/resources/*
```

~~Often you may be tempted to use command chmod R 777 *~~

Warning: Access for Owner, Group, Others depend on user ID (UID) and group ID (GID) as stored with the directory or file, not the actual SAF identity or group. This has implications when moving entire filesystems from one LPAR to another using utilities like ADRDSSU.

CWWKB0121I: The server process UMASK value is set to 0000

- sets permission bit for new files deployed using the RESTful administration interface to rw-rw-rw (666 x'OR 000)

Tech/Tip: Use SAF SURROGAT resources for administration

RACF Surrogate access allows a designated administrative identity the ability to invoke commands and perform functions as if they were running under the identity that will be used for the z/OS Connect server started task. This may be useful because identities associated with started task are normally restricted and cannot be used for accessing TSO or OMVS shells,

Use the following examples as guides and create the surrogate resources and permit access. In these examples, ***LIBSERV*** represents the RACF identity under which the z/OS Connect server will be running and ***adminUser*** represent the administrative RACF identity.

Define a SURROGAT profile for the server's SAF identity

RDEFINE SURROGAT BPX.SRV.*LIBSERV*

Define a SURROGAT submit profile to allow job submission as the server's SAF identity

RDEFINE SURROGAT *LIBSERV*.SUBMIT

Permit an administrative identity to act as a surrogate of the Liberty task identity

PERMIT BPX.SRV.*LIBSERV* CLASS(SURROGAT) ID(*adminGrp*) ACC(READ)

PERMIT *LIBSERV*.SUBMIT CLASS(SURROGAT) ID(*adminGrp*) ACC(READ)

Refresh the SURROGAT in storage profiles

SETROPTS RACLIST(SURROGAT) REFRESH

Now any identity in group *adminGrp* can submit JCL with the *USER=LIBSERV* parameter on the job card or use the OMVS switch user command (*su -s LIBSERV*) to execute OMVS scripts or commands as LIBSERV.



Tech/Tip: z/OS : Also use SAF UNIXPRIV/FACILITY resources

An alternative to using a surrogate access is to permit the identity under which the customization will be done to enhanced Unix privileges. Specially, permitting the identity to Unix privileges SUPERUSER.FILESYS, SUPERUSER.FILESYS.CHANGEPERMS and SUPERUSER.FILESYS.CHOWN.

- *Permit an administrative identity to write to any local directory or file*
PERMIT SUPERUSER.FILESYS CLASS(UNIXPRIV)
 ID(adminUser) ACC(CONTROL)
- *Permit an administrative identity to change permission bit of any local directory or file*
PERMIT SUPERUSER.FILESYS.CHANGEPERMS CLASS(UNIXPRIV)
 ID(adminUser) ACC(READ)
- *Permit an administrative identity to change the ownership of any directory or file*
PERMIT SUPERUSER.FILESYS.CHOWN CLASS(UNIXPRIV)
 ID(adminUser) ACC(READ)
- *Permit an administrative identity switch to root (su -s root) or the Enable superuser mode(SU) Setup option in ISHELL*
PERMIT BPX.SUPERUSER CLASS(FACILITY) ID(adminUser) ACC(READ)
- *Refresh the UNIXPRIV and/or FACILITY instorage profiles*
SETROPTS RACLIST(UNIXPRIV,FACILITY) REFRESH

https://www.ibm.com/support/knowledgecenter/en/SSLTBW_2.4.0/com.ibm.zos.v2r4.bpxb200/usspriv.htm

Use the power these commands provide carefully and only when necessary

Tech/Tip: z/OS : JCL examples of using SURROGAT/UNIXPRIV access



```
//ZCEESRVR JOB 'ZCEE',CLASS=A,REGION=0M,NOTIFY=&SYSUID,USER=LIBSERV
//*****
//** SET SYMBOLS
//*****
//EXPORT EXPORT SYMLIST=(*)
// SET JAVAHOME='"/usr/lpp/java/J8.0_64'
// SET ZCEEPATH='"/usr/lpp/IBM/zosconnect/v3r0'
// SET SERVER='zceesrvr'
// SET TEMPLATE='zosconnect:apiRequester'
// SET WLPUSER='"/var/zosconnect'
//*****
//** Step ZCEESRVR - Use the zosconnect command to create a server
//*****
//ZCEESRVR 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 WLP_USER_DIR=&WLPUSER; +
&ZCEEPATH/bin/zosconnect create &SERVER +
--template=&TEMPLATE
```

Using the SURROGAT RACF resources means there is no need to have access to LIBSERV's password, in fact LIBSERV may be protected and not even have a password. Any files or directories created will be owned by LIBSERV.

```
//ZCEESRVR JOB 'ZCEE',CLASS=A,REGION=0M,NOTIFY=&SYSUID
//*****
//** SET SYMBOLS
//*****
//EXPORT EXPORT SYMLIST=(*)
// SET JAVAHOME='"/usr/lpp/java/J8.0_64'
// SET ZCEEPATH='"/usr/lpp/IBM/zosconnect/v3r0'
// SET SERVER='zceesrvr'
// SET TEMPLATE='zosconnect:apiRequester'
// SET WLPUSER='"/var/zosconnect'
// SET USER='LIBSERV'
// SET GROUP='LIBGRP'
//*****
//** Step ZCEESRVR - Use the zosconnect command to create a server
//*****
//ZCEESRVR 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 WLP_USER_DIR=&WLPUSER; +
&ZCEEPATH/bin/zosconnect create &SERVER +
--template=&TEMPLATE
//SYSTSIN DD *,SYMBOLS=EXECSYS
BPXBATCH SH +
export WLP_USER_DIR=&WLPUSER; +
export JAVA_HOME=&JAVAHOME; +
export WLP_USER_DIR=&WLPUSER; +
&ZCEEPATH/bin/zosconnect create &SERVER +
--template=&TEMPLATE; +
chown -R &USER:&GROUP $WLP_USER_DIR/servers/&SERVER
```

Alternatively, use the change ownership command, *chown*, to change the user and group attributes of the user associated with the STARTED task. This requires UNIXPRIV RACF access.

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



```
WG31# - 3270
File Edit Settings View Communication Actions Window Help
File Directory Special_file Tools File_systems Options Setup Help
UNIX System Services ISPF Shell
Enter a pathname and do one of these:
- Press Enter.
- Select an action bar choice.
- Specify an action code or command on the command line.
Return to this panel to work with a different pathname.
More: +
```

```
/var/zcee
EUID=200042
```

```
WG31# - 3270
File Edit Settings View Communication Actions Window Help
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.

$ id
uid=5504(USER3) gid=2(SYS1)
$ su - libserv
$ id
uid=200042(LIBSERV) gid=200034(LIBGRP) groups=200033(GMINVOKE),200036(ZCEEUSRS)
$
```

```
Command ==> su libserv
MA B
Connected to remote server/host wg31a using lu/pool TCP00117 and port 23
```

```
====> _          RUNNING
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
```

Tech-Tip: Super user privilege (su) 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.

Also super user privilege access is required to use the ps –ef command



A Tour of a server's directories and files

```
/var/zosconnect/v3r0<
  /extensions  (see previous slide)
${WLP_USER_DIR}
  /servers
    /serverName<
      ims-admin-services.xml
      /logs
      /resources
        /imsmobile-config
        /security
        /zosconnect
      server.xml
      /workarea#
      /tranlog #
```

- The extensions subdirectory will always be in /var/zosconnect/v3r0

- Each server (serverName) will have a unique subdirectory in the location specified by WLP_USER_DIR, which **defaults** to /var/zosconnect.
- Important, use the same value for starting a server that was used when the server was created.

- The location of the *serverName* directory is based on the concatenation of the value of the *WLP_USER_DIR* environment variable with the constant *servers* and does not have to be in directory /var/zosconnect.
- The *serverName* directory structure and its initial contents are created by by invoking the *zosconnect create serverName* script.
- *serverName* can be a mount point with a dedicated file system mounted at this mount point (see above). This can be used to isolate servers to dedicated file systems.
- The number, size and output location of messages.log and trace files in the *logs* directory can be controlled with the Liberty <logging> configuration element or the output location controlled by using the *com.ibm.ws.logging.log.directory* Java directive as a JVM options override, more on this later.
- #These directories maintain state information and it is a good practice is to add the --clean parameter to the server startup JCL, e.g., PARMS='serverName --clean', especially after service is applied.



A Tour of Key Server Configuration Directories and Files

A z/OS Connect EE V3.0 server configuration structure looks like this:

```
 ${WLP_USER_DIR}
  /servers
    /zceesrv1
      /logs
        /ffdc
        messages.log
      /resources
        /security
        /zosconnect
        /apis
        /apiRequesters
        /rules
        /services
        server.xml
      /tranlog
      /workarea
```

The messages.log file is the key output file for messages about Liberty and the processing taking place in the Liberty server. The output written to this file can be written to the SPOOL by including DD statement MSGLOG in the startup JCL, e.g.,
//MSGLOG DD SYSOUT=*,FREE=CLOSE,SPIN=(UNALLOC,1M)

The security directory contains files **ltpa.keys** and **key.p12**.
ltpa.keys is the server specific LTPA token. **key.p12** is a self-signed certificate that expires in one year.

The /zosconnect directory is where the deployed APIs, services, and API requester files will be placed.

The server.xml file is the key configuration file. It is here that z/OS Connect EE V3.0 definitions go which define the essential backend connectivity.

The *WLP_USER_DIR* environment variable sets the value of the root directory of the server's configuration files and directories, e.g.,
WLP_USER_DIR=/var/zosconnect

Tech/Tip: Use multiple mount points with multiple ZFS file systems



Create the mount points and mount file systems prior to running zconsetup

```
mkdir -p /var/zosconnect  
mkdir -p /var/zosconnect/servers  
mkdir -p /var/zosconnect/group1  
mkdir -p /var/zosconnect/group2  
mkdir -p /var/zosconnect/group3
```

SYS1.PARMLIB (BPXPRM##)

```
MOUNT FILESYSTEM('OMVS.ZCEEVAR.ZFS')  
  MOUNTPOINT('/var/zosconnect')  
  TYPE(ZFS) MODE(READ)  
MOUNT FILESYSTEM('OMVS.ZCEE.SERVERS.ZFS')  
  MOUNTPOINT('/var/zosconnect/servers')  
  TYPE(ZFS) PARM('AGGRGROW') MODE(RDWR)  
MOUNT FILESYSTEM('OMVS.ZCEE.GROUP1.ZFS')  
  MOUNTPOINT('/var/zosconnect/group1')  
  TYPE(ZFS) PARM('AGGRGROW') MODE(RDWR)  
MOUNT FILESYSTEM('OMVS.ZCEE.GROUP2.ZFS')  
  MOUNTPOINT('/var/zosconnect/group2')  
  TYPE(ZFS) PARM('AGGRGROW') MODE(RDWR)  
MOUNT FILESYSTEM('OMVS.ZCEE.GROUP.ZFS')  
  MOUNTPOINT('/var/zosconnect/group3')  
  TYPE(ZFS) PARM('AGGRGROW') MODE(RDWR)
```

- Create a dedicated filesystem for the root z/OS Connect /var directory, e.g., /var/zosconnect/v3r0/extensions. This provides portability for migrations and system upgrades. Note: MODE(READ) will apply to /var/zosconnect/servers.

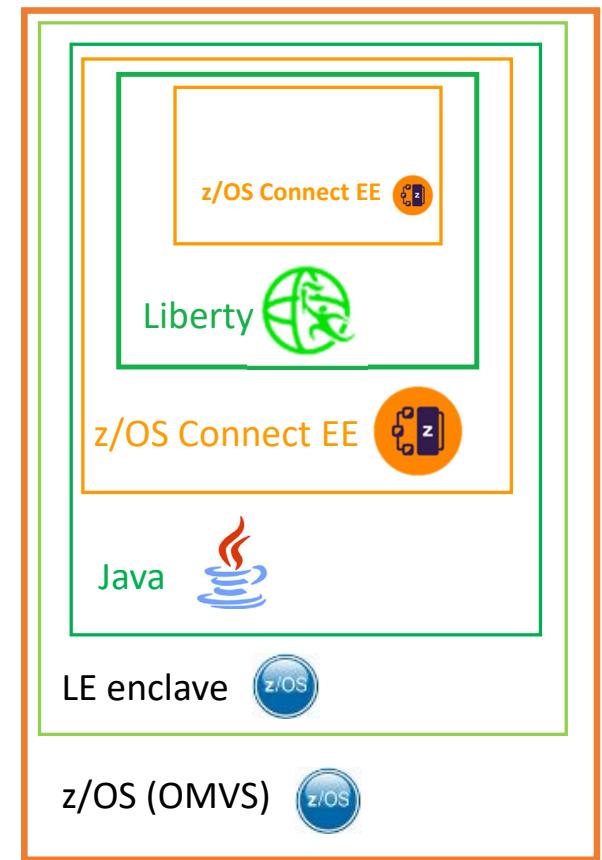
- Create a dedicated filesystem for each set or groups of servers. These filesystems will contain the server configuration directories for 1 or more servers.
- Each server's WLP_USER_DIR environment variable will be set to the mount point, e.g., *WLP_USER_DIR=/var/zosconnect/group1* when the server is created and in the server's startup JCL.

df -P | grep /var/zosconnect

| Filesystem | 512-blocks | Used | Available | Capacity | Mounted on |
|-----------------------|------------|---------|-----------|----------|-------------------------|
| OMVS.ZCEEVAR.ZFS | 69120 | 68658 | 462 | 100% | /var/zosconnect |
| OMVS.ZCEE.SERVERS.ZFS | 159120 | 76455 | 82665 | 48% | /var/zosconnect/servers |
| OMVS.ZCEE.GROUP1.ZFS | 135360 | 1506 | 133854 | 2% | /var/zosconnect/group1 |
| OMVS.ZCEE.GROUP2.ZFS | 4059360 | 2591284 | 1468076 | 64% | /var/zosconnect/group2 |
| OMVS.ZCEE.GROUP3.ZFS | 135360 | 17858 | 117502 | 14% | /var/zosconnect/group3 |

z/OS Connect consists of a stack of software

- z/OS Connect EE is a WebSphere Liberty Profile (WLP) feature
- WLP (aka Liberty) provides a Java runtime environment
- z/OS Connect EE Java code starts the Liberty process*
- Java (OMVS process)
- Language Environment (LE) enclave
- Uses various z/OS services and facilities (SAF,WLM, etc.)
- Knowing the layers exist is important regarding
 - Understanding configuration options, e.g., environment variables, etc.
 - Understanding the health of the server
 - Performing performance tuning



* z/OS Connect starts a Liberty process using a system programming interface (SPI). See the Notes at URL <https://www.ibm.com/docs/en/was-liberty/zos?topic=liberty-embedding-server-in-your-applications> regarding restrictions in this environment.



z/OS Connect JCL Procedure

```
//ZCEESRVR PROC PARMs='zceesrvr'  
//  
// SET ZCONHOME='/usr/lpp/IBM/zosconnect/v3r0'  
//  
//ZCON      EXEC PGM=BPXBATSL,REGION=0M,MEMLIMIT=8G,  
//                  PARM='PGM &ZCONHOME./bin/zosconnect run &PARMS. --clean '  
//STDOUT    DD      SYSOUT=*  
//STDERR    DD      SYSOUT=*  
//STDIN     DD      DUMMY  
//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.angelnName=ZCEE -Xmx512m  
OPENJ9_JAVA_OPTIONS=-Xoptionsfile=/var/zcee/properties/myServer.property
```

<https://www.ibm.com/docs/en/zos/2.1.0?topic=bpbatch-guidelines-defining-stdenv>



Tech/Tip: Liberty and Java environment variables and z/OS Connect

Liberty environment variables are available in a z/OS Connect environment.

- **WLP_USER_DIR** – Liberty environment variable informs the runtime environment where to look for shared resources and server definitions (e.g., server.xml)

Java related environment variables are also available in a z/OS Connect environment.

- **JAVA_HOME** – The OMVS directory where the Java executables (*/bin* directory) can be located.
- **JVM_OPTIONS** – A z/OS Connect environment variables that provides Java options and/or system properties. The contents of *JVM_OPTIONS* is added to the **java** command line in the *zosconnect* startup script.
- **IBM_JAVA_OPTIONS** – An IBM JAVA environment variable (deprecated and eventually will be replaced by *environment variable OPENJ9_JAVA_OPTIONS*). Environment variable *IBM_JAVA_OPTIONS* variable can be used to provide Java options and/or system properties.
- **OPENJ9_JAVA_OPTIONS** – An OpenJ9 environment variable (eventually will replace the deprecated environment variable *IBM_JAVA_OPTIONS*). Environment variable *OPENJ9_JAVA_OPTIONS* variable can be used to provide Java options and/or system properties.

Note: Any Java option or system property using *JVM_OPTIONS* supersedes the same Java non-standard options or system property when provided by *IBM_JAVA_OPTIONS* or *OPENJ9_JAVA_OPTIONS*. Java options and system properties and directives provided by *IBM_JAVA_OPTIONS* supersede the same property when provided by the *OPENJ9_JAVA_OPTIONS* environment variable.

The following environment variables are automatically set in a Liberty server and be used as variables in the server XML configuration files.

- **server.config.dir** – whose value will automatically be set to the value of variable *WLP_USER_DIR* concatenated with the name of the server, e.g. */var/zosconnect/servers/serverName*
- **server.output.dir** - whose value will automatically be set to the value of variable *WLP_OUTPUT_DIR* concatenated with the name of the server, e.g. */var/zosconnect/servers/serverName*
- **wlp.server.name** - whose value will automatically be set to the value of the server as provided in the *zosconnect run* command, e.g., PARMS value provided in the JCL procedure.

Tech-Tip: Java standard options are common across all JVM implementations (e.g., *-verbose* and *-classpath*) Non-standard options are unique to a JVM implementation and are identified using *-X*. System properties (*-D*) are passed on to the Java application for the application use.



Tech-Tip: z/OS Connect JCL Procedure STDENV JCL Examples

```
//ZCON      EXEC PGM=BPXBATSL,REGION=0M,MEMLIMIT=8G,  
//                      PARM='PGM &ZCONHOME./bin/zosconnect run &PARMS. --clean'  
//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 PATH='/var/zcee/properties/&PARMS..property',  
//                           PATHOPTS=ORDONLY  
//  
//          or  
//STDENV      DD DISP=SHR,DSN=JOHNSON.ZCEE.STDENV(COMMON)  
//          DD DISP=SHR,DSN=JOHNSON.ZCEE.STDENV(OPENJ9)  
//          DD DISP=SHR,DSN=JOHNSON.ZCEE.STDENV(IBMOPTS)  
//          DD DISP=SHR,DSN=JOHNSON.ZCEE.STDENV(JVMOPTHC)  
//          DD DISP=SHR,DSN=JOHNSON.ZCEE.STDENV(JAVAHOME)  
//          DD DISP=SHR,DSN=JOHNSON.ZCEE.STDENV(ZCEEANGL)  
//          DD DISP=SHR,DSN=JOHNSON.ZCEE.STDENV(WLPUSER)
```

Either one OMVS property file or multiple PDS members.

The last occurrence environment variable encountered determines the value of the environment variable.

Which value used for a Java option or property depends on which environment variable is used to specify the option or property.

Trailing blanks are truncated for in-stream data sets, but not for other data sets.

BTW, the DCB characteristics the STDENV PDS/PDSE data set were (LRECL=400,BLKSIZE=32400).



Tech-Tip: z/OS Connect JCL STDENV PDS concatenation observations

Member COMMON

```
_BPX_SHAREAS=YES  
_CEE_RUNOPTS=HEAPPOOLS (ON) , HEAPPOOLS64 (ON)  
JAVA_HOME=/usr/lpp/java/J8.0_64  
ZCON_ENV_DEBUG=TRUE  
WLP_USER_DIR=/var/alt/zosconnect
```

Green indicated the environment variable, Java option(-X) or system property(-D) that are used.
Red indicates the environment variable, Java option(-X) or system property(-D) that are ignored.

Member OPENJ9

```
OPENJ9_JAVA_OPTIONS=-verbose:sizes -Xms75m -Dcom.ibm.ws.zos.core.angelName=OPENJ9  
-Dcom.ibm.ws.logging.message.file.name=openj9.log #
```

Member IBMOPTS

```
IBM_JAVA_OPTIONS=-verbose:jni -Xms80m -Dcom.ibm.ws.logging.message.file.name=ibmopts.log  
-Dcom.ibm.ws.zos.core.angelName=IBMOPTS #
```

Member JVMOPTHC

```
JVM_OPTIONS=-Xoptionsfile=/var/zcee/properties/javaHCD.property -Dcom.ibm.ws.zos.core.angelName= -Xmx256m -verbose:sizes
```

Member JAVAHOME

```
JAVA_HOME=/u/johnson/java/J8.0_64
```

Member ZCEEANGL

```
OPENJ9_JAVA_OPTIONS=-Dcom.ibm.ws.zos.core.angelName=ZCEEANGL -Dcom.ibm.ws.logging.message.file.name=zceeanogl.log -Xmx16m -Xms60m  
-verbose:gc #
```

Member WLPUSER

```
WLP_USE_DIR=/var/zosconnect
```

Default settings for the OpenJ9 VM <https://www.ibm.com/docs/en/sdk-java-technology/8?topic=reference-default-settings>

mitchj@us.ibm.com

These entries do not span multiple lines in the PDS member(the contents are continuous on one line).

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Tech/Tip: Liberty Java Directives for controlling output

`com.ibm.ws.logging.console.format (consoleFormat)` - The required format for the console. Valid values are basic or json format.

`com.ibm.ws.logging.console.log.level (consoleLogLevel)` - This filter controls the granularity of messages that go to the console. The valid values are INFO, AUDIT, WARNING, ERROR, and OFF. By default, the console log level is set to AUDIT.

`com.ibm.ws.logging.hideMessage (hideMessage)` - Use this attribute to configure the messages that you want to hide from the `console.log` and `message.log` files. If the messages are configured to be hidden, then they are redirected to the `trace.log` file.

`com.ibm.ws.logging.log.directory (logDirectory)` - Use this attribute to set a directory for all log files, excluding the `console.log` file, but including FFDC. The default log location path is `WLP_OUTPUT_DIR/serverName/logs`

`com.ibm.ws.logging.max.file.size (maxFileSize)` - The maximum size (in MB) that a log file can reach before it is rolled. The Liberty runtime does only size-based log rolling. To disable this attribute, set the value to 0. The maximum file size is approximate. By default, the value is 20.

`com.ibm.ws.logging.max.files (maxFiles)` - If a maximum file size exists, this setting is used to determine how many of each of the log files are kept. This setting also applies to the number of exception logs that summarize exceptions that occurred on any day. So, if this number is 10, you might have 10 message logs, 10 trace logs, and 10 exception summaries in the `ffdc` directory. The default value is 2.

`com.ibm.ws.logging.message.format (messageFormat)` - The required format for the `messages.log` file. Valid values are basic or json format. By default, `messageFormat` is set to the environment variable `WLP_LOGGING_MESSAGE_FORMAT` (if set) or basic.

`com.ibm.ws.logging.trace.file.name (traceFileName)` - The `trace.log` file is only created if additional or detailed trace is enabled. `stdout` is recognized as a special value; and causes trace to be directed to the original standard out stream.

bootstrap.properties example:

```
com.ibm.ws.logging.message.file.name=basqstrtMessages.log  
com.ibm.ws.logging.log.directory=/u/common/logs
```

N.B. `consoleFormat`, `logDirectory`, etc. can be specified in the `<logging/>` Liberty configuration element. Note the recommendation for the attributes in red is for them to be provided in Java directives.

Tech/Tip: The initial server.xml configuration file and how to modify it



Default 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
    <cors id="defaultCORSConfig"
          domain="/"
          allowedOrigins="*"
          allowedMethods="GET, POST, PUT, DELETE, OPTIONS"
          allowedHeaders="Origin, Content-Type, Authorization, Cache-Control, Pragma, Expires, Set-Cookie"
          allowCredentials="true"
          maxAge="3600"/>
    - - - - - - - - - - - - - - - - 18 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>
```

Modified server.xml configuration file

```
<server description="zCEE Server">
    <include location="${server.config.dir}/includes/safSecurity.xml"/>
    <include location="${server.config.dir}/includes/ipicIDProp.xml"/>
    <include location="${server.config.dir}/includes/keyring.xml"/>
    <include location="${server.config.dir}/includes/groupAccess.xml"/>
    <include location="${server.config.dir}/includes/shared.xml"/>
    <include location="${server.config.dir}/includes/apiRequesterHTTPS.xml"/>
    <include location="${server.config.dir}/includes/imsDatabase.xml"/>

    <!-- 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="9090"
                  httpsPort="9453" />
```

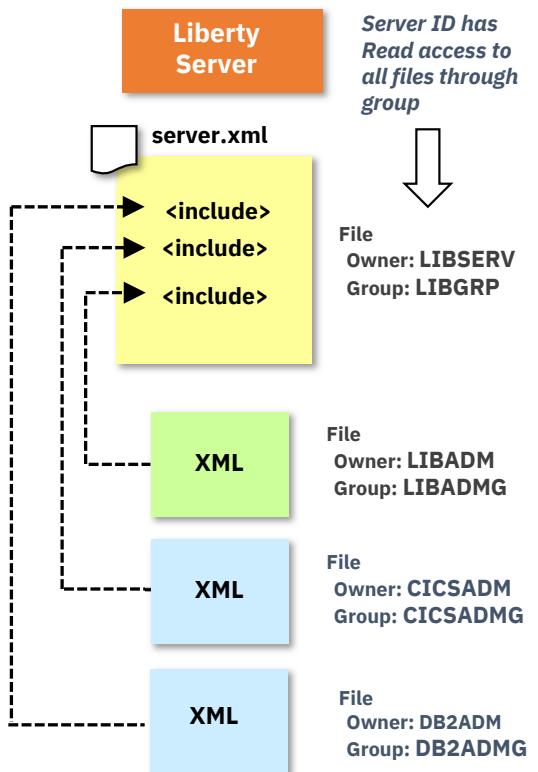
*Added in V3.0.48 with no HOLD information provided

The simplifies administration by :

- Customizing just the ports in the server.xml file.
- Using “include” statements to make further changes such as adding additional features and additional XML configuration elements.
- Review <https://www.ibm.com/docs/en/was-liberty/nd?topic=liberty-configuration-element-merging-rules> to understand merging rules.



Take advantage of Liberty's support for server XML "include" file processing



This allows portions of the configuration to be held in files outside the main `server.xml` file

Two primary uses:

1. Hold sensitive configuration information in file that is READ to select people, but not the read group
2. Allow a user to update their portion of the server configuration, but not other parts of it

For the second use-case it is important to ensure the user can not override configuration in the main XML. Use the "onConflict" tag in the `<include>` element:

```
<include location="myIncludeFile.xml" onConflict="IGNORE"/>
```

This tells Liberty to ignore XML elements in include file that are also found in the main `server.xml`. It does not prevent them from injecting configuration elements not found in the main `server.xml`. If there is a concern about that, don't use include processing.

Nesting of an include file within a include file is possible



Using “administration include” files to manage the server XML

- Setup a server.xml using ‘include’ statements and allow other administrator to manage those included files, but not the server.xml itself.
- Control what configuration can be overridden in included files using the ‘onConflict’ option provided with the include element (see Ignore, Replace, Merge).

https://www.ibm.com/support/knowledgecenter/en/SSAW57/liberty/com.ibm.websphere.wlp.nd.multiplatform.doc/ae/cwlp_config_include.html

server.xml (owned by ID ADMIN1)

```
<include location="${server.config.dir}/includes/db2.xml onConflict="IGNORE"/>
<include location="${server.config.dir}/includes/cics.xml onConflict="IGNORE"/>
<include location="${server.config.dir}/includes/imsDb.xml onConflict="IGNORE"/>
<featureManager>
  <feature>zosconnect:zosConnect-2.0</feature>
  <feature>zosconnect:zosConnectCommands-1.0</feature>
  <feature>apiDiscovery-1.0</feature>
<featureManager>
```

db2.xml (owned and managed by a DBA)

```
<server description="Db2 REST">
  <zosconnect_zosConnectServiceRestClientConnection id="Db2Conn" host="wg31.washington.ibm.com" port="2446" basicAuthRef="dsn2Auth" />
  <zosconnect_zosConnectServiceRestClientBasicAuth id="dsn2Auth" applName=DSN2APPL/>
</server>
```

cics.xml (owned and managed by a CICS administrator)

```
<server description="CICS">
  <featureManager> <feature>zosconnect:cicsService-1.0</feature> </featureManager>
  <zosconnect_cicsIpicConnection id="catalog" host="wg31" port="1491"/>
  <zosconnect_cicsIpicConnection id="cscvinc" host="wg31" port="1493"/>
</server>
```

imsDB.xml (owned and managed by a IMS administrator)

```
<server description="IMS DATABASE">
  <featureManager> <feature>zosconnect:dbService-1.0</feature> </featureManager>
  <connectionFactory id="DFSIVPACConn" > <properties:imsudbJLocat databaseName="DFSIVPA" datastoreName="IVP1" driverType="4" portNumber="5555" datastoreServer="wg31" user="USER1" password="USER1" flattenTables="True"/> </connectionFactory>
</server>
```



Tech-Tip: Review configuration conflicts

```
ÝAUDIT  " CWWKG0102I: Found conflicting settings for cscvincAPI instance of zosconnect_endpointConnection configuration.  
Property port has conflicting values:  
  Value 9443 is set in file:/var/zosconnect/servers/myServer/includes/apiRequesterHTTPS.xml.  
  Value 9443 is set in file:/var/zosconnect/servers/myServer/includes/apiRequesterHTTPS.xml.  
  Value 9463 is set in file:/var/zosconnect/servers/myServer/includes/oauth.xml.  
Property port will be set to 9463.  
Property host has conflicting values:  
  Value https://dvipa.washington.ibm.com is set in file:/var/zosconnect/servers/myServer/includes/apiRequesterHTTPS.xml.  
  Value https://dvipa.washington.ibm.com is set in file:/var/zosconnect/servers/myServer/includes/apiRequesterHTTPS.xml.  
  Value https://mpz3.washington.ibm.com is set in file:/var/zosconnect/servers/myServer/includes/oauth.xml.  
Property host will be set to https://mpz3.washington.ibm.com.  
Property authenticationConfigRef has conflicting values:  
  Value mySAFAuth is set in file:/var/zosconnect/servers/myServer/includes/apiRequesterHTTPS.xml.  
  Value myoAuthConfig is set in file:/var/zosconnect/servers/myServer/includes/oauth.xml.  
Property authenticationConfigRef will be set to myoAuthConfig.
```

onConflict="MERGE" Conflicting elements will be merged, and the last value encountered will be used.

onConflict="REPLACE" When elements conflict, the element in the included file will be ignored

onConflict="IGNORE" Conflicting elements in the included file are ignored.

Tech/Tip: Administrative – Use symbolic links for an administrative shortcut

- Create an “administration” subdirectory, e.g., `zcee` in directory `/var`
- Then create a symbolic link in the “administration” directory to each Liberty server’s configuration directory and other frequently accessed directories.

```
ls -al /var/zcee
drwxrwxrwx 4 JOHNSON SYS1          8192 Aug 16 12:23 .
drwxrwxrwt 25 OMVSKERN SYS1         8192 Aug 16 11:56 ..
lrwxrwxrwx 1 JOHNSON SYS1          57 Aug 16 12:22 CSCWLW -> /var/wlp/cics/CICS53Z/CSCWLW/wlp/usr/servers/defaultServer
lrwxrwxrwx 1 JOHNSON SYS1          57 Aug 16 12:22 CICSWLW -> /var/wlp/cics/CICS53Z/CICSWLW/wlp/usr/servers/cicswlp
drwxrwxrwx 2 JOHNSON SYS1         8192 Aug 16 15:30 hcd
lrwxrwxrwx 1 JOHNSON SYS1          27 Jun 10 15:55 includes -> /global/zosconnect/includes
lrwxrwxrwx 1 JOHNSON SYS1          28 Aug 16 10:12 mqweb -> /var/mqm/mqweb/servers/mqweb
lrwxrwxrwx 1 JOHNSON SYS1          32 Jun  4 12:49 myServer -> /var/zosconnect/servers/myServer
drwxr-xr-x 2 JOHNSON SYS1         8192 Aug 16 13:14 properties
lrwxrwxrwx 1 JOHNSON SYS1          18 Aug 17 12:47 shared -> /var/shared/zosconnect/resources/zosconnect
lrwxrwxrwx 1 JOHNSON SYS1          24 May 13 2020 walop3a -> /var/wlp/servers/walop3a
lrwxrwxrwx 1 JOHNSON SYS1          24 May 13 2020 walrp3a -> /var/wlp/servers/walrp3a
lrwxrwxrwx 1 JOHNSON SYS1          31 May 14 2020 wazz34a -> /var/zosconnect/servers/wazz34a
lrwxrwxrwx 1 JOHNSON SYS1          24 Aug 16 10:32 wlphats -> /var/wlp/servers/wlphats
lrwxrwxrwx 1 JOHNSON SYS1          36 Aug 16 10:31 zceearpir -> /var/ats/zosconnect/servers/zceearpir
lrwxrwxrwx 1 JOHNSON SYS1          39 Aug 16 10:18 zceecics -> /var/cicsts/zosconnect/servers/zceecics
lrwxrwxrwx 1 JOHNSON SYS1          35 Aug 16 10:31 zceedvm -> /var/ats/zosconnect/servers/zceedvm
lrwxrwxrwx 1 JOHNSON SYS1          32 Jun 10 15:54 zceeoipid -> /var/zosconnect/servers/zceeoipid
lrwxrwxrwx 1 JOHNSON SYS1          36 Aug 16 10:14 zceesrvr -> /var/ats/zosconnect/servers/zceesrvr
lrwxrwxrwx 1 JOHNSON SYS1          44 Aug 16 11:57 zosmfServer -> /var/zosmf/configuration/servers/zosmfServer
```

Not all these directories are for z/OS Connect servers, there are CICS Liberty servers, a MQ Web Console Liberty server, a zOSMF Liberty server, a HATS Liberty server and a couple of standard Liberty servers for Java applications.

One administration directory to manage them all!

Tech/Tip: Administrative – Use dedicated ZFS filesystem at the mount points

- Create mount points in the “administrative” directory for shared r/w directories
- Avoid creating directories and files in the root file system.
- Use a common or shared mount point
 - Use /var mount point for local read/write file systems
 - Use /global for sharing a mount point across multiple LPARs
- Use ZFS filesystems and use AGGRGROW to allow R/W ZFS filesystems to automatically go into extents (>16).

```
SYS1.PARMLIB(BPXPRM##)
MOUNT FILESYSTEM('OMVS.ZCEE.ZFS')
  MOUNTPOINT('/var/zcee')
  TYPE(ZFS) PARM('AGGRGROW') MODE(RDWR)
MOUNT FILESYSTEM('OMVS.ZCEEHCD.ZFS')
  MOUNTPOINT('/var/zcee/hcd')
  TYPE(ZFS) PARM('AGGRGROW') MODE(RDWR)
MOUNT FILESYSTEM('OMVS.ZCEE.SHARED.ZFS')
  MOUNTPOINT('/var/shared/zosconnect')
  TYPE(ZFS) PARM('AGGRGROW') MODE(RDWR)
```



Tech/Tip: Useful Liberty environment variables that can be used in XML configuration

Some environment variables are set for you and can also be used in the server configuration files. For example, the following environment variables are automatically set and available in a Liberty server.

- **server.config.dir** – whose value will automatically be set to the value of variable WLP_USER_DIR concatenated with the name of the server, e.g.
`/var/zosconnect/servers/serverName`
- **server.output.dir** - whose value will automatically be set to the value of variable WLP_OUTPUT_DIR concatenated with the name of the server, e.g.
`/var/zosconnect/servers/serverName`
- **wlp.server.name** - whose value will automatically be set to the value of the server as provided in the `zosconnect run` command, e.g., PARMS value provided in the JCL procedure.



Using “include” XML configuration files between servers

Consider adding an “includes” directory to each server’s configuration directory and then adding “include” statements to this local directory to each server’s server.xml file and then populate each “include” directory.

```
<include location="${server.config.dir}/includes/basicSecurity.xml"/>
<include location="${server.config.dir}/includes/ipic.xml"/>
<include location="${server.config.dir}/includes/keyringInbound.xml"/>
<include location="${server.config.dir}/includes/groupAccess.xml"/>
<include location="${server.config.dir}/includes/shared.xml"/>
<include location="${server.config.dir}/includes/oauth.xml"/>
```

-  /var/zosconnect/servers/zceesrv1/includes
-  /var/zosconnect/servers/zceesrv2/includes
-  /var/zosconnect/servers/zceesrv3/includes

And then change an “include” file in each server’s XML file as needed

```
<include location="${server.config.dir}/includes/safSecurity.xml"/>
<include location="${server.config.dir}/includes/ipicIDProp.xml"/>
<include location="${server.config.dir}/includes/keyringOutboundMutual.xml"/>
<include location="${server.config.dir}/includes/groupAccess.xml"/>
<include location="${server.config.dir}/includes/shared.xml"/>
<include location="${server.config.dir}/includes/oauth.xml"/>
```

**F ZCEESRV1,REFRESH,CONFIG
F ZCEESRV2,REFRESH,CONFIG
F ZCEESRV3,REFRESH,CONFIG**

Contents of the three “includes” directory

basicSecurity.xml
db2.xml
db2TLS.xml
groupAccess.xml
ipic.xml
ipicIDProp.xml
keyringInbound.xml
keystore.xml
keyringMutual.xml
keyringOutboundMutual.xml
safSecurity.xml

The issue here is that each of the included files must be maintained in 3 locations

So, let’s take this a step further



Sharing XML configuration files between servers

What is better than simply creating an “includes” directory in each server configuration directory, is to create an “includes” symbolic link pointing to a common location/directory

```
<include location="${server.config.dir}/includes/basicSecurity.xml"/>
<include location="${server.config.dir}/includes/ipic.xml"/>
<include location="${server.config.dir}/includes/keyringInbound.xml"/>
<include location="${server.config.dir}/includes/groupAccess.xml"/>
<include location="${server.config.dir}/includes/shared.xml"/>
<include location="${server.config.dir}/includes/oauth.xml"/>
```

```
<include location="${server.config.dir}/includes/safSecurity.xml"/>
<include location="${server.config.dir}/includes/ipicIDProp.xml"/>
<include location="${server.config.dir}/includes/keyringOutboundMutual.xml"/>
<include location="${server.config.dir}/includes/groupAccess.xml"/>
<include location="${server.config.dir}/includes/shared.xml"/>
<include location="${server.config.dir}/includes/oauth.xml"/>
```

- /var/zosconnect/servers/zceesrv1/includes
- /var/zosconnect/servers/zceesrv2/includes
- /var/zosconnect/servers/zceesrv3/includes

Contents of the these three “includes” directories

basicSecurity.xml
db2.xml
db2TLS.xml
groupAccess.xml
ipic.xml
ipicIDProp.xml
keyringInbound.xml
keystore.xml
keyringMutual.xml
keyringOutboundMutual.xml
safSecurity.xml

F BAQSTRT,REFRESH,CONFIG

But wait, let's take this a step further



Sharing XML configuration files between servers across an LPAR or Sysplex

What is better is to replace the *includes* subdirectories with symbolic links. Now the included files can be in a shared or common location which then can be accessed from multiple servers on a single or from multiple LPARs. Updates to the “include” files are made in one administrative directory.

OMVS commands

Symbolic links to a shared local LPAR directory

```
ln -s /var/shared/zosconnect/includes /var/zosconnect/servers/zceesrv1/includes  
ln -s /var/shared/zosconnect/includes /var/zosconnect/servers/zceesrv2/includes  
ln -s /var/shared/zosconnect/includes /var/zosconnect/servers/zceesrv3/includes
```

*Symbolic links to a shared Sysplex directory **

```
ln -s /global/zosconnect/includes /var/zosconnect/servers/zceesrv1/includes  
ln -s /global/zosconnect/includes /var/zosconnect/servers/zceesrv2/includes  
ln -s /global/zosconnect/includes /var/zosconnect/servers/zceesrv3/includes
```

The server.xml file contains these “include” statements

```
<include location="${server.config.dir}/includes/safSecurity.xml"/>  
<include location="${server.config.dir}/includes/ipicIDProp.xml"/>  
<include location="${server.config.dir}/includes/keyringOutboundMutual.xml"/>  
<include location="${server.config.dir}/includes/groupAccess.xml"/>  
<include location="${server.config.dir}/includes/shared.xml"/>  
<include location="${server.config.dir}/includes/oauth.xml"/>
```

Consider adding the “In” commands to the JCL used to create a new server

```
BPXEATCH SH +  
export JAVA_HOME=&JAVAHOME; +  
export WLP_USER_DIR=&WLPUSER; +  
&ZCEEPATH/bin/zosconnect create &SERVER +  
--template=&TEMPLATE; +  
ln -s /var/shared/zosconnect/includes $WLP_USER_DIR/servers/&SERVER/includes; +  
ln -s $WLP_USER_DIR/servers/&SERVER /var/zceesrv/&SERVER
```



/var/shared/zosconnect/includes

Contents of the common “includes” directory

*basicSecurity.xml
db2.xml
db2TLS.xml
groupAccess.xml
ipic.xml
ipicIDProp.xml
keyringInbound.xml
keystore.xml
keyringMutual.xml
keyringOutboundMutual.xml
safSecurity.xml*

Perhaps an extreme example but consider creating an “include” file with just the desired include statements and then include this file in a server’s server.xml file. For example, an include that add CICS, SAF security and SSL and another file that adds CICS and SAF security (no SSL).



Tech-TIP: A practical example-PTF V3.0.35 included a CORS update

July 2020

V3.0.35 (APAR PH26291)
Server code update

Enhancements

- The text of messages BAQR0417W and BAQR0418W has been updated. For more information, see z/OS Connect EE [Runtime Messages](#).

Fixes

- PH21761 A CICS region reports **SOS DFHSM0133 WBSEBUF** when z/OS Connect EE requester is in use.
- PH25345 Passing user credentials in the request body to the authentication server to obtain a JWT causes a NPE in z/OS Connect EE.
- PH21819 z/OS Connect EE sets some CORS headers automatically.

Attention

When this fix is applied, additional CORS configuration is required in `server.xml` to enable connections from the z/OS Connect EE API toolkit and JavaScript clients. For more information, see [Configuring Cross-Origin Resource Sharing on a z/OS Connect Enterprise Edition Server](#)

`cors.xml`

```
<?xml version="1.0" encoding="UTF-8"?>
<server description="CORS entries">

    <!-- add cors to allow cross origin access, e.g. when using swagger doc from zOS Connect Enterprise
        Edition -->
    <cors id="defaultCORSConfig"
        domain="/"
        allowedOrigins="*"
        allowedMethods="GET, POST, PUT, DELETE, OPTIONS"
        allowedHeaders="Origin, Content-Type, Authorization, Cache-Control, Expires, Pragma"
        allowCredentials="true"
        maxAge="3600"/>

</server>
```

`server.xml`

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



Using the *bootstrap.properties* file to customize the server's configuration XML[#]

zceesrv1's bootstrap.properties

```
httpPort=9080
httpsPort=9443
ipicPort=1491
cicsHost=wg31.washington.ibm.com
network=ZOSCONN1
applid=ZOSCONN1
com.ibm.ws.zos.core.angelName=named_angel
```

zceesrv2's bootstrap.properties

```
httpPort=9090
httpsPort=9453
ipicPort=1492
cicsHost=wg31.washington.ibm.com
network=ZOSCONN2
applid=ZOSCONN2
com.ibm.ws.zos.core.angelName=named_angel
```

server.xml

```
<!-- To access this server from a remote client, add a host attribute to the following
element, e.g. host="*" -->
<httpEndpoint id="defaultHttpEndpoint"
    host="*"
    httpPort="${httpPort}"
    httpsPort="${httpsPort}" />
```

ipicIDProp.xml

```
<zosconnect_cicsIpicConnection id="catalog"
    host="${cicsHost}" port="${ipicPort}"
    zosConnectNetworkid="${network}" zosConnectApplid="${applid}"/>

<zosconnect_cicsIpicConnection id="cscvinc"
    host="${cicsHost}" port="${ipicPort}"
    zosConnectNetworkid="${network}" zosConnectApplid="${applid}"/>

<zosconnect_cicsIpicConnection id="miniloan"
    host="${cicsHost}" port="${ipicPort}"
    zosConnectNetworkid="${network}" zosConnectApplid="${applid}"/>
```

#Located in directory \${server.config.dir} and uses EBCDIC encoding



Sharing XML configuration files – using *variable* files

“variables” files whose names are based on the name of the server

myServer.xml

```
<variable name= "unauthenticatedUser" value= "WSGUEST" />
<variable name="profilePrefix" value= "BBGZDFLT" />
```

zceoepid.xml

```
<variable name= "unauthenticatedUser" value="ZCGUEST" />
<variable name="profilePrefix" value="EMJZDFLT" />
```

server.xml

```
<server description="new server">
<include location="${server.config.dir}/includes/safSecurity.xml"/>
<include location="${server.config.dir}/includes/${wlp.server.name}.xml"/>

    <!-- Enable features -->
    <featureManager>
        <feature>zosconnect:zosConnect-2.0</feature>
        <feature>zosconnect:zosConnectCommands-1.0</feature>
    </featureManager>
```

safSecurity.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<server description="SAF security">

    <!-- Enable features -->
    <featureManager>
        <feature>appSecurity-2.0</feature>
        <feature>zosSecurity-1.0</feature>
    </featureManager>

    <webAppSecurity allowFailOverToBasicAuth="true" />
    <safRegistry id="saf" />
    <safAuthorization racRouteLog="ASIS" />
    <safCredentials unauthenticatedUser="${unauthenticatedUser}"
        profilePrefix="${profilePrefix}" />
</server>
```

Tech/Tip: Use Symbolic links to simplify commands in command shells 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 for example, change these commands from:

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

Which leads to simpler and shorter OMVS commands:

```
//EXPORT EXPORT SYMLIST=(*)
// SET SERVER='defaultServer'
// SET SHARED='/var/zcee/shared'
// 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 +
export serverName=$SERVER; +
export sharedDir=$SHARED; +
export WLP_USER_DIR=$WLPUSER; +
ln -s $WLP_USER_DIR/servers/$serverName /var/zcee/$serverName; +
ln -s $sharedDir/includes /var/zcee/$serverName/includes
```

Directory Shortcuts

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

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

`ln -s oldname newname`

Add exports to /u/home/.profile or /etc/profile files

```
export serverName=defaultServer
export sharedDir=/var/zcee/shared
export WLP_USER_DIR=/var/zosconnect
```

or

```
//ZCEELN EXEC PGM=IKJEFT01,REGION=0M
//SYSTSPRT DD SYSOUT=*
//SYSERR DD SYSOUT=*
//STDOUT DD SYSOUT=*
//SYSTSIN DD *
BPXBATCH SH +
ln -s $WLP_USER_DIR/servers/$serverName /var/zcee/$serverName; +
ln -s $sharedDir/includes /var/zcee/$serverName/includes
```



Also use symbolic links to share z/OS Connect artifacts in a default location

By default, each server has their own dedicated *resources/zosconnect* subdirectory

-  /var/zosconnect/servers/zceesrv1/resources/zosconnect
-  /var/zosconnect/servers/zceesrv2/resources/zosconnect
-  /var/zosconnect/servers/zceesrv3/resources/zosconnect

Contents of each of the "resources/zosconnect" directory

- /apis
- /apiRequesters
- /rules
- /services

Specify a standard default directory location for these artifacts and then use a symbolic link to the actual real directory

OMVS commands

Symbolic links to a local file system

```
ln -s /var/shared/zosconnect/resources/zosconnect /var/zcee/shared
```

Or a symbolic links to a shared file system

```
ln -s /global/zosconnect/resources/zosconnect /var/zcee/shared
```

-  /var/shared/zosconnect/resources/zosconnect/.....
-  /global/zosconnect/resources/....

Then use the *location* attribute to override the default directories

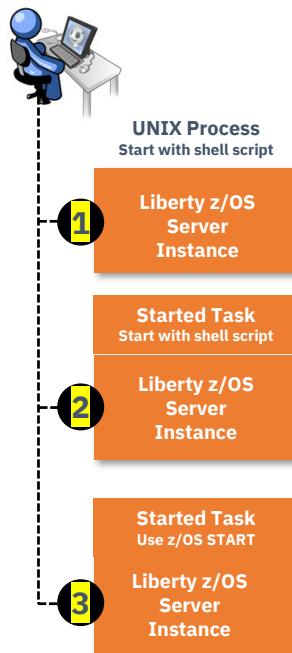
```
shared.xml
<zosconnect_apiRequesters location="/var/zcee/shared/apiRequesters">
</zosconnect_apiRequesters>
<zosconnect_zosConnectAPIs location="/var/zcee/shared/apis">
</zosconnect_zosConnectAPIs>
<zosconnect_services location="/var/zcee/shared/services">
</zosconnect_services>
```

This XML is now portable between servers on LPARs in or not in a SYSPLEX.

z/OS : Starting Liberty Servers

All three options result in a Liberty z/OS server, and functionally there's very little difference.

When started as a UNIX process, the MODIFY command interface is not present. For production use, the best practice is to use a started task.



1. UNIX Process
 - Use the 'server' shell script in the installation /bin directory
 - Syntax: `server start zceesrv1`
 - ID of server will be based on ID that issued the command
2. Started Task using server shell script (server start zceesrv1)
 - Set **WLP_ZOS_PROCEDURE** environment variable in server.env file
 - Example: `WLP_ZOS_PROCEDURE=ZCEEPROC,JOBNAME=ZCEESVR1,PARMS='ZCEESVR1'`
 - ID of the server will be based on the SAF STARTED profile that takes effect
3. **Started Task using START command**
 - **Common procedure:** `START ZCEEPROC,JOBNAME=ZCEESVR1,PARMS='ZCEESVR1'`
 - **Dedicated proc:** `START ZCEEPROC`
 - **ID of the server will be based on the SAF STARTED profile that takes effect**

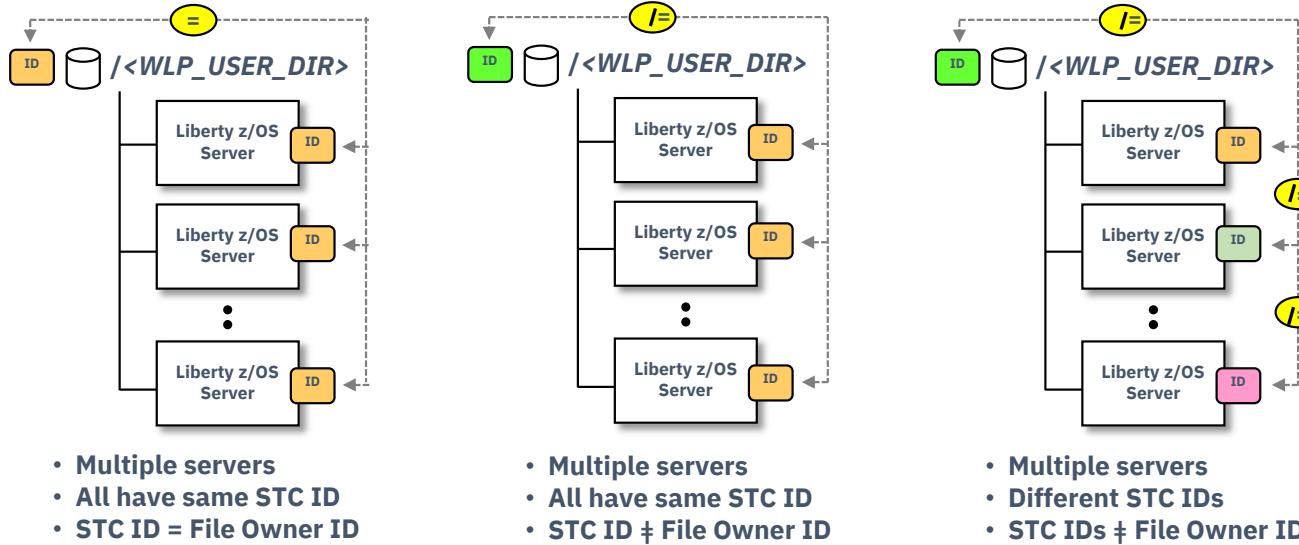
Expectation is for production servers #3 will be used

Liberty z/OS good practices:

<https://www.ibm.com/support/pages/node/6355605>

z/OS Security – Range of options – Started Task IDs

On z/OS, the best practice for Liberty servers in production is that they run as ‘Started Tasks’ (STCs).



**Should all servers sharing WLP_USER_DIR share the same STC ID?
It is a matter of the degree of identity isolation that is required**

z/OS : Assigning ID to started tasks: SAF STARTED

The first question here is whether you wish to have a common started task ID that is shared among servers, or if you wish each server to have a unique ID

Then the second question is whether servers under a WLP_USER_DIR will share a common JCL start proc, or use unique start procs for each server

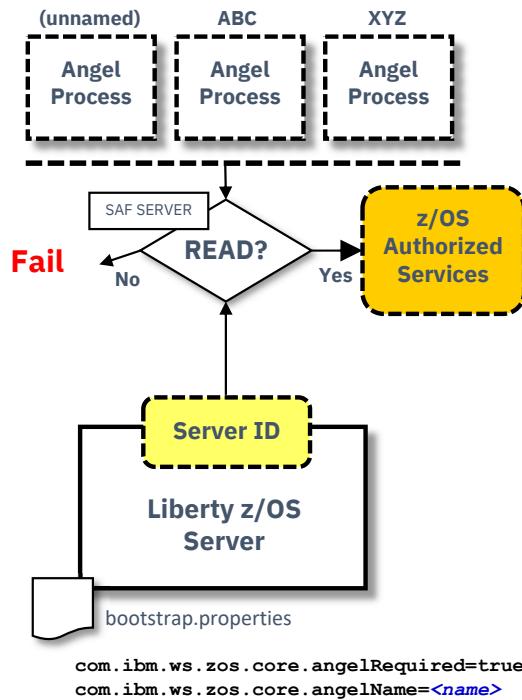
| | <i>Common Identity per task</i> | <i>Unique Identities per task</i> |
|--|---|---|
| <i>Common JCL Procedure</i> | <pre>RDEFINE STARTED ZCEEPROC.* S ZCEEPROC, JOBNAME=<i>server1</i>, PARMs='<i>server1</i>' S ZCEEPROC, JOBNAME=<i>server2</i>, PARMs='<i>server2</i>'</pre> | <pre>RDEFINE STARTED ZCEEPROC.<i>server1</i> RDEFINE STARTED ZCEEPROC.<i>server2</i> S ZCEEPROC, JOBNAME=<i>server1</i>, PARMs='<i>server1</i>' S ZCEEPROC, JOBNAME=<i>server2</i>, PARMs='<i>server2</i>'</pre> |
| <i>Unique JCL Procedure per server</i> | <pre>RDEFINE STARTED ZCEE*.* S ZCEESRV1, JOBNAME=<i>server1</i>, PARMs='<i>server1</i>' S ZCEESRV2, JOBNAME=<i>server2</i>, PARMs='<i>server2</i>'</pre> | <pre>RDEFINE STARTED ZCEESRV1.* RDEFINE STARTED ZCEESRV2.* S ZCEESRV1, JOBNAME=<i>server1</i>, PARMs='<i>server1</i>' S ZCEESRV2, JOBNAME=<i>server2</i>, PARMs='<i>server2</i>'</pre> |

Note: Using unique JCL procedure eliminates the need to specify PARMs on the start commands

It's possible to use a combination of the above, even under the same WLP_USER_DIR. So there's no "one best answer" here. What's best is what's best for you.



z/OS : The Angel process – what is this about?



The Angel Process is a started task that is used to protect access to z/OS privileged or authorized services. This is done with SAF SERVER profiles.

- Authorized services include: WOLA, SAF, WLM, RRS, DUMP
- The ability to start multiple Angel processes on an LPAR was introduced in 16.0.0.4. This is called "Named Angels". It provides a way to separate Angel usage between Liberty servers:
 - An Angel process can be started with a NAME='<name>' parameter (or it can be started as a "default" without a name). The name may be up to 54 characters.
 - Liberty servers can be pointed at a specific Angel with a bootstrap property

Best practice:

- You may create separate named Angels for isolation of Test and Production, but do not take this practice too far. A few Angels, yes; dozens, no.
- Establish automation routines to start the Angels at IPL
- Grant SAF GROUP access to the SERVER profiles, then connect server IDs as needed

List of current Liberty Features

https://www.ibm.com/support/knowledgecenter/SSEQTP_liberty/com.ibm.websphere.wlp.doc/ae/rwlp_feat.html

z/OS : SAF SERVER profiles related to the Angel



Best practice:

- Establish all the SERVER profiles ahead of time. Existence of profile does not grant access; READ access does.
- Determine what access a server needs and grant only that; check "is available" messages in messages.log to verify

Tech/Tip: The SAFLOG parameter was added in a recent Liberty drop. If this parameter is set to Y, additional security related messages will be written to the JES messages and console if a Liberty server does not have authorization to use an angel-controlled privileged function. See URL

https://www.ibm.com/support/knowledgecenter/SS7K4U_liberty/com.ibm.websphere.wlp.zseries.doc/ae/rwlp_newinrelease.html

Liberty 21.0.6 add a new property to identify required services, com.ibm.ws.zos.core.angelRequiredServices, for more details see URL

<https://www.ibm.com/docs/en/was-liberty/zos?topic=overview-process-types-zos>



Tech/Tip: z/OS Privileges controlled by SERVER resources

- SAFCRED – needed if you intend to use SAF for security elements such as registry, certificates and EJBROLES.
- ZOSWLM – needed if you wish to classify work using WLM
- TXRRS – needed for access to RRS for transaction coordination. You should not need this for z/OS Connect EE as it does not create global transactions and therefore does not need the services of RRS for that purpose. You may want to create and have on hand for *other* Liberty servers not running z/OS Connect EE.
- ZOSDUMP – needed if you wish to use the MODIFY interface to the Liberty z/OS server to process a dump operation. This is good to have available if IBM support requests a dump for your z/OS Connect EE server.
- PRODMGR – needed if you wish to enable IFAUSAGE (SMF) for Liberty on z/OS.
- ZOSAIO – needed if you wish to permit the enablement of the use of Asynchronous TCP/IP sockets I/O for Liberty on z/OS.
- LOCALCOM – needed for optimized local adapter services.
- WOLA – needed if you wish to use WebSphere Optimized Local Adapter support for cross memory communications between tasks.



Tech/Tip: Sample RACF Commands for SERVER resources

```
RDEFINE SERVER BBG.ANGEL UACC(NONE) OWNER(SYS1)
PERMIT BBG.ANGEL CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSAFM UACC(NONE) OWNER(SYS1)
PERMIT BBG.AUTHMOD.BBGZSAFM CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSAFM.SAFCRED UACC(NONE)
PERMIT BBG.AUTHMOD.BBGZSAFM.SAFCRED CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSAFM.ZOSWLM UACC(NONE)
PERMIT BBG.AUTHMOD.BBGZSAFM.ZOSWLM CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSAFM.TXRRS UACC(NONE)
PERMIT BBG.AUTHMOD.BBGZSAFM.TXRRS CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSAFM.ZOSDUMP UACC(NONE)
PERMIT BBG.AUTHMOD.BBGZSAFM.ZOSDUMP CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.SECPFX.BBGZDFLT UACC(NONE)
PERMIT BBG.SECPFX.BBGZDFLT CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSAFM.WOLA UACC(NONE) OWNER(SYS1)
PERMIT BBG.AUTHMOD.BBGZSAFM.WOLA CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSAFM.LOCALCOM UACC(NONE) OWNER(SYS1)
PERMIT BBG.AUTHMOD.BBGZSAFM.LOCALCOM CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSCFM UACC(NONE) OWNER(SYS1)
PERMIT BBG.AUTHMOD.BBGZSCFM CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSCFM.WOLA UACC(NONE) OWNER(SYS1)
PERMIT BBG.AUTHMOD.BBGZSCFM.WOLA CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSAFM.PRODMGR UACC(NONE) OWNER(SYS1)
PERMIT BBG.AUTHMOD.BBGZSAFM.PRODMGR CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

RDEFINE SERVER BBG.AUTHMOD.BBGZSAFM.ZOSAIO UACC(NONE) OWNER(SYS1)
PERMIT BBG.AUTHMOD.BBGZSAFM.ZOSAIO CLASS(SERVER) ACCESS(READ) ID(LIBSERV)

SETROPTS RACLST(SERVER) REFRESH
```

SAF APPL and EJBRole Resources

Connect z/OS Connect users to a common group

CONNECT (FRED,USER1,JOHNSON) GROUP(ZCEEUSRS)

Define a APPL profile for the server's SAF profilePrefix and permit access

RDEFINE APPL BBGZDFLT UACC(NONE) OWNER(SYS1)

PERMIT BBGZDFLT CLASS(APPL) ACCESS(READ) ID(WSGUEST#, ZCEEUSRS)

SETROPTS RACLIST(APPL) REFRESH

Define an EJBROLE profile for the server's SAF profilePrefix and permit access

**RDEFINE EJBROLE BBGZDFLT.zos.connect.access.roles.zosConnectAccess +
OWNER(SYS1) UACC(NONE)**

**PERMIT BBGZDFLT.zos.connect.access.roles.zosConnectAccess +
CLASS(EJBROLE) ID(ZCEEUSRS) ACCESS(READ)**

Refresh the EJBROLE in storage profiles

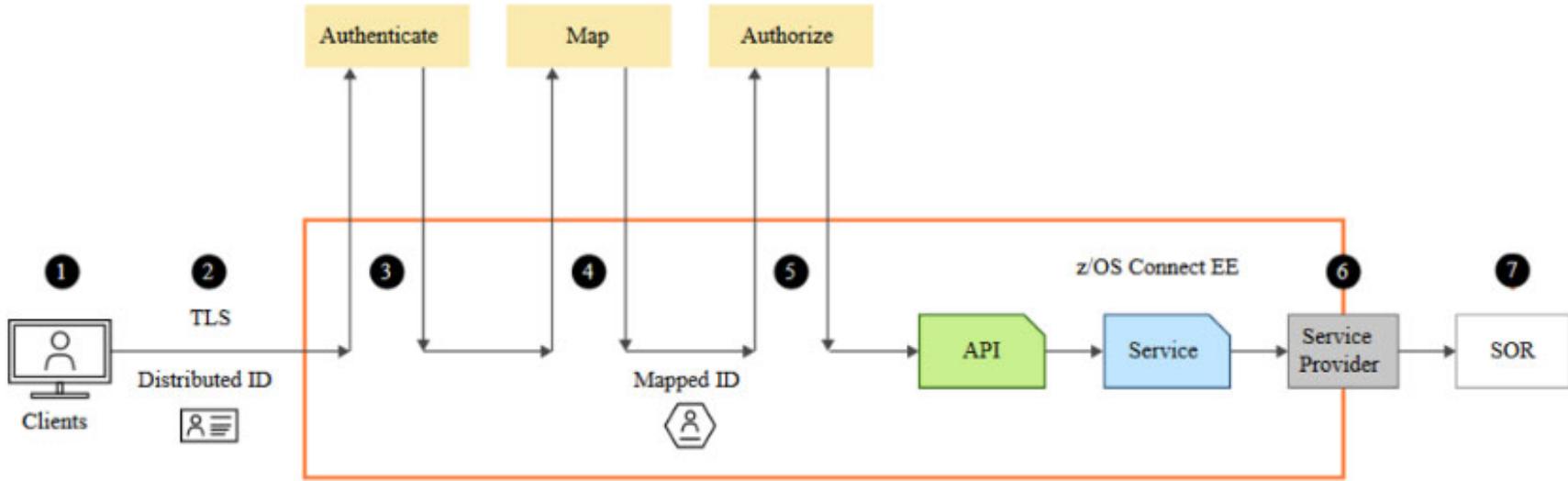
SETROPTS RACLIST(EJBROLE) REFRESH

```
<safCredentials unauthenticatedUser="WSGUEST" profilePrefix="BBGZDFLT" />
```

https://www.ibm.com/support/knowledgecenter/SS7K4U_liberty/com.ibm.websphere.wlp.zseries.doc/ae/twlp_config_security_saf.html
https://www.ibm.com/support/knowledgecenter/SS4SVW_beta/securing/saf_unauthenticated_id.html#concept_saf_unauthenticated_id



Details of a typical z/OS Connect EE API Provider security flow



1. The credentials provided by the client
2. Secure the connection to the Liberty server
3. Authenticate the client. This can be within the Liberty server or by requesting verification from a third-party server
4. Map the authenticated identity to a user ID in the user registry
5. Authorize the mapped user ID to connect to z/OS Connect EE and optionally authorize user to invoke actions on APIs
6. Secure the connection to the System of Record (SoR) and provide security credentials to be used to invoke the program or to access the data resource
7. The program or database request may run in the SoR under the mapped ID



z/OS Connect Security server XML Authentication Configuration

- requireAuth - requires the client to provide credentials

```
<zosconnect_zosConnectManager  
    requireAuth="true|false"  
    requireSecure="true"/>  
  
<zosconnect_zosConnectAPIs>  
    <zosConnectAPI name="catalog"  
        requireAuth="true|false"  
        requireSecure="true"/>  
</zosconnect_zosConnectAPIs>  
  
<zosconnect_services>  
    <service id="selectByEmployee"  
        name="selectEmployee"  
        requireAuth="true|false"  
        requireSecure="true"/>  
</zosconnect_services>  
  
<zosconnect_apiRequesters>  
    requireAuth="true|false"  
    <apiRequester name="cscvincapi_1.0.0"  
        requireAuth="true|false"  
        requireSecure="true"/>  
</zosconnect_apiRequesters>
```

Globally, requires that users specify security credentials to be authenticated order to access APIs, services and API requesters, unless overridden on the specific resource definitions.

Requires that users specify security credentials to be authenticated in order to access the API.

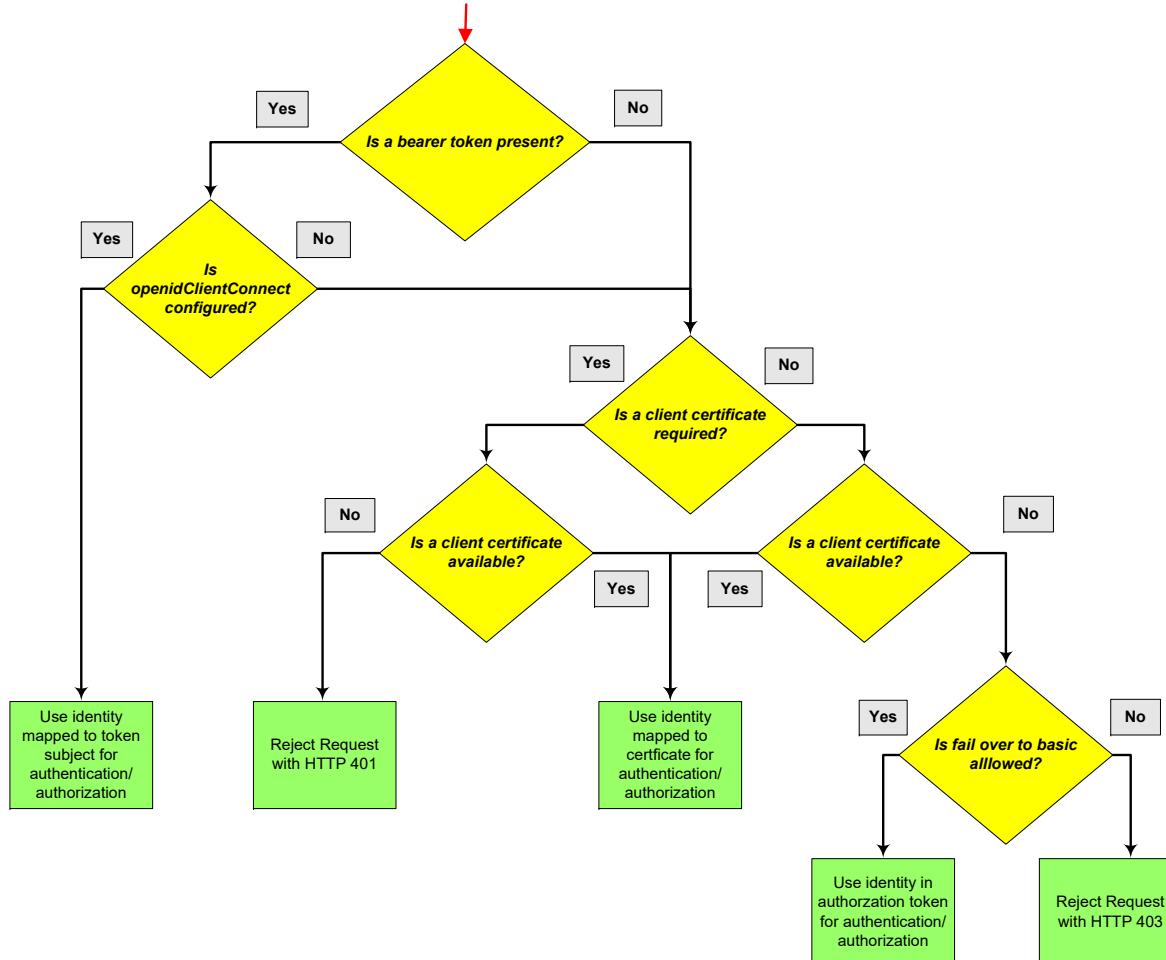
Requires that users specify security credentials to be authenticated in order to directly access the service. This attribute is ignored when the service is invoked from an API, then only the API requireAuth attribute is relevant.

Requires that users specify security credentials to be authenticated in order to access all API requesters. If the requireAuth attribute is not set, the global setting on the zosconnect_zosConnectManager element is used instead, unless the requireAuth attribute is overridden on the specific API requester.

The requireAuth attribute controls whether an inbound request must provide credentials using one of the three authentication methods, e.g., basic, client certificate, or third-party token.



Authentication Credential Precedence



z/OS Connect Security server XML Authentication Configuration



- **requireSecure** - requires the use of TLS (SSL) for communications

```
<zosconnect_zosConnectManager  
    requireAuth="true"  
    requireSecure="true|false"/>  
  
<zosconnect_zosConnectAPIs>  
    <zosConnectAPI name="catalog"  
        requireAuth="true"  
        requireSecure="true|false"/>  
</zosconnect_zosConnectAPIs>  
  
<zosconnect_services>  
    <service id="selectByEmployee"  
        name="selectEmployee"  
        requireAuth="true"  
        requireSecure="true|false"/>  
</zosconnect_services>  
  
<zosconnect_apiRequesters>  
    requireAuth="true"  
    <apiRequester name="cscvincapi_1.0.0"  
        requireAuth="true"  
        requireSecure="true|false"/>  
</zosconnect_apiRequesters>
```

Globally, requires that inbound request using HTTPS in order to access APIs, services and API requesters, unless overridden on the specific resource definitions.

Requires that inbound request use HTTPS in order to access the API.

Requires that inbound request use HTTPS when directly accessing this service.

Requires that all inbound request for this API requester use HTTPS.

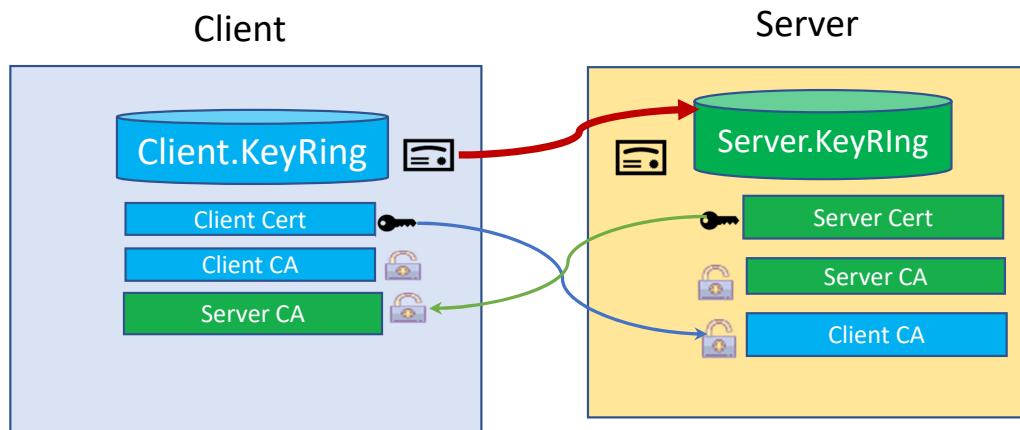
requireSecure controls inbound TLS connections

Let's review the basic TLS Handshake Flow

TLS handshake –

Server Authentication

Mutual Authentication (optional)



safkeyring:///KeyRing v safkeyring://owner/KeyRing

RACF FACILITY resources

- IRR.DIGTCERT.LISTRING
 - READ to list your own key ring
 - UPDATE to list another user's key ring
- IRR.DIGTCERT.LIST
 - READ to list your own certificate
 - UPDATE to list another user's certificate
 - CONTROL to list SITE of CERTAUTH certificates

Certificate with a private key*

Certificate Authority (CA) certificate chain#

*For server and/or mutual authentication to work, the endpoint sending its server or client certificate must use a personal certificate with a private key. The private key is required to decrypt (or encrypt) a message digest that is sent from the other endpoint during the handshake flow. Generation of a message digest also requires access to the CA certificate used to sign the certificate.

#Refers to the set or of certificates used to issue the server or client personal certificate including any intermediate certificates all the way to the root CA.



Using this Liberty JSSE server XML configuration

```
<!-- Enable features -->
<featureManager>
    <feature>transportSecurity-1.0</feature>
</featureManager>

<sslDefault sslRef="DefaultSSLSettings"
    outboundSSLRef="OutboundSSLSettings" />

<ssl id="DefaultSSLSettings"
    keyStoreRef="CellDefaultKeyStore"
    trustStoreRef="CellDefaultKeyStore"
    clientAuthenticationSupported="true"
    clientAuthentication="true"
    serverKeyAlias="Liberty Server Cert"/>

<keyStore id="CellDefaultKeyStore"
    location="safkeyring:///Liberty.KeyRing"
    password="password" type="JCERACFKS"
    fileBased="false" readOnly="true" />

<ssl id="OutboundSSLSettings"
    keyStoreRef="OutboundKeyStore"
    trustStoreRef="OutboundKeyStore"/>

<keyStore id="OutboundKeyStore"
    location="safkeyring:///zCEE.KeyRing"
    password="password" type="JCERACFKS"
    clientKeyAlias="Liberty Client Cert"
    fileBased="false" readOnly="true" />
```

SSL repertoires

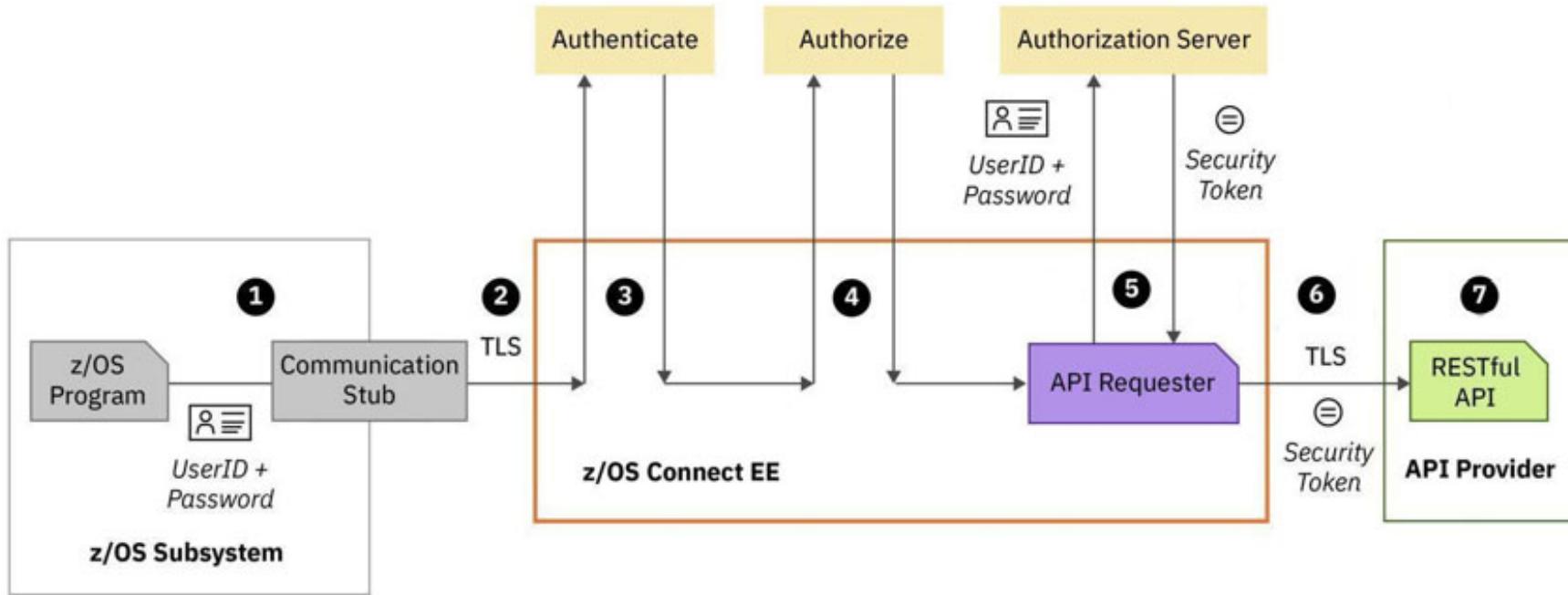
Tech-Tip: when more than one personal certificate is connected to a key ring. Use the SSL repertoire *serverKeyAlias* or *clientKeyAlias* attributes to select the personal certificate to be used in a handshake.

```
<zosconnect_authorizationServer sslCertsRef="SSL repertoire"/>
<zosconnect_cicsIpicConnection sslCertsRef="SSL repertoire"/>
<zosconnect_endpointConnect sslCertsRef="SSL repertoire"/>
<zosconnect_zosConnectRestClient sslCertsRef="SSL repertoire"/>
<zosconnect_zosConnectServiceRestClientConnection sslCertsRef="SSL repertoire"/>
```

F BAQSTRT,REFRESH,KEYSTORE



Details of a typical z/OS Connect EE API Requester security flow



1. A user ID and password can be used for basic authentication by the Liberty EE server
2. Connection between the CICS, IMS, or z/OS application and the Liberty server can use TLS
3. Authenticate the CICS, IMS, or z/OS application.
4. Authorize the authenticated user ID to connect to Liberty and to perform specific actions on z/OS Connect EE API requesters
5. If required, pass the user ID and password credentials to an authorization server to obtain a security token.
6. Secure the connection to the external API provider, and provide security credentials such as a security token to be used to invoke the API
7. The API runs in the external API provider

A Review of connecting z/OS Connect servers to to z/OS subsystems



Tech-Tip: Liberty's “adminCenter” Feature

- The Web browser interface feature “adminCenter” was used to display the server’s configuration files

The screenshot shows two side-by-side views of the IBM Liberty adminCenter interface. Both views are titled "Server Config" and show the "server.xml" configuration file.

The left view is labeled "Design" and displays a tree-based configuration editor. The tree shows a "Server" node with several "Include" entries pointing to various XML files like "imsmobile-config/services/ims-services.xml", "imsmobile-config/interactions/ims-interactions.xml", etc. Below the tree, there is a "Description" field containing the text "new server".

The right view is labeled "Source" and displays the raw XML code for the "server.xml" file. The code includes declarations for multiple servers and various configuration sections such as "featureManager" and "httpEndpoint". The "source" tab is highlighted in both views.

```
1<server description="new server">
2<include location="/var/zosconnect/servers/myServer/resources/imsmobile-config/services/ims-services.xml" optional="true"/>
3<include location="/var/zosconnect/servers/myServer/resources/imsmobile-config/interactions/ims-interactions.xml" optional="true"/>
4<include location="/var/zosconnect/servers/myServer/resources/imsmobile-config/connections/ims-connections.xml" optional="true"/>
5<include location="${server.config.dir}/includes/safSecurity.xml"/>
6<include location="${server.config.dir}/includes/safTrace.xml"/>
7<include location="${server.config.dir}/includes/ipic.xml"/>
8<include location="${server.config.dir}/includes/keyring.xml"/>
9<include location="${server.config.dir}/includes/shared.xml"/>
10<include location="${server.config.dir}/includes/oauth.xml"/>
11<include location="${server.config.dir}/includes/audit.xml"/>
12<include location="${server.config.dir}/includes/mq.xml"/>
13<include location="${server.config.dir}/includes/db2.xml"/>
14<include location="${server.config.dir}/includes/wlm.xml"/>
15<include location="${server.config.dir}/includes/restConnector.xml"/>
16<include location="${server.config.dir}/includes/smf.xml"/>
17<include location="${server.config.dir}/includes/adminCenter.xml" />
18<!-- Enable features -->
19<featureManager>
20    <feature>apiDiscovery-1.0</feature>
21    <feature>zosconnect:zosConnect-2.0</feature>
22    <feature>zosconnect:zosConnectCommands-1.0</feature>
23    <feature>imsmobile:imsmobile-2.0</feature>
24</featureManager>
25<!-- To access this server from a remote client add a host attribute to the following element, e.g. host="" -->
26<httpEndpoint host="" httpPort="9080" httpsPort="9443" id="defaultHttpEndpoint"/>
```

Server XML - Accessing a CICS program using IPIC



The server.xml file is the key configuration file:

inquireSingle Service

Configuration

Required Configuration

Coded character set identifier (CCSID): 37

Connection reference: catalog

Optional Configuration

Enter the optional configuration for this service.

Transaction ID:

Transaction ID usage:

WG31

File Edit Settings View Communication Actions Window Help

OVERTYPE TO MODIFY

```
CEDA ALTER TCpipservice( IPIC      )
TCpipservice  : IPIC
GROup        : SYSPGRP
DEscription   ==> DFHISAIPI
Urm          ==> 01491
PDrtnumber   ==> 1-65535
Status        ==> Open
PROtocol     ==> IPic
TRansaction  ==> CISS
Backlog       ==> 00000
TSqprefix    :
Host          ==> ANY
(Mixed Case) ==>
Ipadress      ==> ANY
SPEcificTcps ==>
SOcketclose   ==> No
MAXPersist    ==> No
MAXDatalen    ==> 000032
+             : 0-240000 (HHMMSS)
                  No | 0-65535
                  3-524288
SYSID=CICS APPLID=CICS53Z
```

PF 1 HELP 2 COM 3 END

6 CRSR 7 SBH 8 SFH 9 MSG 10 SB 11 SF 12 CNCL

M8 E 06/022

Connected to remote server/host wg31 using lu/pool TCP00104 and port 23

Features are functional building blocks. When configured here, that function becomes available to the Liberty server

catalog.xml

Design Source

```
<server description="CICS IPIC - catalog">
<!-- Enable features -->
<featureManager>
<feature>zosconnect:cicsService-1.0</feature>
</featureManager>
<zosconnect_cicsIpicConnection id="catalog">
<host>wg31.washington.ibm.com</host>
<port>1491</port>
<transid>CSMI</transid>
<transidUsage>EIB_AND_MIRROR</transidUsage>
</zosconnect_cicsIpicConnection>
</server>
```

Define IPIC connection to CICS



Server XML – Accessing an IMS Transaction using OTMA

ivtnoService Service Configuration

Required Configuration

Enter the required configuration for this service.

Connection profile: **IMSCONN**

Interaction profile: **IMSINTER**

Optional Configuration

Enter the optional configuration for this service.

IMS destination override:

Program name:

Overview Configuration

IMS Connect HWSCFG

```
HWS=(ID=IMS14HWS,XIBAREA=100,RACF=Y,RRS=N)
TCPIP=(HOSTNAME=TCPIP,PORTID=(4000,LOCAL),RACFID=JOHNSON,TIMEOUT=5000)
DATASTORE=(GROUP=OTMAGRP,ID=IVP1, MEMBER=HWSMEM, T MEMBER=OTMAMEM)
IMSPLEX=(MEMBER=IMS14HWS, T MEMBER=PLEX1)
ODACCESS=(ODBMAUTOCONN=Y,
DRDAPORT=(ID=5555,PORTTMOT=6000), ODBMTMOT=6000)
```

connections/ims-connection.xml#

```
<server>
<imsmobile_imsConnection comment="" connectionFactoryRef="CF1" connectionTimeout="-1" connectionType="IMSCONNECT" id="IMSCONN"/>
<connectionFactory containerAuthDataRef="Connection1_Auth" id="CF1">
    <properties.gmoa hostName="wg31.washington.ibm.com" portNumber="4000"/>
</connectionFactory>

<authData id="Connection1_Auth" password="encryptedPassword1" user="userName1"/>
</server>
```

interactions/ims-interactions.xml#

```
<server>
<imsmobile_interaction comment="" commitMode="1" id="IMSINTER" imsConnectCodepage="Cp1047" imsConnectTimeout="0"
    imsDatastoreName="IVP1" interactionTimeout="-1" ltermOverrideName="" syncLevel="0"/>
</server>
```

Server XML – Accessing an IMS Database using ODBA



Service Project Editor: Configuration

Required Configuration

Enter the required configuration for this service.

Connection profile: DFSIVPACConn

ConnectionFactory

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

IMS Connect HWSCFG

```
HWS=(ID=IMS14HWS,XIBAREA=100,RACE=N,RRS=N)
TCPIP=(HOSTNAME=TCPIP,PORTID=(4000,LOCAL),RACFID=JOHNSON,TIMEOUT=5000)
DATASTORE=(GROUP=OTMAGRP,ID=IVP1, MEMBER=HWSMEM,TMEMBER=OTMAMEM)
IMSPLEX=(MEMBER=IMS14HWS,TMEMBER=PLEX1)
ODACCESS=(ODBMAUTOCONN=Y,
DRDAPORT=(ID=5555,PORTTMOT=6000),ODBMTMOT=6000)
```

Server XML - Accessing a Db2 REST service



Service Project Editor: Configuration

Required Configuration

Enter the required configuration for this service.

Connection reference: db2conn

Definition Configuration

DSNL004I -DSN2 DDF START
COMPLETE
LOCATION DSN2LOC
LU
USIBMWZ.DSN2APPL
GENERICLU -NONE
DOMAIN
WG31.WASHINGTON.IBM.COM
TCPPORT 2446
SECPORT 2445
RESPORT 2447

db2pass.xml

Design Source

```
1 <server description="DB2 REST">
2
3   <zosconnect_zosConnectServiceRestClientConnection id="db2conn"
4     host="wg31.washington.ibm.com"
5     port="2446"
6     basicAuthRef="dsn2Auth" />
7
8   <zosconnect_zosConnectServiceRestClientBasicAuth id="dsn2Auth"
9     applName="DSN2APPL"/>
10
11</server>
12
```

The diagram illustrates the mapping between the Service Project Editor's configuration and the db2pass.xml file. A red arrow points from the 'db2conn' connection reference in the editor to the 'basicAuthRef="dsn2Auth"' attribute in the XML. Another red arrow points from the '2446' port value in the configuration table to the 'port="2446"' attribute in the XML.

Server XML - Using JMS to access MQ



*twoWay Service X

Service Project Editor: Configuration

Required Configuration

Enter the required configuration for this service.

Connection factory JNDI name: jms/qmgrCf

Request destination JNDI name: jms/requestQueue

Reply destination JNDI name: jms/replyQueue

Wait interval: 3000

MQMD format: MQSTR

Coded character set identifier (CCSID): 37

Is message persistent:

Reply selection: msgIDToCorrelID

Expiry: -1

Definition Configuration

mq.xml

Design Source

```
2 <featureManager>
3   <feature>zosconnect:mqService-1.0</feature>
4 </featureManager>
5
6 <variable name="wmqJmsClient.rar.location"
7   value="/usr/lpp/mqm/V9R1M1/java/lib/jca/wmq.jmsra.rar"/>
8 <wmqJmsClient nativeLibraryPath="/usr/lpp/mqm/V9R1M1/java/lib"/>
9
10 <connectionManager id="ConMgr1" maxPoolSize="5"/>
11
12 <jmsConnectionFactory id="qmgrCF" jndiName="jms/qmgrCf">
13   connectionManagerRef="ConMgr1">
14   <properties.wmqJMS transportType="BINDINGS"
15     queueManager="QMZ1" />
16 </jmsConnectionFactory>
17
18 <jmsConnectionFactory id="qmgrCF2" jndiName="jms/qmgrCf2">
19   connectionManagerRef="ConMgr1">
20   <properties.wmqJMS transportType="CLIENT"
21     queueManager="ZMQ1"
22     channel="LIBERTY.DEF.SVRCONN"
23     hostName="wg31.washington.ibm.com"
24     port="1422" />
25 </jmsConnectionFactory>
26
27 <jmsQueue id="q1" jndiName="jms/default">
28   <properties.wmqJms
29     baseQueueName="ZCONN2.DEFAULT.MQZCEE.QUEUE"
30     CCSID="37"/>
31 </jmsQueue>
32
33 <jmsQueue id="requestQueue" jndiName="jms/request">
34   <properties.wmqJms
35     baseQueueName="ZCONN2.TRIGGER.REQUEST"
36     targetClient="MQ"
37     CCSID="37"/>
38 </jmsQueue>
39
40 <jmsQueue id="replyQueue" jndiName="jms/replyQueue">
41   <properties.wmqJms
42     baseQueueName="ZCONN2.TRIGGER.RESPONSE"
43     targetClient="MQ"
44     CCSID="37"/>
45 </jmsQueue>
46
47
```

Server XML – Accessing a HATS REST service



```
getCompany.properties - Notepad
File Edit Format View Help
provider=rest
name=getCompany
version=1.0
description=Obtain a list of companies
requestSchemaFile=getCompanyRequest.json
responseSchemaFile=getCompanyResponse.json
verb=POST
uri=/Trader/rest/GetCompany
connectionRef=HatsConn
```

Server Config

hats.xml

Read only Close

Design Source

```
<server description="HATS">
  <zosconnect_zosConnectServiceRestClientConnection id="HatsConn"
    host="wg31.washington.ibm.com"
    port="29080" />
</server>
```

HATS Liberty server.xml

```
<!-- To access this server from a remote client, add a host attribute to the following element, e.g. host="*" -->
<httpEndpoint id="defaultHttpEndpoint"
  httpPort="29080" host="*"
  httpsPort="29443" />
```

Server XML- Accessing an MVS application using WOLA



```
filea.properties - Notepad
File Edit Format View Help
name=Filea
version=1.0
provider=wola
description=Test COBOL batch program
language=COBOL
program=ATSFIL
register=FILEAZCON
connectionRef=wolaCF
requestStructure=./fileareq.cpy
responseStructure=./filearsp.cpy
```

Server Config

wola.xml

Read only Close

Design Source

```
<server description="WOLA">
  <featureManager>
    <feature>zosLocalAdapters-1.0</feature>
  </featureManager>
  <zosLocalAdapters wolaGroup="ZCEESRVR"
    wolaName2="ZCEESRVR"
    wolaName3="ZCEESRVR"/>
  <connectionFactory id="wolaCF"
    jndiName="eis/ola">
    <properties.ola/>
  </connectionFactory>
</server>
```

```
* SET THE VALUES FOR USE WITH WOLA REGISTRATION
  MOVE 'FILEAZCON'          TO REG-REGNAME.
  MOVE 'ZCEESRVR'           TO REG-DAEMONGRP.
  MOVE 'ZCEESRVR'           TO REG-NODE.
  MOVE 'ZCEESRVR'           TO REG-SVRNAME.
  MOVE 'ATSFIL'              TO SVC-SERVICE-NAME.
  INSPECT REG-DAEMONGRP CONVERTING ' ' to LOW-VALUES.
* Register to a Local Liberty server
  CALL 'BBOA1REG' USING
    REG-DAEMONGRP,REG-NODE,REG-SVRNAME,REG-REGNAME,REG-MINCONN,REG-MAXCONN,REG-FLAGS,RSP-RC,RSP-RSN.
```

Server XML – Accessing a DVM server using WOLA



Server Config

dvs.xml

Read only Close

Design Source

```
<?xml version="1.0" encoding="UTF-8"?>
<server description="new server">
  <!-- Enable features -->
  <featureManager>
    <feature>usr:dvsProvider</feature>
    <feature>zosLocalAdapters-1.0</feature>
  </featureManager>
  <!-- Adapter Details with WOLA Group Name (ZCEEDVM) -->
  <zosLocalAdapters wolaName3="NAME3"
    wolaName2="NAME2"
    wolaGroup="ZCEEDVM"/>
  <!-- DVS Service Details with Register Name (ZCEEDVM) -->
  <zosconnect_zosConnectService invokeURI="/dvs">
    serviceDescription=""
    serviceRef="dvsService"
    serviceName="dvsService"
    id="zosConnectDvsService"/>
  <usr_dvsService invokeURI="/dvs">
    serviceName="DVSS1"
    registerName="ZCEEDVM"
    connectionFactoryRef="wolaCF"
    id="dvsService"/>
  <connectionFactory jndiName="eis/ola" id="wolaCF">
    <properties.ola/>
  </connectionFactory>
  <zosconnect_zosConnectService serviceRef="svc1">
    serviceAsyncRequestTimeout="600s"
    serviceName="dvs1" id="sdef1"/>
  <zosconnect_localAdaptersConnectService
    connectionWaitTimeout="7200"
    connectionFactoryRef="wolaCF"
    serviceName="DVSS1"
    registerName="ZCEEDVM"
    id="svc1"/>
</server>
```

DVS.AVZS.SAVZEXEC (AVZSIN00)

```
/*
 * Enable z/OS Connect interface facility
 */
if DoThis then
  do
    /*
     * The following parameter enables the z/OS Connect interface
     * facility.
    */
    "MODIFY PARM NAME(ZCONNECT)           VALUE(YES)"
    "MODIFY PARM NAME(NETWORKBUFFERSIZE)   VALUE(96K)"
  /*
   * The "DEFINE ZCPATH" command(s) can be used to define
   * paths to z/OS Connect regions to handle requests.
   * Use a separate "DEFINE ZCPATH" command to define each
   * path required (Note that a single path can handle
   * several different requests)
   * refer to the documentation for details about the parameters,
   * and information about optional parameters.
  */
    "DEFINE ZCPATH",
    "  NAME(ZCEE)                      '',
    "  RNAME(ZCEEDVM)                  '',
    "  WNAME(ZCEEDVM)                  '',
    ""
end
```

Server XML – Accessing a File Manager server



```
filea.properties - Notepad
File Edit Format View Help
name=filea
provider=filemanager
host=wg31.washington.ibm.com
version=1.0
port=2800
file=USER1.ZCEE.FILEA
template=USER1.ZCEE.TEMPLATE(FILEA)
connid=default
userid=USER1
passwd=USER1

<
Ln 1, Col 1 100% Windows (CRLF) UTF-8 ..:
```

Server Config

filemgr.xml

Read only Close

Design Source

```
<?xml version="1.0" encoding="UTF-8"?>
<server description="new server">
  <!-- Enable features -->
  <featureManager>
    <feature>filemanager:fmProvider-2.0</feature>
  </featureManager>
  <FileManager_Connection id="default">
    <runport>2800</runport>
    <max_timeout>1800</max_timeout>
  </FileManager_Connection>
</server>
```

SYS1.PROCLIB(IPVSRV1)

```
//IPVSRV1 PROC PORT=2800,FAMILY='AF_INET',TRACE=N
//      SET ENV=''
//RUN      EXEC PGM=IPVSRV,REGION=40M,
//      PARM='(&ENV/&PORT &FAMILY &TRACE')
// SET IPV=SYSP.ADFZ.JCL          <== Update HLQ
//STEPLIB  DD DISP=SHR,DSN=ADFZ.SIPVMODA      <== ADFzCC APF LIBRARY
//SYSPRINT DD SYSOUT=*
//IPVTRACE DD SYSOUT=*
//STDOUT   DD SYSOUT=*
///* Server wide, then participating product configurations
//CONFIG   DD DISP=SHR,DSN=&IPV.(IPVCFG)
```

Server XML – API Requester - Accessing an API Provider



```
cscvinc.properties - Notepad
File Edit Format View Help
apiDescriptionFile=./cscvinc.json
dataStructuresLocation=./syslib
apiInfoFileLocation=./syslib
logFileDirectory=./logs
language=COBOL
connectionRef=cscvincAPI
requesterPrefix=csc
Ln 1, Col 1 100% Unix (LF) UTF-8
```

Server Config

apiRequesterHTTPS.xml

Design Source

```
<server description="API Requester">
  <!-- Enable features -->
  <featureManager>
    <feature>zosconnect:apiRequester-1.0</feature>
  </featureManager>
  <zosconnect_apiRequesters location="/global/zosconnect/resources/apiRequesters"
    idAssertion="ASSERT_ONLY">
    <apiRequester name="cscvinc_1.0.0" requireSecure="false"/>
  </zosconnect_apiRequesters>
  <zosconnect_endpointConnection id="mqapi"
    host="http://dvipa.washington.ibm.com"
    port="9443"
    authenticationConfigRef="mySAFAuth"
    connectionTimeout="10s"
    receiveTimeout="40s" />
  <zosconnect_endpointConnection id="cscvincAPI"
    host="https://dvipa.washington.ibm.com"
    port="9443"
    connectionTimeout="10s"
    receiveTimeout="40s" />
  <zosconnect_endpointConnection id="miniloancicsAPI"
    host="https://dvipa.washington.ibm.com"
    port="9443"
    authenticationConfigRef="mySAFAuth"
    connectionTimeout="10s"
    receiveTimeout="40s" />
  <zosconnect_authData id="mySAFAuth"
    user="USER1"
    password="user1" />
</server>
```

Server Config

server.xml

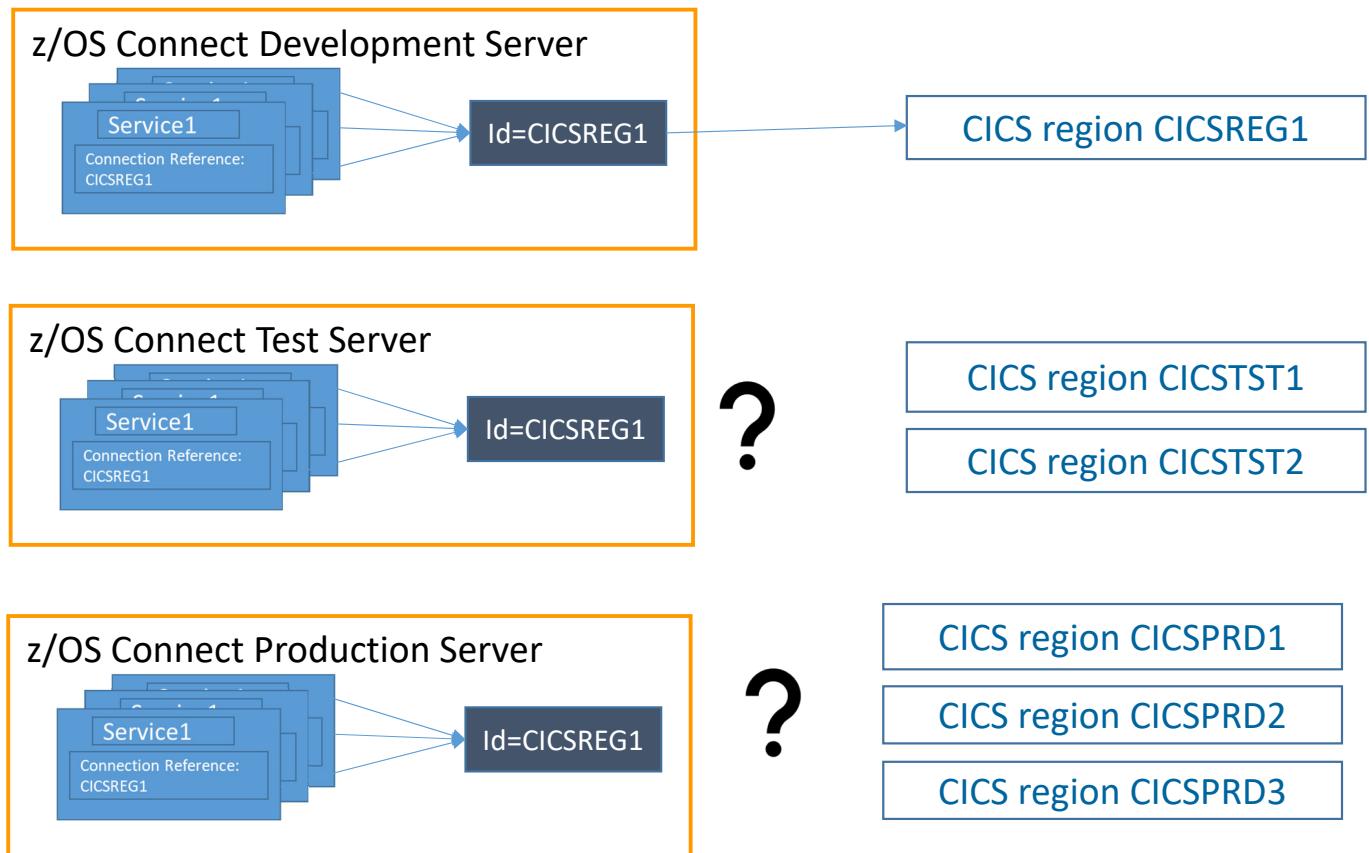
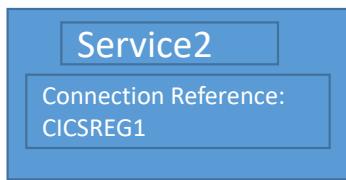
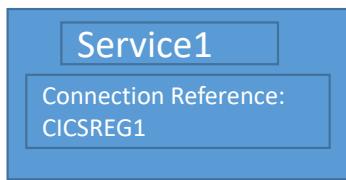
Design Source

```
<!-- To access this server from a remote client add a host attribute to the following
element, e.g. host="*" -->
<httpEndpoint host="*"
  httpPort="9080"
  httpsPort="9443"
  id="defaultHttpEndpoint"/>
```



Use naming conventions for service and endpoint connection references

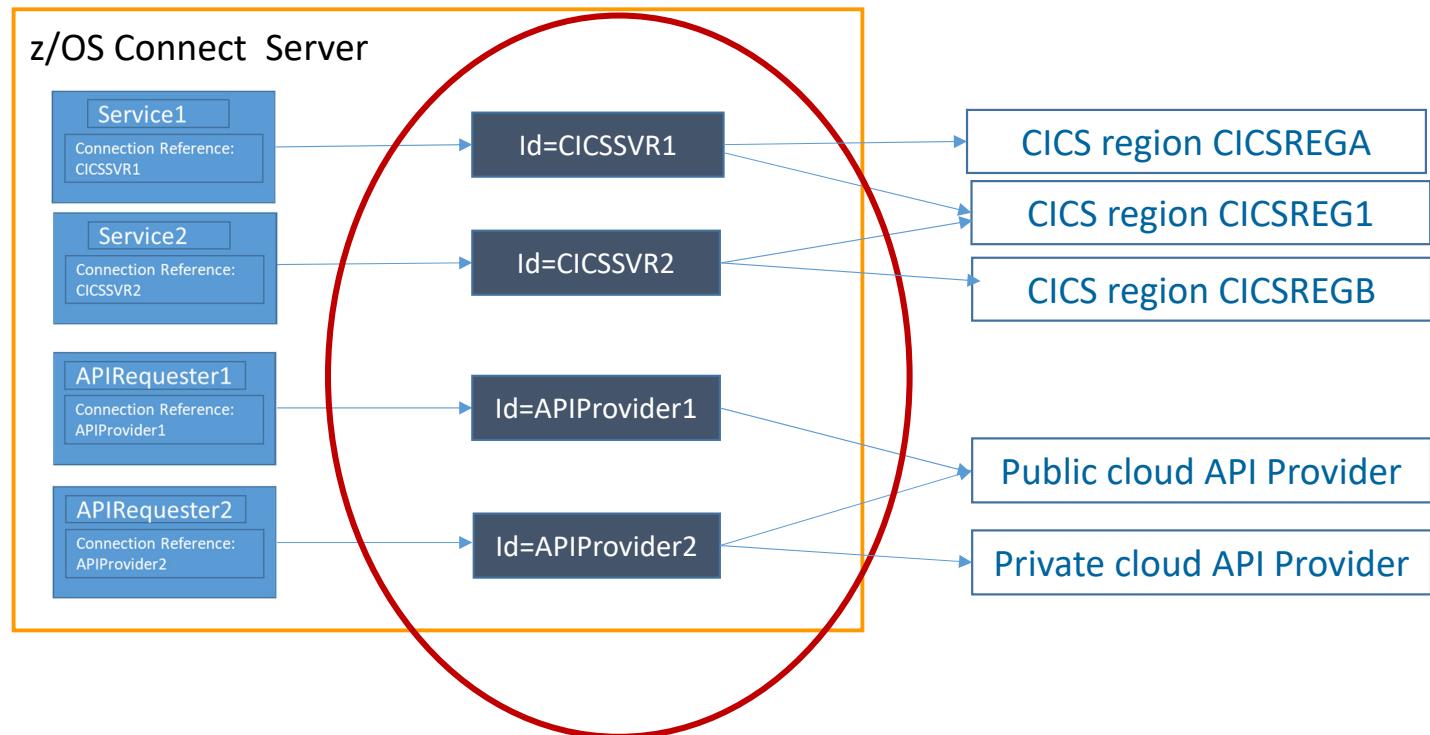
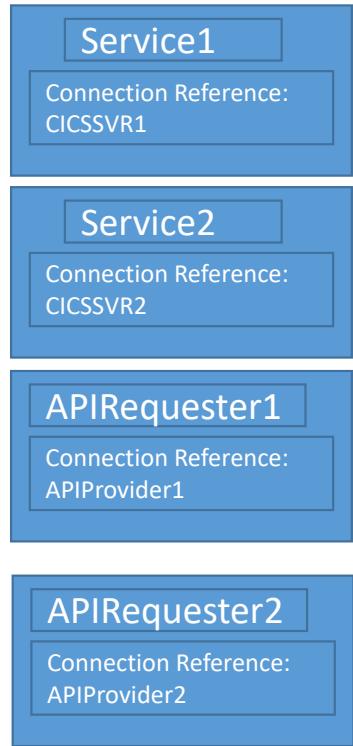
Don't couple service and API requester connection names to specific systems or endpoints





Use naming conventions for connection references

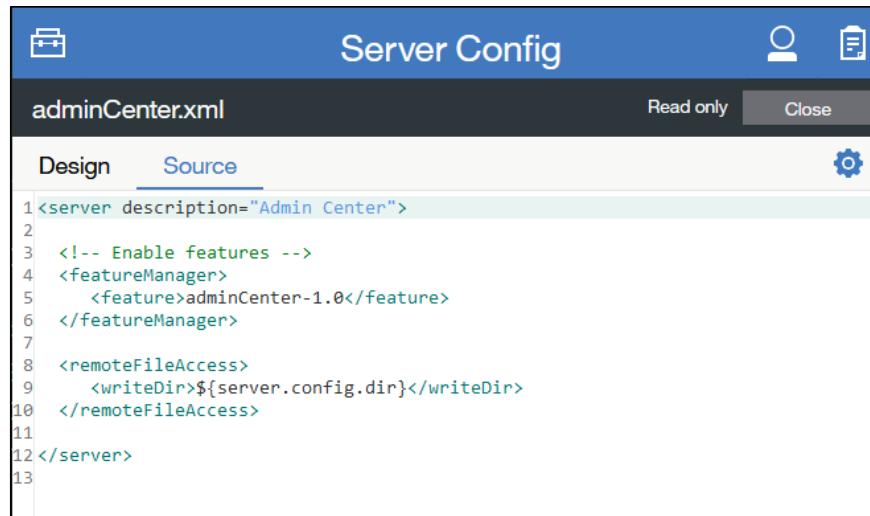
Use application meaningful names or an extendable convention for connection reference names



Useful Liberty features and MVS commands

Use the adminCenter-1.0 feature to update the server XML from a browser

Administrators can use a web interface to maintain the server XML configuration.



```
Server Config
adminCenter.xml
Read only Close

Design Source

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
```

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

Tech-Tip: Liberty's “adminCenter” Feature to update server XML

- Web browser interface to the server's configuration files

The screenshot shows the IBM Liberty adminCenter interface for managing server configuration files. The main window title is "Server Config" and the file being edited is "server.xml". The interface has two tabs: "Design" and "Source". The "Source" tab is currently active, showing the XML code for the configuration.

```

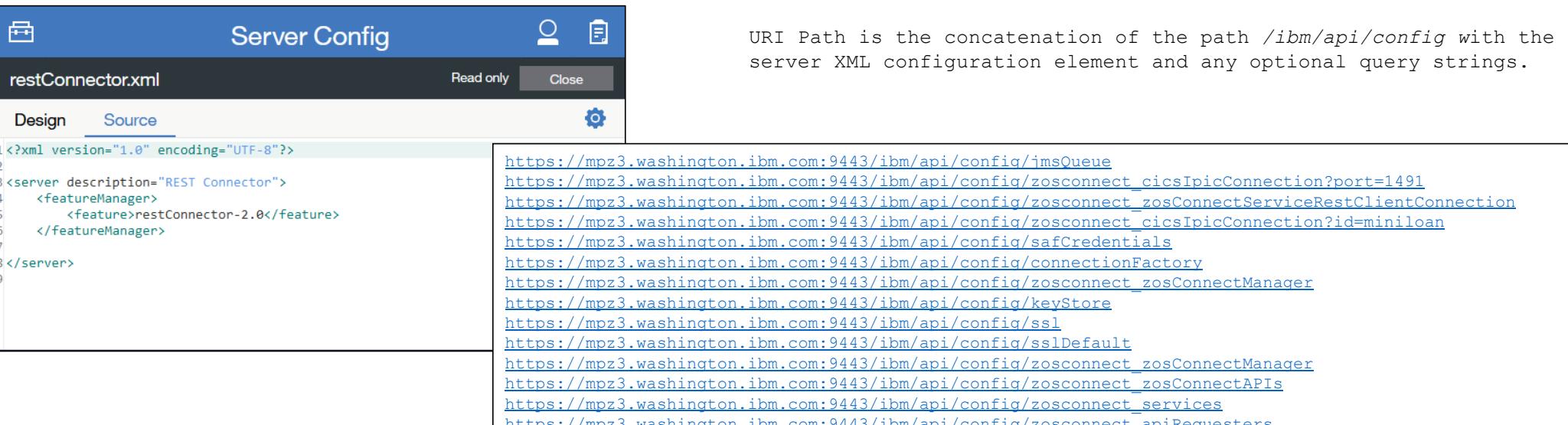
<server description="new server">
  <include location="/var/zosconnect/servers/myServer/resources/imsmobile-config/services/ims-services.xml" optional="true"/>
  <include location="/var/zosconnect/servers/myServer/resources/imsmobile-config/interactions/ims-interactions.xml" optional="true"/>
  <include 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/safTrace.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 />
      </zosconnect_apiRequesters>
    </zosconnect_apiRequester>
  </wsSecurityProvider>
  <!-- To access this server from a remote client add a host attribute to the following element, e.g. host="*" -->
  <httpEndpoint host="*" httpPort="9080" httpsPort="9443" id="defaultHttpEndpoint"/>
  <!-- add cors to allow cross origin access, e.g. when using swagger UI to fetch swagger doc from zOS Connect Enterprise Edition -->
  <cors allowCredentials="true" allowedHeaders="Origin, Content-Type, Authorization, Cache-Control, Expires, Pragma" allowedMethods="GET, POST, PUT, PATCH, DELETE, HEAD, OPTIONS" maxAge="1800" />
</server>

```

A red oval highlights the status bar message "Press Ctrl+space for content assist." A modal dialog titled "Preserve JSON payload character format" is open, showing options "true" and "false (default)". Another smaller modal dialog titled "Partial reader group" is also visible.

Use the restConnector-2.0 feature to see real time configuration details

A secure, REST administrative connector that enables remote access from a Java client or Web browser (GET only) or directly through an HTTPS call to the current runtime configuration.



The screenshot shows the 'Server Config' interface with the 'restConnector.xml' file open. The 'Source' tab is selected, displaying the XML configuration:

```

1<?xml version="1.0" encoding="UTF-8"?>
2
3<server description="REST Connector">
4  <featureManager>
5    <feature>restConnector-2.0</feature>
6  </featureManager>
7
8</server>
9

```

To the right, a list of REST endpoints is shown, each starting with <https://mpz3.washington.ibm.com:9443>:

- [ibm/api/config/jmsQueue](https://mpz3.washington.ibm.com:9443/ibm/api/config/jmsQueue)
- [ibm/api/config/zosconnect_cicsIpicConnection?port=1491](https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_cicsIpicConnection?port=1491)
- [ibm/api/config/zosconnect_zosConnectServiceRestClientConnection](https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_zosConnectServiceRestClientConnection)
- [ibm/api/config/zosconnect_cicsIpicConnection?id=miniloan](https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_cicsIpicConnection?id=miniloan)
- [ibm/api/config/safCredentials](https://mpz3.washington.ibm.com:9443/ibm/api/config/safCredentials)
- [ibm/api/config/connectionFactory](https://mpz3.washington.ibm.com:9443/ibm/api/config/connectionFactory)
- [ibm/api/config/zosconnect_zosConnectManager](https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_zosConnectManager)
- [ibm/api/config/keyStore](https://mpz3.washington.ibm.com:9443/ibm/api/config/keyStore)
- [ibm/api/config/ssl](https://mpz3.washington.ibm.com:9443/ibm/api/config/ssl)
- [ibm/api/config/sslDefault](https://mpz3.washington.ibm.com:9443/ibm/api/config/sslDefault)
- [ibm/api/config/zosconnect_zosConnectManager](https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_zosConnectManager)
- [ibm/api/config/zosconnect_zosConnectAPIs](https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_zosConnectAPIs)
- [ibm/api/config/zosconnect_services](https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_services)
- [ibm/api/config/zosconnect_apiRequesters](https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_apiRequesters)

Below the configuration file, a RACF command block is shown:

```

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(USER1) ACCESS(READ)
PERMIT BBGZDFLT.com.ibm.ws.management.security.resource.Reader CLASS(EJBROLE) ID(ZCEEUSRS) ACCESS(READ)
SETR RACLIST(EJBROLE) REFRESH

```

restConnector-2.0 feature examples

<https://mpz3.washington.ibm.com:9443/ibm/api/config/safCredentials>



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

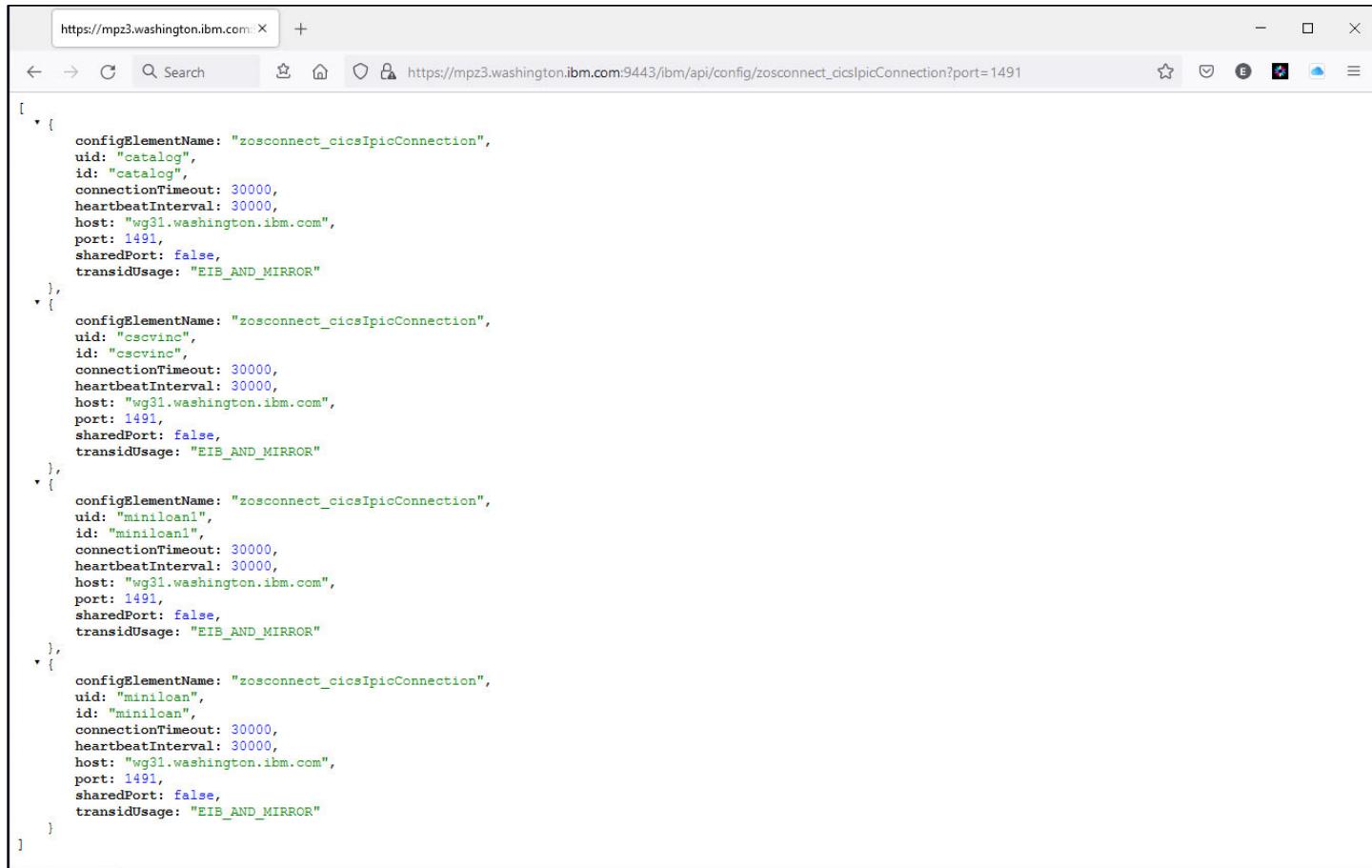
https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_zosConnectServiceRestClientConnection?port=2446



```
[{"configElementName": "zosconnect_zosConnectServiceRestClientConnection", "uid": "Db2Conn", "id": "Db2Conn", "allowChunking": true, "basicAuthRef": {"configElementName": "zosconnect_zosConnectServiceRestClientBasicAuth", "uid": "dns2Auth", "id": "dns2Auth", "password": "*****", "userName": "USER1"}, "connectionTimeout": 30000, "host": "sg31.washington.ibm.com", "port": "2446", "receiveTimeout": 60000} ]
```

restConnector-2.0 feature

https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_cicsIpicConnection?port=1491



The screenshot shows a web browser window displaying a JSON array of configuration elements. The URL in the address bar is https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_cicsIpicConnection?port=1491. The JSON data lists four connection configurations:

```
[{"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"}]
```

restConnector-2.0 feature

https://mpz3.washington.ibm.com:9443/ibm/api/config/zosconnect_services

```

File Edit View History Bookmarks Tools Help
https://mpz3.washington.ibm.com:9443/ibm/api/cor ...
[{"configElementName": "zosconnect_services", "location": "/global/zosconnect/resources/services", "pollingRate": 5000, "service": [{"configElementName": "service", "uid": "zosconnect_services/service/default-0", "name": "mqPutService", "property": [{"configElementName": "property", "uid": "zosconnect_services/service/default-0]/property/default-0", "name": "useCallerPrincipal", "value": "*****"}], "runGlobalInterceptors": true}, {"updateTrigger": "disabled"}]}

```

<https://mpz3.washington.ibm.com:9443/ibm/api/config/featureManager>

```

File Edit View History Bookmarks Tools Help
https://mpz3.washington.ibm.com:9443/ibm/api/config/fe ...
[{"configElementName": "featureManager", "feature": [{"name": "appSecurity-2.0", "version": "1.0"}, {"name": "zosSecurity-1.0", "version": "1.0"}, {"name": "zosconnect:cicsService-1.0", "version": "1.0"}, {"name": "transportSecurity-1.0", "version": "1.0"}, {"name": "zosconnect:apiRequester-1.0", "version": "1.0"}, {"name": "zosconnect:apiRequester-1.0", "version": "1.0"}, {"name": "zosconnect:mqService-1.0", "version": "1.0"}, {"name": "zosWlm-1.0", "version": "1.0"}, {"name": "restConnector-2.0", "version": "1.0"}, {"name": "monitor-1.0", "version": "1.0"}, {"name": "zosRequestLogging-1.0", "version": "1.0"}, {"name": "adminCenter-1.0", "version": "1.0"}, {"name": "apiDiscovery-1.0", "version": "1.0"}, {"name": "zosconnect:zosConnect-2.0", "version": "1.0"}, {"name": "zosconnect:zosConnectCommands-1.0", "version": "1.0"}, {"name": "imsmobile:imsmobile-2.0", "version": "1.0"}], "onError": "WARN"}]

```

Use the apiDiscovery-1.0 feature to execute RESTful APIs directly*



The screenshot shows a browser window titled "IBM REST API Documentation". The URL is <https://mpz3.washington.ibm.com:9443/api/explorer/#/cscvinc>. The page displays the "Liberty REST APIs" section, specifically for the "cscvinc" service. It lists several REST operations:

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

For each operation, there are "Show/Hide", "List Operations", and "Expand Operations" links.

*V3.0.48

Liberty MVS Commands

F BAQSTRT,REFRESH,CONFIG

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

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 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 JOBNAM ZCEEAPIR PID 16777398
CWWKB0080I ACTIVE SERVER ASID 4b JOBNAM ZCEEDVM PID 50331780
CWWKB0080I ACTIVE SERVER ASID 4f JOBNAM WLPRPSRV PID 138
CWWKB0080I ACTIVE SERVER ASID 4a JOBNAM ZCEESRVR PID 50331815
CWWKB0080I ACTIVE SERVER ASID 50 JOBNAM ZCEEOPID PID 33554605
CWWKB0080I ACTIVE SERVER ASID 4c JOBNAM ZCEEHATS PID 143
CWWKB0080I ACTIVE SERVER ASID 4e JOBNAM WLPOPSRV PID 33554565
CWWKB0080I ACTIVE SERVER ASID 58 JOBNAM MQWEBS PID 152
```

F BAQZANGL,VERSION

Displays the version level of the angel

z/OS Connect MVS Commands



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.

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

Where do I look when things go wrong?

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 this these categories.

- **Basic Security issues**
 - Insufficient access to local SAF resources, e.g., APPL, EJBROLE, 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.c1210620210527-1900)
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@MPZ3
*****
[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 .securityopenidconnect.client.internal.OidcClientConfigImpl
[9/3/21 13:41:31:691 GMT] 00000045 rity.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
I 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

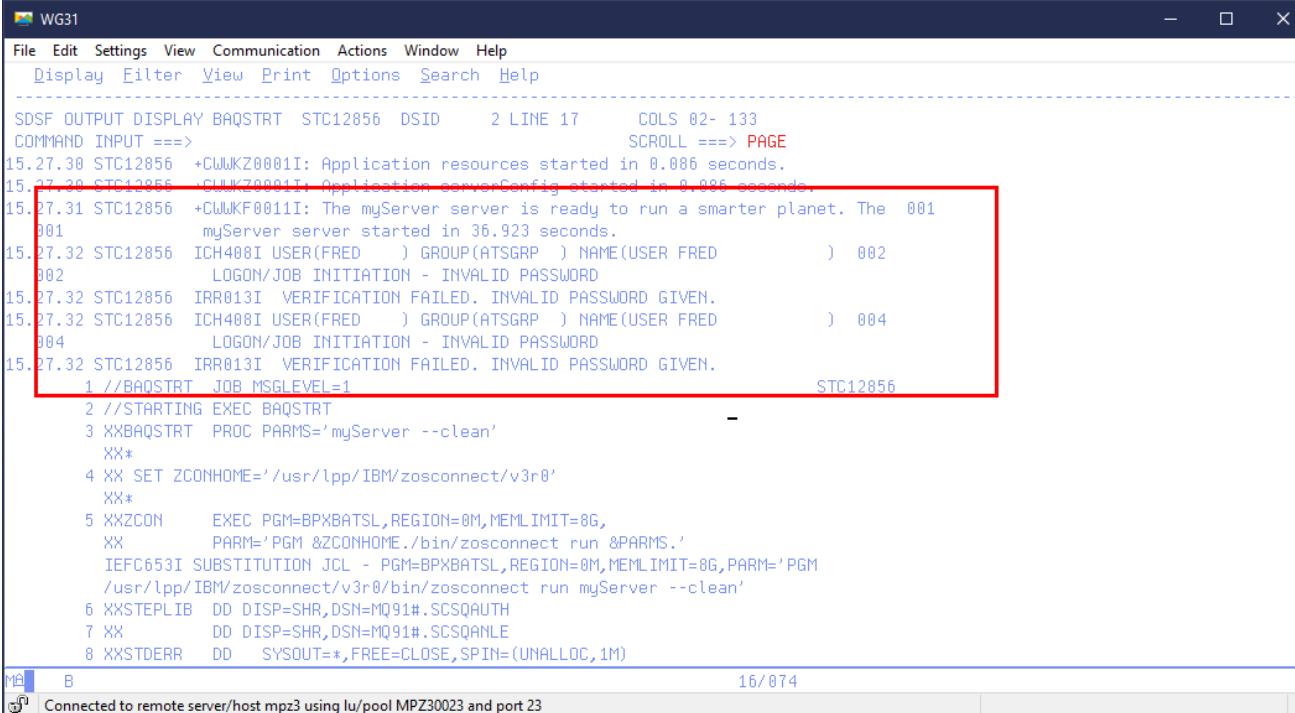
The STDOUT may show:

```
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 JESMSGGLG and SYSLOG displays:



```
WG31
File Edit Settings View Communication Actions Window Help
Display Filter View Print Options Search Help

SDSF 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 0.085 seconds.
15.27.31 STC12856 +CWWKF0011I: 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 //BADSTRT 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)
```



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:

```
WG31  
File Edit Settings View Communication Actions Window Help  
File Edit Edit_Settings Menu Utilities Compilers Test Help  
VIEW      /MPZ3/var/zosconnect/servers/myServer/logs/messages.log  
Command ==> -  
Columns 00100 00223  
Scroll ==> PAGE  
000256 CWWKS1100A: Authentication did not succeed for user ID FRED. An invalid user ID or password was specified.  
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 *****  
A B  
Connected to remote server/host mpz3 using lu/pool MPZ30023 and port 23  
04/015
```

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

From URL <https://www.ibm.com/docs/en/zos/2.4.0?topic=acee-return-reason-codes>



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

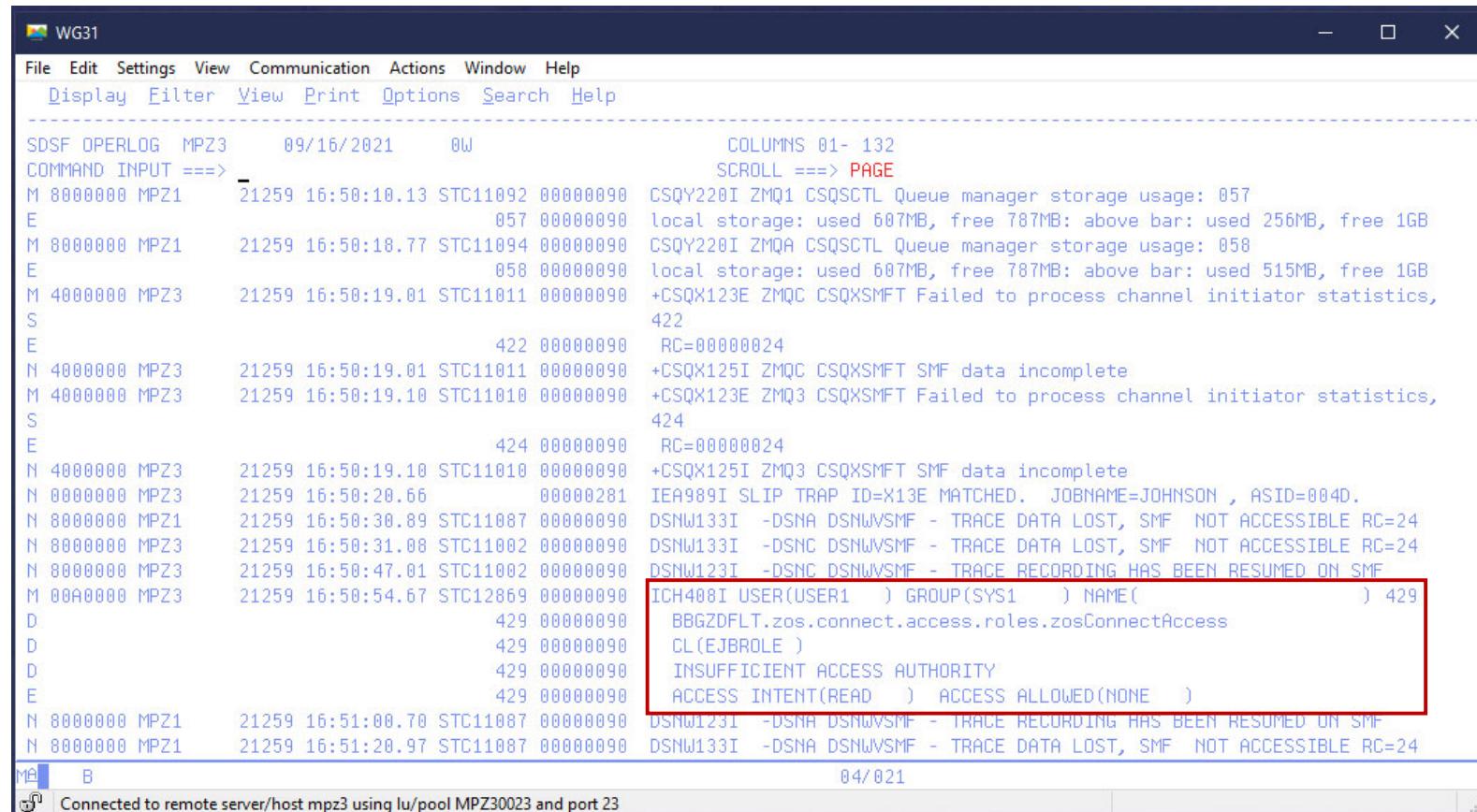
```
SDSF OUTPUT DISPLAY BAQSTRT STC12844 DSID 103 LINE 98      COLS 02- 133
COMMAND INPUT ==> SCROLL ==> PAGE
AUDIT  " CWWKZ0001I: Application serverConfig started in 4.006 seconds.
AUDIT  " CWWKZ0001I: Application resources started in 4.007 seconds.
AUDIT  " CWWKT0016I: Web application available (default_host): 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.
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 *****
```

M A B 04/021

Connected to remote server/host mpz3 using lu/pool MPZ30019 and port 23

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
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 000000281 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 DSNW123T -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

```

Connected to remote server/host mpz3 using lu/pool MPZ30023 and port 23

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 - 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

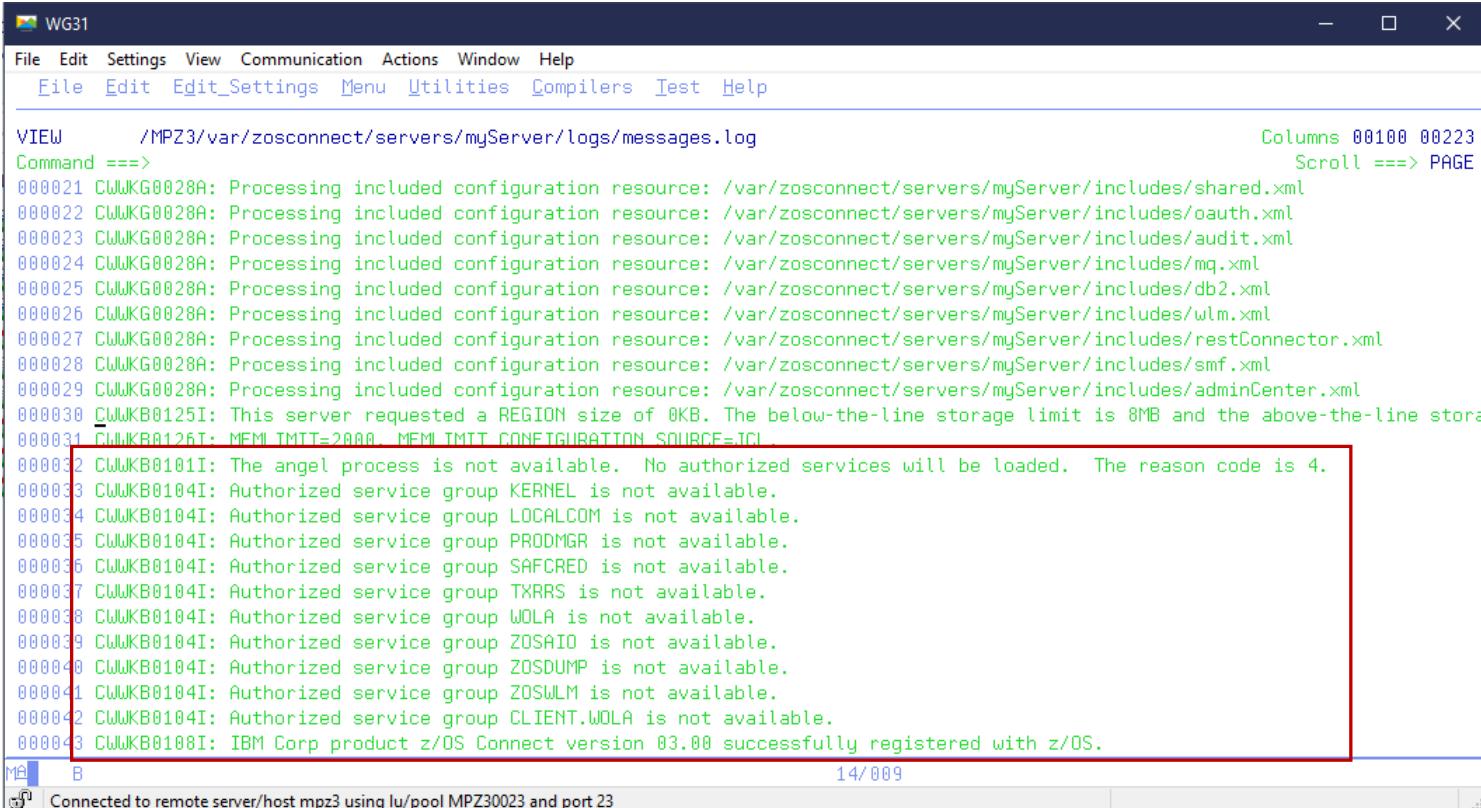
16.31.55 STC12862 ---- THURSDAY, 16 SEP 2021 ----
16.31.55 STC12862 IEF695I START BAQSTRT WITH JOBNAME BAQSTRT IS ASSIGNED TO USER LIBSERV , GROUP LIBGRP
16.31.55 STC12862 $HASP373 BAQSTRT STARTED
16.32.03 STC12862 +CLWJKE0001I: The server myServer has been launched.
16.32.20 STC12862 BPXMF023I (LIBSERV) 282
   282          GMDIG7777I: IMS service provider (20210816-0926) for z/OS Connect
   282          Enterprise Edition initialized successfully.
16.32.50 STC12862 +CLWJKZ0001I: Application resources started in 14.912 seconds.
16.32.50 STC12862 +CLWJKZ0001I: Application serverConfig started in 14.910 seconds.
16.32.55 STC12862 +CLWJKF0011I: 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.*

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.



```
WG31
File Edit Settings View Communication Actions Window Help
File Edit Edit_Settings Menu Utilities Compilers Test Help
VIEW      /MPZ3/var/zosconnect/servers/myServer/logs/messages.log          Columns 00100 00223
Command ==>                                         Scroll ==> PAGE
000021 CUWKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/shared.xml
000022 CUWKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/oauth.xml
000023 CUWKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/audit.xml
000024 CUWKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/mq.xml
000025 CUWKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/db2.xml
000026 CUWKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/wlm.xml
000027 CUWKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/restConnector.xml
000028 CUWKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/smf.xml
000029 CUWKG0028A: Processing included configuration resource: /var/zosconnect/servers/myServer/includes/adminCenter.xml
000030 CUWKB0125I: This server requested a REGION size of 8KB. The below-the-line storage limit is 8MB and the above-the-line stor
000031 CUWKB0126I: MEM1 TMIT=2000... MEM1 TMIT CONFIGURATION SOURCE=TCI
000032 CUWKB0101I: The angel process is not available. No authorized services will be loaded. The reason code is 4.
000033 CUWKB0104I: Authorized service group KERNEL is not available.
000034 CUWKB0104I: Authorized service group LOCALCOM is not available.
000035 CUWKB0104I: Authorized service group PRODMGR is not available.
000036 CUWKB0104I: Authorized service group SAFCRED is not available.
000037 CUWKB0104I: Authorized service group TXRRS is not available.
000038 CUWKB0104I: Authorized service group WOLA is not available.
000039 CUWKB0104I: Authorized service group ZOSAIO is not available.
000040 CUWKB0104I: Authorized service group ZOSDUMP is not available.
000041 CUWKB0104I: Authorized service group ZOSWLM is not available.
000042 CUWKB0104I: Authorized service group CLIENT.WOLA is not available.
000043 CUWKB0108I: IBM Corp product z/OS Connect version 03.00 successfully registered with z/OS.
MA B
Connected to remote server/host mpz3 using lu/pool MPZ30023 and port 23
14/009
```



External resource issues (HTTP 500) - CICS

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://mpz3.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://mpz3.washington.ibm.com:9443/cscvinc/employee/948478.
```



External resource issues (HTTP 500) – Db2

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://mpz3.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"}
```

```
[9/14/21 20:04:59:821 GMT] 00000048 com.ibm.ws.logging.internal.impl.IncidentImpl I FFDC1015I: An FFDC  
Incident has been created: "javax. ws.rs.InternalServerErrorException: HTTP 500 Internal Server Error  
com.ibm.zosconnect.service.client.rest.internal.SarRestClientServiceImpl 528" at ffdc_21.09.14_20.04.59.0.log
```

```
[9/14/21 20:04:59:826 GMT] 00000048 com.ibm.zosconnect.internal.web.ServiceProxyServlet W BAQR0429W: API db2employee  
encountered an error while processing a request under URL https://mpz3.washington.ibm.com:9443/db2/employee/details/000050.  
[9/14/21 20:05:00:045 GMT] 00000046 osconnect.service.client.rest.internal.RestClientServiceImpl E BAQR0558E: The remote  
service invocation failed with response message: HTTP 500 Internal Server Error and response body:  
{"StatusCode":500,"StatusDescription":"Service zCEEService.selectEmployee execution 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.

Let's step back - 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.IMSTCIPManagedConnection@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.IMSTCIPManagedConnection.callSendRecv(IMSTCIPManagedConnection.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.executeTransServiceInputTMRA(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)
```

IMS service provider classes
z/OS Connect Java classes

A Google search of ICO0001E 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

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



z/OS Connect Java classes

```
-----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"
```

Root cause – Keyring configuration issue

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.CicsIpccConnection.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

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 = MPZ3
. . .
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
BPX1CL0: RetVal = 0, RC = 0, Reason = 0x00000000
GetAddrInfo Failed: RetVal = -1, RC = 1, Reason = 0x78AE1004
GetAddrInfo Ended: 2021/09/12 12:55:32.364732
*****
EZB3111I Unknown host 'WG31.WASHINGTON.IBM.COM'
```

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

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.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.  
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.DetailedJMSEception: 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 unexpectedJMSEception  
occurred while processing a request for service 'mqGetService'. The exception message was 'MQJCA1011: Failed to allocate a JMS connection.'
```

Spacing added between lines to improve readability

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Slide 97

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.ManagedConnectionFactoryImpl.<init>(ManagedConnectionFactoryImpl.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.createManagedJMSSession(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.DetailedJMSException: 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.



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

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 (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 personal certificate 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>



Other common TLS handshake issues

- ***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.SSLEException: Received fatal alert: bad_certificate error (handshake), vc=1083934466
Caught exception during unwrap, javax.net.ssl.SSLEException: 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.

- ***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.

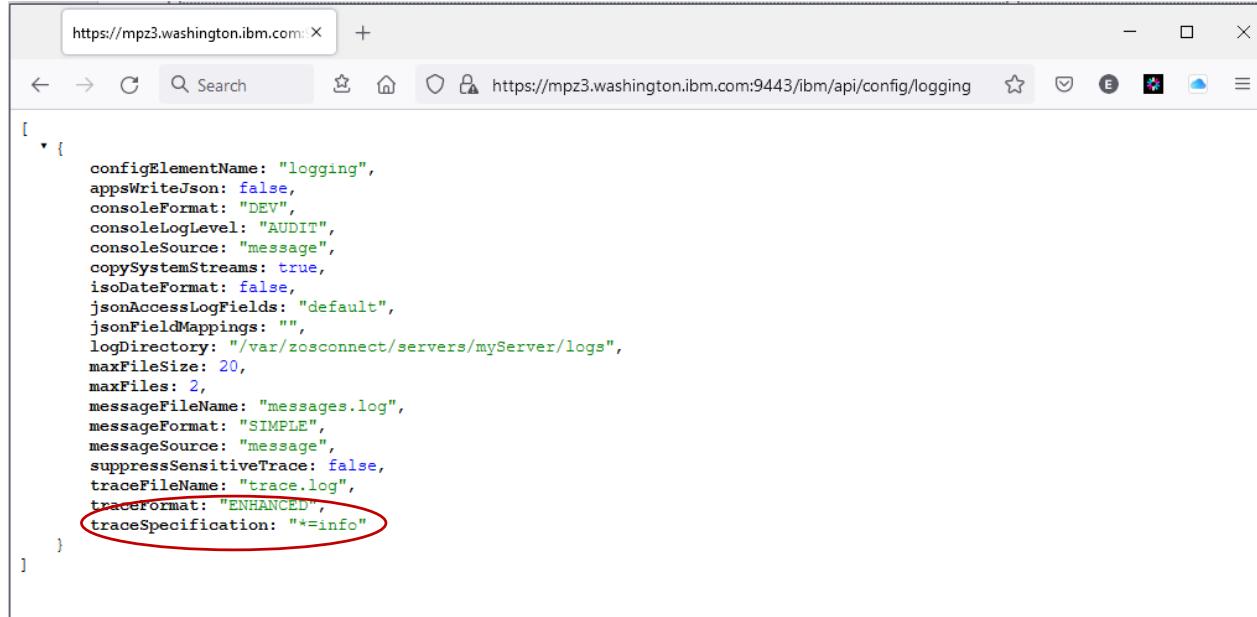
The first FACILITY resource gives the identity access to their own key ring and the second allows access to the certificates. Of if virtual keyrings are in use, then the identity needs READ or UPDATE authority to the <ringOwner>.<ringName>.LST resource in the RDATALIB class. READ access enables retrieving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

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://mpz3.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", "tracerFormat": "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 BAQSTRT,REFRESH,CONFIG

Disable enhanced tracing

F BAQSTRT,LOGGING='*=INFO'

Or

F BAQSTRT,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/usr/zosconnect/servers/myServer/logs/trace.log

Command ==>

003637 > getSSLConfig: DefaultSSLSettings Entry
003638 < getSSLConfig Exit
003639 SSLConfig.toString() {

003683 > determineIfCSIV2SettingsApply Entry
003684 (com.ibm.ssl.remoteHost:*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl)
003685 < determineIfCSIV2SettingsApply (original settings) Exit

003730 3 keyStoreType: JCERACFKS
003731 3 trustStoreType: JCERACFKS

003734 3 keyStore: safkeuring:///Liberty.KeyRing
003735 3 keyStoreName: CellDefaultKeyStore
003736 3 keyStorePassword: *****
003737 3 trustStore: safkeuring:///Liberty.KeyRing
003738 3 trustStoreName: CellDefaultKeyStore
003739 3 trustStorePassword: *****

003741 (com.ibm.ssl.remoteHost:*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl)
004117 K 3 Error occurred during a read, exception:javax.net.ssl.SSLHandshakeException: Empty server certificate chain
004119 3 Caught exception during unwrap, javax.net.ssl.SSLHandshakeException: Empty server certificate chain
004142 (com.ibm.ssl.remoteHost:*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl)
004144 > isTransportSecurityEnabled Entry
004145 < isTransportSecurityEnabled true Exit

004150 > getSSLConfig: DefaultSSLSettings Entry
004151 < getSSLConfig Exit
004152 SSLConfig.toString() {

004196 > determineIfCSIV2SettingsApply Entry
004197 (com.ibm.ssl.remoteHost:*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl)
004198 < determineIfCSIV2SettingsApply (original settings) Exit

004243 3 keyStoreType: JCERACFKS
004244 3 trustStoreType: JCERACFKS

004247 3 keyStore: safkeuring:///Liberty.KeyRing
004248 3 keyStoreName: CellDefaultKeyStore
004249 3 keyStorePassword: *****
004250 3 trustStore: safkeuring:///Liberty.KeyRing
004251 3 trustStoreName: CellDefaultKeyStore
004252 3 trustStorePassword: *****

004254 (com.ibm.ssl.remoteHost:*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl)
004630 K 3 Error occurred during a read, exception:javax.net.ssl.SSLHandshakeException: Empty server certificate chain
004632 3 Caught exception during unwrap, javax.net.ssl.SSLHandshakeException: Empty server certificate chain
004655 (com.ibm.ssl.remoteHost:*, com.ibm.ssl.direction=inbound, com.ibm.ssl.remotePort=9443, com.ibm.ssl.endPointName=defaultHttpEndpoint-ssl)
004657 > isTransportSecurityEnabled Entry
004658 < isTransportSecurityEnabled true Exit

Columns 00101 00252
Scroll ==> PAGE

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- 44 Line(s) not Displayed
- 2 Line(s) not Displayed
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- 43 Line(s) not Displayed
- 44 Line(s) not Displayed
- 2 Line(s) not Displayed
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- 375 Line(s) not Displayed
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- 22 Line(s) not Displayed
- 1 Line(s) not Displayed
- 1 Line(s) not Displayed
- 375 Line(s) not Displayed
- 1 Line(s) not Displayed

MAP A 03/019

Connected to remote server/host mpz3 using lu/pool MPZ30006 and port 23

Use thread number and/or package name to control which trace records are displayed

Monitoring Java, Liberty and z/OS Connect

Java Health Center – Monitors the Java environment



Configuring the Monitoring Agent using JVM directives

Java Directives

- Xhealthcenter:level=headless *run without a client*
- Dcom.ibm.java.diagnostics.healthcenter.headless.output.directory=/var/zcee/hcd *directory where HCD will be stored*
- Dcom.ibm.java.diagnostics.healthcenter.socket.readwrite=on *collect socket sent/receive data*
- Dcom.ibm.java.diagnostics.healthcenter.headless.files.to.keep=2 *number of HCD files to retain*
- Dcom.ibm.java.diagnostics.healthcenter.headless.delay.start=value=0 *delay start value in minutes*
- Dcom.ibm.java.diagnostics.healthcenter.headless.run.pause.duration=0 *pause between runs, in minutes*
- Dcom.ibm.java.diagnostics.healthcenter.headless.run.duration=0 *run duration, in minutes*
- Dcom.ibm.java.diagnostics.healthcenter.headless.run.number.of.runs=0 *number of runs*
- Dcom.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

```
-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>

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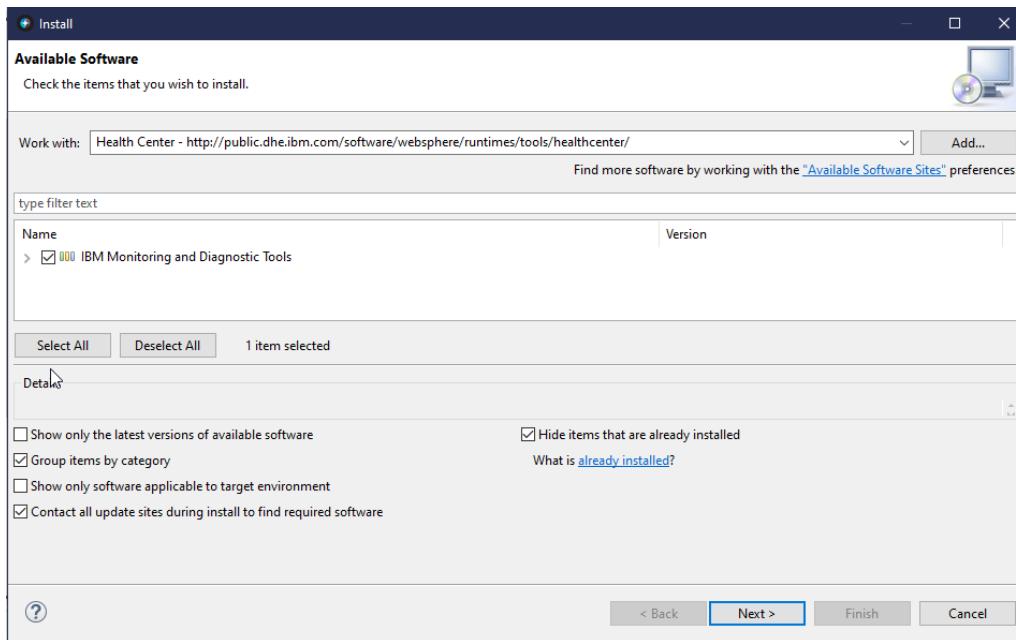
Java Health Center – Monitoring Agent Configuration

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

```
SYS1.PROCLIB(BAQSTRT)
//BAQSTRT PROC PARM='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
```

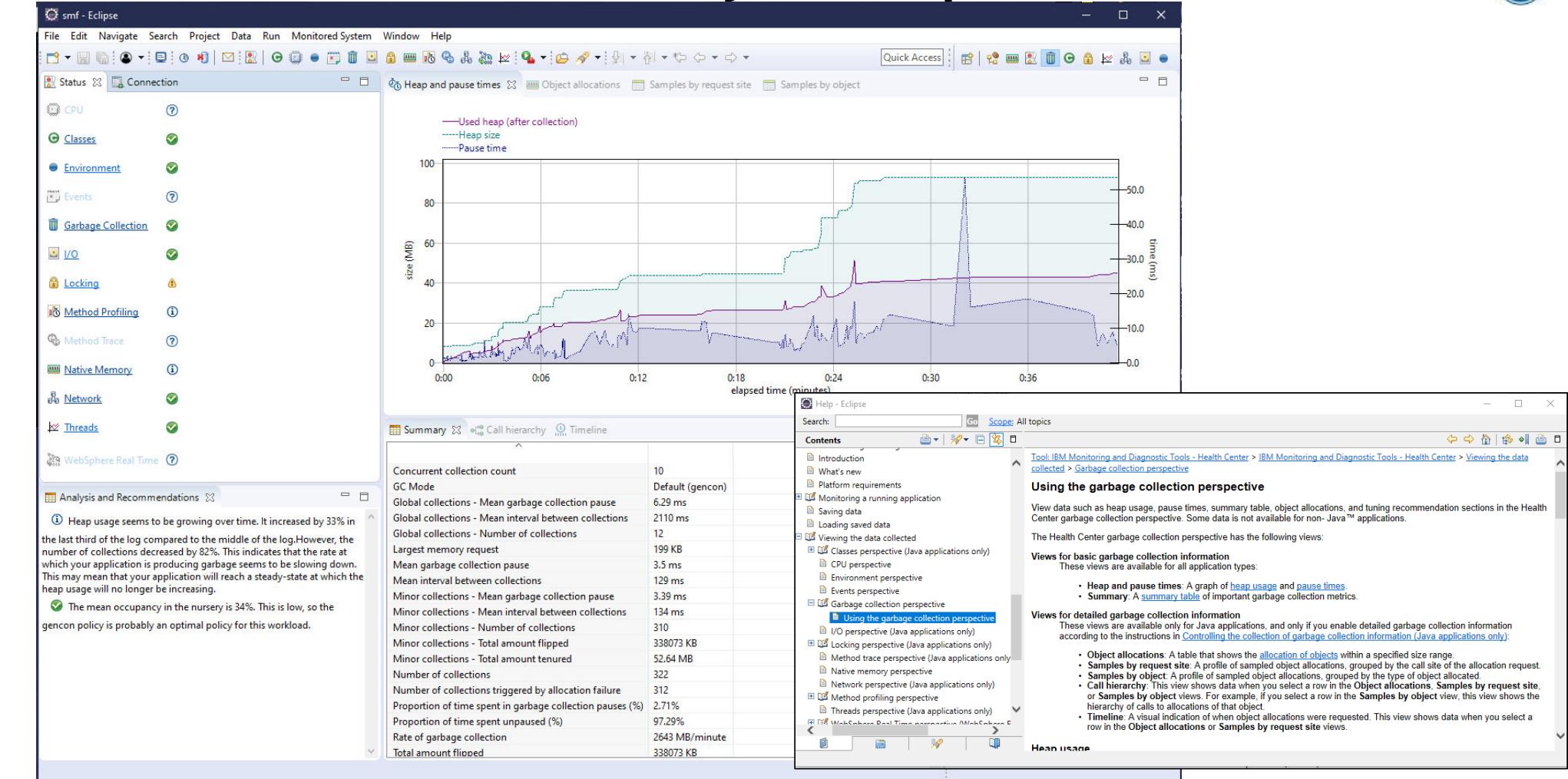
Java Health Center – Client Configuration

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



The plug-in is available for download from <http://public.dhe.ibm.com/software/websphere/runtimes/tools/healthcenter/>

Java Health Center – HEAP analysis example



Java Health Center – Network analysis example



smf - Eclipse

File Edit Navigate Search Project Data Run Monitored System Window Help

Status Connection

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

Analysis and Recommendations

- Your application has made 1,270 open socket requests and 820 close socket requests.
- Your application has 17 open sockets.
- No problems detected

Sockets

Socket ID filter:

| 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 | 65470 | 32953 bytes | 38334 bytes | Open | [0x2a00aa00] Default... |
| 112 | Server | 0:0:0:ffff:c0a8:3c | 59411 | | | Open | [0x2a253d00] Shared... |
| 127 | Server | 0:0:0:ffff:c0a8:3c | 2446 | 87343 bytes | 98768 bytes | Closed | [0x2a019f00] Default... |
| 136 | Server | 0:0:0:ffff:c0a8:11c9 | 9080 | | | Open | [0x2b38c800] Default... |
| 138 | ServerS... | 0:0:0:0:0 | 59412 | 4248 bytes | 8818 bytes | Open | [0x2a253d00] Shared... |
| 144 | Server | 0:0:0:ffff:c0a8:3c | 9443 | | | Open | [0x2a019f00] Default... |
| 164 | ServerS... | 0:0:0:0:0 | 176 | | | Open | [0x2a253d00] Shared... |
| 183 | Client | 0:0:0:ffff:c0a8:11c9 | 4000 | 182558 bytes | 186691 bytes | Closed | [0x2a00aa00] Default... |
| 186 | Server | 0:0:0:ffff:c0a8:11f3 | 7883 | | | Open | [0x2a14f400] Default... |
| 196 | Server | 0:0:0:ffff:c0a8:3c | 61723 | | | Closed | [0x29fcbb00] Default... |
| 204 | Server | 0:0:0:ffff:c0a8:11f3 | 7880 | 1428 bytes | 602 bytes | Open | [0x2a253d00] Shared... |
| 215 | Client | 0:0:0:ffff:c0a8:11c9 | 1491 | 116825 bytes | 62048 bytes | Open | [0x2b38c800] Default... |
| 226 | Server | 0:0:0:ffff:c0a8:11f3 | 7863 | 2447 bytes | 1059 bytes | Closed | [0x2a00aa00] Default... |
| 227 | Server | 0:0:0:ffff:c0a8:11f3 | 9463 | 9892 bytes | 8675 bytes | Open | [0x2aa3c100] Default... |
| 228 | Server | 0:0:0:ffff:c0a8:11f3 | 7849 | | | Closed | [0x29fcbb00] Default... |
| 230 | Server | 0:0:0:ffff:c0a8:11f3 | 7850 | 39936 bytes | 54048 bytes | Open | [0x2a00aa00] Default... |
| 231 | Server | 0:0:0:ffff:c0a8:11f3 | 9463 | 10868 bytes | 7460 bytes | Open | [0x2a14f400] Default... |
| 233 | Server | 0:0:0:ffff:c0a8:11f3 | 7810 | 22059 bytes | 11436 bytes | Open | [0x2a00aa00] Default... |
| 234 | Server | 0:0:0:ffff:c0a8:11f3 | | | | Closed | [0x2a00aa00] Default... |

Sockets open Network I/O

number (amount)

elapsed time (minutes)

c0a8:11c9 = 192.168.17.201

Java Health Center – Method Profiling



The screenshot shows the Java Health Center interface for method profiling, running in Eclipse.

Left Sidebar: Monitored System status and analysis recommendations.

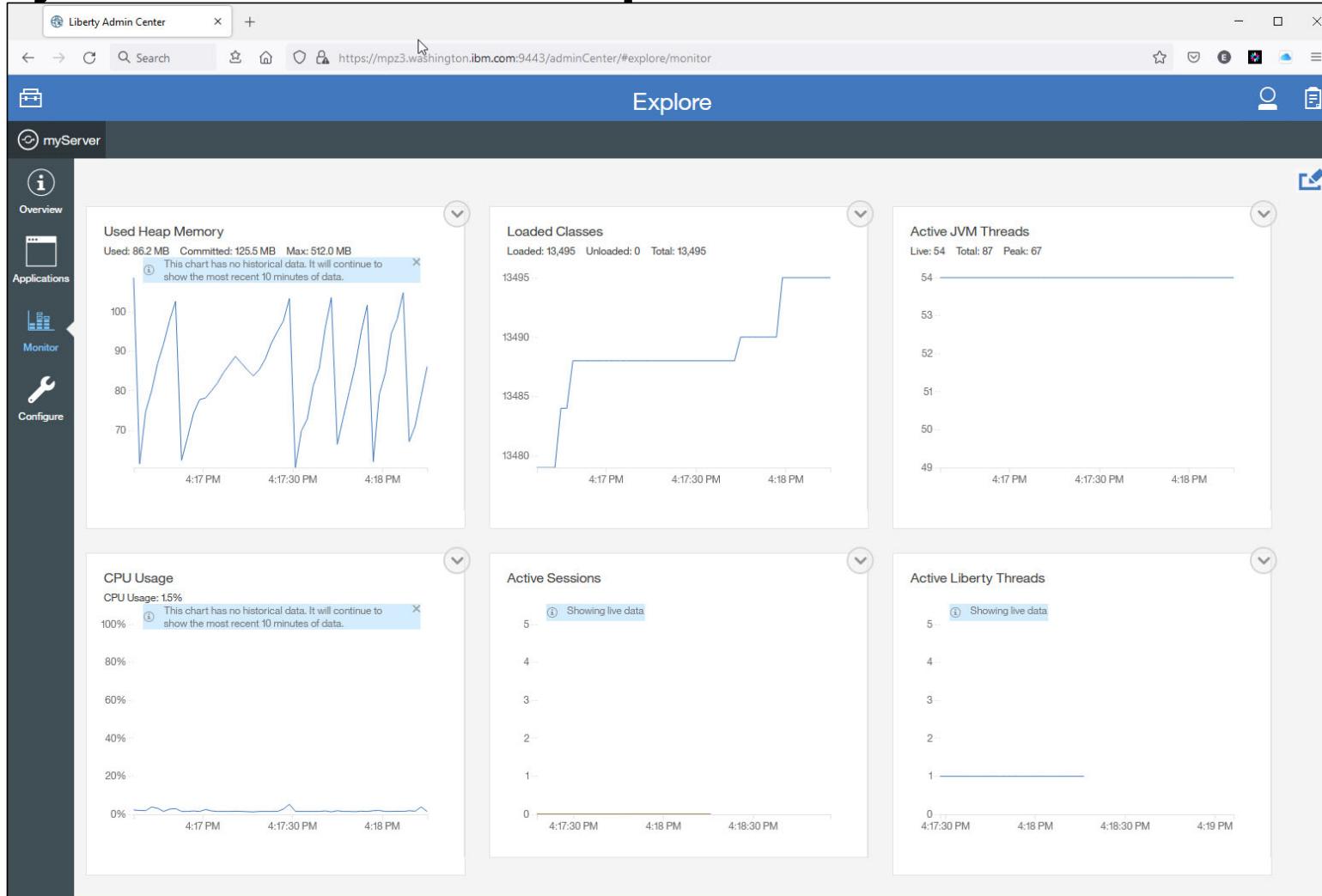
Top Bar: smf - Eclipse, File, Edit, Navigate, Search, Project, Data, Run, Monitored System, Window, Help.

Central Area:

- Sample based profile:** Shows a table of sampled methods with their self and tree times.
- Samples over time:** A graph showing the number of samples over time, with a red circle highlighting a peak around 2:30 and a blue arrow pointing to a later point.
- Invocation paths:** A separate window showing a list of sampled methods.
- Method trace summary:** A graph showing the number of samples over time, with a blue arrow pointing to a peak around 2:00.



Liberty Admin Center feature provides real time monitoring





Workload Manager - Definitions

WLM Report Classes

```

mpz3
File Edit Settings View Communication Actions Window Help
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
Action Name Description -- Last Change --
User Date
--- BAOSTC _____ JOHNSON 2021/09/04
--- WMQFTE _____ JOHNSON 2021/08/31
--- WMQFTER _____ JOHNSON 2021/08/31
--- WMQFTEZ _____ JOHNSON 2021/08/31
--- ZCEEADM _____ JOHNSON 2021/08/02
--- ZCEEAPIR _____ JOHNSON 2021/08/05
--- ZEECICS _____ JOHNSON 2021/08/05
--- ZCEEDB2 _____ JOHNSON 2021/08/05
--- ZEEIMS _____ JOHNSON 2021/08/05
--- ZCEEMQ _____ JOHNSON 2021/08/05
--- ZCEEOTHR _____ JOHNSON 2021/08/02
--- ZCEESTC _____ JOHNSON 2021/09/02
***** Bottom of data *****
M A 10/004
Connected to remote server/host mpz3 using lu/pool MPZ30008 and port 23

```

WLM Service Classes

```

mpz3
File Edit Settings View Communication Actions Window Help
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 *****
M A 19/004
Connected to remote server/host mpz3 using lu/pool MPZ30008 and port 23

```

WLM "CB" Classification Rules

Top Window:

```

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 ==>
-----Qualifier----- -----Class-----
Action Type Name Start DEFAULTS: Service Report
1 CN myServer _____ OPS_HIGH ZCEEOTHR
2 TC TCAPIR _____ OPS_HIGH BAOSTC
2 TC TCCICS _____ OPS_HIGH ZCEEAPIR
2 TC TCDB2 _____ OPS_HIGH ZCEEDB2
2 TC TCIMS _____ OPS_HILO ZEEIMS
2 TC TCMQ _____ OPS_MED ZCEEMQ
2 TC TCOTHR _____ OPS_LOW ZCEEOTHR
M A 07/021
Connected to remote server/host mpz3 using lu/pool MPZ30008 and port 23

```

Bottom Window:

```

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 ==>
-----Qualifier----- -----Class-----
Action Type Name Start DEFAULTS: Service Report
1 CN zceex _____ OPS_HIGH ZCEEOTHR
2 TC TCAPIR _____ OPS_HIGH ZCEESTC
2 TC TCCICS _____ OPS_HIGH ZCEEADM
2 TC TCDB2 _____ OPS_HIGH ZCEEAPIR
2 TC TCIMS _____ OPS_HILO ZCEEDB2
2 TC TCMQ _____ OPS_MED ZEECICS
2 TC TCOTHR _____ OPS_HILO ZCEEIMS
M A 07/021
Connected to remote server/host mpz3 using lu/pool MPZ30008 and port 23

```

Workload Manager – WLM Classification server XML



The corresponding required sever 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

Server Config

wlm.xml

Design Source

```
<?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.

mpz3

File Edit Settings View Communication Actions Window Help

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

Description . . . WLP/zCEE Transactions

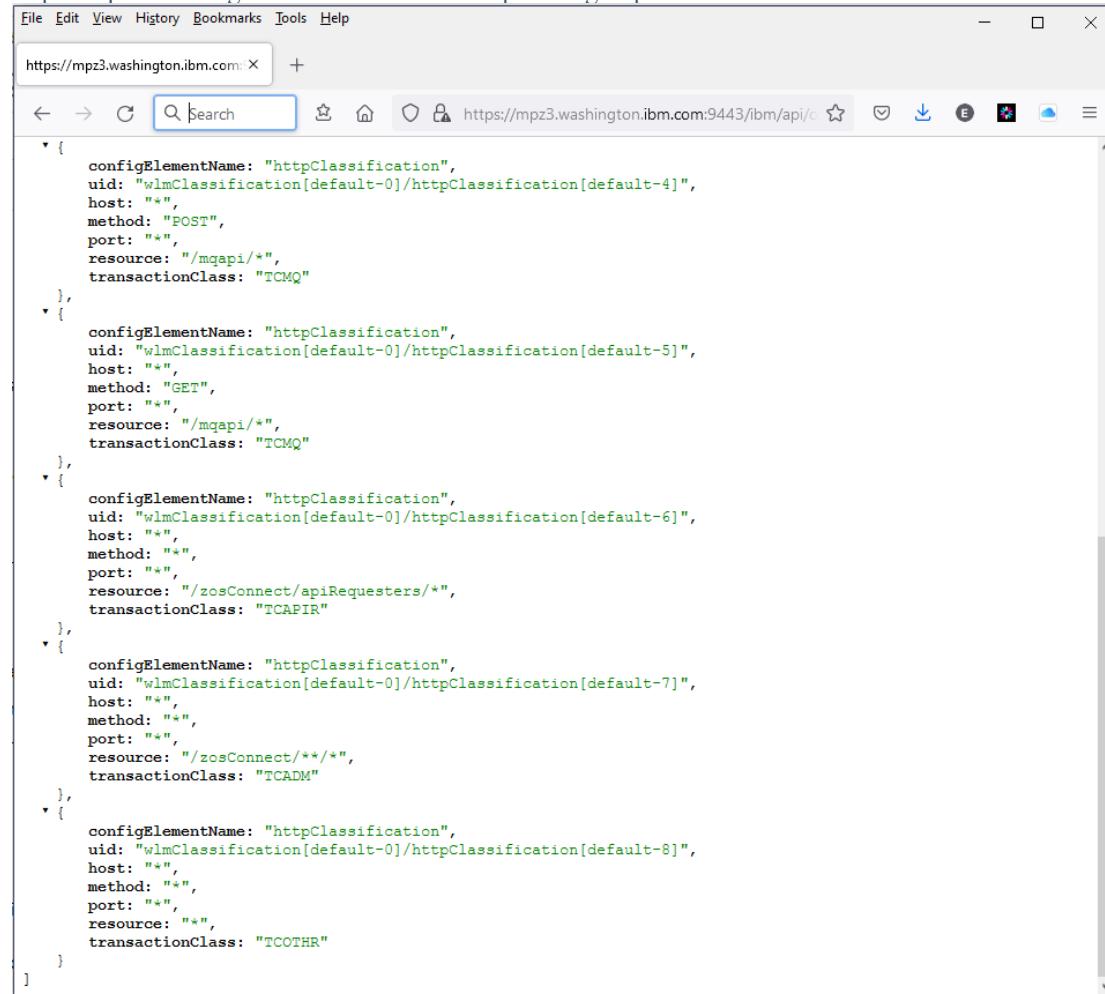
Action codes: A=After C=Copy M=Move I=Insert rule
B=Before D=Delete row R=Repeat IS=Insert Sub-rule

More ==>

| Action | Type | Name | Start | Qualifier | Class | Service | Report |
|--------|------|--------|-------|-----------|-------|----------|----------|
| 1 | CN | zcees* | | | | OPSLHIGH | ZCEEOTHR |
| 2 | TC | TCAPIR | | | | OPSLHIGH | ZCEESTC |
| 2 | TC | TCDB2 | | | | OPSLHIGH | ZCEADM |
| 2 | TC | TCCICS | | | | OPSLHIGH | ZCEEAPTR |
| 2 | TC | TCIMS | | | | OPSLHILO | ZCEEADBM |
| 2 | TC | TCMQ | | | | OPSLHILO | ZCEEIMS |
| 2 | TC | TCOTHR | | | | OPSLMED | ZCEEMQ |
| | | | | | | OPSLHILO | ZCEEOTHR |

Workload Manager – Active HTTP Classification

https://mpz3.washington.ibm.com:9443/ibm/api/config/httpClassification



The screenshot shows a web browser window displaying a JSON array of configuration elements for Workload Manager Active HTTP Classification. The URL in the address bar is https://mpz3.washington.ibm.com:9443/ibm/api/config/httpClassification. The browser interface includes a menu bar (File, Edit, View, History, Bookmarks, Tools, Help), a toolbar with icons for back, forward, search, and refresh, and a status bar at the bottom.

```
[{"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.FFFFFF | 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 | 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 | | | | |
| 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 ==>

POLICY=WSCPOL REPORT CLASS=ZCEEAPIR PERIOD=1

| -TRANSACTIONS-- | | TRANS-TIME | HHH.MM.SS.FFFFFF | 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 | SINGLE | 0.0 |
|----------|-------|-----|-------|-------|------|-----|-------|--------|-----|--------|------|--------|-----|
| CPU | 4485K | SRB | 0.000 | IIPCP | 0.12 | ENQ | 0.000 | RESP | 0.4 | TOTAL | 0.00 | BLOCK | 0.0 |
| MSO | 0 | RCT | 0.000 | IIP | 0.73 | CRM | 0.000 | CONN | 0.3 | SHARED | 0.00 | SHARED | 0.0 |
| SRB | 0 | IIT | 0.000 | AAPCP | 0.00 | LCK | 0.000 | DISC | 0.0 | | | HSP | 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 | | | | | | | | | | | |
| 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. In the center, it says 'Server Config'. On the left is a small icon of a server. On the right are icons for search, refresh, and close. Below the header, the title 'smf.xml' is displayed, followed by 'Read only' and a 'Close' button. There are two tabs: 'Design' and 'Source'. The 'Source' tab is selected, showing the XML code for the SMF configuration. The code is as follows:

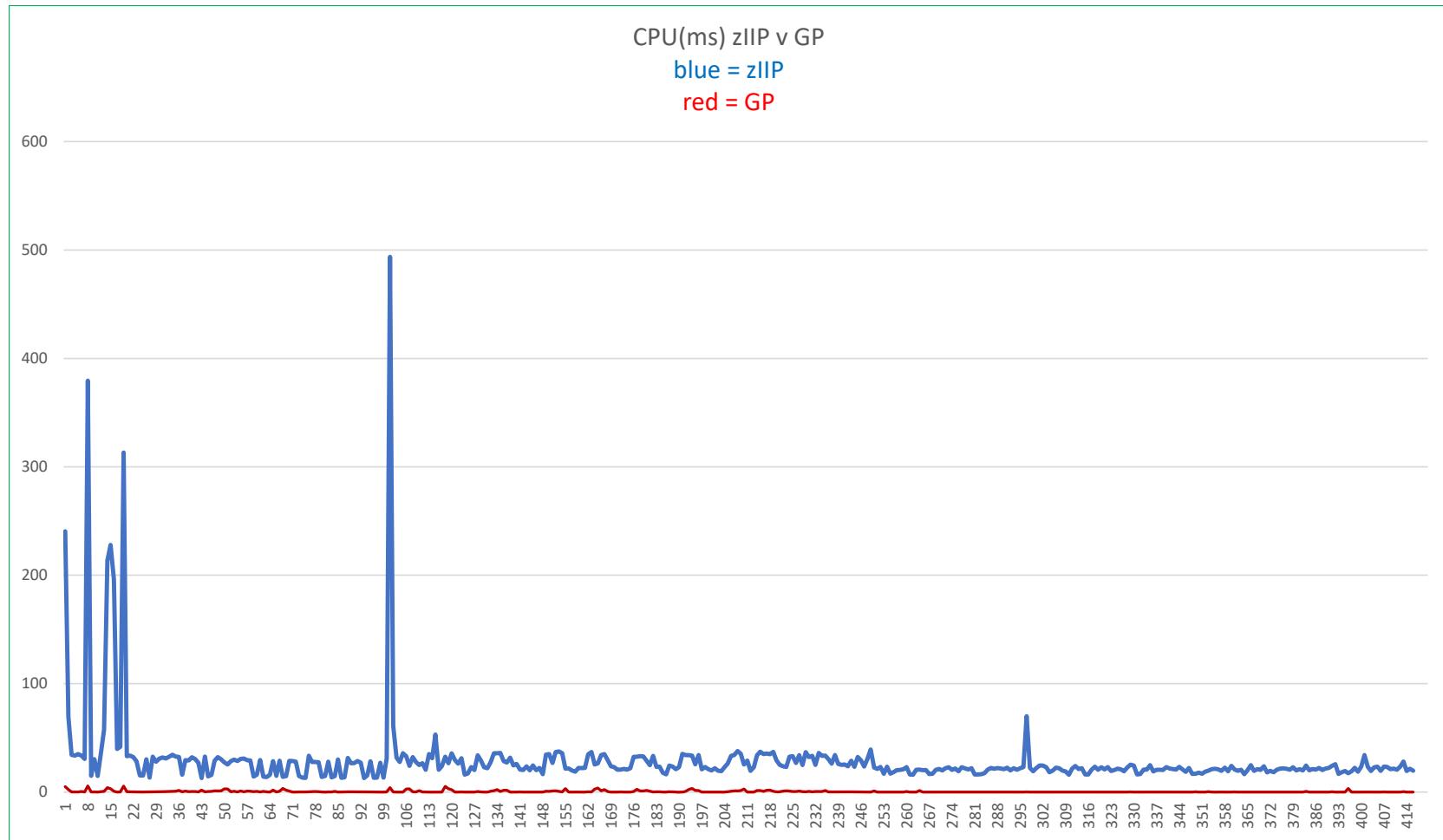
```
1<?xml version="1.0" encoding="UTF-8"?>
2
3<server description="SMF">
4    <featureManager>
5        <feature>monitor-1.0</feature>
6        <feature>zosRequestLogging-1.0</feature>
7    </featureManager>
8
9</server>
10
```

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

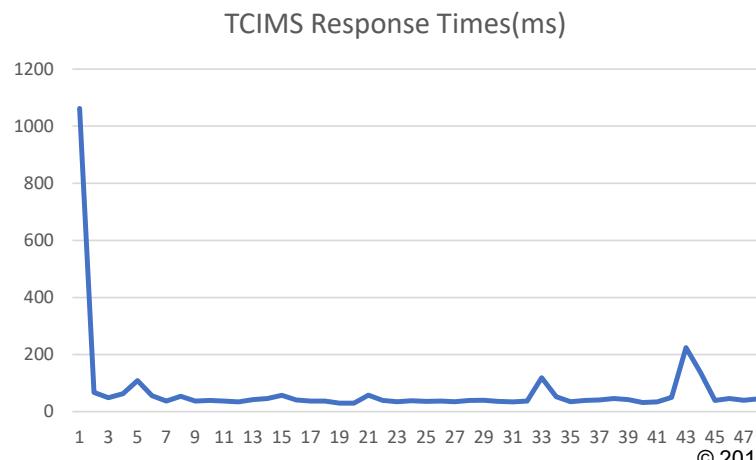
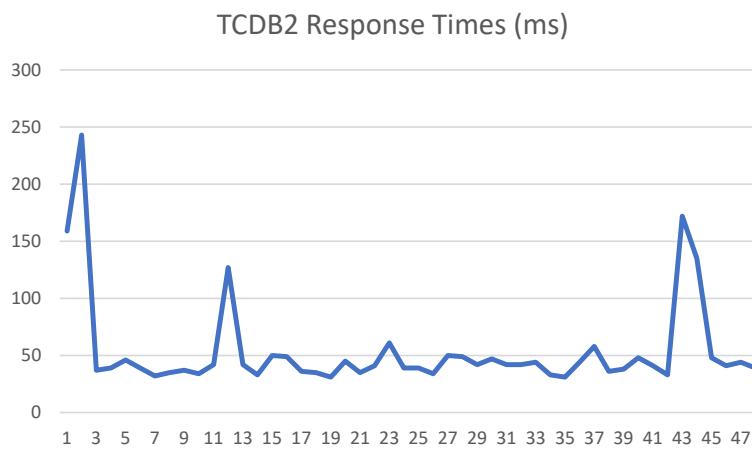
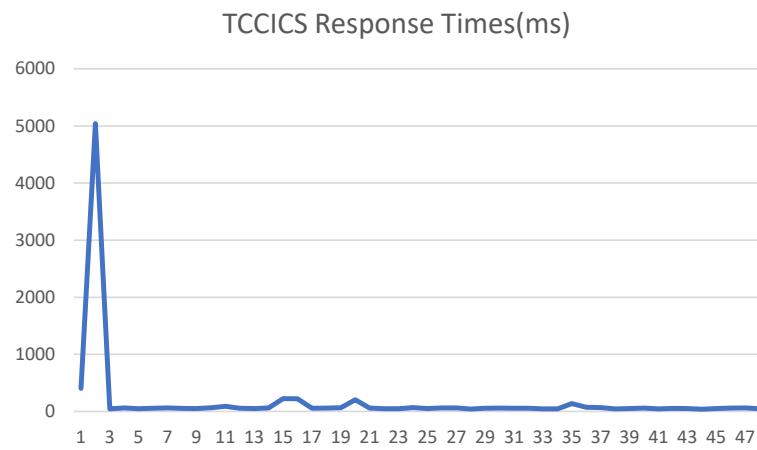
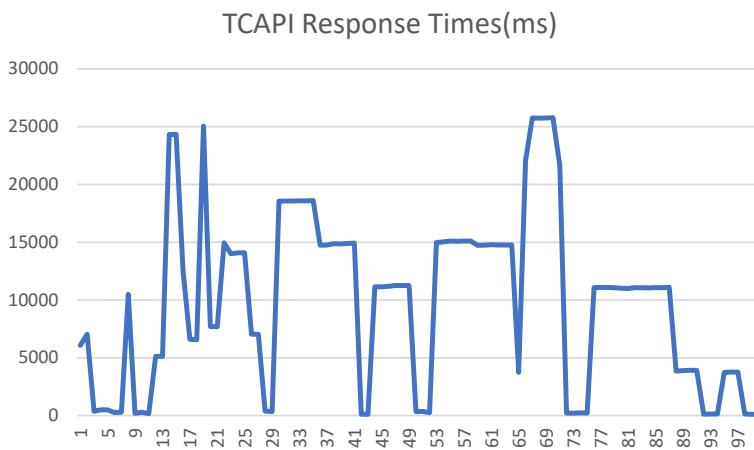
<https://www.ibm.com/support/pages/node/6355403>



Liberty SMF 120 type 11 – GP v zIIP comparison example



Liberty SMF 120 type 11 – Response times comparisons example



z/OS Connect SMF 123 server XML configuration



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

```
<?xml version="1.0" encoding="UTF-8"?>
<server description="SMF reporting">
  <zosconnect_zosConnectManager>
    globalInterceptorsRef="interceptorList_g"/>
  <zosconnect_authorizationInterceptor id="auth">
    safCacheTimeout="600"/>
  <zosconnect_auditInterceptor id="audit">
    apiRequesterSmfVersion="2"
    apiProviderSmfVersion="2"/>
  <zosconnect_zosConnectInterceptors id="interceptorList_g">
    interceptorRef="audit"/>
</server>
```

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

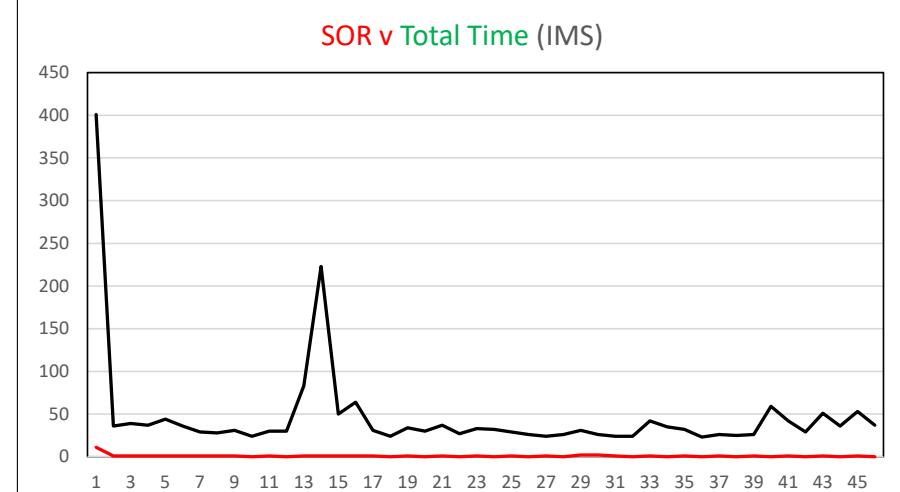
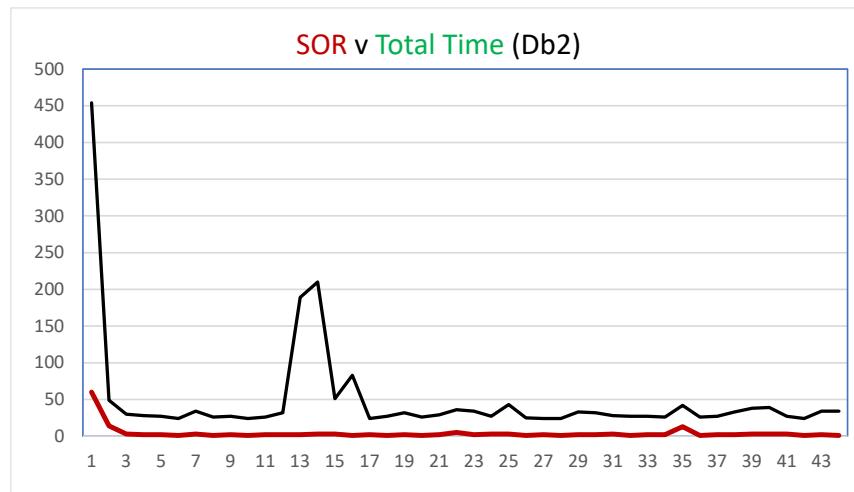
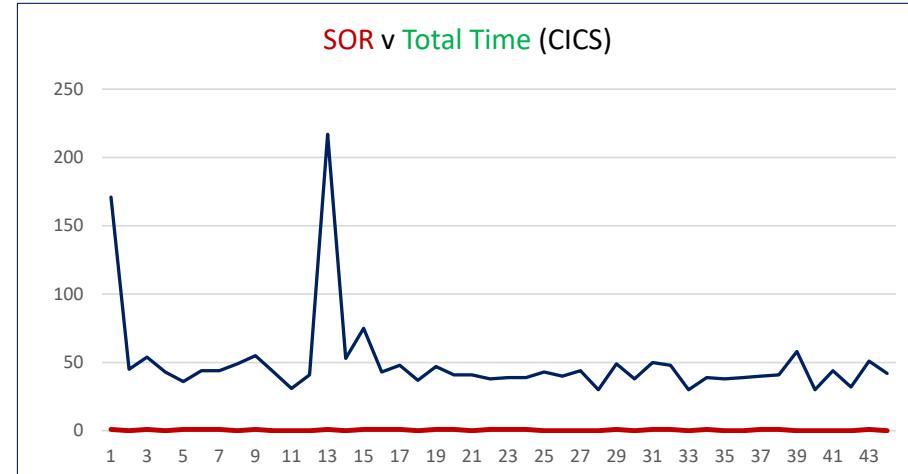
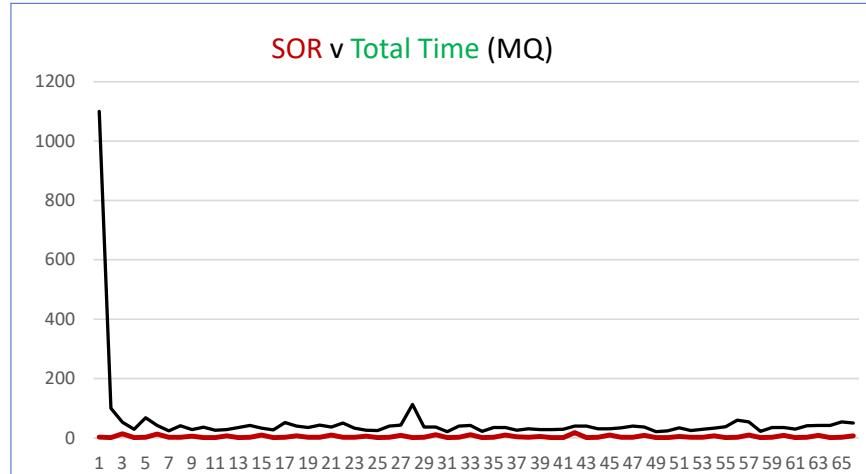
auditApiProviderResponseHeaders.name
(no value)

auditApiProviderResponseHeaders.desc

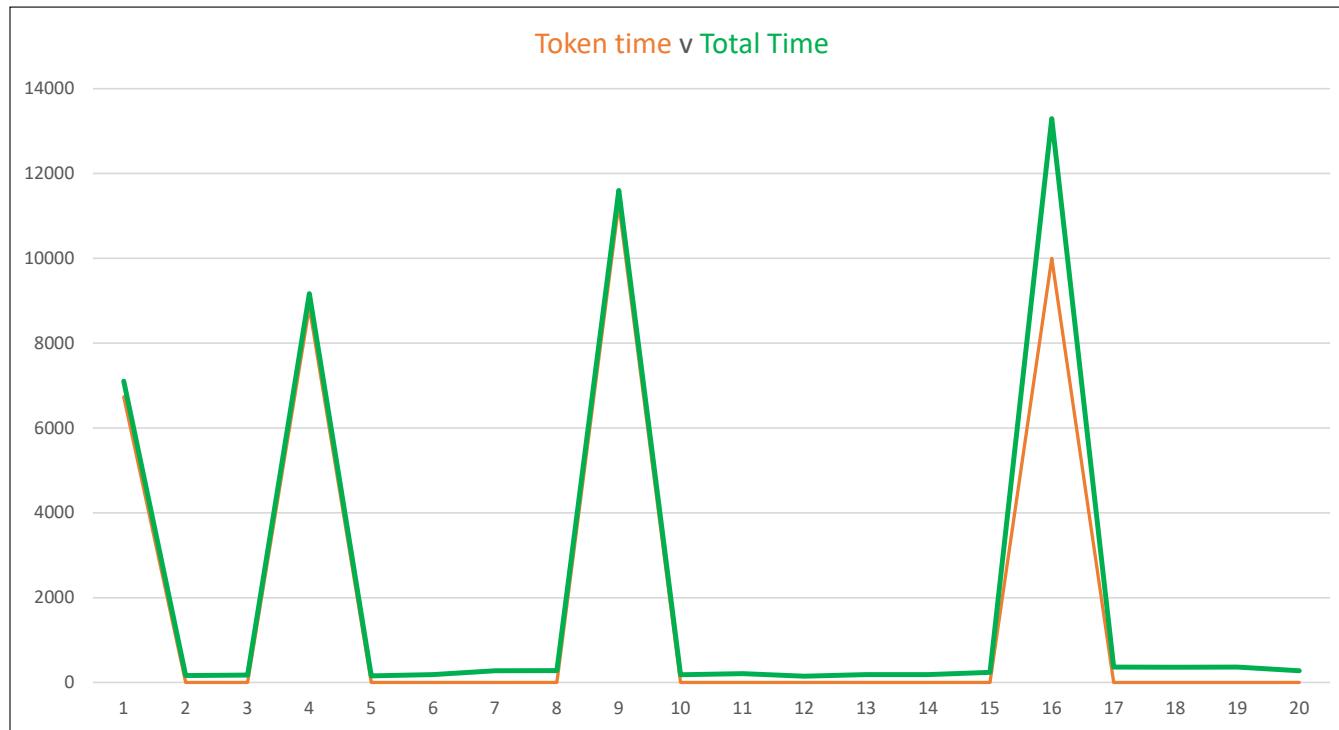
API requester SMF Version
2

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

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



z/OS Connect SMF 123 subtype 2 version 2 graph example



BAQSMFP output



```
*****
* SMF123.1 V2 Request Data Section *
*****
SMF123S1_REQ_TYPE = API (1)
SMF123S1_HTTP_RESP_CODE = 500
SMF123S1_REQ_TIMED_OUT = NO
SMF123S1_USER_NAME = FRED
SMF123S1_USER_NAME_MAPPED =
SMF123S1_CLIENT_IP_ADDR = 192.168.0.60
SMF123S1_API_NAME = db2employee
SMF123S1_API_VERSION = 1.0.0
SMF123S1_SERVICE_NAME = selectEmployee
SMF123S1_SERVICE_VERSION = 1.0.0
SMF123S1_REQ_METHOD = GET
SMF123S1_REQ_QUERY_STR =
SMF123S1_REQ_TARGET_URI = /db2/employee/000010
SMF123S1_REQ_PAYLOAD_LEN = 0
SMF123S1_RESP_PAYLOAD_LEN = 0
SMF123S1_TIME_ZC_ENTRY = 0x00DA2FB8 38ED5494 04000000 08880001
UTC_CONV_TIME_ZC_ENTRY = 2021/08/19 15:30:24.905545 UTC
SMF123S1_TIME_ZC_EXIT = 0x00DA2FB8 38F3883F A8000000 08880001
UTC_CONV_TIME_ZC_EXIT = 2021/08/19 15:30:24.930947 UTC
SMF123S1_TIME_SOR_SENT = 0x00DA2FB8 38F232A9 76000000 08A00001
UTC_CONV_TIME_SOR_SENT = 2021/08/19 15:30:24.925482 UTC
SMF123S1_TIME_SOR_RECV = 0x00DA2FB8 38F300A4 AA000000 08880001
UTC_CONV_TIME_SOR_RECV = 2021/08/19 15:30:24.928778 UTC
SMF123S1_SP_NAME = restclient-1.0
SMF123S1_SOR_REFERENCE = Db2Conn
SMF123S1_SOR_IDENTIFIER = Db2:DSN2LOC,wg31.washington.ibm.com:2446
SMF123S1_SOR_RESOURCE = services/zCEEService/selectEmployee
SMF123S1_REQ_ID = 302
SMF123S1_TRACKING_TOKEN = 0x42415131 77734859 41514159 314E6670 31395046
35304455 312B6E7A 51454241
514E6F76 75446A74 564A5145 41413D3D 40404040 40404040 40404040
SMF123S1_REQ_HDR1 =
SMF123S1_REQ_HDR2 =
SMF123S1_REQ_HDR3 =
SMF123S1_REQ_HDR4 =
SMF123S1_RESP_HDR1 =
SMF123S1_RESP_HDR2 =
SMF123S1_RESP_HDR3 =
```

```
*****
* SMF123.2 V2 Request Data Section *
*****
SMF123S2_REQ_APP_TYPE = ZOS (3)
SMF123S2_HTTP_RESP_CODE = 200
SMF123S2_REQ_STATUS_CODE = 200
SMF123S2_REQ_RETRY = NO
SMF123S2_REQ_PAYLOAD_LEN = 0
SMF123S2_RESP_PAYLOAD_LEN = 269
SMF123S2_USER_NAME = USER1
SMF123S2_USER_NAME_MAPPED =
SMF123S2_USER_NAME_ASSERTED = USER1
SMF123S2_API_REQ_NAME = cscvinc 1.0.0
SMF123S2_API_REQ_VERSION = 1.0.0
SMF123S2_ENDPOINT_REFERENCE = cscvincAPI
SMF123S2_ENDPOINT_HOST = https://mpz3.washington.ibm.com
SMF123S2_ENDPOINT_PORT = 9463
SMF123S2_ENDPOINT_FULL_PATH = /cscvinc/employee/111111
SMF123S2_ENDPOINT_METHOD = GET
SMF123S2_ENDPOINT_STUB_STR
SMF123S2_TIME_STUB_SENT = 0x00DA2FC1 7D34CE8B 4A000000 084C0001
UTC_CONV_TIME_STUB_SENT = 2021/08/19 16:11:52.420584 UTC
SMF123S2_TIME_ZC_ENTRY = 0x00DA2FC1 7D58AE00 0E000000 08A00001
UTC_CONV_TIME_ZC_ENTRY = 2021/08/19 16:11:52.567534 UTC
SMF123S2_TIME_ZC_EXIT = 0x00DA2FC1 87DCB806 E6000000 08880001
UTC_CONV_TIME_ZC_EXIT = 2021/08/19 16:12:03.594112 UTC
SMF123S2_TIME_TOKEN_GET_START = 0x00DA2FC1 7D59D3A6 E6000000 08A00001
UTC_CONV_TIME_TOKEN_GET_START = 2021/08/19 16:11:52.572218 UTC
SMF123S2_TIME_TOKEN_GET_FINISH = 0x00DA2FC1 7D59DF85 CC000000 088C0001
UTC_CONV_TIME_TOKEN_GET_FINISH = 2021/08/19 16:11:52.572408 UTC
SMF123S2_TIME_ENDPOINT_SENT = 0x00DA2FC1 7D5A0328 04000000 088C0001
UTC_CONV_TIME_ENDPOINT_SENT = 2021/08/19 16:11:52.572978 UTC
SMF123S2_TIME_ENDPOINT RECEIVED = 0x00DA2FC1 87DCB816 58000000 08880001
UTC_CONV_TIME_ENDPOINT RECEIVED = 2021/08/19 16:12:03.593249 UTC
SMF123S2_MVS_JOBNAME = USER1GE2
SMF123S2_MVS_JOBID = JOB09543
SMF123S2_MVS_SYSNAME = MPZ3
SMF123S2_MVS_ASID = 54
SMF123S2_MVS_SID = MPZ3
SMF123S2_REQ_ID = 732
SMF123S2_TRACKING_TOKEN = 0x42415131 77734859 41514159 314E6670 31395046
35304455 312B6E7A 51454241
514E6F76 77583159 7275414F 40404040 40404040 40404040 40404040
SMF123S2_REQ_HDR1 =
SMF123S2_REQ_HDR2 =
SMF123S2_REQ_HDR3 =
```

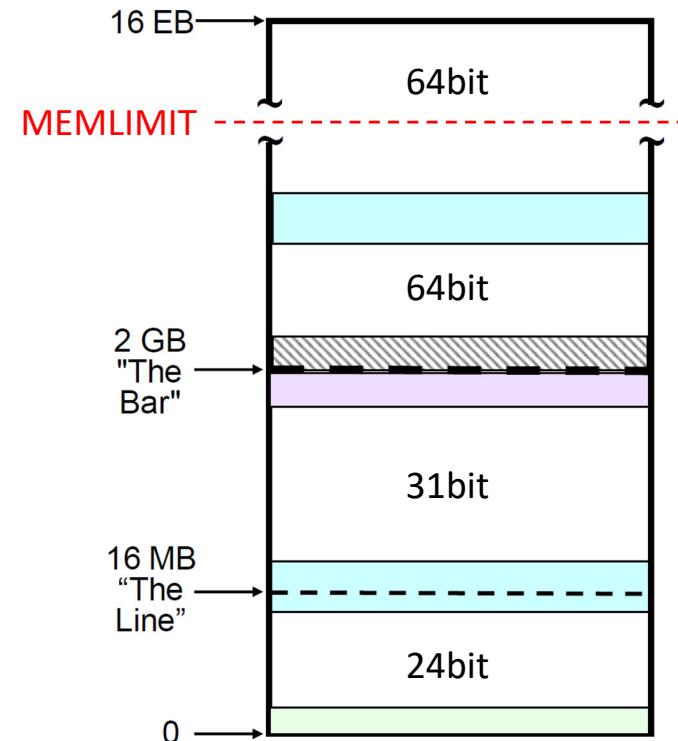
CICS Performance Analyzer

| V5R4M0 | | CICS Performance Analyzer z/OS Connect Summary | | | | | |
|--|-----------|--|------------|-------------------------------------|--|--------|--|
| ZCEE0001 Printed at 13:35:01 8/21/2021 | | Data from 11:30:24 8/19/2021 to 12:11:24 8/19/2021 | | | | Page 1 | |
| Initial CICS PA report | | | | | | | |
| JOBNAME : BAQSTRT SPNAME : imsmobile-2.0 | | | | | | | |
| Request: 49 Fail: 0 Timed out: 0 Get: 49 Post: 0 Put: 0 Delete: 0 | | | | | | | |
| ----- Maximum value Request details ----- | | | | | | | |
| SOR Sent Latency | Avg .0326 | Max .3781 | Req ID 551 | ZC Entry 19/08/2021 12:09:45.036778 | | | |
| SOR Response | .0016 | .0183 | 551 | 19/08/2021 12:09:45.036778 | | | |
| ZC Exit Latency | .0025 | .0048 | 504 | 19/08/2021 12:09:36.823661 | | | |
| ZC Response | .0367 | .3982 | 551 | 19/08/2021 12:09:45.036778 | | | |
| ZC Time | .0351 | .3799 | 551 | 19/08/2021 12:09:45.036778 | | | |
| JOBNAME : BAQSTRT SPNAME : restclient-1.0 | | | | | | | |
| Request: 50 Fail: 50 Timed out: 0 Get: 50 Post: 0 Put: 0 Delete: 0 | | | | | | | |
| ----- Maximum value Request details ----- | | | | | | | |
| SOR Sent Latency | Avg .0478 | Max .5953 | Req ID 488 | ZC Entry 19/08/2021 12:09:33.386614 | | | |
| SOR Response | .0027 | .0127 | 594 | 19/08/2021 12:09:52.016624 | | | |
| ZC Exit Latency | .0014 | .0029 | 524 | 19/08/2021 12:09:40.369997 | | | |
| ZC Response | .0519 | .6004 | 488 | 19/08/2021 12:09:33.386614 | | | |
| ZC Time | .0492 | .5972 | 488 | 19/08/2021 12:09:33.386614 | | | |
| JOBNAME : BAQSTRT SPNAME : CICS-1.0 | | | | | | | |
| Request: 49 Fail: 0 Timed out: 0 Get: 49 Post: 0 Put: 0 Delete: 0 | | | | | | | |
| ----- Maximum value Request details ----- | | | | | | | |
| SOR Sent Latency | Avg .0300 | Max .0589 | Req ID 450 | ZC Entry 19/08/2021 12:09:26.478282 | | | |
| SOR Response | .0011 | .0049 | 517 | 19/08/2021 12:09:39.019456 | | | |
| ZC Exit Latency | .0077 | .0138 | 450 | 19/08/2021 12:09:26.478282 | | | |
| ZC Response | .0387 | .0741 | 450 | 19/08/2021 12:09:26.478282 | | | |
| ZC Time | .0376 | .0727 | 450 | 19/08/2021 12:09:26.478282 | | | |

Memory - MEMLIMIT

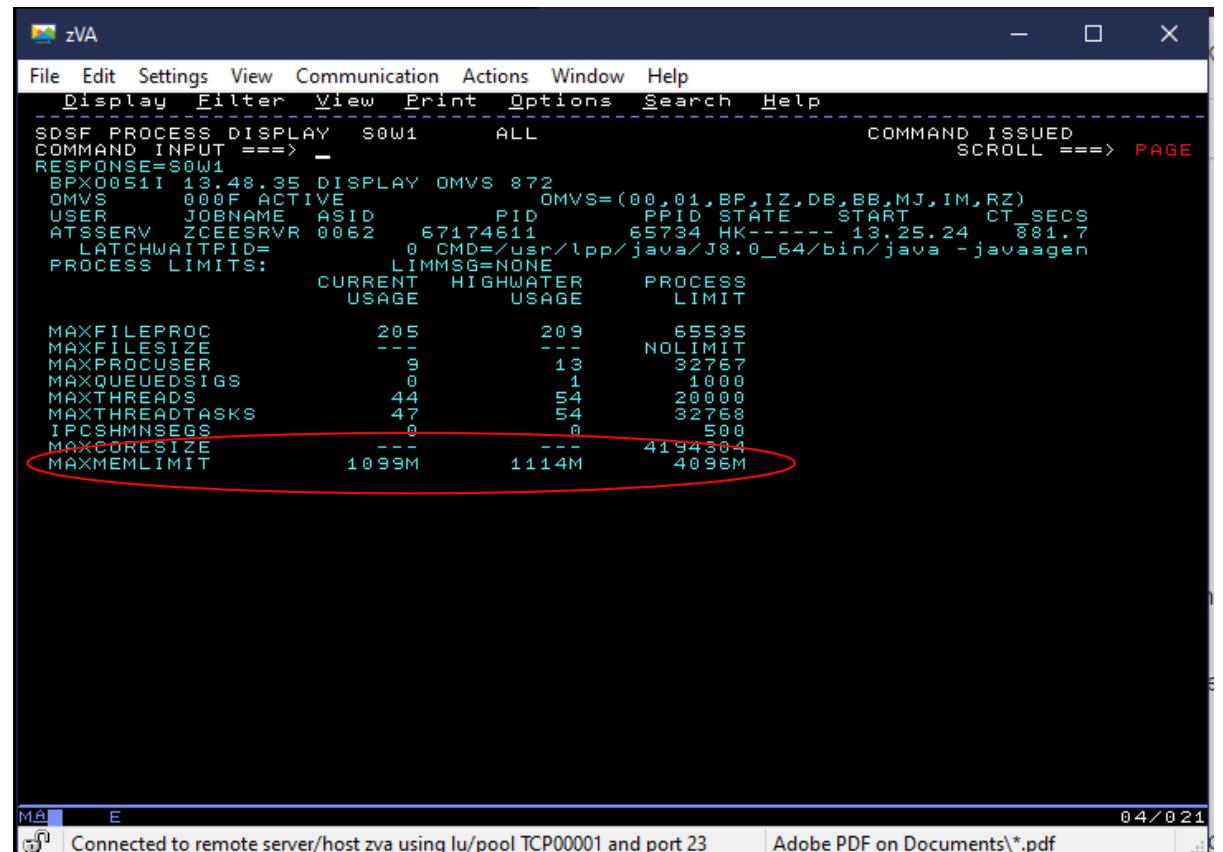
```
//ZCON EXEC PGM=BPXBATSL,REGION=0M,MEMLIMIT=8G,  
//      PARM='PGM &ZCONHOME./bin/zosconnect run &PARMS.'
```

- Limits the amount of 64-bit storage
 - Only a limit, not pre-allocated
- Java
 - Heap
 - Caches
- z/OS
 - Native thread stack storage
 - 3MB for each thread



MEMLIMIT

- OMVS display
 - Monitor periodically
 - Track high water mark
 - `/D OMVS,LIMITS,PID=<server pid>`



```
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 ===> - SCROLL ===> PAGE
RESPONSE=S0W1
BPX051I 13.48.35 DISPLAY OMVS 872
OMVS 000F ACTIVE OMVS=(00,01,BP,IZ,DB,BB,MJ,IM,RZ)
USER JOBNAME 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 PROCESS
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
IPCSHMSEGs 0 0 500
MAXCORESIZE --- --- 4194304
MAXMEMLIMIT 1098M 1114M 4096M
```

The screenshot shows the z/OS zVA interface with the SDSF PROCESS DISPLAY command running. The output lists various system parameters and process limits. A red oval highlights the last row of the table, which represents the current usage and limit for memory, specifically MAXMEMLIMIT.



Locating the server's process ID

| SDSF PROCESS DISPLAY MPZ3 ALL | | LINE 1-5 (5) | | | | | | | | | |
|-------------------------------|-------------------------------|-----------------|-------|-------|----------|----------|------|------|-------|--------------|--|
| COMMAND INPUT ===> PS | | SCROLL ===> CSR | | | | | | | | | |
| NP | JOBNAME | Status | Owner | State | CPU-Time | PID | PPID | ASID | ASIDX | LatchWaitPID | Command |
| BAQSTRT | WAITING FOR CHILD | LIBSERV | 1W | 40.01 | 69050 | 83955129 | 42 | 002A | | | /bin/sh /usr/lpp/IBM/zosconnect/v3r0/bin |
| BAQSTRT | OTHER KERNEL WAIT | LIBSERV | HK | 40.01 | 16846267 | 69050 | 42 | 002A | | | /usr/lpp/java/J8.0_64/bin/java -javagen |
| BAQZANGL | SWAPPED, RUNNING | LIBANGE | 1RI | 0.01 | 50399398 | 83953829 | 77 | 004D | | | /usr/lpp/IBM/zosconnect/v3r0/wplib/nat |
| BAQZANGL | SWAPPED, FILE SYS KERNEL WAIT | LIBANGE | 1FI | 0.01 | 83953829 | 1 | 77 | 004D | | | BPXBATA2 |
| BAQSTRT | FILE SYS KERNEL WAIT | LIBSERV | 1F | 40.01 | 83955129 | 1 | 42 | 002A | | | BPXBATSL |

Tech-Tip: The **PS** SDSF command requires access to SAF SDSF resource ISFCMD.ODSP.PROCESS.*.

```
*****
product = WAS FOR Z/OS 21.0.0.9, z/OS Connect 03.00.52 (wlp-1.0.56.cl210920210909-1618)
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 = 16780584@wg31
*****
```





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 Recommendations

- 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 ISSUED
COMMAND INPUT ===> _ SCROLL ===> PAGE
RESPONSE=WG31
BPX0051I 11.14.07 DISPLAY OMVS 705
OMVS 000F ACTIVE OMVS=(Z3,MJ)
USER JOBNAM ASID PID PPID STATE START CT_SECS
LIBSERV BAQSTRT 0071 33554704 16777415 HK----- 20.16.20 96.3
LATCHWAITPID= 0 CHD=/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
MAXSHNSEGS 0 0 500
MAXCORESIZE -- -- 4194304
MAXMEMLIMIT 1026M 1061M 4096M
```

MA A 04 / 021
Connected to remote server/host wg31a using lu/pool TCP00109 and port 23 Adobe PDF on Documents*.pdf

- Ensure SOR connections are configured appropriately
 - IPIC Send Sessions, IMS Connection Pool, Db2 http max connections
- Take action when USAGE comes within 80-90% of **maxThreads**

IBM z Omegamon for JVM

The image displays four windows from the IBM z Omegamon for JVM interface:

- WG31 - 3270**: Shows the "z/OS Connect Request Summary". It includes a table for API requests and a list of available APIs.
- WG31 - 3270**: Shows the "Requests by Service Name". It includes a table for service requests and a list of available services.
- WG31 - 3270**: Shows the "z/OS Connect Request Detail" for a specific event. The log details a GET request for /cscvinc/employee/444444.
- CMS on platform WG31(z/OS)**: A terminal window showing the command "pol TCP00109 and port 23" and its output "01/002".

IBM z Omegamon for JVM

WG31 - 3270

File Edit View Communication Actions Window Help

File Edit View Tools Navigate Help 04/02/2019 18:59:29
Auto Update : Off
SMF ID : WG31
Coll ID : KJJ1

Command ==> KJJZCDD z/OS Connect Request Detail

```

Event time..... 04/02/19 18:49:14.525
Request Type... API
API name.... filequeue
Request URI... /filequeue/mq
Query String...
Method..... GET
Port..... 9453
HTTP code.... 200 (OK)
Timeout.... No
Service Name... FileaQueue
Total Req Time.. 0.016206s
z/OS Conn Time.. 0.016206s
SoR Resp Time.. 0.000000s
SoR ID.... NONE
SoR Ref.... NONE
SoR Resource.. NONE
Remote Address.. 192.168.0.141
Request Length.. 0
Response Length.. 191
Correlator.... e6e2d3d7d3c5e7400011000010d5ea51
Operation.... getFilea
Provider.... IBM MQ for z/OS
User ID.... Fred

```

VERIFY | BACK | HOME | Hub WG31:CMS on platform WG31(z/OS) 01/002

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

Event time..... 04/02/19 18:48:34.790
Request Type... API
API name.... db2employee
Request URI... /db2/employee/000020
Query String...
Method..... GET
Port..... 9453
HTTP code.... 200 (OK)
Timeout.... No
Service Name... selectEmployee
Total Req Time.. 0.022592s
z/OS Conn Time.. 0.022592s
SoR Resp Time.. 0.000000s
SoR ID.... NONE
SoR Ref.... NONE
SoR Resource.. NONE
Remote Address.. 192.168.0.141
Request Length.. 0
Response Length.. 326
Correlator.... e6e2d3d7d3c5e7400011000010d5ea50
Operation.... getSelectEmployee
Provider.... restclient-1.0
User ID.... Fred

VERIFY | BACK | HOME | Hub WG31:CMS on platform WG31(z/OS) 01/002

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

WG31 - 3270

File Edit View Communication Actions Window Help

File Edit View Tools Navigate Help 04/02/2019 19:00:52
Auto Update : Off
SMF ID : WG31
Coll ID : KJJ1

Command ==> KJJZCDD z/OS Connect Request Detail

```

Event time..... 04/02/19 18:47:54.267
Request Type... API
API name.... cscvinc
Request URI... /cscvinc/employee/444444
Query String...
Method..... GET
Port..... 9453
HTTP code.... 200 (OK)
Timeout.... No
Service Name... cscvincService
Total Req Time.. 0.008006s
z/OS Conn Time.. 0.005515s
SoR Resp Time.. 0.002491s
SoR ID.... USIBMWZ .CICS59Z
SoR Ref.... cscvinc
SoR Resource.. CSMI_CSCVINC
Remote Address.. 192.168.0.141
Request Length.. 0
Response Length.. 302
Correlator.... e6e2d3d7d3c5e7400011000010d5ea50
Operation.... getCscvincService
Provider.... CICS-1.0
User ID.... Fred

```

VERIFY | BACK | HOME | Hub WG31:CMS on platform WG31(z/OS) 01/002

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

Event time..... 04/02/19 19:07:04.090
Request Type... API
API name.... phonebook
Request URI... /phonebook/contacts/LAST1
Query String...
Method..... GET
Port..... 9453
HTTP code.... 200 (OK)
Timeout.... No
Service Name... ivtnoService
Total Req Time.. 0.345265s
z/OS Conn Time.. 0.169460s
SoR Resp Time.. 0.181805s
SoR ID.... IVPN
SoR Ref.... IVTNO
SoR Resource.. IVTNO
Remote Address.. 192.168.0.141
Request Length.. 0
Response Length.. 158
Correlator.... e6e2d3d7d3c5e7400011000010d5ea55
Operation.... getPhoneBookService1
Provider.... imsmobile-2.0
User ID.... Fred

VERIFY | BACK | HOME | Hub WG31:CMS on platform WG31(z/OS) 01/002

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

Miscellaneous Odds and Ends



z/OS Connect administration API

Interface providing meta-data and life-cycle operations for z/OS Connect services, APIs and API requesters.

APIs : Operations for working with APIs

Show/Hide | List Operations | Expand Operations

| | | |
|---------------|-----------------|---|
| GET | /apis | Returns a list of all the deployed z/OS Connect APIs |
| POST | /apis | Deploys a new API into z/OS Connect |
| DELETE | /apis/{apiName} | Undeploys an API from z/OS Connect |
| GET | /apis/{apiName} | Returns detailed information about a z/OS Connect API |
| PUT | /apis/{apiName} | Updates an existing z/OS Connect API |

Services : Operations for working with services

Show/Hide | List Operations | Expand Operations

| | | |
|---------------|---|---|
| GET | /services | Returns a list of all the deployed z/OS Connect services |
| POST | /services | Deploys a new service into z/OS Connect |
| DELETE | /services/{serviceName} | Undeploys a service from z/OS Connect |
| GET | /services/{serviceName} | Returns detailed information about a z/OS Connect service |
| PUT | /services/{serviceName} | Updates an existing z/OS Connect service |
| GET | /services/{serviceName}/schema/{schemaType} | Returns the request or response schema for a z/OS Connect service |

API Requesters : Operations that work with API Requesters.

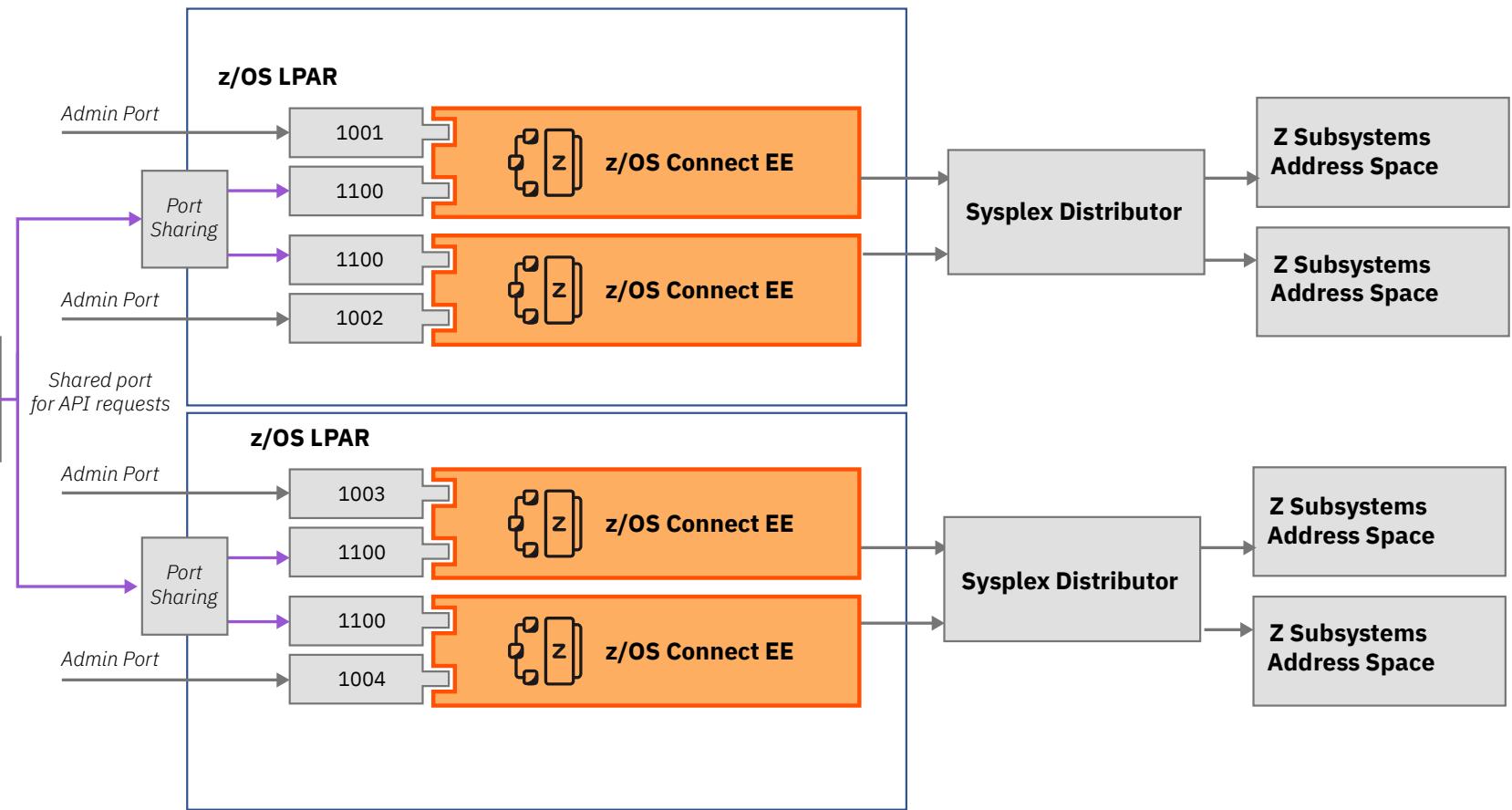
Show/Hide | List Operations | Expand Operations

| | | |
|---------------|-----------------------------------|--|
| GET | /apiRequesters | Returns a list of all the deployed z/OS Connect API Requesters |
| POST | /apiRequesters | Deploys a new API Requester into z/OS Connect and invoke an API Requester call |
| DELETE | /apiRequesters/{apiRequesterName} | Undeploys an API Requester from z/OS Connect |
| GET | /apiRequesters/{apiRequesterName} | Returns the detailed information about a z/OS Connect API Requester |
| PUT | /apiRequesters/{apiRequesterName} | Updates an existing z/OS Connect API Requester |

High Availability



Topology



i ibm.biz/zosconnect-ha-concepts

i ibm.biz/zosconnect-scenarios



Sysplex DVIPAs

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

No SERVERWLM 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!

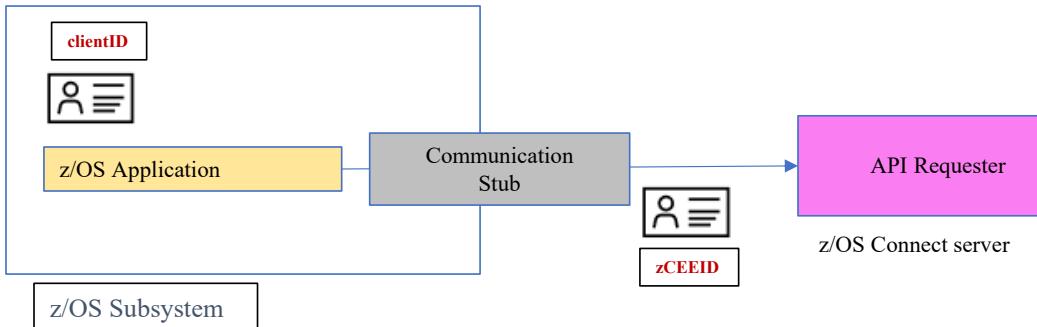
EZA0622I Hometest was successful - all Tests Passed!

```
<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" />
```

The screenshot shows a browser window titled "REST API Documentation". The address bar contains the URL <https://dvipa.washington.ibm.com:9443/api/explorer/>. The page itself is titled "Liberty REST APIs" and displays a list of available APIs under the "cscvinc" namespace. The listed operations are:

- cscvinc**
 - 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
- jwltvpDemoApi**
 - 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

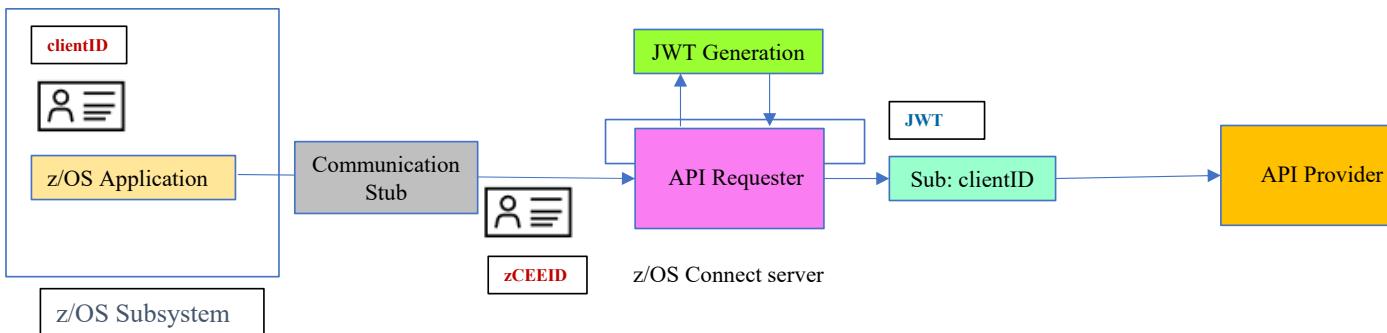
API Requester - authentication with identity assertion and JWT generation



zCEEID – The identity that is used for authenticating connectivity the z/OS subsystem to the zCEE server. It is configured using basic authentication or for CICS, TLS client authentication.

clientID – the identity under which the z/OS application is executing.

- For CICS, the task owner
- For IMS, the transaction owner
- For batch, the job owner



```
<zosconnect_apiRequesters idAssertion="ASSERT_ONLY">  
</zosconnect_apiRequesters>
```

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*

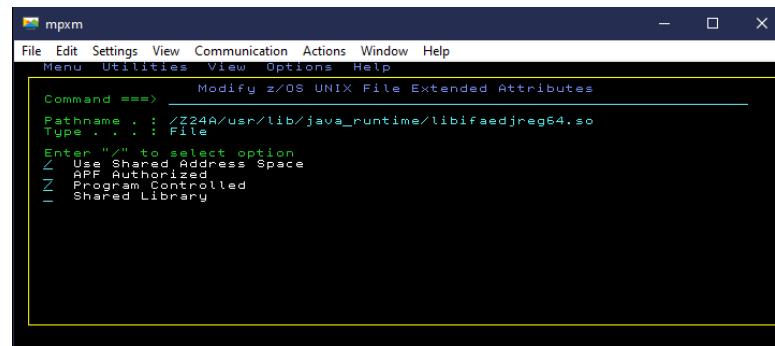
```
RDEFINE SURROGAT clientID.BAQASSRT UACC(NONE) OWNER(SYS1)
PERMIT clientID.BAQASSRT CLASS(SURROGAT) ACCESS(READ) ID(zCEEID)
```

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: z/OS : Switching to root authority



The image displays two terminal windows side-by-side. The left window is titled 'mpxm' and shows the command 'mpxm' being entered at the prompt. The right window is titled 'WG31 - 3270' and shows a menu with options 1 through 8 circled in red. The bottom of the right window shows a command-line interface with the user 'johnson' and a message about superuser rights.

```
mpxm
File Edit Settings View Communication Actions Window Help
File Directory Special_file Tools File_systems Options Setup Help
1. *User...
2. *User list...
3. *All users...
4. *All groups...
5. *Permit field access...
6. *Character Special...
7. Enable superuser mode(SU)
8. *Group list...

/u/johnson
Some choices (*) require
superuser or the "special"
attribute for full function, or
both

EUID=200000

Command ==> M A B 03/047
Connected to remote server/host wg31a using lu/pool TCP00110 Adobe PDF on Documents\*.pdf
```

```
WG31 - 3270
File Edit Settings View Communication Actions Window Help
File Directory Special_file Tools File_systems Options Setup Help
1. *User...
2. *User list...
3. *All users...
4. *All groups...
5. *Permit field access...
6. *Character Special...
7. Enable superuser mode(SU)
8. *Group list...

Enter a pathname and do one of these:
- Press Enter.
- Select an action bar choice.
- Specify an action code or command on

Return to this panel to work with a differ

/u/johnson
Some choices (*) require
superuser or the "special"
attribute for full function, or
both

JOHNSON:/u/johnson: >id
uid=990016(JOHNSON) gid=0(SYS1)
JOHNSON:/u/johnson: su
JOHNSON:/u/johnson: >>id
uid=0(OMVSKERN) gid=0(SYS1)
JOHNSON:/u/johnson: >

EUID=200000

Command ==> M A B 03/047
Connected to remote server/host wg31a using lu/pool TCP00110 Adobe PDF on Documents\*.pdf
```

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.



Use z/OS Connect API Policies to change runtime behavior

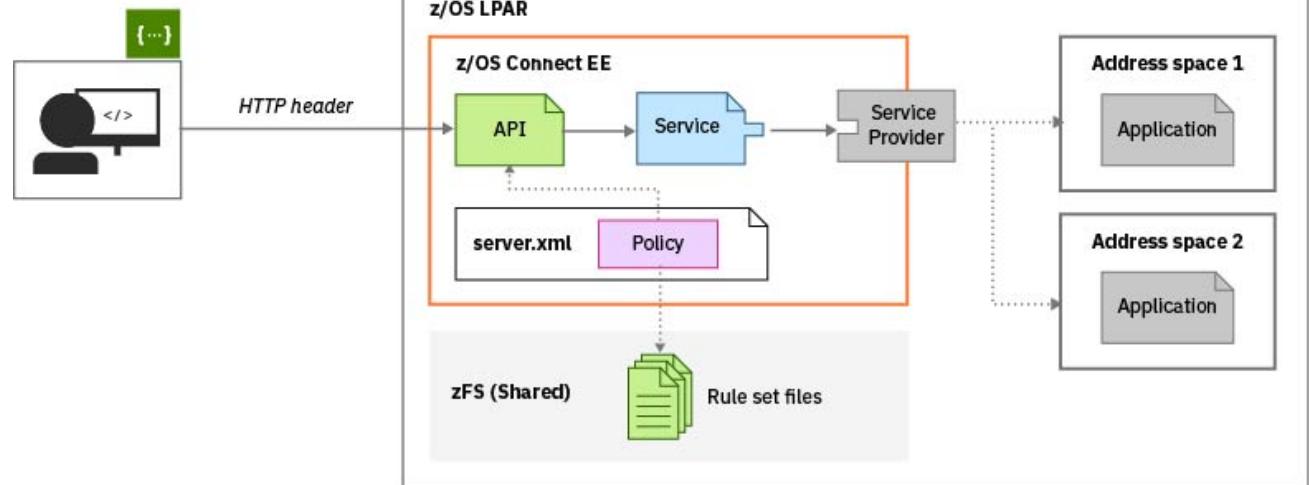
- HTTP header properties can be used to select alternative for IMS (V3.0.4) , CICS (V3.0.10), Db2 (V3.0.36) or MQ (V3.0.39)
- Policies can be configured globally for every API in the server or for individual APIs (V3.0.11)

CICS attributes
• cicsCcsid
• cicsConnectionRef
• cicsTransId

IMS attributes
• imsConnectionRef
• imsInteractionRef
• imsInteractionTimeout
• imsLtermOverrideName
• imsTranCode
• imsTranExpiration

Db2 attributes
• db2ConnectionRef
• db2CollectionID

MQ attributes
• mqConnectionFactory
• mqDestination
• mqReplyDestination





A sample API Policies for CICS

```
<ruleset name="CICS rules">
  <rule name="csmi-rule">
    <conditions>
      <header name="cicsMirror" value="CSMI,MIJO"/> *
    </conditions>
    <actions>
      <set property="cicsTransId" value="${cicsMirror}"/>
    </actions>
  </rule>
  <rule name="connection-rule">
    <conditions>
      <header name="cicsConnection"
             value="cscvinc,cics92,cics93"/>
    </conditions>
    <actions>
      <set property="cicsConnectionRef" value="${cicsConnection}">
    </actions>
  </rule>
</ruleset>
```

GET.employee.(numb)

GET.employee.(numb)

Body - cscvincServiceOperation

HTTP Request

HTTP Headers

cicsMirror optional string

cicsConnection optional string

Path Parameters

numb Required string

Query Parameters

Body - cscvincServiceOperation

Curl

```
curl -X GET --header 'Accept: application/json' --header 'cicsMirror: MIJO' --header 'cicsConnection: cscvinc' 'https://m...
```

*Transaction MIJO needs to be a clone of CSMI (e.g., invoke program DFHMIRS)



Displaying zCEE 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.
```



Provide remote access to configuration/log information

The image shows three browser windows demonstrating remote access to server configuration and log files:

- Top Left Window:** A browser window titled "wg31.washington.ibm.com:9443/se" showing the XML configuration file for a new server. The page states: "This XML file does not appear to have any style information associated with it. The document tree is shown below." The XML code includes sections for server description, feature manager, and various configuration files like safSecurity.xml, ipicSSLIDProp.xml, keyringOutbound.xml, groupAccess.xml, shared.xml, oauth.xml, and adminCenter.xml.
- Top Right Window:** A browser window titled "wg31.washington.ibm.com:9443/server/config/logs/messages.log" displaying the messages.log file. The log output shows product details, Java runtime environment, and process information. It also includes a configuration snippet for the featureManager and httpEndpoint.
- Bottom Window:** A browser window titled "wg31.washington.ibm.com:9443/server/config/logs/trace.log" displaying the trace.log file. The log output shows various trace entries, including security-related logs and dependency manager activity. A red oval highlights a specific trace entry: "I TRAS0018I: The trace state has been changed. The new trace state is".



Provide remote access to z/OS Connect archives files

The screenshot shows two browser windows and a code snippet. The left window displays the index of the `/resources/zosConnect` directory, listing four entries: `apis`, `services`, `apiRequesters`, and `rules`. The right window shows the index of the `/resources/zosConnect/services` directory, listing three SAR files: `cscvincDeleteService.sar`, `cscvincInsertService.sar`, and `cscvincSelectService.sar`. A modal dialog is open, prompting the user to choose how to open the `cscvincSelectService.sar` file, with options to open it with WINZIP32.EXE or save it. Below the browser windows is a code snippet from a configuration file:

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

Today we covered

- **A Review OMVS, Liberty and RACF security/configuration**
- **Connecting z/OS Connect servers to other z/OS subsystems**
- **Useful Liberty features and MVS commands**
- **Where do look when things go wrong**
- **Managing and Monitoring Liberty and z/OS Connect**
- **Miscellaneous Odds and Ends**
- **Additional Material - sample administrative JCL**

z/OS Connect Wildfire Github Site <https://ibm.biz/Bdf8BZ>

A screenshot of two browser windows side-by-side. The left window shows the main repository page for 'ibm-wsc/zCONNEE-Wildfire-Workshop'. The right window shows a specific directory listing for 'xml/' within the same repository. Both windows display a list of XML files uploaded by user 'emitchj'.

The left window (repository page):

- Code tab selected
- Issues: 1
- Pull requests: 0
- Actions: 0
- Projects: 0
- Wiki: 0
- Security: 0
- Insights: 0
- Settings: 0

The right window (xml/ directory listing):

| File | Action | Last Modified |
|-----------------------|----------------------|---------------|
| adminCenter.xml | Add files via upload | 14 months ago |
| apiRequester.xml | Add files via upload | 14 months ago |
| apiRequesterHTTPS.xml | Add files via upload | 14 months ago |
| apiRequesterTrace.xml | Add files via upload | 14 months ago |
| atssaf.xml | Add files via upload | 4 months ago |
| basicSecurity.xml | Add files via upload | 14 months ago |
| cicsTrace.xml | Add files via upload | 14 months ago |
| cors.xml | Add files via upload | 11 months ago |
| db2.xml | Add files via upload | 14 months ago |
| db2TLS.xml | Add files via upload | 14 months ago |



Thank you for listening and your questions.

Additional Material

Sample Administrative JCL

Sample JCL - Check Java installation by display Java version information

```
//JOHNSONS JOB (ACCOUNT),JOHNSON,NOTIFY=JOHNSON,REGION=0M,  
// CLASS=A,MSGCLASS=H,MSGLEVEL=(1,1),USER=LIBSERV  
//*****  
//* SET SYMBOLS  
//*****  
//EXPORT EXPORT SYMLIST=(*)  
// SET JAVAHOME='/usr/lpp/java/J8.0_64'  
//*****  
/* STEP JAVA - INVOKE THE java -version COMMAND  
//*****  
/JAVA EXEC PGM=IKJEFT01,REGION=0M  
/SYSTSPRT DD SYSOUT=*  
/SYSERR DD SYSOUT=*  
/STDOUT DD SYSOUT=*  
/STDENV DD DUMMY  
/SYSTSIN DD *,SYMBOLS=EXECSYS  
BPXBATCH SH +  
export JAVA_HOME=&JAVAHOME; +  
$JAVA_HOME/bin/java -version
```

Sample JCL - 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
```

Sample JCL - Executing the z/OS Connect Build Toolkit on z/OS

```
//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.

Sample JCL - 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=sto+  
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)

Sample JCL - Executing the Liberty *productInfo* command

```
/******  
/* SET SYMBOLS  
/******  
//EXPORT EXPORT SYMLIST=(*  
// SET WLPDIR='/usr/lpp/IBM/zosconnect/v3r0/wlp'  
//PRODINFO EXEC PGM=IKJEFT01,REGION=0M,MEMLIMIT=4G  
//SYSTSPRT DD SYSOUT=*  
//SYSERR DD SYSOUT=*  
//STDOUT DD SYSOUT=*  
//SYSTSIN DD *,SYMBOLS=EXECSYS  
BPXBATCH SH +  
Export WLPDIR=&WLPDIR; +  
$WLPDIR/bin/productInfo version; +  
$WLPDIR/bin/productInfo featureInfo | grep cics; +  
$WLPDIR/bin/productInfo featureInfo | grep mq; +  
$WLPDIR/bin/productInfo featureInfo | grep ims; +  
$WLPDIR/bin/productInfo validate | grep 'Product validation'
```

```
productInfo featureInfo  
productInfo version  
productInfo validate
```

```
Product name: z/OS Connect  
Product version: 03.00.48  
Product edition: z/OS Connect Enterprise Edition  
  
cicsService-1.0 "1.0.0"  
wmqJmsClient-1.1 "1.0.0"  
wmqJmsClient-2.0 "1.0.0"  
Product Extension: mqzosconnect  
mqService-1.0 "1.0.0"  
Product Extension: imsmobile  
imsmobile-2.0 "2.0.0.202108160933"  
Product validation completed successfully.
```

Sample JCL - 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"
```

Sample JCL - 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,  
// JAVACLS='com.ibm.ws390.sm.smfview.JclSmf'  
//STDENV DD DISP=SHR,DSN=JOHNSON.JCLLIB.CNTL(STDENV)  
//SMFDATA DD DISP=SHR,DSN=MPZ3.DUMPSMF  
//SMFENV DD *,SYMBOLS=EXECSYS  
# 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 "
```

Sample JCL – Using ADRDSSU to dump/restore MVS data sets



ZCEEDUMP

```
//EXPORT EXEC PGM=IDCAMS  
// 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=ADRDSU,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=ADRDSU,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)
```

Sample JCL – 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=*
```

Sample JCL – 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.DUMPSSMF.SORT  
//RMFSORT EXEC PGM=SORT,REGION=0M  
//SORTIN DD DISP=SHR,DSN=MPZ3.DUMPSSMF  
//SORTOUT DD DISP=(,CATLG),DSN=JOHNSON.DUMPSSMF.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.DUMPSSMF.SORT  
//MFPMMSGDS DD SYSOUT=*  
//SYSIN DD *  
    SYSOUT(O)  
    SYSRPTS(WLMGL(RCPER)) /*WORKLOAD ACTIVITY REPORT */
```

Sample JCL - Restarting the Java Health Center collection

| SDSF PROCESS DISPLAY MPZ3 ALL | | LINE 1-5 (5) | | | | | | | | | |
|-------------------------------|----------|-------------------------------|----------------|-------|----------|----------|----------|------|-------|--------------|--|
| COMMAND INPUT ==> PS | | SCROLL ==> CSR | | | | | | | | | |
| NP | JOBNAME | Status | Owner | State | CPU-Time | PID | PPID | ASID | ASIDX | LatchWaitPID | Command |
| | BAQSTRT | WAITING FOR CHILD | LIBSERV | 1W | 40.01 | 69050 | 83955129 | 42 | 002A | | /bin/sh /usr/lpp/IBM/zosconnect/v3r0/bin |
| | BAQSTRT | OTHER KERNEL WAIT | LIBSERV | HK | 40.01 | 16846267 | 69050 | 42 | 002A | | /usr/lpp/java/J8.0_64/bin/java -javagen |
| | BAQZANGL | SWAPPED, RUNNING | LIBANGE | 1RI | 0.01 | 50399398 | 83953829 | 77 | 004D | | /usr/lpp/IBM/zosconnect/v3r0/wlplib/nat |
| | BAQZANGL | SWAPPED, FILE SYS KERNEL WAIT | LIBANGE | 1FI | 0.01 | 83953829 | | 1 | 77 | 004D | BPXBATA2 |
| | BAQSTRT | FILE SYS KERNEL WAIT | 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.cl210920210909-1618)
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 = 16780584@wg31
*****
```

```
//JOHNSONS 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.