

zOSSEC1 – Liberty and IBM z/OS Connect Security

A dive into Liberty and z/OS Connect Security

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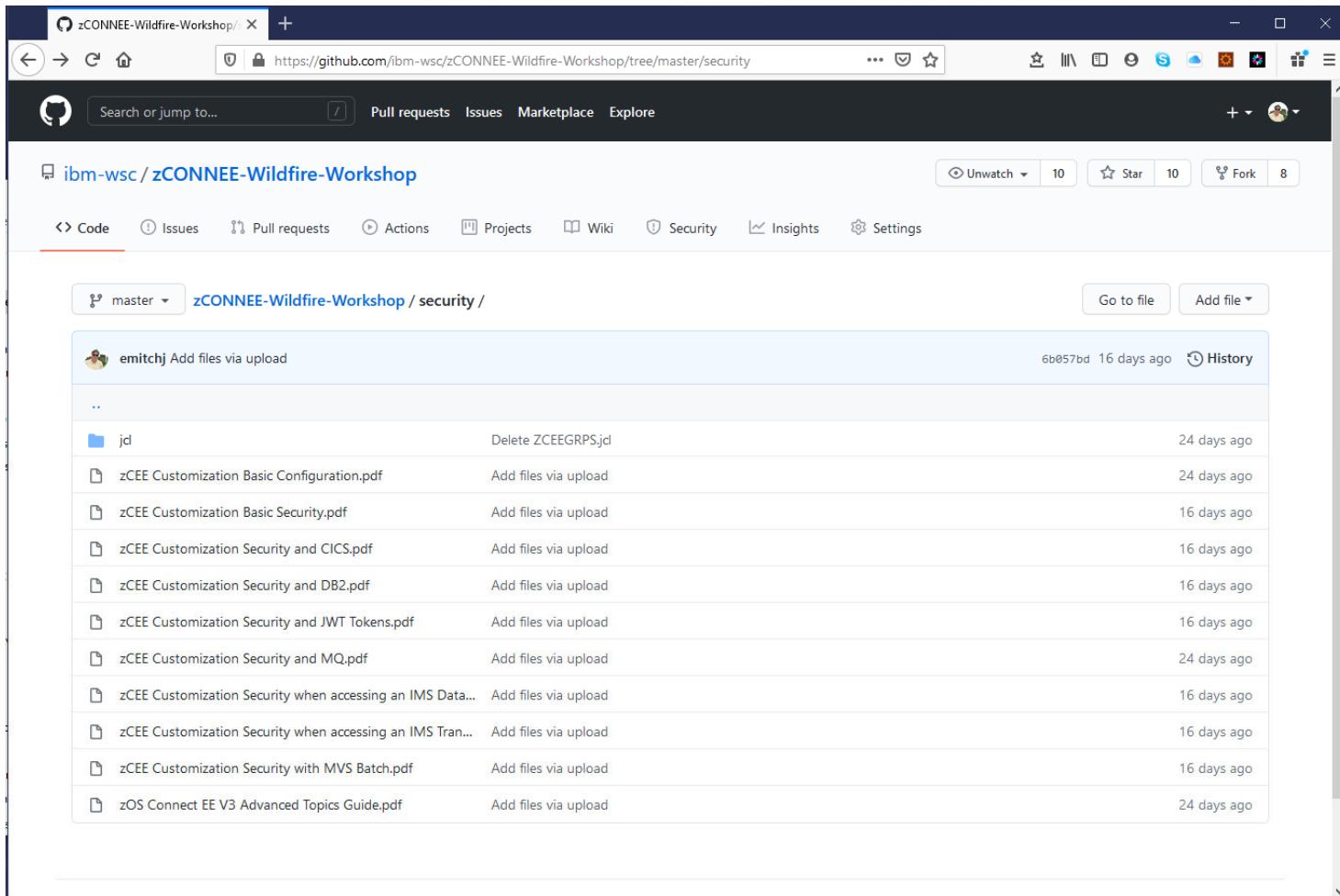
Topics

- Liberty and z/OS Connect Security Overview
- Authentication
 - Basic Authentication
 - Mutual Authentication using TLS
 - Third Party Tokens
- Encryption and Message Integrity using TLS
- Authorization
- Propagating identities to z/OS subsystems
- z/OS Connect API Requester and third-party tokens

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 Liberty  or 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 z/OS Connect development.

Detailed examples of the topics covered today are available on GitHub

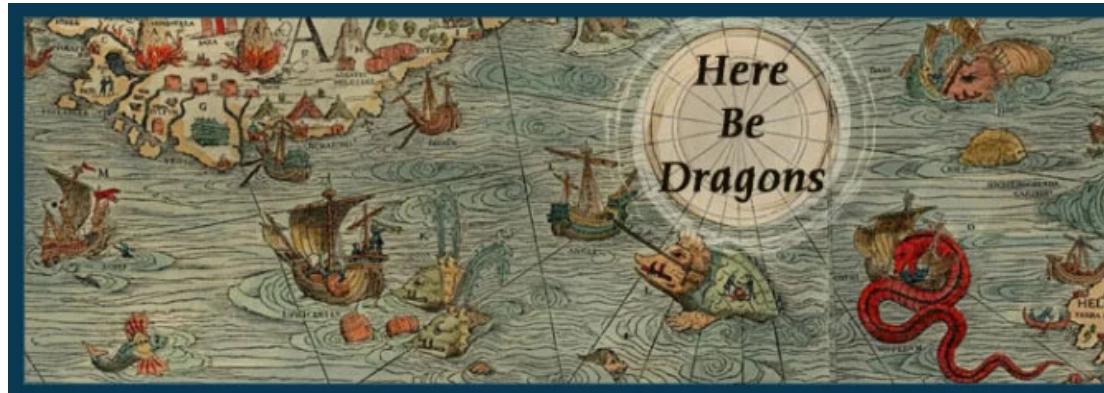


The screenshot shows a GitHub repository page for 'ibm-wsc/zCONNEE-Wildfire-Workshop'. The repository has 10 stars, 8 forks, and 16 issues. The 'Code' tab is selected, showing the 'master' branch. The 'security' directory contains the following files:

File	Description	Last Commit
..		24 days ago
jcl	Delete ZCEEGRPS.jcl	24 days ago
zCEE Customization Basic Configuration.pdf	Add files via upload	24 days ago
zCEE Customization Basic Security.pdf	Add files via upload	16 days ago
zCEE Customization Security and CICS.pdf	Add files via upload	16 days ago
zCEE Customization Security and DB2.pdf	Add files via upload	16 days ago
zCEE Customization Security and JWT Tokens.pdf	Add files via upload	16 days ago
zCEE Customization Security and MQ.pdf	Add files via upload	24 days ago
zCEE Customization Security when accessing an IMS Data...	Add files via upload	16 days ago
zCEE Customization Security when accessing an IMS Tran...	Add files via upload	16 days ago
zCEE Customization Security with MVS Batch.pdf	Add files via upload	16 days ago
zOS Connect EE V3 Advanced Topics Guide.pdf	Add files via upload	24 days ago

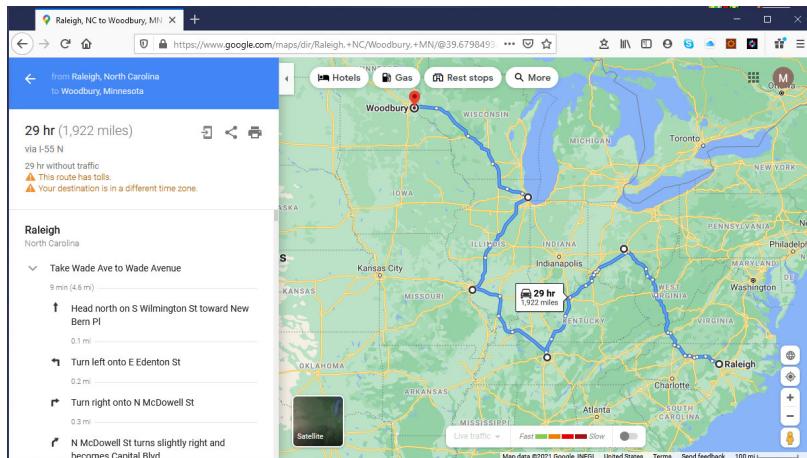
Map of the journey to implementing security

Sometimes it seems like implementing security is starting with a map like this:



"Here be dragons" (hic sunt dracones in Latin) means dangerous or unexplored territories.

When we would really like to have available is a Google map with step-by-step directions:



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But when securing Liberty and z/OS Connect, there is probably not a direct route to your destination. There will be a series of waypoints or intermediate steps on the journey which must be addressed.

We need to understand the challenges

- Providing secure access between middleware components involves combining disparate security technologies e.g., different registries like LDAP and SAF along with TLS in order to propagate security credentials from a client though various hops all the way to the targeted resource.
 - This is a driver for implementing open security models like OAuth and OpenID Connect and standard tokens like JSON Web Tokens (covered in this presentation)
- Integrating security involves integrating security between different products like z/OS Connect, WebSphere Liberty Profile on z/OS along with CICS, IMS, Db2, MQ,... probably for the first time in your environment.
 - Security details for of these components are documented in different places
- Considering that security is often at odds with **performance**, the more secure techniques often mean more processing overhead, especially if not configured optimally
 - Remember, security is probably not a choice but a requirement.



A single simple step-by-step linear path is not always possible, the best approach may be to build a solution using components, one step at a time based on the waypoints involved and the ultimate security goal. Providing security by understanding these waypoints and the corresponding options is the focus of this presentation. In fact, you may want to implement security by working backwards.

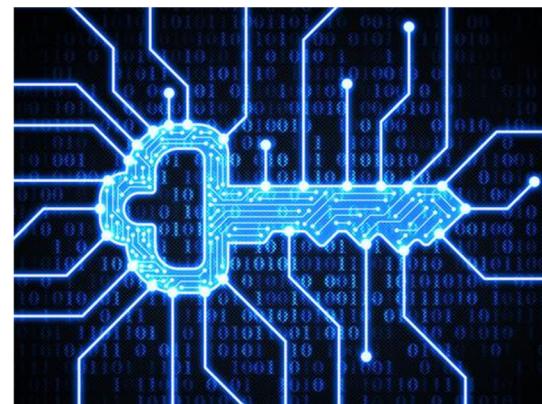
z/OS Connect Security

Overview

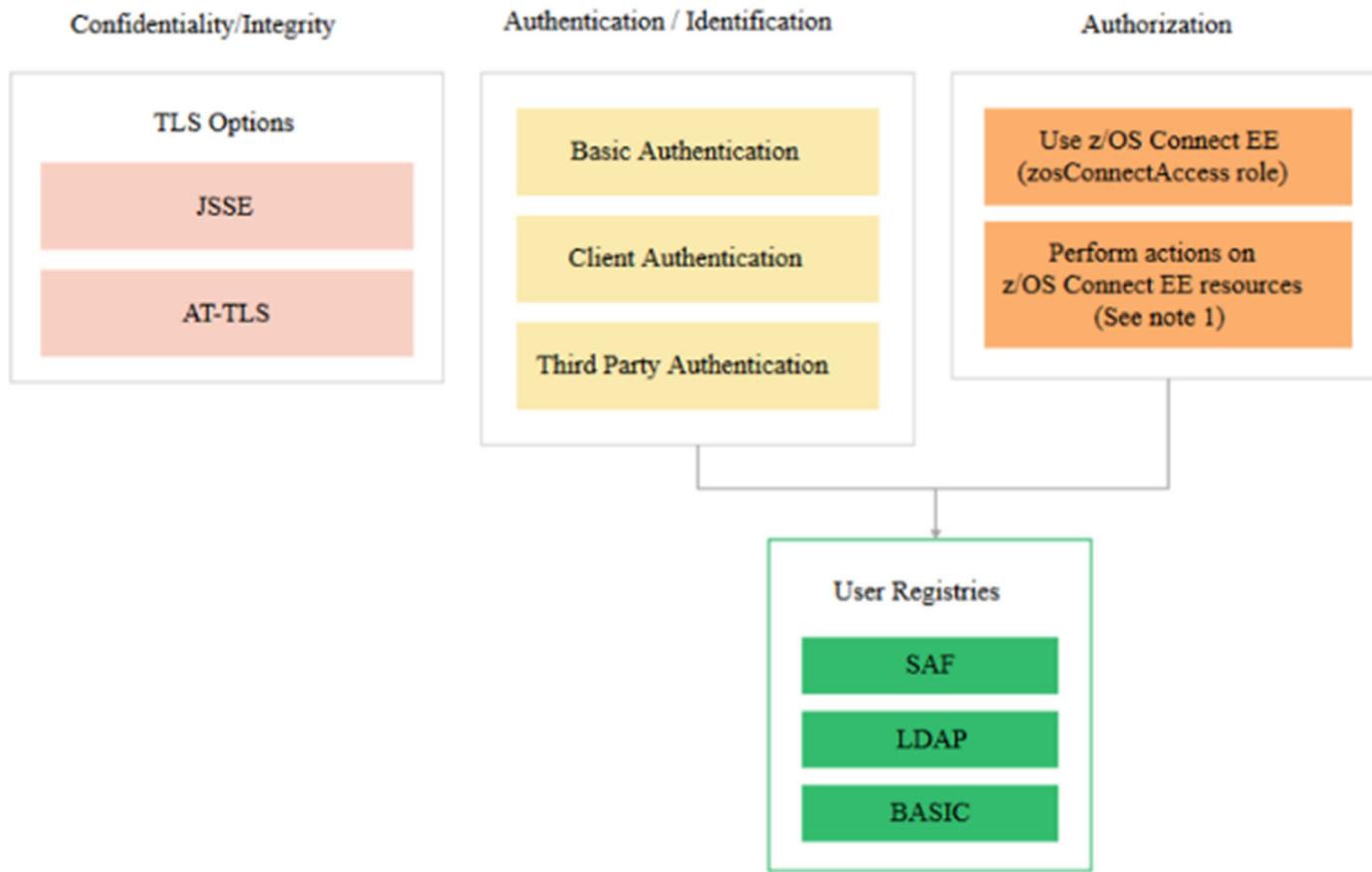
General security terms or considerations

Security involves

- Identifying who or what is requesting access (**Authentication**)
 - Basic Authentication
 - Mutual Authentication using Transport Layer Security (TLS), formerly known as SSL
 - Third Party Tokens
- Ensuring that the message has not been altered in transit (**Data Integrity**) and ensuring the confidentiality of the message in transit (**Encryption**)
 - TLS (encrypting messages and using a digital signature)
- Controlling access (**Authorization**)
 - Is the authenticated identity authorized to access to z/OS Connect
 - Is the authenticated identity authorized to access a specific API, Services, etc.



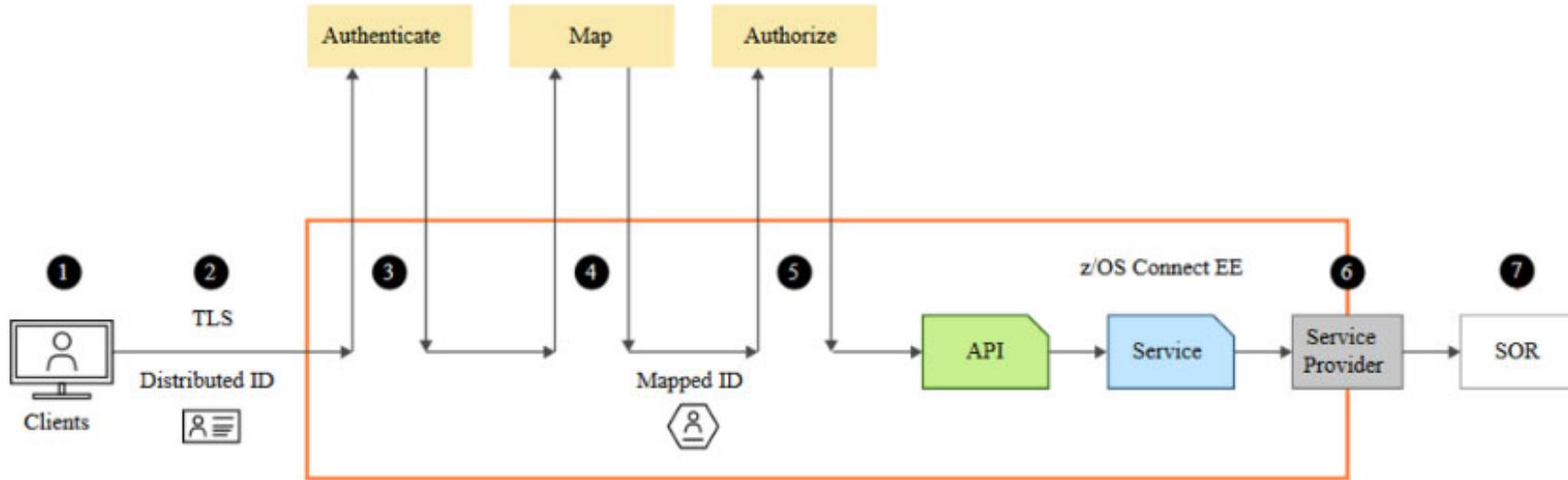
Liberty and z/OS Connect EE security options



The actions which can be controlled by authorization are deploying, querying, updating, starting, stopping and deleting of APIs, services and API requesters.



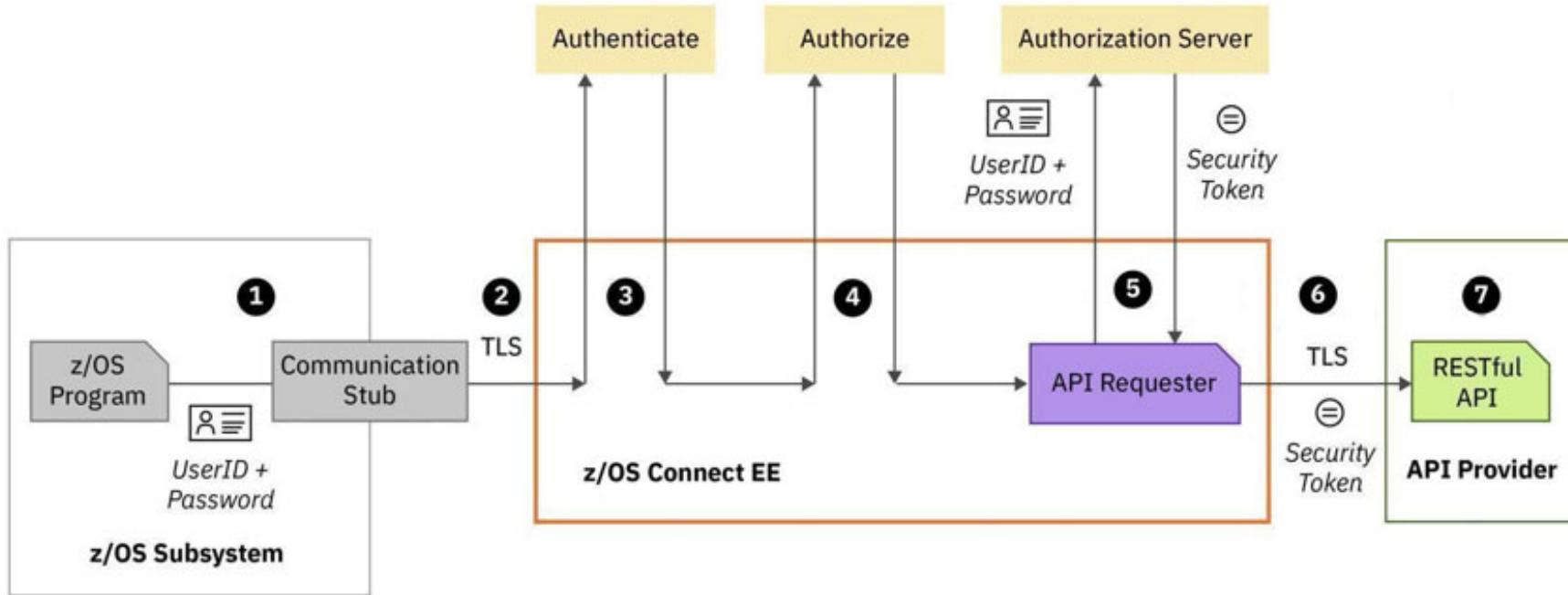
Details of a typical z/OS Connect EE API Provider security flow



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



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

**Now let's explore the security options for
inbound connections**

General security terms or considerations

Security involves

- Identifying who or what is requesting access (**Authentication**)
 - Basic Authentication
 - Mutual Authentication using Transport Layer Security (TLS), formerly known as SSL
 - Third Party Tokens
- Ensuring that the message has not been altered in transit (**Data Integrity**) and ensuring the confidentiality of the message in transit (**Encryption**)
 - TLS (encrypting messages and using a digital signature)
- Controlling access (**Authorization**)
 - Is the authenticated identity authorized to access to z/OS Connect
 - Is the authenticated identity authorized to access a specific API, Services, etc.

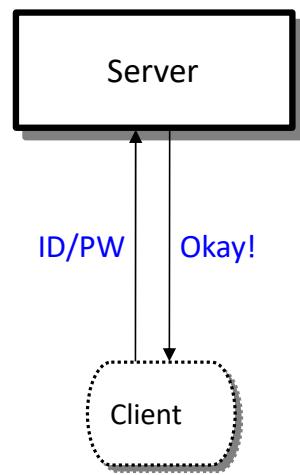




Liberty Authentication Options

Several different ways this can be accomplished:

Basic Authentication

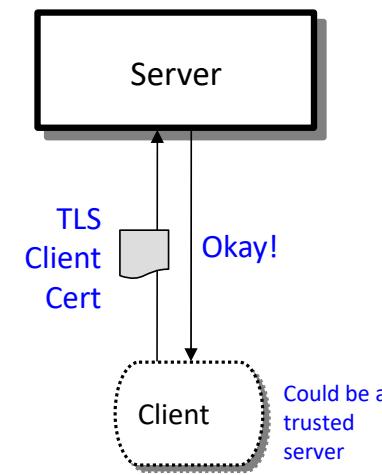


Client supplies ID/PW or ID/PassTicket

Server checks registry:

- Basic (server.xml)
- SAF

Client Certificate



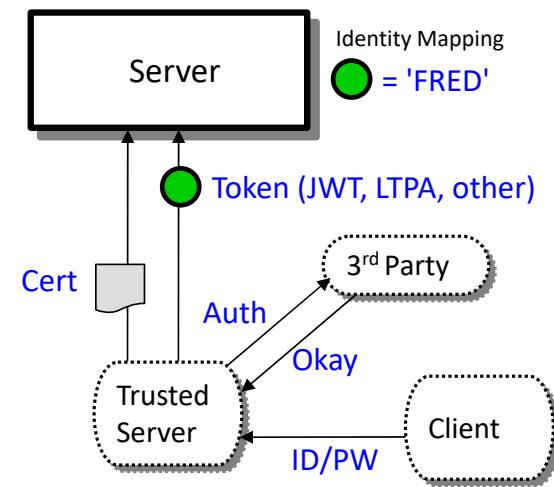
Client supplies client personal certificate

Server validates client personal certificate and maps it to an identity

Registry options:

- SAF

Third Party Authentication



Client authenticates to 3rd party sever

Client receives a trusted 3rd party token

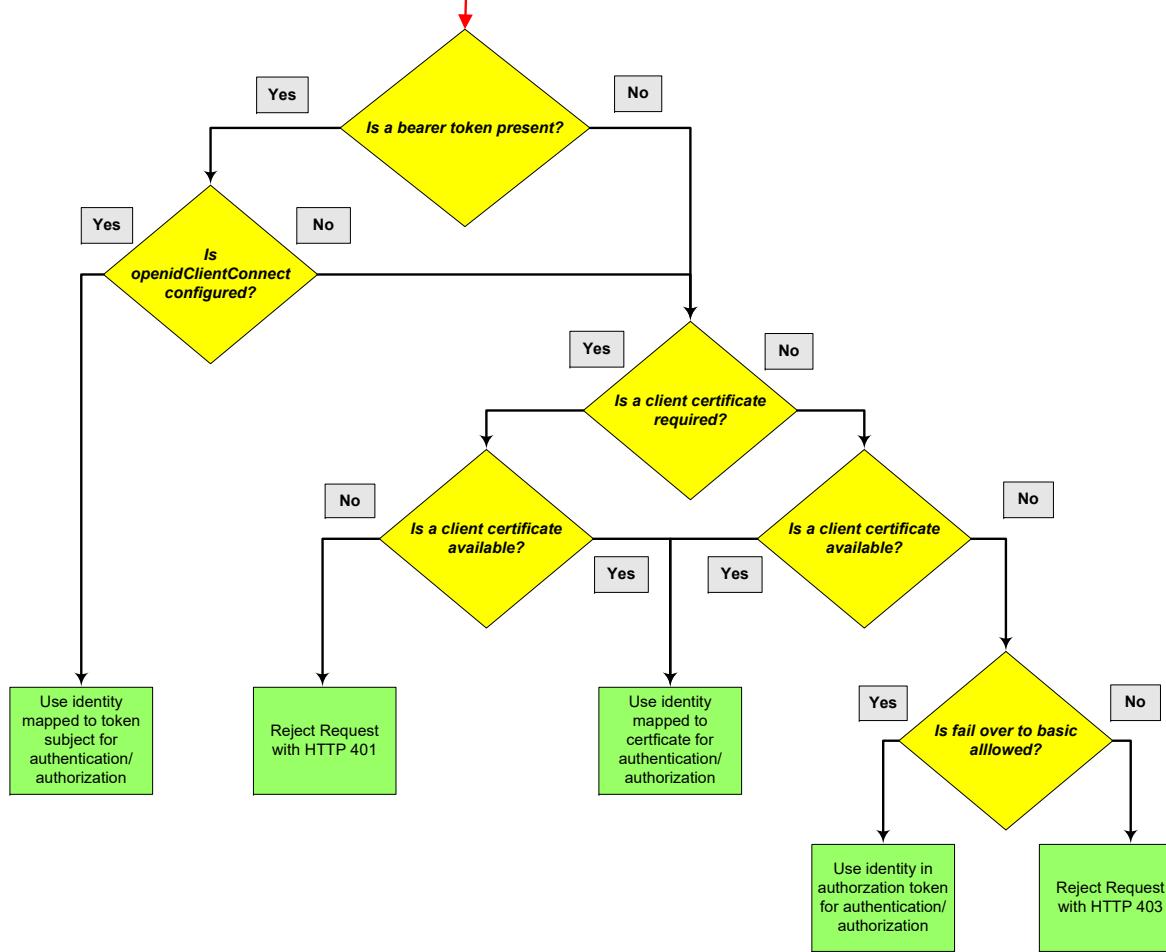
Token flows to server and is mapped to an identity

Registry options:

- We may not need to know these details.



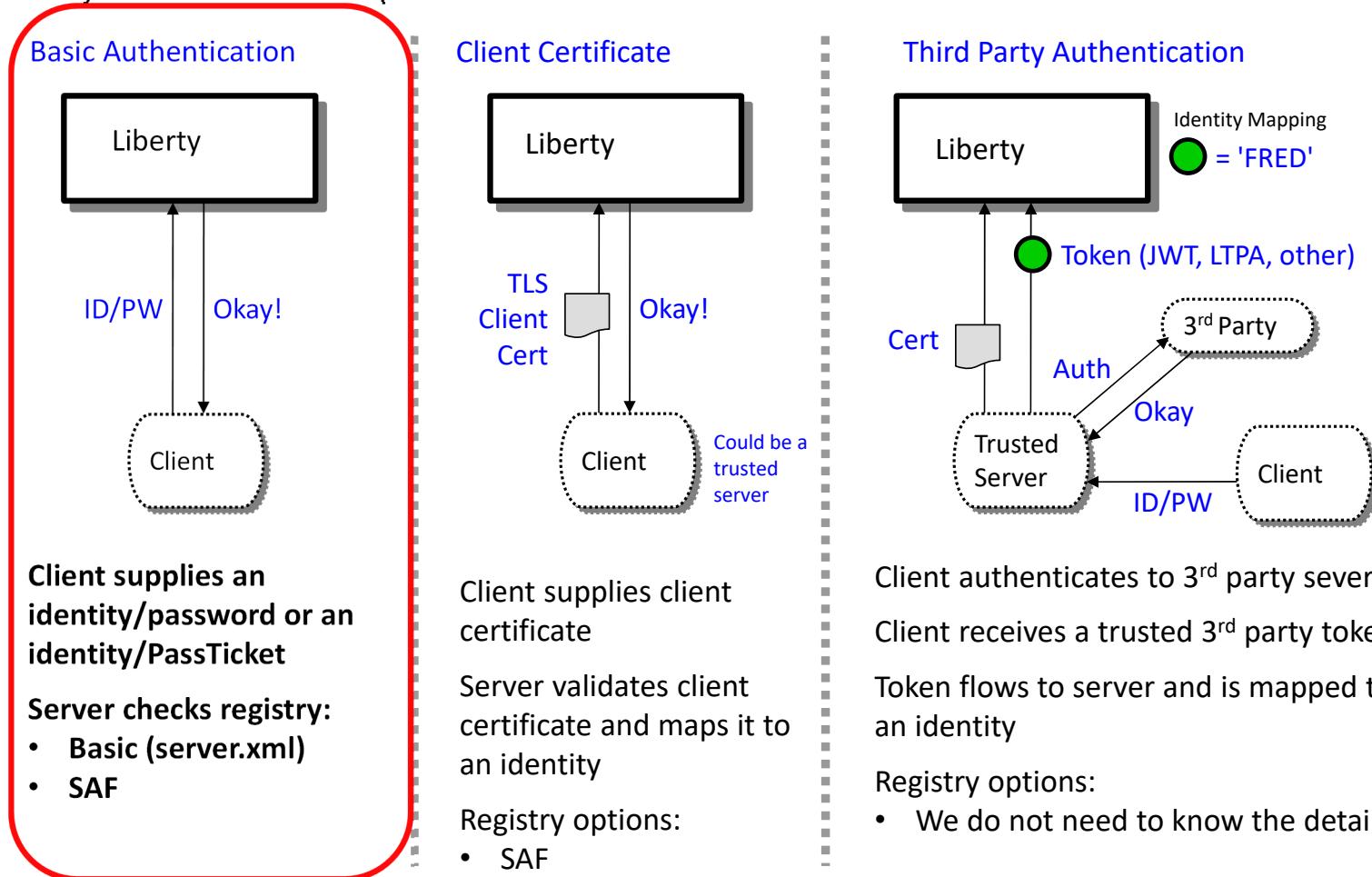
Authentication Credential Precedence





Authentication - Basic Authentication

Several different ways this can be accomplished:



Basic authentication – Where the client provides an identity and password



- ❑ server XML security configuration:

```
<featureManager>
    <feature>appSecurity-2.0</feature>
    <feature>zosSecurity-1.0</feature>
</featureManager>

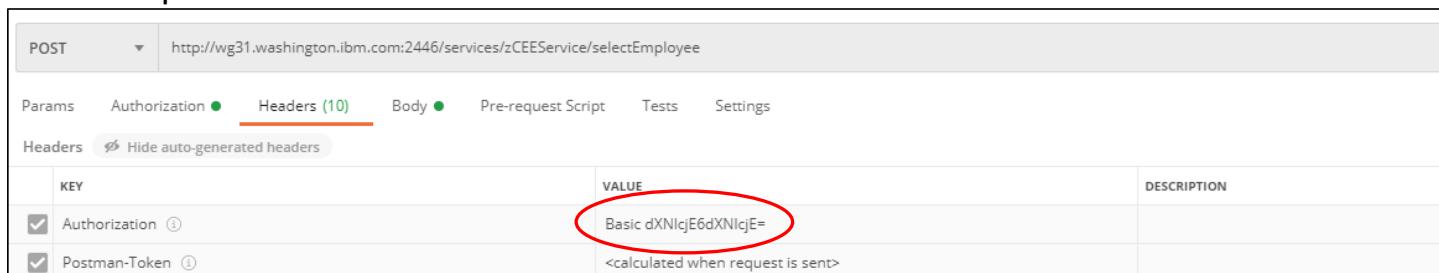
<webAppSecurity allowFailOverToBasicAuth="true" />

<safRegistry id="saf" />
<safAuthorization racRouteLog="ASIS" />
<safCredentials unauthenticatedUser="WSGUEST"
    profilePrefix="BBGZDFLT" />
```

Note that these are Liberty configuration elements documented in the Liberty KC, i.e., no `zosconnect_` prefix.

- ❑ When sending a request to a Liberty server running z/OS Connect, basic authentication information (identity and password) is provided in the HTTP header in a Basic *Authorization* token with the identity and password encoded or formatted using Base64.

- An example with Postman:



The screenshot shows a Postman request configuration. The method is set to POST and the URL is `http://wg31.washington.ibm.com:2446/services/zCEEService/selectEmployee`. The 'Headers' tab is selected, showing two entries: 'Authorization' with the value 'Basic dXNlcjE6dXNlcjE=' circled in red, and 'Postman-Token' with the value '<calculated when request is sent>'.

- An example with cURL:

```
curl -X GET --user fred:fredpwd --header "Content-Type: application/json ..."
```



z/OS Connect Security server XML Authentication Configuration

```
<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.



Basic authentication – Where the client provides an identity and password

- When sending a request to a Liberty server running z/OS Connect, basic authentication information (identity and password) is provided in the HTTP header in a Basic *Authorization* token with the identity and password encoded or formatted using Base64.
 - Remember the earlier examples Postman and cURL.
 - An example with API Discovery feature.

The screenshot shows the IBM REST API Documentation interface. Under the 'cscvinc' service, there is a 'GET /cscvinc/employee/{employee}' operation. In the 'Try it out' section, the 'Authorization' parameter is set to 'Basic dGvIcpwYXNzd29yZA=='. This field is circled in red.

```
URL url = new URL("https://wg31.washington.ibm.com:9453/db2/department?dept1=C01&dept2=C01");
System.out.println("URL: " + url);
HttpsURLConnection conn = (HttpsURLConnection) url.openConnection();
conn.setRequestMethod("GET");
conn.setRequestProperty("Content-Type", "application/json");
byte[] bytesEncoded = Base64.encodeBase64("Fredi:fredpwd".getBytes());
conn.addRequestProperty("Authorization", new String(bytesEncoded));

try {
    if (conn.getResponseCode() != 200) {
        throw new RuntimeException("Failed : HTTP error code : " + conn.getResponseCode());
    }
    BufferedReader bufferedReader = new BufferedReader(new InputStreamReader((conn.getInputStream())));
    String output;
    StringBuilder stringBuffer = new StringBuilder();
    while ((output = bufferedReader.readLine()) != null) {
        stringBuffer.append(output);
    }
    JSONObject json = new JSONObject(stringBuffer.toString());
    JSONArray jsonArray = json.getJSONArray("ResultSet 1 Output");
    JSONObject jsonEntry = new JSONObject();
    for (int index = 0; index < jsonArray.length(); index++) {
        jsonEntry = jsonArray.getJSONObject(index);
        if (jsonEntry.has("employeeNumber")){
```

Tech/Tip: Use <https://www.base64encode.org> to encode identity and password

Encode to Base64 format
Simply enter your data then push the encode button.

To encode binaries (like images, documents, etc.) use the file upload form a little further down on this page.

UTF-8 Destination character set.
LF (Unix) Destination newline separator.
 Encode each line separately (useful for when you have multiple entries).
 Split lines into 76 character wide chunks (useful for MIME).
 Perform URL-safe encoding (uses Base64URL format).
 Live mode OFF Encodes in real-time as you type or paste (supports only the UTF-8 character set).

> **ENCODE** < Encodes your data into the area below.



Basic authentication – COBOL API Requester

- ❑ A MVS batch or IMS requester application sends basic authentication information (identity and password) by using environment variables.
 - BAQUSERNAME
 - BAQPASSWORD
- ❑ The variables can be provided in JCL using CEEOPTS DD statement:

```
//CEELOPTS DD *  
  POSIX(ON),  
  ENVAR("BAQURI=wg31.washington.ibm.com",  
"BAQPORT=9080",  
"BAQUSERNAME=USER1",  
"BAQPASSWORD=USER1")
```

Note that the communications stub generates the Authentication header token we saw earlier

- ❑ Or, provided by using a CEEROPT or CEEUOPT module:

```
CEEROPT CSECT  
CEEROPT AMODE ANY  
CEEROPT RMODE ANY  
CEEXOPT POSIX=((ON),OVR),  
ENVAR=((BAQURI=wg31.washington.ibm.com',  
'BAQPORT=9120',  
'BAQUSERNAME=USER1',  
'BAQPASSWORD=USER1'),OVR),  
RPTOPTS=((ON),OVR)  
END
```

Tech/Tip: This is good opportunity to use a pass ticket rather than a password

Tech/Tip: A PassTicket provides an alternative to a password



- ❑ A PassTicket is generated by or for a client by using a secured sign-on key (whose value is masked or encrypted) to encrypt a valid *RACF identity* combined with the *application name* of the targeted resource. Also embedded in the PassTicket is a time stamp (based on the current Universal Coordinated Time (UCT)) which sets the time when the PassTicket will expire (usually 10 minutes).
- ❑ Access to PassTickets is managed using the RACF PTKTDATA class.
- ❑ For z/OS Connect, a RACF PassTicket can be used for basic authentication when connecting from any REST client on any platform to a z/OS Liberty server and for requests from a z/OS Connect server accessing IMS and Db2.
- ❑ ***PassTickets do not have to be generated on z/OS using RACF services.*** IBM has published the algorithm used to generate a PassTickets, see manual *z/OS Security Server RACF Macros and Interfaces, SA23-2288-40*. *Github has examples using Java, Python and other example are available on other sites.*

```
<safRegistry id="saf" />
  <safAuthorization racRouteLog="ASIS" />
  <safCredentials unauthenticatedUser="WSGUEST"
    profilePrefix="BBGZDFLT" />
```

Tech/Tip: Generating PassTickets on z/OS

- On z/OS, a COBOL user application can generate a pass tickets by calling RACF service IRRSPK00:

```
*-----  
* Build IRRSPK00 parameters  
*-----  
MOVE 0 to ws-length  
MOVE LENGTH OF identity to identity-length.  
INSPECT FUNCTION REVERSE (identity)  
    TALLYING ws-length FOR ALL SPACES.  
SUBTRACT ws-length FROM identity-length.  
MOVE 0 to ws-length  
MOVE LENGTH OF applid to applid-length.  
INSPECT FUNCTION REVERSE (applid)  
    TALLYING ws-length FOR ALL SPACES.  
SUBTRACT ws-length FROM applid-length.  
MOVE 8 to passTicket-length.  
MOVE 'NOTICKET' to passTicket.  
MOVE X'0003' to irr-functionCode.  
MOVE X'00000001' to irr-ticketOptions.  
SET irr-ticketOptions-ptr to ADDRESS OF irr-ticketOptions.  
*-----  
* Call RACF service IRRSPK00 to obtain a pass ticket based  
* on identity and applid  
*-----  
PERFORM CALL-RACF.  
IF irr-safrc NOT = zero then  
    DISPLAY "SAF_return_code:      " irr-safrc  
    DISPLAY "RACF_return_code:    " irr-racfrc  
    DISPLAY "RACF_reason_code:   " irr-racfrsn  
End-if  
.  
*-----  
* Call IRRSPK00 requesting a pass ticket  
*-----  
CALL-RACF.  
    CALL W-IRRSPK00 USING irr-workarea,  
        IRR-ALET, irr-safrc,  
        IRR-ALET, irr-racfrc,  
        IRR-ALET, irr-racfrsn,  
        IRR-ALET, irr-functionCode,  
        irr-optionWord,  
        IRR-PASSSTICKET,  
        irr-ticketOptions-ptr,  
        IRR-IDENTITY,  
        IRR-APPLID.  
CALL-RACF-END.
```



Tech/Tip: RACF resources for using PassTickets

- ❑ First define a PTKTDATA resource using the *appName* assigned to the target subsystem:

```
RDEFINE PTKTDATA appName SSIGNON(KEYMASK(keymaskValue))
    APPLDATA('NO REPLAY PROTECTION')
```

Where:

appName is an application name assigned to the resource, e.g., BBGZDFLT
keymaskValue is the value of the secured sign-on application key, a 64-bit hex value
replayProtection indicates if a pass ticket can be reused

- ❑ Access to using PassTickets is controlled by another PTKTDATA resource, *IRRPTAUTH.appName.identity*. UPDATE access is required. For example, to use PassTickets to access a z/OS Connect server the resources below need to be defined and access permitted.

```
<safRegistry id="saf" />
  <safAuthorization racRouteLog="ASIS" />
  <safCredentials unauthenticatedUser="WSGUEST"
    profilePrefix="BBGZDFLT" />
```

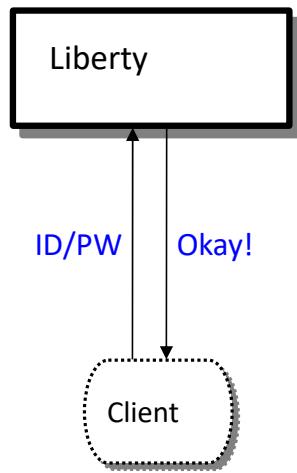
```
RDEFINE PTKTDATA BBGZDFLT SSIGNON(0123456789ABCDEF)
    APPLDATA('NO REPLAY PROTECTION') UACC(NONE)
RDEFINE PTKTDATA IRRPTAUTH.BBGZDFLT.* UACC(NONE)
PERMIT IRRPTAUTH.BBGZDFLT.* ID(LIBSERV) CLASS(PTKTDATA) ACCESS(UPDATE)
PERMIT IRRPTAUTH.BBGZDFLT.USER1 ID(USER1) CLASS(PTKTDATA) ACCESS(UPDATE)
```



Authentication - TLS Mutual Authentication

Several different ways this can be accomplished:

Basic Authentication



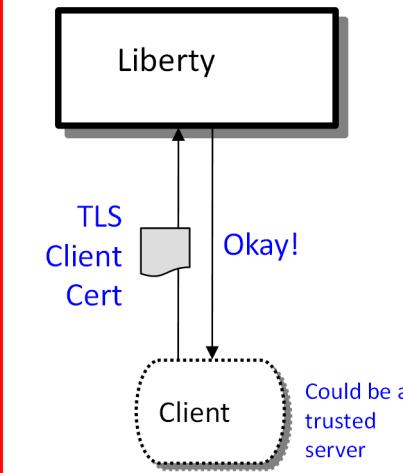
Server prompts for ID/PW

Client supplies ID/PW or ID/PassTicket

Server checks registry:

- Basic (server.xml)
- SAF

Client Certificate



Server prompts for client certificate.

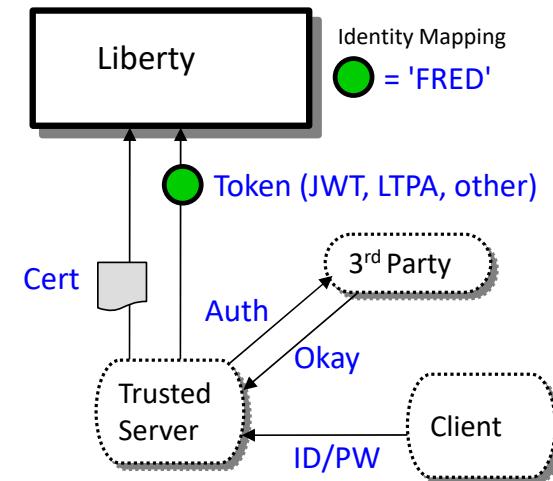
Client supplies personal certificate

Server validates client certificate and maps it to an identity

Registry options:

- SAF

Third Party Authentication



Client authenticates to 3rd party sever

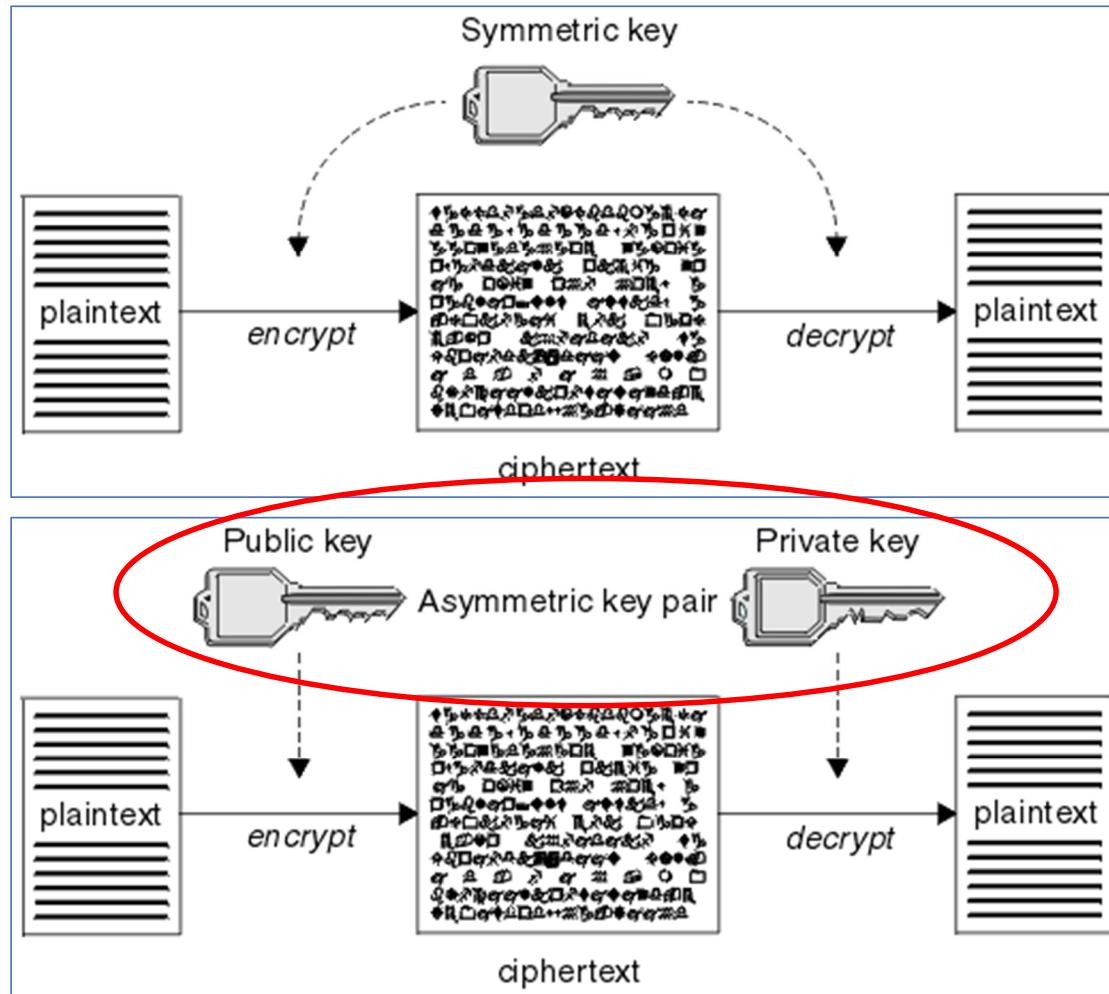
Client receives a trusted 3rd party token

Token flows to Liberty z/OS and is mapped to an identity

Registry options:

- We may not need to know these details.

Tech-Tip: Symmetric key v. Asymmetric key pair



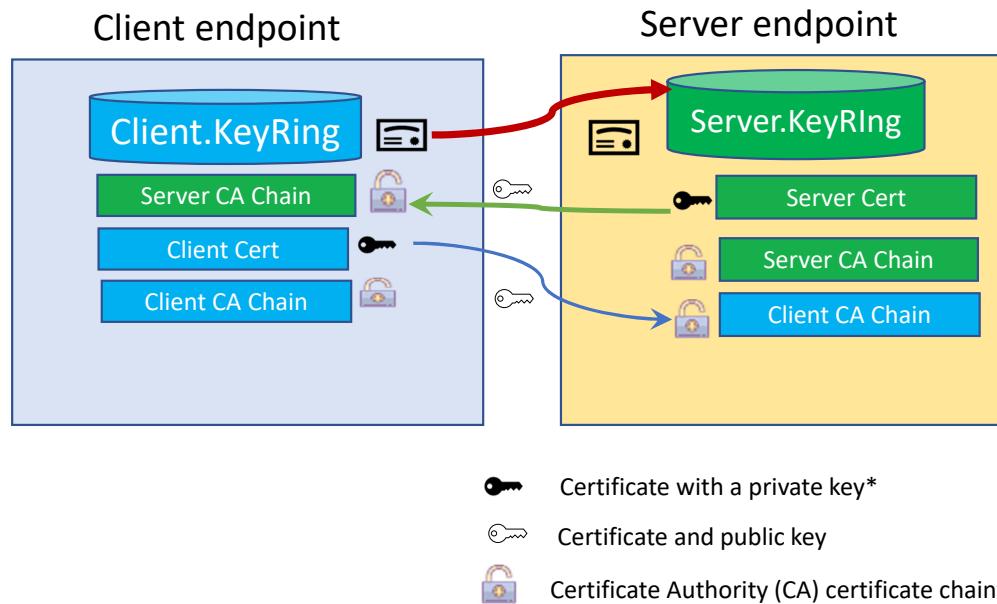
An asymmetric key pair is the preferred solution. There is no risk of compromise by sending a symmetric or shared key outside of a protected communication flow.

Let's explore the basic TLS Handshake Flow (HTTPS)

The HTTPS protocol involves a TLS handshake –

Server Authentication (always occurs when HTTPS is the protocol)

Mutual Authentication (optional, at the request of the server endpoint)



*For server and/or mutual authentication to work, the endpoint sending the 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 up to and including the root CA.

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

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

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

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

Tech/Tip: 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 from 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 know as "shared secret" or "session key" (symmetric encryption)
15. Client and server will use this "shared secret" or "session key" to encrypts messages sent between the endpoints.

Tech/Tip: A note on cipher suite names

A CipherSuite is a suite of cryptographic algorithms used by a TLS connection. A suite comprises three distinct algorithms:

- The key exchange and authentication algorithm, used during the handshake
- The encryption algorithm, used to encipher the data
- The MAC (Message Authentication Code) algorithm, used to generate the message digest

There are several options for each component of the suite, but only certain combinations are valid when specified for a TLS connection. The name of a valid CipherSuite defines the combination of algorithms used. For example, the CipherSuite ***TLS_RSA_WITH_AES_128_CBC_SHA*** specifies:

- The RSA key exchange and authentication algorithm
- The AES encryption algorithm, using a 128-bit key and cipher block chaining (CBC) mode
- The SHA-1 Message Authentication Code (MAC)

Note				
To use some CipherSuites, the 'unrestricted' policy files need to be configured in the JRE. For more details of how policy files are set up in an SDK or JRE, see the IBM SDK Policy files topic in the Security Reference for IBM SDK, Java Technology Edition for the version you are using.				
Table 1. CipherSpecs supported by IBM MQ and their equivalent CipherSuites				
CipherSpec	Equivalent CipherSuite (IBM JRE)	Equivalent CipherSuite (Oracle JRE)	Protocol	FIPS 140-2 compatible
ECDHE_ECDSA_3DES_EDE_CBC_SHA256	SSL_ECDHE_ECDSA_WITH_3DES_EDE_CBC_SHA	TLS_ECDHE_ECDSA_WITH_3DES_EDE_CBC_SHA	TLS 1.2	yes
ECDHE_ECDSA_AES_128_CBC_SHA256	SSL_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256	TLS_ECDHE_ECDSA_WITH_AES_128_CBC_SHA256	TLS 1.2	yes
ECDHE_ECDSA_AES_128_GCM_SHA256	SSL_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256	TLS_ECDHE_ECDSA_WITH_AES_128_GCM_SHA256	TLS 1.2	yes
ECDHE_ECDSA_AES_256_CBC_SHA384	SSL_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384	TLS_ECDHE_ECDSA_WITH_AES_256_CBC_SHA384	TLS 1.2	yes
ECDHE_ECDSA_AES_256_GCM_SHA384	SSL_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384	TLS_ECDHE_ECDSA_WITH_AES_256_GCM_SHA384	TLS 1.2	yes
ECDHE_ECDSA_NULL_SHA256	SSL_ECDHE_ECDSA_WITH_NULL_SHA	TLS_ECDHE_ECDSA_WITH_NULL_SHA	TLS 1.2	no
ECDHE_ECDSA_RC4_128_SHA256	SSL_ECDHE_ECDSA_WITH_RC4_128_SHA	TLS_ECDHE_ECDSA_WITH_RC4_128_SHA	TLS 1.2	no
ECDHE_RSA_3DES_EDE_CBC_SHA256	SSL_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA	TLS_ECDHE_RSA_WITH_3DES_EDE_CBC_SHA	TLS 1.2	yes
ECDHE_RSA_AES_128_CBC_SHA256	SSL_ECDHE_RSA_WITH_AES_128_CBC_SHA256	TLS_ECDHE_RSA_WITH_AES_128_CBC_SHA256	TLS 1.2	yes
ECDHE_RSA_AES_128_GCM_SHA256	SSL_ECDHE_RSA_WITH_AES_128_GCM_SHA256	TLS_ECDHE_RSA_WITH_AES_128_GCM_SHA256	TLS 1.2	yes
ECDHE_RSA_AES_256_CBC_SHA384	SSL_ECDHE_RSA_WITH_AES_256_CBC_SHA384	TLS_ECDHE_RSA_WITH_AES_256_CBC_SHA384	TLS 1.2	yes
ECDHE_RSA_AES_256_GCM_SHA384	SSL_ECDHE_RSA_WITH_AES_256_GCM_SHA384	TLS_ECDHE_RSA_WITH_AES_256_GCM_SHA384	TLS 1.2	yes
ECDHE_RSA_NULL_SHA256	SSL_ECDHE_RSA_WITH_NULL_SHA	TLS_ECDHE_RSA_WITH_NULL_SHA	TLS 1.2	no
ECDHE_RSA_RC4_128_SHA256	SSL_ECDHE_RSA_WITH_RC4_128_SHA	TLS_ECDHE_RSA_WITH_RC4_128_SHA	TLS 1.2	no

https://www.ibm.com/support/knowledgecenter/SSFKSJ_9.1.0/com.ibm.mq.dev.doc/q113210_.htm

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Slide 30



Using this Liberty JSSE server XML configuration (requires HTTPS)

```

<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|false"
    <apiRequester name="cscvincapi_1.0.0"
        requireAuth="true"
        requireSecure="true|false"/>
</zosconnect_apiRequesters>

```

```

<!-- 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"/>

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

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

<keyStore id="OutboundKeyStore"
    location="safkeyring:///zCEE.KeyRing"
    password="password" type="JCEERACFKS"
    fileBased="false" readOnly="true" />

```

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

Tech/Tip: Regarding *clientAuthentication* and *clientAuthenticationSupported*. Understand the implications of the interactions between these attributes. There may instances where you want to use HTTPS, but not always with mutual authentication Consider setting *clientAuthentication* to false when setting *clientAuthenticationSupported* to true.



Tech-Tip: RACF Key Rings are protected by resource profiles

Two types of profiles are checked: **Ring Specific** or **Global**

- **Ring Specific** uses RDATALIB class profiles:

- <ring owner>.<ring name>.LST
- <virtual ring owner>.IRR_VIRTUAL_KEYRING.LST

- **READ** access – read all certificates and own private key
- **UPDATE** access – read other user's private keys
- **CONTROL** access – read CA / SITE private keys

- **Global** uses FACILITY class profiles:

- IRR.DIGTCERT.LISTRING:

- **READ** access – read own key rings and own private keys and read SITE and CA Virtual key rings.
- **UPDATE** access – read other user's rings (Can not read others user's private keys)

- IRR.DIGTCERT.GENCERT:

- **CONTROL** access – read CA / SITE private keys

- **Note:** Private keys are only returned when certificate usage is **PERSONAL**

- **Remember:** When switching from Global FACILITY class profiles to Ring Specific RDATALIB class profiles, the Ring specific will be checked first.

Shared key ring

RACF RDATALIB resources

- RDEFINE RDATALIB LIBSERV.ClientKeyRing.LST UACC(NONE)
- PERMIT LIBSERV.ClientKeyRing.LST CLASS(RDATALIB)
ID(LIBSERV) ACCESS(READ)

JSSE - safkeyring://LIBSERV/Liberty.KeyRing

AT-TLS - LIBSERV/Liberty.KeyRing

Shared Virtual key ring

RACF RDATALIB resources

- RDEFINE RDATALIB CERTIFAUTH.IRR_VIRTUAL_KEYRING_LST UACC(NONE)
- PERMIT CERTIFAUTH.IRR_VIRTUAL_KEYRING_LST CLASS(RDATALIB)
ID(LIBSERV) ACCESS(READ)

JSSE - safkeyring:///*AUTH*/

AT-TLS - *AUTH*/

Tech/Tip: RACF digital certificate (RACDCERT) command review

```
RACDCERT CERTAUTH GENCERT SUBJECTSDN(CN('Liberty CA') +
    OU('LIBERTY')) WITHLABEL('Liberty CA') TRUST SIZE(2048) NOTAFTER(DATE(2022/12/31))
RACDCERT ID(LIBSERV) GENCERT SUBJECTSDN(CN('wg31.washington.ibm.com') +
    O('IBM') OU('LIBERTY')) WITHLABEL('Liberty Client Cert') +
    ALTNAMES(DOMAIN('wg31z.washington.ibm.com')) SIGNWITH(CERTAUTH LABEL('Liberty CA')) SIZE(2048) +
    NOTAFTER(DATE(2022/12/31))
```

```
RACDCERT ID(LIBSERV) GENCERT SUBJECTSDN(CN('wg31.washington.ibm.com') +
    O('IBM') OU('LIBERTY')) WITHLABEL('Liberty Server Cert')
RACDCERT ID(LIBSERV) GENREQ(LABEL('Liberty Server Cert')) DSN(CERT.REQ)
```

Send the certificate to your Certificate Authority to be signed

```
racdcert CERTAUTH withlabel('Liberty CA') add('USER1.LIBCA.PEM') TRUST
racdcert id(LIBSERV) withlabel('Liberty Server Cert') add('LIBSERV.P12') password('secret') TRUST
```

```
/* Create Liberty key ring and connect CA and personal certificates */
racdcert id(libserv) addring(Liberty.KeyRing)
racdcert id(libserv) connect(ring(Liberty.KeyRing) label('CICS CA') certauth usage(certauth))
racdcert id(libserv) connect(ring(Liberty.KeyRing) label('Liberty CA') certauth usage(certauth)
/* Connect default personal certificate */
racdcert id(libserv) connect(ring(Liberty.KeyRing) label('Liberty Client Cert') default
```

```
setropts raclist(digtcert) refresh
```

Broadcom Support web pages

Site of *What ACF2 security setup is needed for IBM's z/OS Connect Enterprise Edition V3.0?*

<https://knowledge.broadcom.com/external/article/128597/what-acf2-security-setup-is-needed-for-i.html>

Site of *ACF2 setup for z/OS Connect Enterprise Edition V3.0*

<https://knowledge.broadcom.com/external/article/142172/acf2-setup-for-zos-connect-enterprise-ed.html>

Site of *Setting up Liberty Server for z/OS with Top Secret*

<https://knowledge.broadcom.com/external/article/37272/setting-up-liberty-server-for-zos-with-t.html>

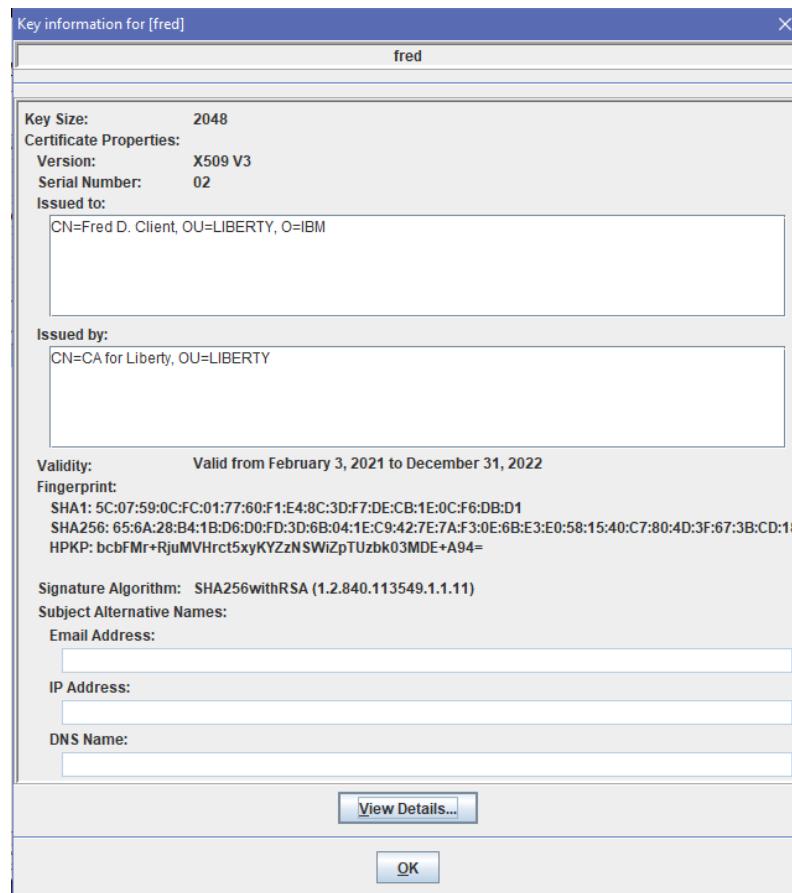
Tech/Tip: Anatomy of a RACF Personal Digital Certificate

Digital certificate information for user ATSSERV:

Label: **RPServer-Server**
Certificate ID: 2QfB4+Lixdn12dfihZmlhZlg4oWZpYWZ
Status: **TRUST**
Start Date: 2020/11/12 00:00:00
End Date: **2029/12/31 23:59:59**
Serial Number:
 >01<
Issuer's Name:
 >**CN=RPServer-CertAuth.OU=CertAuth**<
Subject's Name:
 >**CN=RPServer-Server.OU=ATS.O=IBM.C=USA**<
Subject's AltNames:
 Domain: **wg31.washington.ibm.com** ←
Signing Algorithm: sha1RSA
Key Type: RSA
Key Size: 2048
Private Key: **YES**
Ring Associations:
 Ring Owner: **ATSSERV**
 Ring:
 >**RpServer.KeyRing**<
 Ring Owner: **LIBSERV**
 Ring:
 >**RpServer.KeyRing**<

Some clients are more sensitive than others when checking common names (CN). They will check the endpoint's actual host name versus the CN and if they do not match, the certificate is rejected. The *AltName* attribute can be used to resolve this issue.

Tech/Tip: Anatomy of a certificate – IkeyMan/keytool



```
c:\Users\workstation\.zosexplorer\.metadata\.plugins\com.ibm.cics.core.comm>keytool -list -keystore explorer_keystore.jks -alias fred -v -storepass changeit
Alias name: fred
Creation date: Mar 8, 2021
Entry type: keyEntry
Certificate chain length: 2
Certificate[1]:
Owner: CN=Fred D. Client, OU=LIBERTY, O=IBM
Issuer: CN=CA for Liberty, OU=LIBERTY
Serial number: 2
Valid from: 2/3/21 11:00 PM until: 12/31/22 10:59 PM
Certificate fingerprints:
MD5: 89:5B:87:D3:CB:E2:DD:D5:CB:78:A9:8E:49:84:F7:C5
SHA1: 5C:07:59:0C:FC:01:77:60:F1:E4:8C:3D:F7:DE:CB:1E:0C:F6:DB:D1
SHA256: 65:6A:28:B4:1B:D6:D0:FD:3D:6B:04:1E:C9:42:7E:7Af3:0E:6B:E3:E0:58:15:40:C7:80:4D:3F:67:3B:CD:18
Signature algorithm name: SHA256withRSA
Version: 3

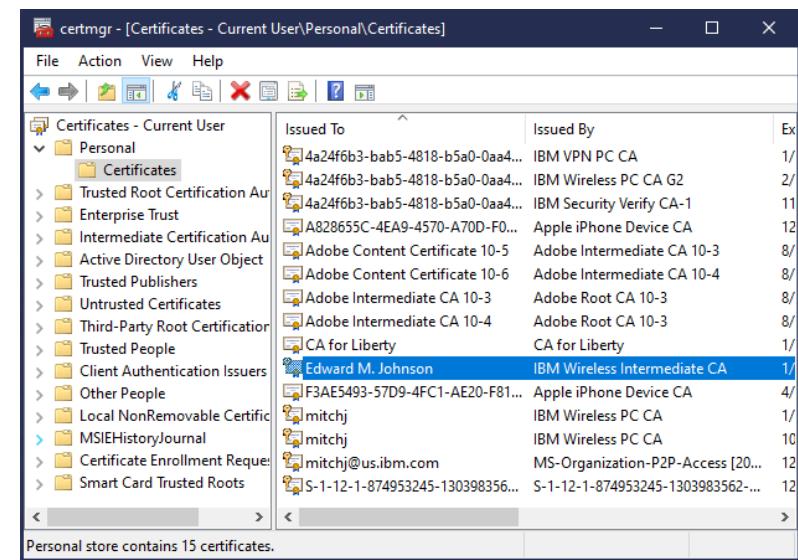
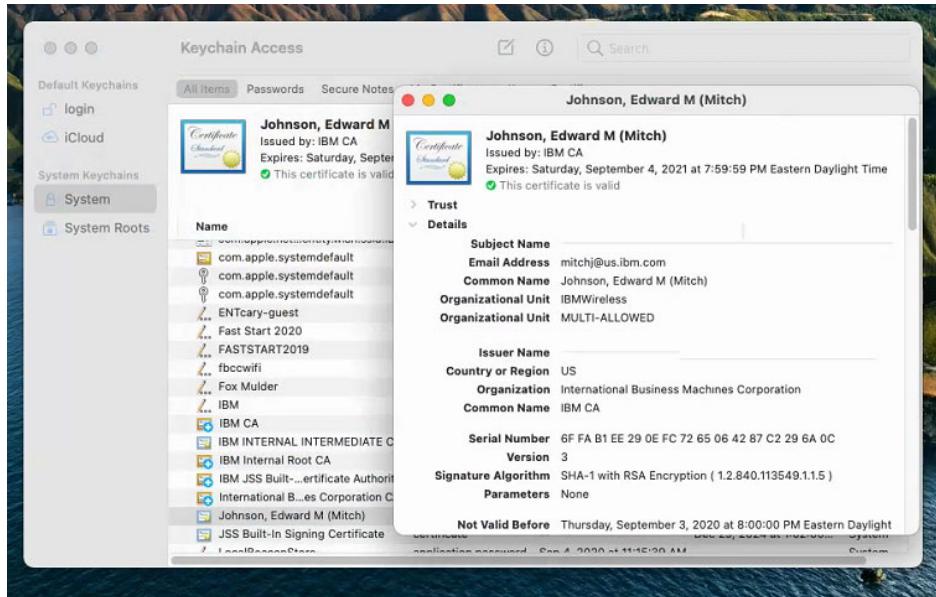
Extensions:
#1: ObjectId: 2.16.840.1.113730.1.13 Criticality=false
0000: 16 30 47 65 6e 65 72 61 74 65 64 20 62 79 20 74 .0Generated.by.t
0010: 68 65 28 53 65 63 75 72 69 74 79 20 53 65 72 76 he.Security.Serv
0020: 65 72 20 66 6f 72 20 7a 2f 4f 53 20 28 52 41 43 er.for.z.OS.RAC
0030: 46 29 F.

#2: ObjectId: 2.5.29.35 Criticality=false
AuthorityKeyIdentifier [
KeyIdentifier [
0000: 6e a0 26 b5 6b d5 82 18 f1 72 00 d7 bc c8 bf 09 n...K....r....,
0010: a4 3a 2f e7 ....
]
]

#3: ObjectId: 2.5.29.14 Criticality=false
SubjectKeyIdentifier [
KeyIdentifier [
```

Both can be found in /usr/lpp/java/J8.0_64/bin or c:/Program Files/IBM/Java80/jre/bin

Tech/Tip: Anatomy of a certificate – Mac/Windows



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Tech/Tip: How to tell the difference?

Public certificate (site or certificate authority or certificate request)

CERTAUTH.PEM - Notepad

File Edit Format View Help

-----BEGIN CERTIFICATE-----

MII1DyVCAj6gIBAgIBADAnBgkqhkiG9w0BAQsFADARMRwIwDgYDVQQLEwdMSUJF
U1RZRCvFQYQVQDQEw5DQSBlm3igTGlzXJ0eTAeFw0yMDExMTUwNDAwMDBAfw0y
MzAxMDEmWzMuNT1McxsEDA0BgVBAStB0xJ0KVSFvkxzAVBGNVBAMTDKNBIGZv
cIBMaWJ1lcnRM5IIBj1AnBkgkhkiG9w0BAQEFAA0CAQ8AMIBcGkCAQEAS57jP
a9WuPi1pC1Ja4TwtngZM0R9hCaItjnYn10RqbHZKkBueg+Zm6ExamrSmj7p
LkLESKjIz683asEZTQVTEsiow+9oVMc61bCVok/F0FhzmTnbRmhk16jMXFeE8
RjWxhtVgUY24J0AxG0oPI7cYoeBYAz39T+hng+4Ip03JKI1IxSJUcYrgJ0WYT
yaU8Jb57nhx30fPhVpxdaNShdImvY9tM/v6644/jBKMo03jBwWn09f1onCs+dC
s+C
s+b+uA04NHV361c9z+Dg95ZpIuXMyWPx8j1dhRzA1R3bmFpy02xTTckREGFq27
gYWOYEcdb+8iNQIDAQAB4GEMIGBMDB8GCWGSAGG+EIBDQ0yFjBHZW51cmF0ZlWq
gYnkgdgh1NIY3YiaXR5In1cZlciBm3lge19pUyAuokDrk1wdgYDVRO0BPAQH/
BAQDAgEGMA8KA1UdEb/wQFMAMB8fWhQYDVRO0B8YFEJZVpWPQpQWqHYY2v1+
TluzksHEMA0GScgs1B5DQEBCuAA4IAQAEPhQsT57yP8DwNyX51QD+LtuFDU36B
4RGtx3XV1H+jSh01Wfvuxp7Igu30v3+7dtFUR5Diup60pKmaEE9v8fbqAgOfD
N6EABN6V18PVQAV9CaW9Sp0PMcwre0AKJDeRywTx1X9aUE1Vqk1KK4ThV/8
RFw+BfBp8zQHQAPOtJ8s270le61WdtDwqFdB5cmFjdLuQavIxLePdHc+CX3t+0
iJTSziLLcBtC6Ainyscw/U4/e0x19m0AvjKrgYmi4rfC1fj8G2Jhk6vxhJBxCR
BD9WvZ9Liua8nugkpzGR03hwcBy0idkaF0ZkeVHt15MRzb6q55b1

-----END CERTIFICATE-----

Personal certificate with private key

A screenshot of a Windows Notepad window titled "USER1.P12 - Notepad". The window contains Japanese text, including some katakana and hiragana. The text appears to be a mix of English words and Japanese characters, possibly a mix-up or a specific type of encoded text. The Notepad interface includes a menu bar with File, Edit, Format, View, and Help, and a status bar at the bottom showing "Ln 1, Col 1034", "100%", "Windows (CRLF)", and "UTF-16 LE".

Tech/Tip: RACF Certificate Filtering and Mapping

Filters for mapping certificates can be created with a RACDCERT command.

- Enter command RACDCERT ID MAP to create a filter that assigns RACF identity ATSUSER to any digital certificate signed with the ATS client signer certificate and where the subject is organizational unit ATS in organization IBM.

```
racdcert id(atsuser) map sdnfilter('OU=ATS.O=IBM')
idnfilter('CN=ATS Client CA.OU=ATS.O=IBM') withlabel('ATS USERS')
```

- Enter command RACDCERT ID MAP to create a filter that assigns RACF identity OTHUSER to any digital certificate signed by the ATS client signer certificate and where the subject is in organization IBM.

```
racdcert id(othuser) map sdnfilter('O=IBM')
idnfilter('O=IBM') withlabel('IBM USERS')
```

- Refresh the in-storage profiles for digital certificate maps.

```
SETRPTS RACLIST(DIGTNMAP) REFRESH
```



Tech/Tip: Combining TLS mutual and basic authentication

```
*****  
/* 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
```

```
<httpEndpoint id="defaultHttpEndpoint"  
host="*"  
httpPort="9080"  
httpsPort="9443" />  
  
<sslDefault sslRef="DefaultSSLSettings"  
outboundSSLRef="DefaultSSLSettings" />  
  
<ssl id="DefaultSSLSettings"  
keyStoreRef="CellDefaultKeyStore"  
trustStoreRef="CellDefaultKeyStore"  
clientAuthenticationSupported="true"  
clientAuthentication="true"/>  
  
<keyStore id="CellDefaultKeyStore"  
location="safkeyring:///Liberty.KeyRing"  
password="password" type="JCERACFKS"  
fileBased="false" readOnly="true" />
```

```
<httpEndpoint id="AdminHttpEndpoint"  
host="*"  
httpPort="-1"  
httpsPort="9445"  
sslOptionsRef="mySSLOptions"/>  
  
<ssLOptions id="mySSLOptions"  
sslRef="BatchSSLSettings" />  
  
<ssl id="BatchSSLSettings"  
keyStoreRef="CellDefaultKeyStore"  
trustStoreRef="CellDefaultKeyStore"  
clientAuthenticationSupported="true"  
clientAuthentication="false"/>
```

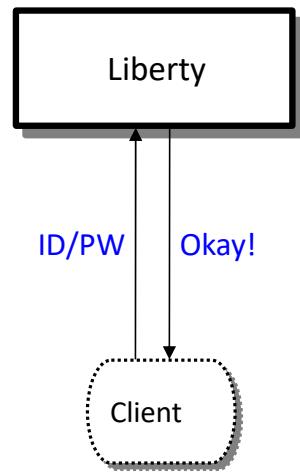
<https://www.rocketsoftware.com/platforms/ibm-z/curl-for-zos>



Authentication - Third Party Authentication

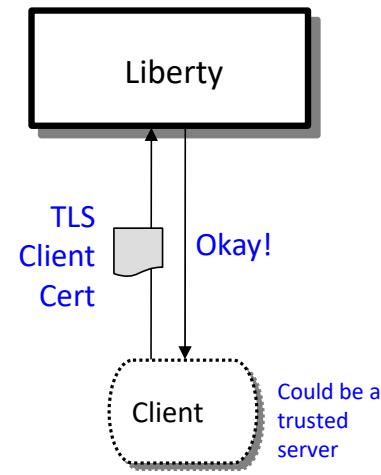
Several different ways this can be accomplished:

Basic Authentication



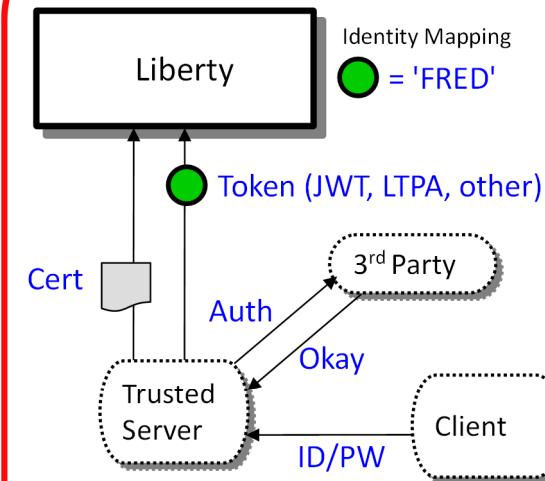
- Server prompts for ID/PW
- Client supplies ID/PW or ID/PassTicket
- Server checks registry:
 - Basic (server.xml)
 - SAF

Client Certificate



- Server prompts for client certificate.
- Client supplies certificate
- Server validates client certificate and maps to an identity
- Registry options:
 - SAF

Third Party Authentication



- Client authenticates to 3rd party sever**
- Client receives a trusted 3rd party token**
- Token flows to Liberty z/OS and is mapped to an identity**
- Registry options:**
 - We may know these detail.



Third Party Authentication Examples

The image displays two side-by-side screenshots of web pages illustrating third-party authentication.

Left Screenshot: UPS Sign Up

This screenshot shows the UPS "Sign Up" page. At the top, there's a banner stating "UPS is open for business: Service impacts related to Coronavirus ...More". Below the banner, the UPS logo is displayed. A "Sign Up / Log in" link and a search bar are visible. The main section is titled "Sign Up" and includes a link for users who already have an ID. It provides several options for sign-up via external services: Google, Facebook, Amazon, Apple, and Twitter. Below these, there are fields for entering personal information: Name*, Email*, User ID*, Password*, and Phone. The "Password" field has a "Show" link next to it. A "Feedback" button is located on the right side of the form.

Right Screenshot: myNCDMV Sign In

This screenshot shows the "Log In to myNCDMV" page. The background features a scenic view of autumn foliage. The page includes "Log In" and "Sign Up" links at the top. The "Log In" section contains fields for "Email Address" (with placeholder "name@example.com") and "Password" (with a "Show Password" link). There is also a "Remember Me" checkbox. Below these are "Log In" and "Forgot Password" buttons. Further down, there are three "Continue with" buttons for Apple, Facebook, and Google. A "Continue as Guest" link is also present. A notice for public computer users is displayed at the bottom, along with a "powered by payit" footer.



Security token types by Liberty

Token type	How used	Pros	Cons
LTPA	Authentication technology used in IBM WebSphere	<ul style="list-style-type: none">Easy to use with WebSphere and DataPower	<ul style="list-style-type: none">IBM Proprietary token
SAML	XML-based security token and set of profiles	<ul style="list-style-type: none">Token includes user id and claimsUsed widely with SoR applications	<ul style="list-style-type: none">Tokens can be heavy to processNo refresh token
OAuth 2.0 access token	Facilitates the authorization of one site to access and use information related to the user's account on another site	<ul style="list-style-type: none">Used widely for social applications e.g., with Google, Facebook, Microsoft, Twitter ...	<ul style="list-style-type: none">Needs introspection endpoint to validate token
JWT	JSON security token format	<ul style="list-style-type: none">More compact than SAMLEase of client-side processing especially mobile	

What is a JWT (JSON Web Token) ?

- JWT is a compact way of representing claims that are to be transferred between two parties
- Normally transmitted via HTTP header
- Consists of three parts
 - Header
 - Payload
 - Signature

The screenshot shows the jwt.io debugger interface. At the top, it says "Encoded" and displays a long string of characters: eyJraWQi0iI0cWpYLWJrWE9Vd19GX... The bottom right corner of this string has a red oval highlighting the timestamp "Mon Nov 02 2020 11:05:58 GMT-0500 (Eastern Standard Time)". To the right, under "Decoded", there are two sections: "HEADER:" and "PAYLOAD:". The "HEADER:" section contains a JSON object with "kid": "4qjX-bkX0Uw_F_uccjRMkB9ivMjXSQwj0RrkYRJq8DM" and "alg": "RS256". The "PAYLOAD:" section contains a JSON object with "sub": "Fred", "token_type": "Bearer", "scope": ["openid", "profile", "email"], "azp": "rpSsl", "iss": "https://wg31.washington.ibm.com:26213/oidc/endpoint/0P", "aud": "myZcee", "exp": 160433158, "iat": 1604330858, "realmName": "zCEERealm", and "uniqueSecurityName": "Fred".

Values derived from the OAUTH configuration:

- signatureAlgorithm="RS256"
- accessTokenLifetime="300"
- resourceIds="myZcee"

<https://jwt.io>

OpenID Connect/OAuth and z/OS Connect

- **From the z/OS Connect Knowledge Center:** z/OS Connect EE security can operate with traditional z/OS security, for example, System Authorization Facility (SAF) and also with open standards such as Transport Layer Security (TLS), JSON Web Token (JWT), and **OpenID Connect**.
- **From the OpenID Core specification:** OpenID Connect 1.0 is a simple identity layer on top of the OAuth 2.0 protocol. It enables Clients to verify the identity of the End-User based on the authentication performed by an Authorization Server, as well as to obtain basic profile information about the End-User in an interoperable and REST-like manner.
- **OAuth 2.0 Core (RFC 6749) Specifications:** <https://tools.ietf.org/html/rfc6749>
- **OpenID Connect Core Specifications:** https://openid.net/specs/openid-connect-core-1_0.html
- **Again, for a very good explanation of this topic see YouTube video OAuth 2.0 and OpenID Connect (in plain English)**
<https://www.youtube.com/watch?v=996OixHze0>

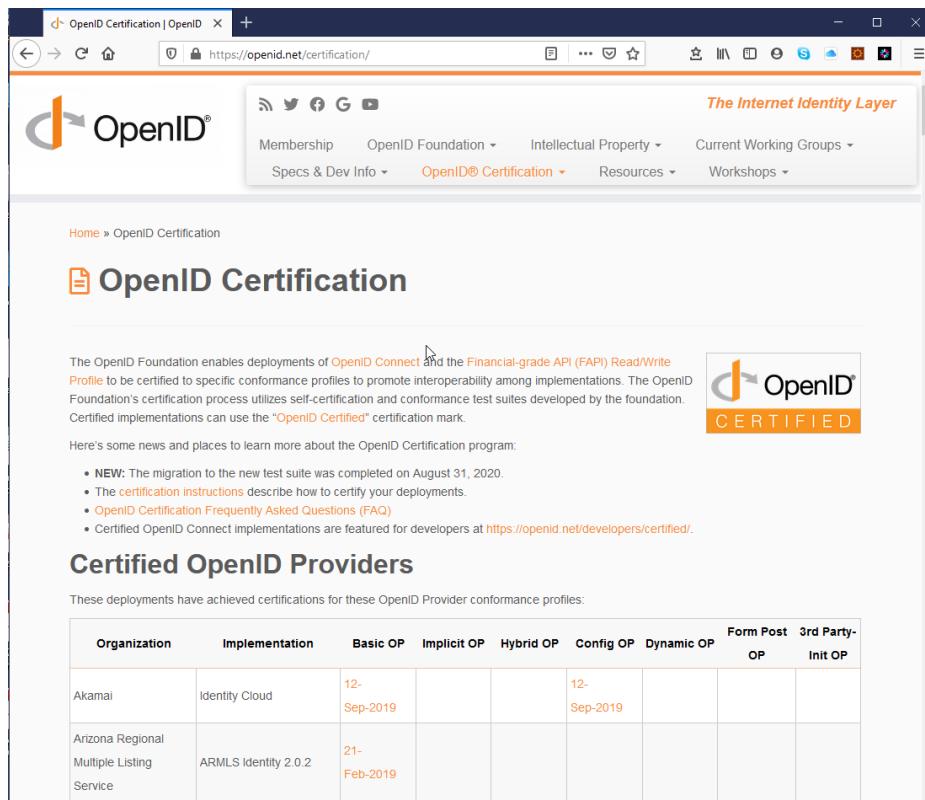
Some basic OAuth/OpenID Connect terms

- **Authorization server** - The server that issues access tokens to the client after authenticating the resource owner and obtaining authorization. *In a z/OS Connect EE API requester scenario, the authorization server is called by the z/OS Connect EE server to retrieve an access token.*
- **Authorization Endpoint** - A service or endpoint on an OAuth authorization server that accepts an authorization request from a client to perform authentication and authorization of a user. The authorization endpoint returns an authorization grant, or code, to the client in the Authorization Code Flow. In the Implicit Flow, the authorization endpoint returns an access token to the client.
- **Token Endpoint** – A service or endpoint on an OP that accepts an authorization grant, or code, from a client in exchange for an access token, ID token, and refresh token
- **Access Token** – A credential that is used to access protected resources. An access token is a string that represents an authorization that is issued to the client. The access token is usually opaque to the client (it does not have to be opaque) and can be JSON Web Token (JWT). See URL <https://tools.ietf.org/html/rfc6749> Section 1.4 for more information.
- **OAuth token** - With OAuth 2.0, access tokens are used to access protected resources. An access token is normally a string that represents an authorization that is issued to the client. The string is usually opaque to the client. Opaque tokens may require that the token recipient call back to the server that issued the token. *However, an access token can also be in the form of a JSON Web Token (JWT) which does not require a call back (introspection).*
- **Scope** - Privilege or permission that allows access to a set of resources of a third party.

Some basic OAuth/OpenID Connect terms

- **Relying Party (RP)** – An entity that relies on an OP to authenticate a user and obtain an authorization to access a user's resource.
For z/OS Connect API Requester, it is the Liberty server configured as an OpenID Connect Client, e.g., using <openidConnectClient> XML configuration elements.
- **OpenID Connect Provider (OP)** - An OAuth 2.0 authorization server that is capable of providing claims to a client or Relying Party (RP) , *an OpenID component.*
- **Resource owner** - An entity capable of granting access to a protected resource. When the resource owner is a person, it is referred to as an end user. *In a z/OS Connect EE API requester scenario, the resource owner might be the user of the CICS, IMS, or z/OS application.*
- **Resource server** - The server that hosts the protected resources and accepts and responds to protected resource requests by using access tokens. *In a z/OS Connect API provider, the resource server is the z/OS Connect server. In a z/OS Connect EE API requester scenario, the resource server is the request endpoint for the remote RESTful API*
- **ID Token** - is an OpenID Connect token that is an extension to OAuth 2.0 specification access tokens. This token is a JSON Web Token (JWT). See URL https://openid.net/specs/openid-connect-core-1_0.html#IDToken for more information about the extensions.

Tech-Tip: There are a multitude of OpenID Certified Providers

A screenshot of a web browser displaying the OpenID Certification page at https://openid.net/certification/. The page header includes the OpenID logo and navigation links for Membership, OpenID Foundation, Intellectual Property, Current Working Groups, Specs & Dev Info, OpenID® Certification (which is highlighted in orange), Resources, and Workshops. Below the header, the page title is "OpenID Certification". A sub-header reads "The Internet Identity Layer". The main content area contains a paragraph about the certification process, mentioning OpenID Connect and the Financial-grade API (FAPI) Read/Write Profile. It also features an "OpenID CERTIFIED" badge. Further down, there's a section titled "Certified OpenID Providers" with a table showing two entries: Akamai and Arizona Regional Multiple Listing Service. The table has columns for Organization, Implementation, Basic OP, Implicit OP, Hybrid OP, Config OP, Dynamic OP, Form Post OP, and 3rd Party-Init OP. The "Basic OP" column for Akamai shows "12-Sep-2019", while the "Implicit OP" column for Arizona Regional Multiple Listing Service shows "21-Feb-2019".

The OpenID Foundation enables deployments of [OpenID Connect](#) and the [Financial-grade API \(FAPI\)](#) Read/Write Profile to be certified to specific conformance profiles to promote interoperability among implementations. The OpenID Foundation's certification process utilizes self-certification and conformance test suites developed by the foundation. Certified implementations can use the "OpenID Certified" certification mark.

Here's some news and places to learn more about the OpenID Certification program:

- **NEW:** The migration to the new test suite was completed on August 31, 2020.
- The [certification instructions](#) describe how to certify your deployments.
- [OpenID Certification Frequently Asked Questions \(FAQ\)](#)
- Certified OpenID Connect implementations are featured for developers at <https://openid.net/developers/certified/>.

Certified OpenID Providers

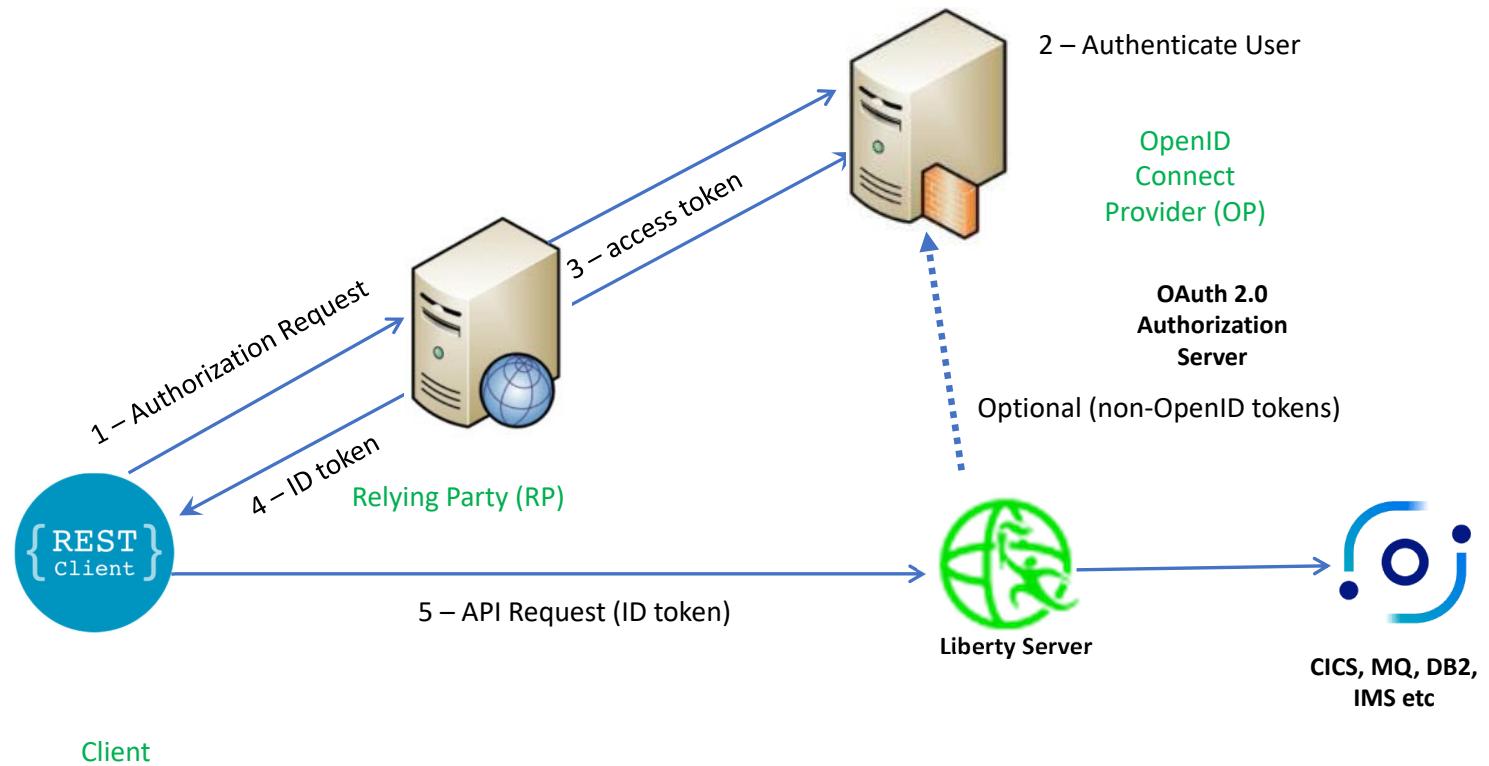
These deployments have achieved certifications for these OpenID Provider conformance profiles:

Organization	Implementation	Basic OP	Implicit OP	Hybrid OP	Config OP	Dynamic OP	Form Post OP	3rd Party-Init OP
Akamai	Identity Cloud	12-Sep-2019			12-Sep-2019			
Arizona Regional Multiple Listing Service	ARMLS Identity 2.0.2	21-Feb-2019						

<https://openid.net/certification/>



Typical Authorization Flow for an OpenID Connect token to a z/OS Connect API Provider





Tech/Tip: Let's explore a flow using a Liberty OpenID Provider as an example

This Liberty server configuration provides a good example of the workings of an authorization server.

```
<httpEndpoint host="*" httpPort="26212" httpsPort="26213" id="defaultHttpEndpoint"/>

<openidConnectProvider id="OP"
    signatureAlgorithm="RS256"
    keyStoreRef="jwtStore"
    oauthProviderRef="OIDCssl" >
</openidConnectProvider>

<oauthProvider id="OIDCssl"
    httpsRequired="true"
    jwtAccessToken="true"
    autoAuthorize ="true"
    accessTokenLifetime="300">

    <!-- Define OIDC Client for zCEE Authentication -->
    <autoAuthorizeClient>zCEEClient</autoAuthorizeClient>
    <localStore>
        <client name="zCEEClient"
            secret="secret"
            displayname="zCEEClient"
            scope="openid"
            enabled="true"
            resourceIds="myZcee"/>
    </localStore>
</oauthProvider>
```

Key Points:

- **keyStoreRef** - A keystore containing the private key necessary for signing with an asymmetric algorithm.
- **jwtAccessToken** - generate a JSON Web Token, serialize it as a string and put in the place of the access token.



Tech/Tip: Generating a JWT using Liberty's the OPID provider

The Liberty server authorization server's XML configuration

```
<!--Key store that contains certificate used to sign JWT-->
<keyStore fileBased="false" id="jwtStore"
  location="safkeyring:///JWT.KeyRing"
  password="password" readOnly="true" type="JCERACFKS"/>

<!-- Define a basic user registry -->
<basicRegistry id="basicRegistry"
  realm="zCEERealm">
  <user name="auser" password="pwd"/>
  <user name="distributed_User1" password="pwd"/>
  <user name="Fred" password="fredpwd"/>
  <user name="distuser1" password="pwd"/>
  <user name="distuser2" password="pwd"/>
</basicRegistry>
```

```
RACMAP ID(FRED) MAP USERDIDFILTER(NAME('Fred'))
  REGISTRY(NAME('*')) WITHLABEL('zCEE JWT FRED')
RACMAP ID(USER1) MAP USERDIDFILTER(NAME('distributed_User1'))
  REGISTRY(NAME('*')) WITHLABEL('zCEE JWT distributedUser1')
RACMAP ID(USER1) MAP USERDIDFILTER(NAME('distuser1'))
  REGISTRY(NAME('*')) WITHLABEL('zCEE JWT distuser1')
RACMAP ID(USER2) MAP USERDIDFILTER(NAME('distuser2'))
  REGISTRY(NAME('*')) WITHLABEL('zCEE JWT distuser2')
```

Tech/Tip: RACMAP Command Summary

```
RACMAP ID(USER1) MAP USERDIDFILTER(NAME('distuser1'))
    REGISTRY(NAME('*')) WITHLABEL('zCEE token user1')
RACMAP ID(USER1) MAP USERDIDFILTER(NAME('distribute_User1'))
    REGISTRY(NAME('zCEERealm')) WITHLABEL('zCEE user1')
RACMAP ID(USER1) MAP USERDIDFILTER(NAME('UID=user1,CN=User Name,OU=IBM ATG,O=IBM,C=US'))
    registry(name('*')) withlabel('USER X500 DN')
RACMAP ID(ATSUSER) MAP USERDIDFILTER(NAME('OU=IBM ATS,O=IBM,C=US'))
    registry(name('*')) withlabel('ATS USER')
RACMAP ID(IBMUSER) MAP USERDIDFILTER(NAME('O=IBM,C=US'))
    registry(name('*')) withlabel('IBM USER')
```

```
RACMAP ID(USER1) LISTMAP(LABEL('USER X500 DN'))

RACMAP ID(USER1) DELMAP (LABEL('zCEE distuser1'))

RACMAP QUERY USERDIDFILTER(NAME('USER1')) REGISTRY(NAME('*'))
```

```
RACMAP ID(USER1) LISTMAP
Label: zCEE token user1
Distributed Identity User Name Filter:
>distuser1<
Registry Name:
>*<

Label: zCEE user1
Distributed Identity User Name Filter:
>distribute_User1<
Registry Name:
>zCEERealm<

Label: USER X500 DN
Distributed Identity User Name Filter:
>UID=user1,CN=User Name,OU=IBM ATG,O=IBM,C=US<
Registry Name:
>*<
```



LibertyOpenID Client identity mapping configuration attributes (z/OS Connect)

```
<safRegistry id="saf" />
<safAuthorization racRouteLog="ASIS" />
<safCredentials unauthenticatedUser="WSGUEST"
  mapDistributedIdentities="true" <-->
  profilePrefix="BBGZDFLT" />
```

Use distributed identity filters to map the distributed identities to SAF user IDs, using IDIDMAP resources and the RACMAP command.

```
<authFilter id="ATSAuthFilter">
  <requestUrl id="ATSDemoUrl"
    name="ATSRefererUri"
    matchType="contains"
    urlPattern="/cscvinc/employee|/db2/employee|/mqapi/loan"/>
</authFilter>
<openidConnectClient id="ATS"
  httpsRequired="true"
  authFilterRef="ATSAuthFilter"
  inboundPropagation="required"
  scope="openid profile email"
  audiences="myZcee"
  issuerIdentifier="https://wg31.washington.ibm.com:26213/oidc/endpoint/OP"
  mapIdentityToRegistryUser="false" <-->
  signatureAlgorithm="RS256"
  userIdentityToCreateSubject="sub"
  trustAliasName="JWT-Signer-Certificate"
  trustStoreRef="jwtTrustStore"
  authnSessionDisabled="true"
  disableLtpaCookie="true">
</openidConnectClient>
<keyStore fileBased="false" id="jwtTrustStore"
  location="safkeyring:///JWT.KeyRing"
  password="password" readOnly="true" type="JCERACFKS"/>
```

Specifies whether to map the identity to a registry user. If this is set to false, then the user registry (SAF) is not used to create the user subject.



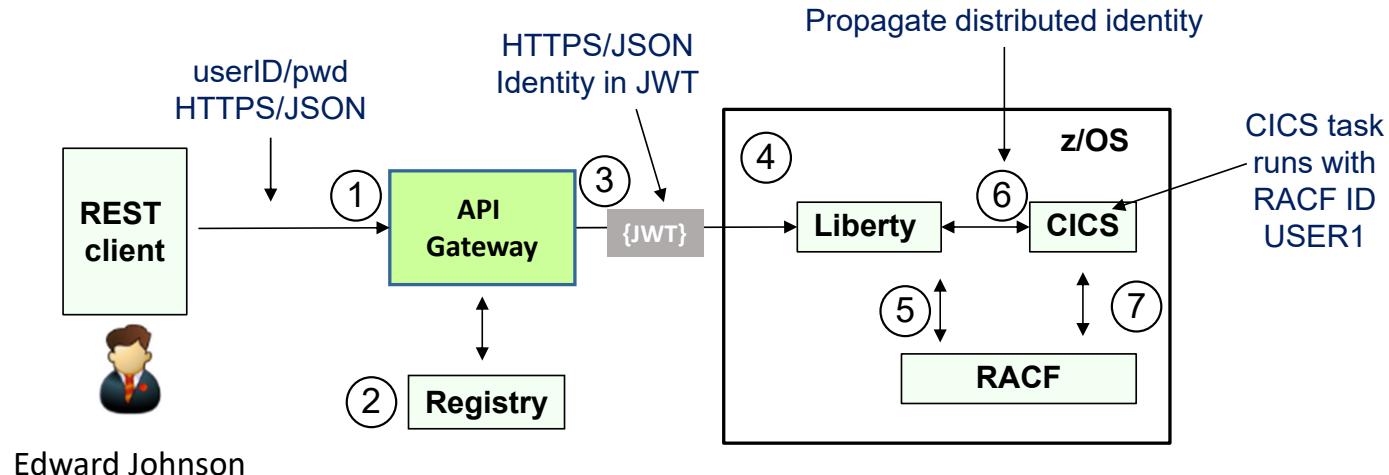
Liberty/zCEE OpenID Client identity mapping configuration attributes (JWK)

```
{  
    "kid": "574eafad-fcb5-412e-97a3-8100a1c1fa5b",  
    "alg": "RS256"  
}  
  
{  
    "sub": "mitchj",  
    "aud": "myZCEE",  
    "iss": "https://wg31.washington.ibm.com:26213/oidc/endpoint/OP",  
    "exp": 1610451176,  
    "iat": 1610451876  
}
```

```
<openidConnectClient  
    id="ATSJWK"  
    clientId="RS-JWT-ZCEE"  
    authFilterRef="jwkAuthFilter"  
    inboundPropagation="required"  
    signatureAlgorithm="RS256"  
    userIdentifier="sub"  
    mapIdentityToRegistryUser="true"  
    issuerIdentifier="https://wg31.washington.ibm.com:26213/oidc/endpoint/OP"  
    disableLtpaCookie="true"  
    audiences="myZcee"  
    jwkEndpointUrl="https://wg31.washington.ibm.com:26213/oidc/endpoint/OP/jwk"  
    jwkClientId="jwtClient"  
    jwkSecret="jwtSecret"/>  
</openidConnectClient>
```



Example scenario – security flow



```
RACMAP ID(USER1) MAP USERDIDFILTER(NAME('Edward Johnson'))  
REGISTRY(NAME('*'))
```

1. User authenticates with the gateway using a "distributed" identity and a password
2. An external registry is used as the user registry for distributed users and groups
3. The API Gateway generates a JWT and forwards the token with the request to z/OS Connect EE
4. Liberty validates JWT
5. Liberty calls RACF to map distributed ID to RACF user ID and authorizes access to API
6. CICS service provider propagates distributed ID to CICS
7. CICS calls RACF to map distributed ID to RACF user ID and performs resource authorization checks

JWT used in scenario – putting it all together

```
{  
  "alg": "RS256"  
}  
  
{  
  "sub": "Edward Johnson",  
  "token_type": "Bearer",  
  "azp": "rpSsl",  
  "iss": "https://wg31.washington.ibm.com:26213/oidc/endpoint/OPssl",  
  "aud": "myZcee",  
  "realmName": "zCEERealm",  
  "uniqueSecurityName": "Edward Johnson"  
}  
RSASHA256(base64UrlEncode(header) + base64UrlEncode(payload))
```

- The header contains an **alg** (algorithm) element value **RS256**
 - **RS256** (RSA Signature with SHA-256) is an asymmetric algorithm which uses a **public/private** key pair
 - **ES512** (Elliptic Curve Digital Signature Algorithm with SHA-512) [link for more info](#)
 - **HS256** (HMAC with SHA-256) is a symmetric algorithm with only one (**secret**) key
- The **iss** (issuer) claim identifies the principal that issued the JWT
- The **sub** (subject) claim **distuser** identifies the principal that is the subject of the JWT
- The **aud** (audience) claim **myZcee** identifies the recipients for which the JWT is intended



Configuring authentication with JWT

Liberty can perform user authentication with JWT using the support that is provided by the *openidConnectClient-1.0* feature. The **<openidConnectClient>** element is used to accept a JWT token as an authentication token

```
<openidConnectClient id="RPssl" inboundPropagation="required"
    signatureAlgorithm="RS256" trustAliasName="JWT-Signer"
    trustStoreRef="jwtTrustStore"
    userIdentityToCreateSubject="sub" mapIdentityToRegistryUser="false"
    issuerIdentifier="https://wg31.washington.ibm.com:26213/oidc/endpoint/OPssl"
    authnSessionDisabled="true" audiences="myZcee"/>
```

- ***inboundPropagation*** is set to required to allow z/OS Connect EE to use the received JWT as an authentication token
- ***signatureAlgorithm*** specifies the algorithm to be used to verify the JWT signature
- ***trustStoreRef*** specifies the name of the keystore element that defines the location of the validating certificate
- ***trustAliasName*** gives the alias or label of the certificate to be used for signature validation
- ***userIdentityToCreateSubject*** indicates the claim to use to create the user subject
- ***mapIdentityToRegistryUser*** indicates whether to map the retrieved identity to the registry user
- ***issuerIdentifier*** defines the expected issuer
- ***authnSessionDisabled*** indicates whether a WebSphere custom cookie should be generated for the session
- ***audiences*** defines a list of target audiences

Using authorization filters



Authentication filter can be used to filter criteria that are specified in the **authFilter** element to determine whether certain requests are processed by certain providers, such as OpenID Connect, for authentication.

```
<openidConnectClient id="RPssl" inboundPropagation="required"
    signatureAlgorithm="RS256" trustAliasName="JWT-Signer"
    trustStoreRef="jwtTrustStore"
    userIdentityToCreateSubject="sub" mapIdentityToRegistryUser= "true"
    issuerIdentifier="https://wg31.washington.ibm.com:26213/oidc/endpoint/OPssl"
    authnSessionDisabled="true" audiences="myZcee"
    authFilterRef="JwtAuthFilter" />
<openidConnectClient id="RPsslG" . . . authFilterRef= "API Gateway" />
<openidConnectClient id="RPsslURL" . . . authFilterRef= "URLFilter" />
<authFilter id="API Gateway">
    <remoteAddress id="ApiAddress" ip="10.7.1.*" matchType="equals" />
</authFilter>
<authFilter id="URLFilter">
    <requestUrl id="URL" urlPattern="/cscvinc/employee|/db2/employee|/mqapi/loan" />
    matchType="equals" /> </authFilter>
<authFilter id="JwtAuthFilter" >
    <requestHeader id="authHeader" name="Authorization" value="Bearer" matchType="contains" />
</authFilter>
```

Some alternative filter types

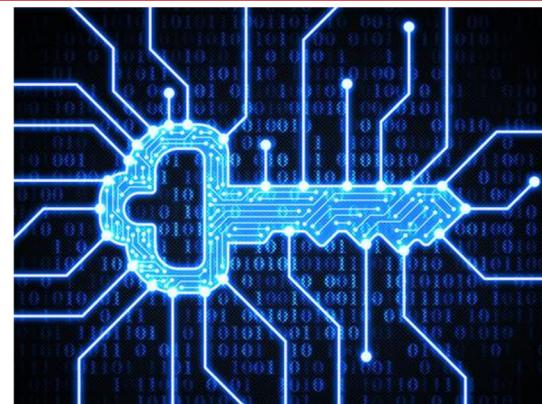
- A **remoteAddress** element is compared against the TCP/IP address of the client that sent the request.
- The **host** element is compared against the "Host" HTTP request header, which identifies the target host name of the request.
- The **requestUrl** element is compared against the URL that is used by the client application to make the request.

General security terms or considerations

Security involves

- Identifying who or what is requesting access (**Authentication**)
 - Basic Authentication
 - Mutual Authentication using Transport Layer Security (TLS), formerly known as SSL
 - Third Party Tokens
- Ensuring that the message has not been altered in transit (**Data Integrity**) and ensuring the confidentiality of the message in transit (**Encryption**)
 - TLS (encrypting messages and using a digital signature)

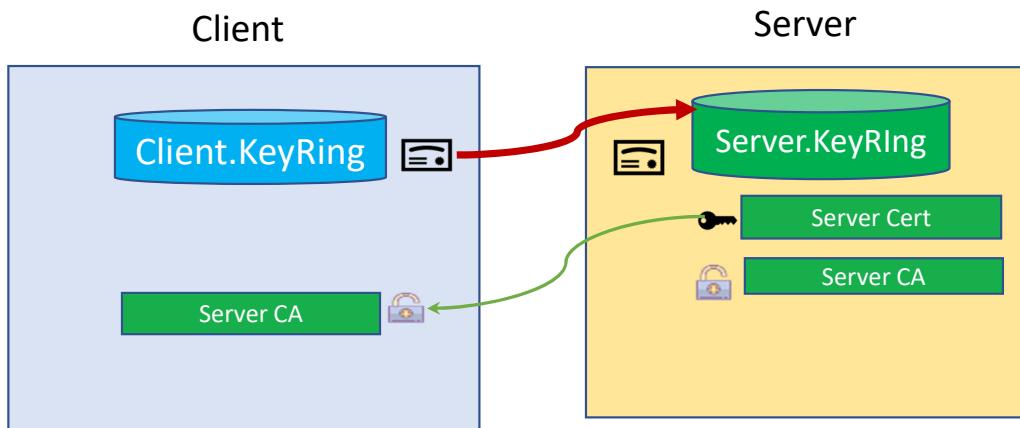
- Controlling access (**Authorization**)
 - Is the authenticated identity authorized to access to z/OS Connect
 - Is the authenticated identity authorized to access a specific API, Services, etc.



Basic TLS Handshake Flow

TLS handshake –

Encryption/Message Integrity



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

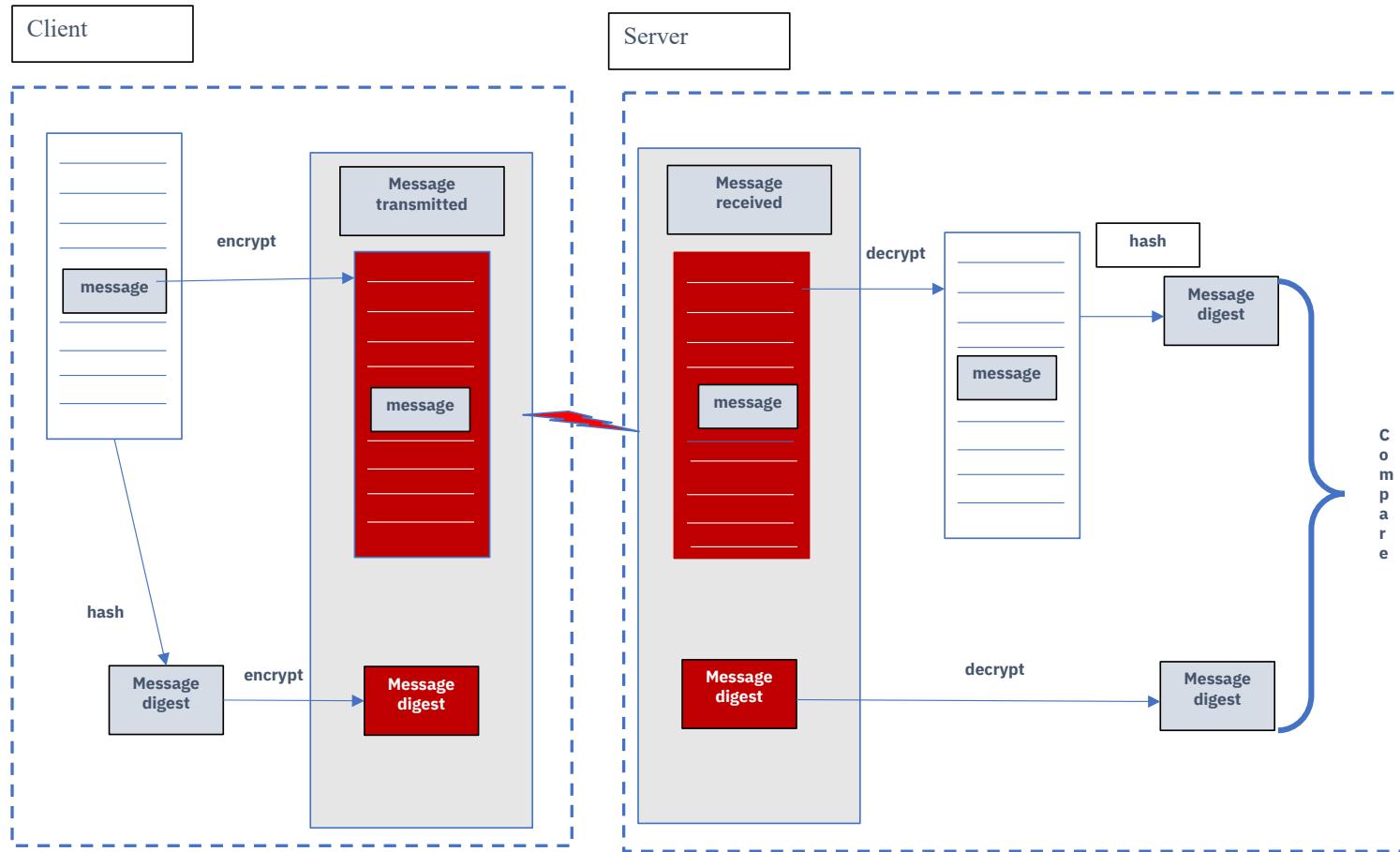
Certificate with a private key*

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.

Message Integrity and Encryption (client to server endpoint)



z/OS Connect Security server XML Configuration (HTTPS)



```
<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.

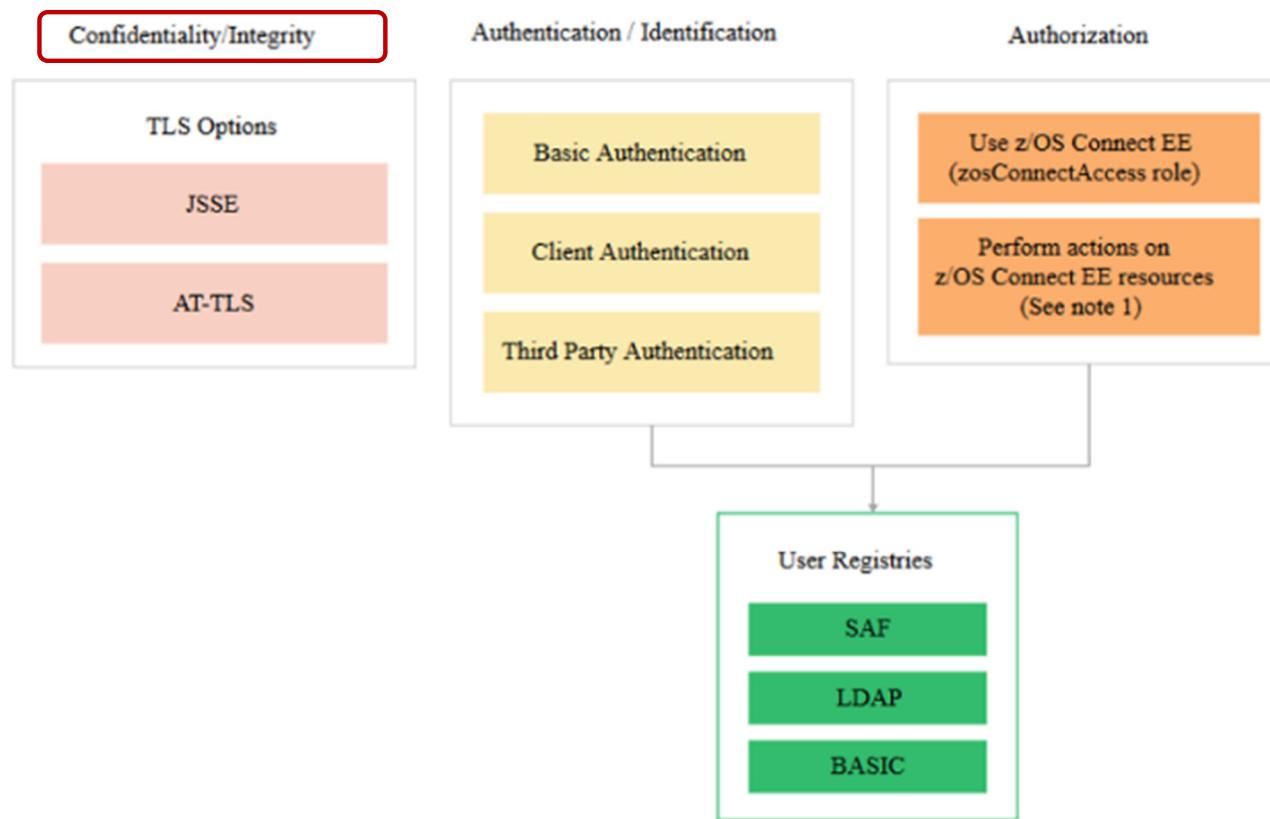
Requires that inbound request use HTTPS in order to access the API.

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

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

requireSecure="true" means the inbound TLS connection must be using HTTPS

Liberty and z/OS Connect EE security options

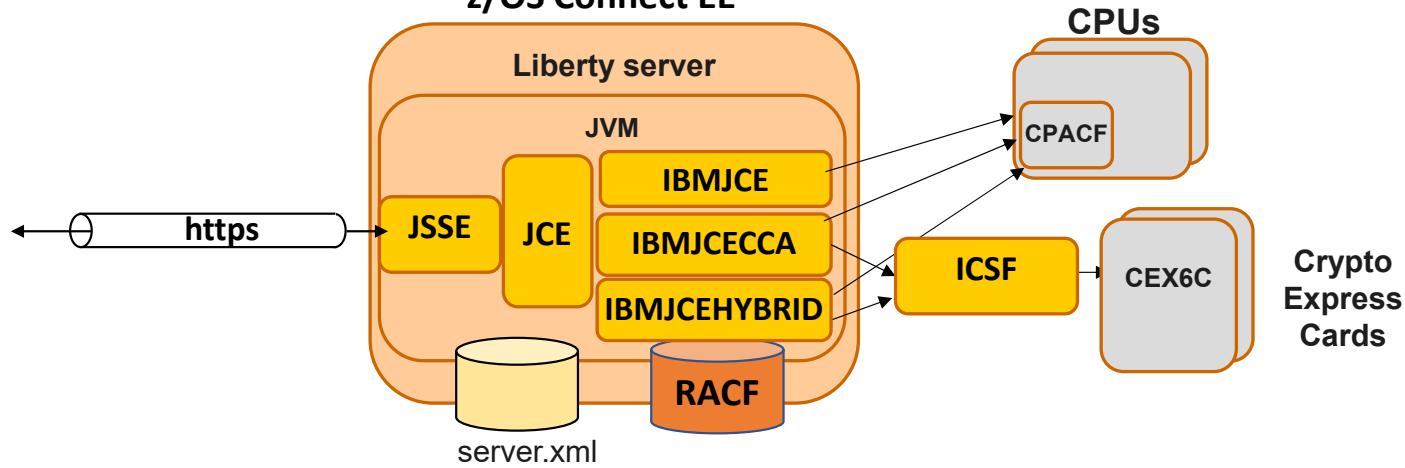


The actions which can be controlled by authorization are deploying, querying, updating, starting, stopping and deleting of APIs, services and API requesters.

Using JSSE with Liberty



The server XML configuration defines the **HTTPS ports, key rings, and other JSSE attributes**
z/OS Connect EE

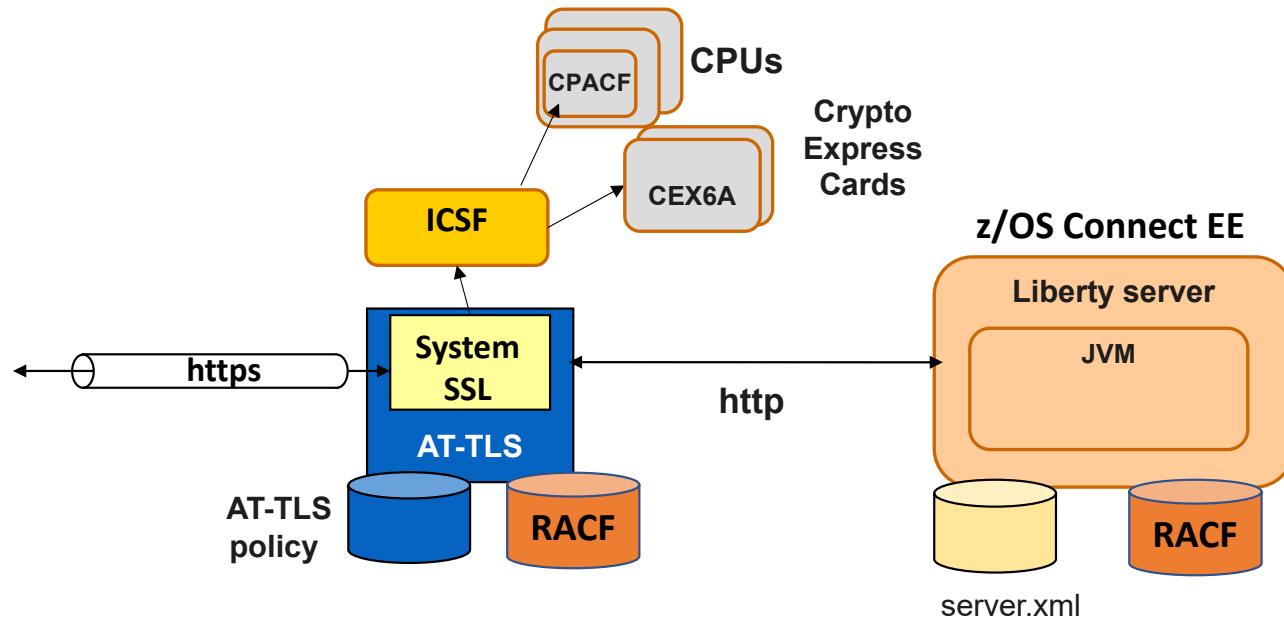


- z/OS Connect EE support for TLS is based on **Liberty** server support
- **Java Secure Socket Extension (JSSE)** API provides framework and Java implementation of TLS protocols used by Liberty HTTPS support
- **Java Cryptography Extension (JCE)** is standard extension to the Java Platform that provides implementation for cryptographic services
- **IBM Java SDK for z/OS** provides three different JCE providers, **IBMJCE**, **IBMJCECCA** and **IBMJCEHYBRID**.
- The JCE providers access **CPACF (CP Assist for Cryptographic Functions)** directly, therefore keep your Java service levels current.



Using AT-TLS with Liberty

The server XML configuration uses no HTTPS protocol, key rings or other JSSE attributes



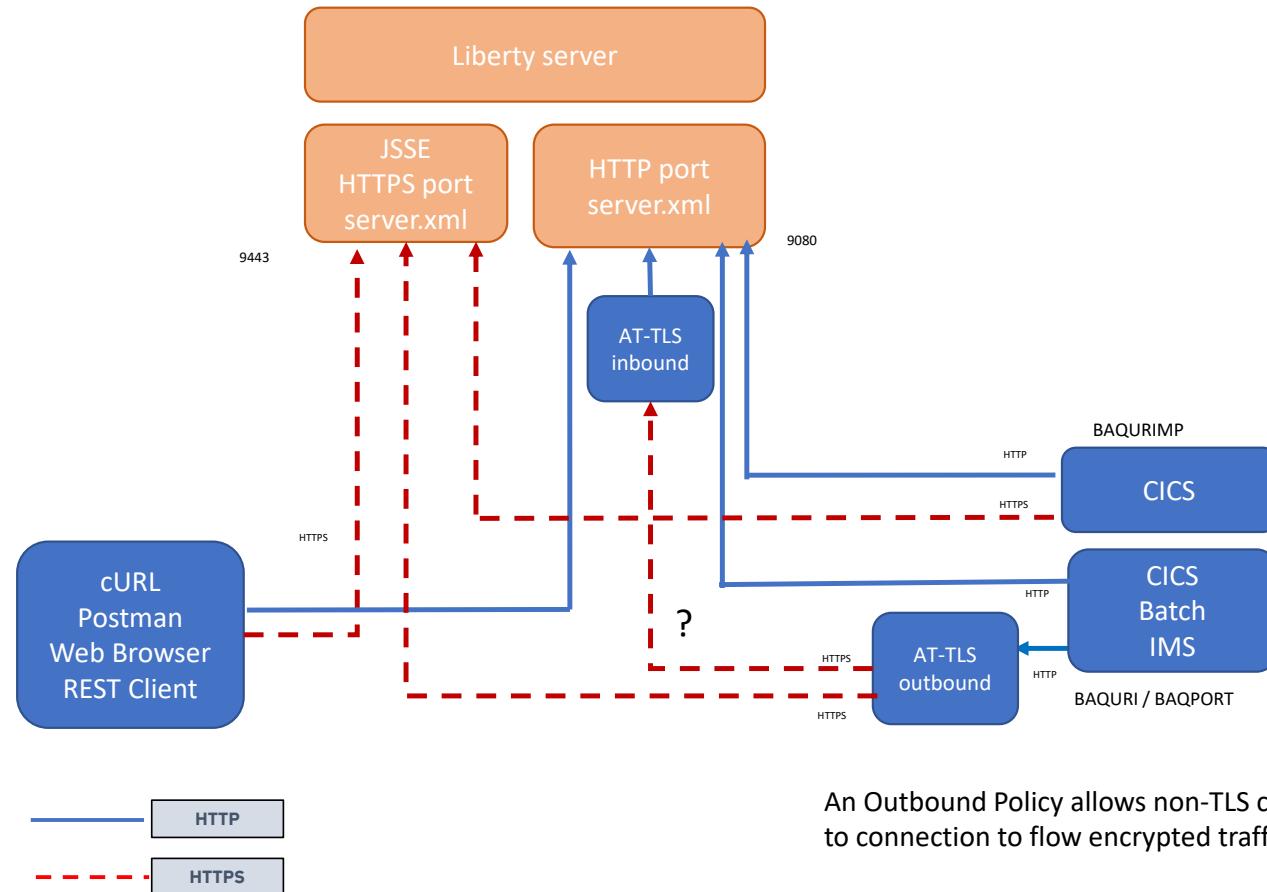
- **Application Transparent TLS (AT-TLS)** creates a secure session on behalf of z/OS Connect
- Only define http ports in **server.xml** (z/OS Connect does not know that TLS session exists)
- Define TLS protection for all applications (including z/OS Connect) in **AT-TLS policy**
- AT-TLS uses **System SSL** which exploits the CPACF and Crypto Express cards via ICSF

JSSE and AT-TLS comparison

Capability	Description	JSSE	AT-TLS
Server authentication	Verification of z/OS Connect server certificate by client	Yes	Yes
Mutual authentication	Verification of client certificate by z/OS Connect	Yes	Yes
TLS client authentication	Use of client certificate for authentication	Yes	No
Support for requireSecure option on APIs, etc.	Requires that API requests are sent over HTTPS	Yes	No
Persistent connections	To reduce number of handshakes	Yes	Yes
Re-use of TLS session	To reduce number of full handshakes	Yes	Yes
Shared TLS sessions	To share TLS sessions across cluster of z/OS Connect instances	No	Yes
zIIP processing	Offload TLS processing to zIIP	Yes	No
CPACF	Offload symmetric encryption to CPACF	Yes	Yes
CEX6	Offload asymmetric operations to Crypto Express cards	Yes	Yes

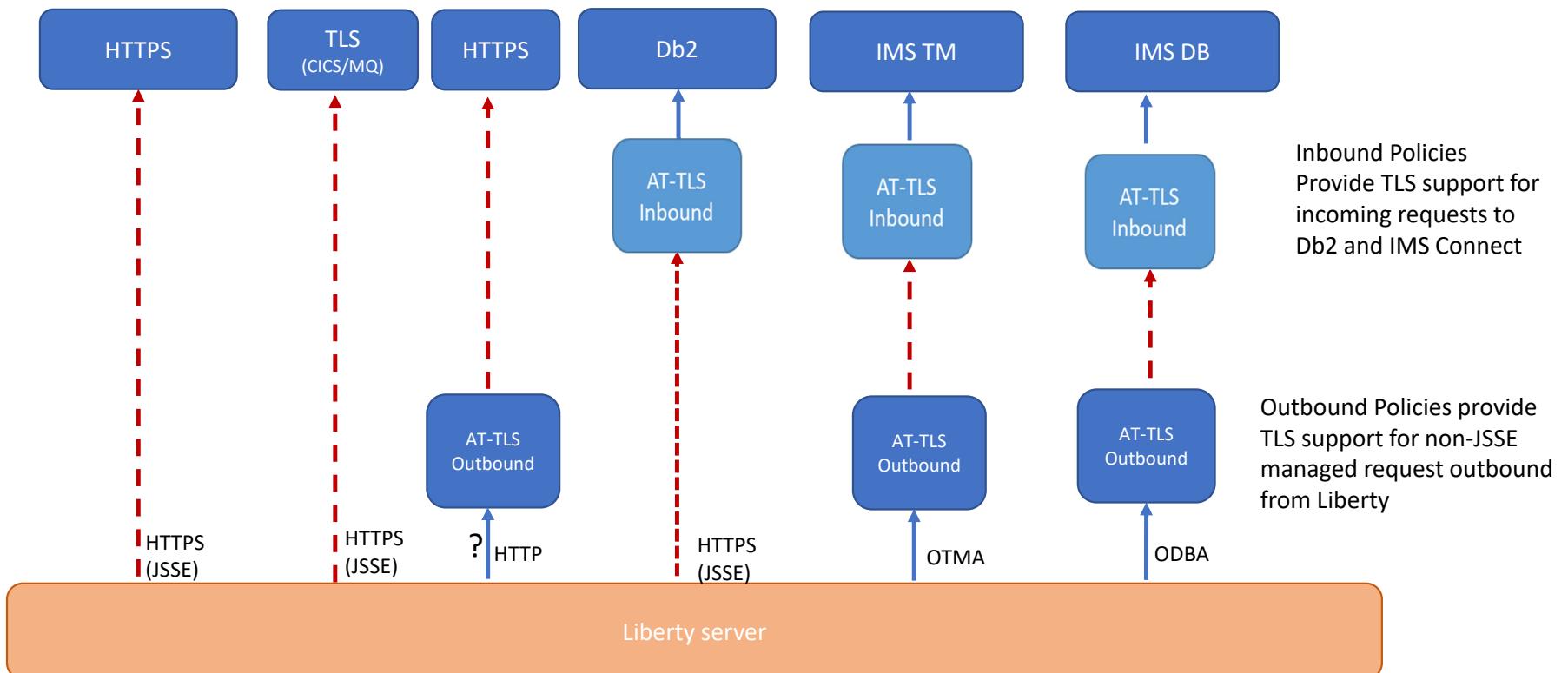


TLS client encryption to a Liberty server scenarios





TLS encryptions from a Liberty server (HTTPS/native to HTTPS/TLS/OTMA/ODBA)



**Let's explore using TLS for
encryption and data integrity
using samples in various scenarios**

Let's explore TLS options using the contents of these key rings

Liberty's outbound key ring

Digital ring information for user LIBSERV:			
Ring: >zCEE.KeyRing<			
Certificate Label Name	Cert Owner	USAGE	DEFAULT
zCEE CA	CERTAUTH	CERTAUTH	NO
Liberty CA	CERTAUTH	CERTAUTH	NO
zCEE Client Cert	ID (LIBSERV)	PERSONAL	YES
xyz Client Cert	ID (LIBSERV)	PERSONAL	NO
DB2 CA	CERTAUTH	CERTAUTH	NO
MQ CA	CERTAUTH	CERTAUTH	NO
CICS CA	CERTAUTH	CERTAUTH	NO

Ring: >Liberty.KeyRing<			
Certificate Label Name	Cert Owner	USAGE	DEFAULT
Liberty Server Cert	ID (LIBSERV)	PERSONAL	YES
Liberty CA	CERTAUTH	CERTAUTH	NO
zCEE CA	CERTAUTH	CERTAUTH	NO
CICS CA	CERTAUTH	CERTAUTH	NO

Digital ring information for user CICSSTC:			
Ring: >CICS.KeyRing<			
Certificate Label Name	Cert Owner	USAGE	DEFAULT
CICS CA	CERTAUTH	CERTAUTH	NO
CICS Client Cert	ID (CICSSTC)	PERSONAL	YES
Liberty CA	CERTAUTH	CERTAUTH	NO
zCEE CA	CERTAUTH	CERTAUTH	NO

Digital ring information for user DB2USER:			
Ring: >Db2.KeyRing<			
Certificate Label Name	Cert Owner	USAGE	DEFAULT
DB2 CA	CERTAUTH	CERTAUTH	NO
zCEE CA	CERTAUTH	CERTAUTH	NO
DB2USER	ID (DB2USER)	PERSONAL	YES

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

Liberty's inbound key ring

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



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" />

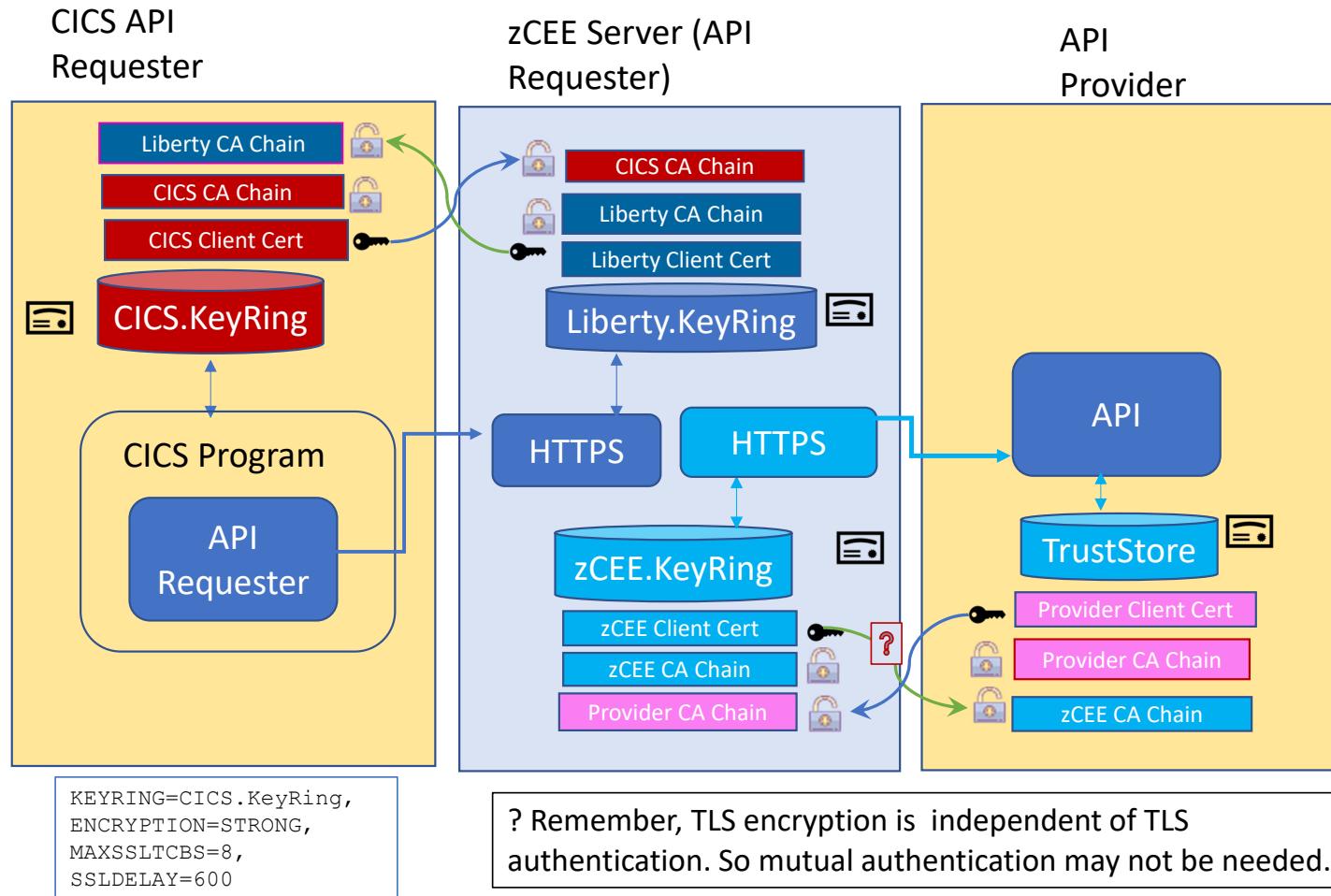
<zosconnect_authorizationServer sslCertsRef="SSL repertoire"/>
<zosconnect_cicsIpicConnection sslCertsRef="SSL repertoire"/>
<zosconnect_endpointConnect sslCertsRef="SSL repertoire"/>
<zosconnect_zosConnectRestClient sslCertsRef="SSL repertoire"/>
<zosconnect_zosConnectServiceRestClientConnection sslCertsRef="SSL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

SSL repertoires

F BAQSTRT,REFRESH,KEYSTORE



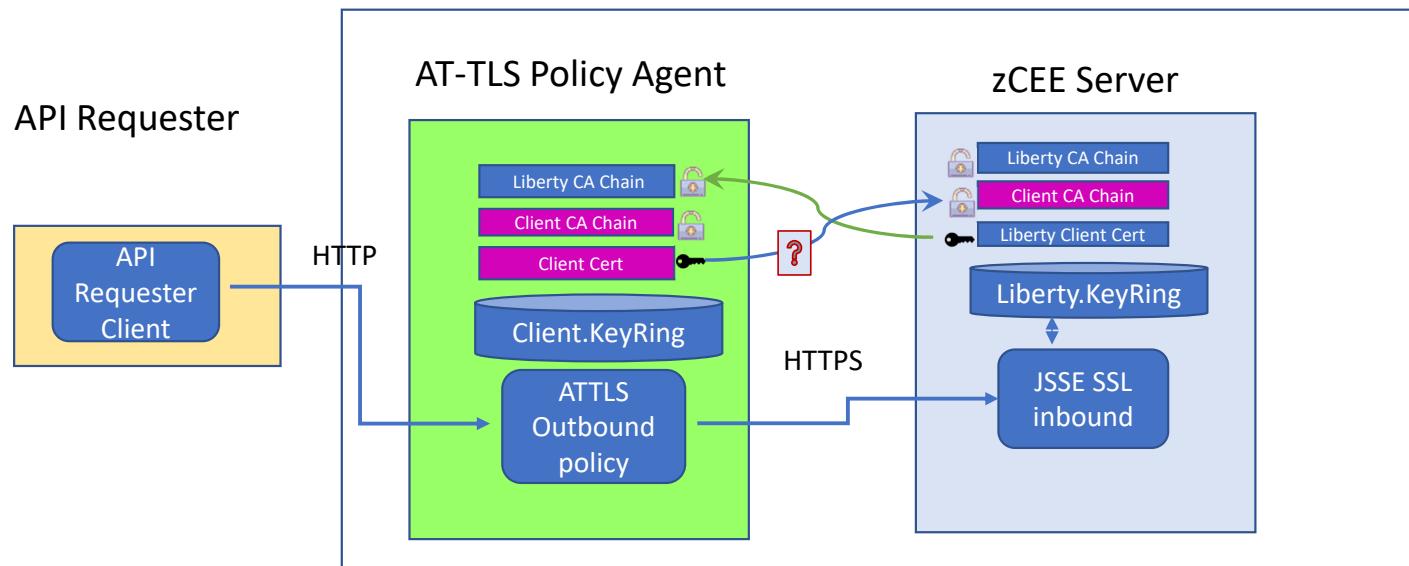
TLS handshake scenario (multiple handshakes)





AT-TLS - outbound policy handshake scenarios

Policy Agent uses an outbound policy and acts a surrogate TLS client



🔑 Certificate with a private key

🔒 Certificate Authority (CA) certificate

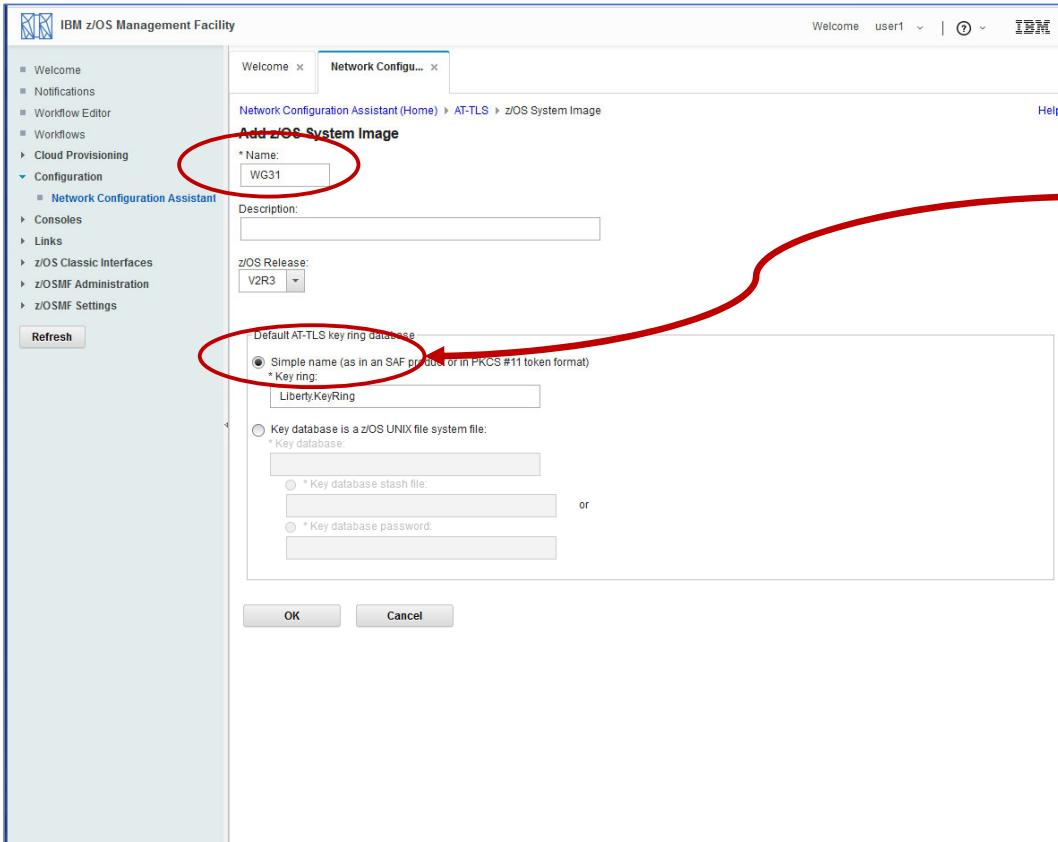
```
<zosconnect_apiRequesters idAssertion="ASSERT_ONLY">  
</zosconnect_apiRequesters>
```



Question if this really needed, remember TLS encryption is independent of TLS authentication.

AT-TLS – setting a default key ring

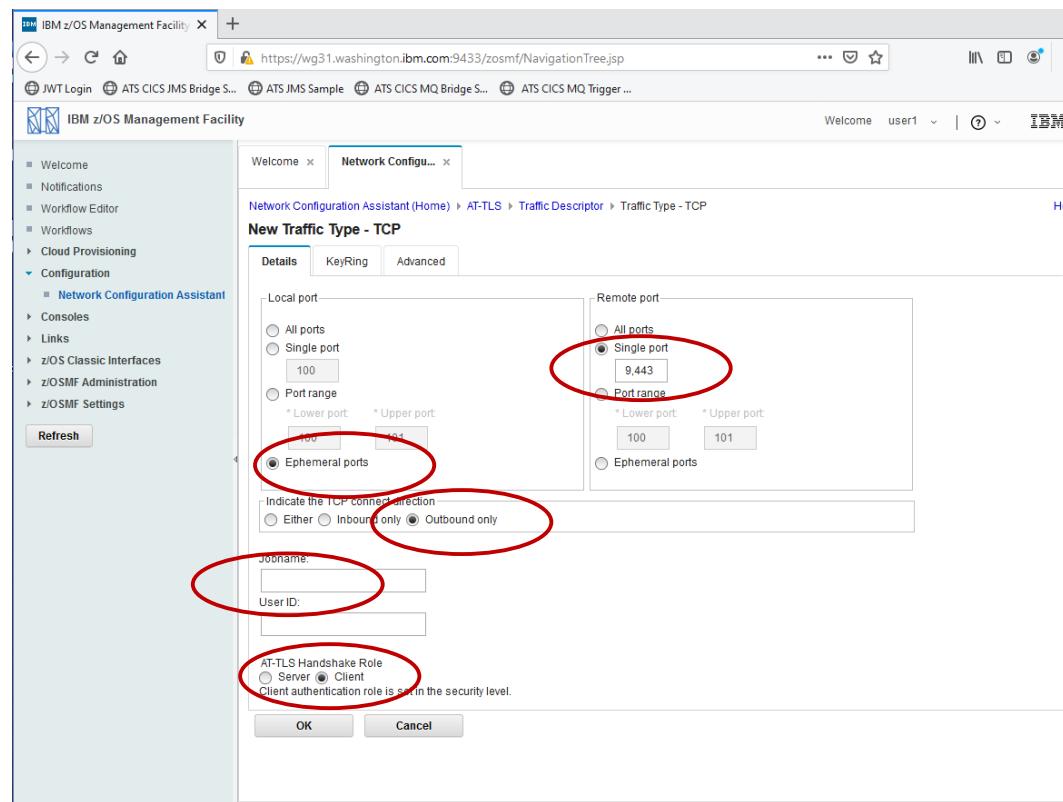
Using zOSMF Network Configuration Assistant to provide default Key Ring name



An SAF key ring name is specified as "identity/keyring". The identity of the current client is used if the identity field is omitted.

AT-TLS – configuring an outbound policy

Using zOSMF Network Configuration Assistant to configure traffic descriptor



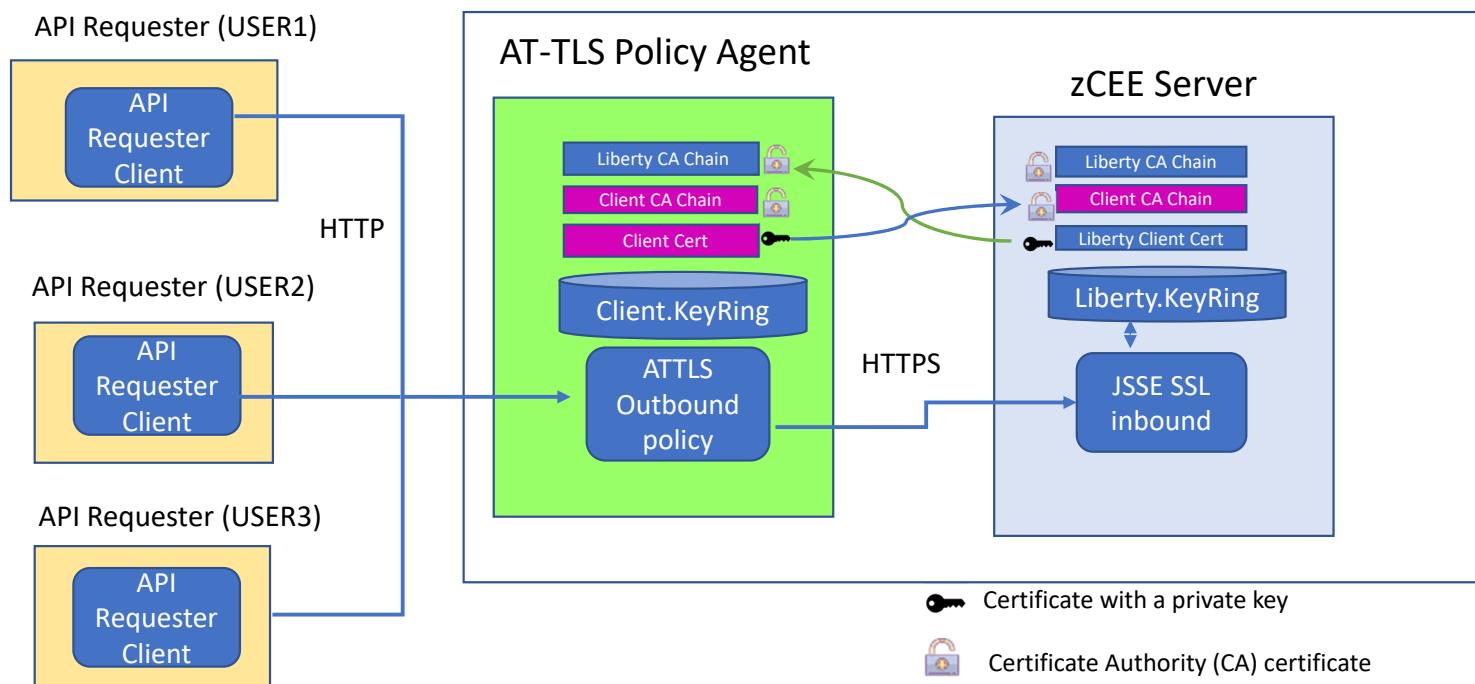
AT-TLS - setting a policy key ring

Using zOSMF Network Configuration Assistant to **traffic descriptor** Key Ring name

The screenshot shows the IBM z/OS Management Facility Network Configuration Assistant interface. The left sidebar has sections like Welcome, Notifications, Workflow Editor, Workflows, Cloud Provisioning, Configuration (selected), Network Configuration Assistant (selected), Consoles, Links, z/OS Classic Interfaces, z/OSMF Administration, and z/OSMF Settings. The main area shows a breadcrumb path: Network Configuration Assistant (Home) > AT-TLS > Traffic Descriptor > Traffic Type - TCP. The 'New Traffic Type - TCP' page has tabs for Details, KeyRing (selected), and Advanced. Under 'KeyRing', it says: 'Specify the key ring database to use for the traffic type specified on the Details tab.' There are three options: 'Use the key ring database defined for the z/OS system image.' (radio button not selected), 'Use a Simple name (as in a SAF product or in PKCS #11 Token format):' (radio button selected, highlighted with a red circle), and 'Use this z/OS UNIX file system key database:' (radio button not selected). Below the first two options are fields: '* Key ring:' with an input field containing 'Liberty.KeyRing', '* Key database:' with an input field, '* Key database stash file:' with an input field, and '* Key database password:' with an input field. A callout box points to the 'Liberty.KeyRing' input field with the text: 'An SAF key ring name is specified as "identity/keyring". The current identity is used if the identity is omitted.'

AT-TLS - outbound policy handshake scenario

Use of a common key ring name for multiple client identities

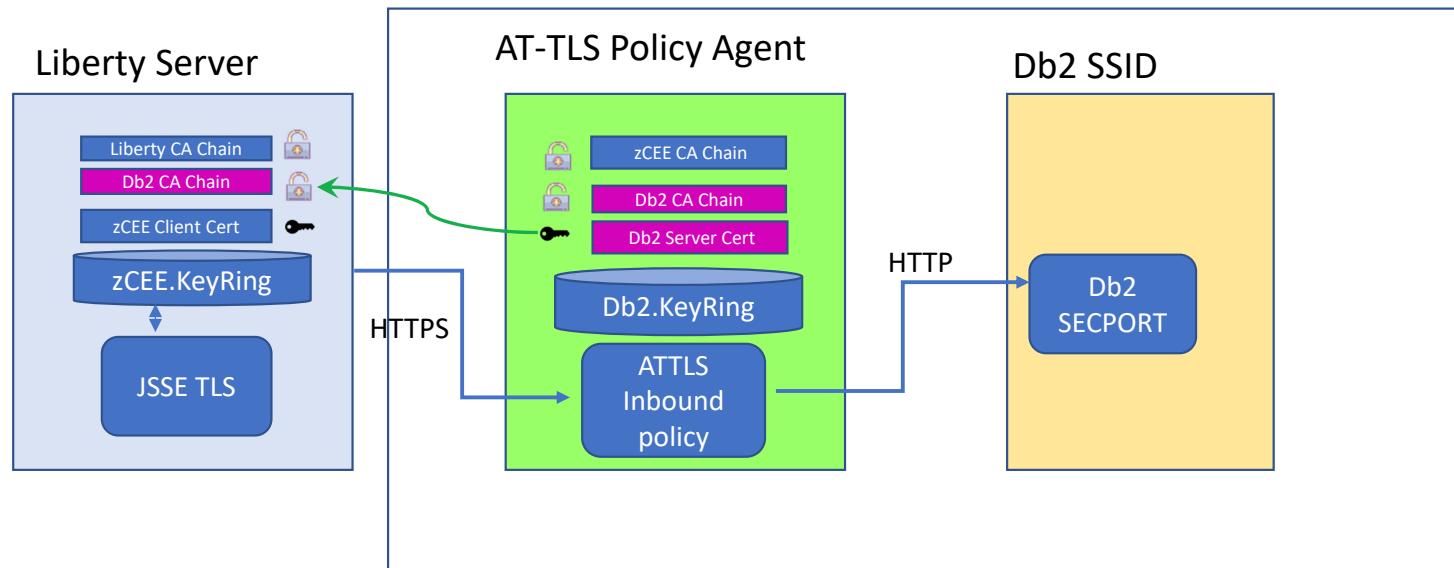


- Each user owns a keyring with the name Liberty.KeyRing.
- Each key ring has a different default client certificate for mutual authentication purposes.

This is a situation when AT-TLS mutual authentication has a benefit.

AT-TLS - inbound policy handshake scenario (Db2)

Policy Agent uses an inbound policy and acts a surrogate TLS server



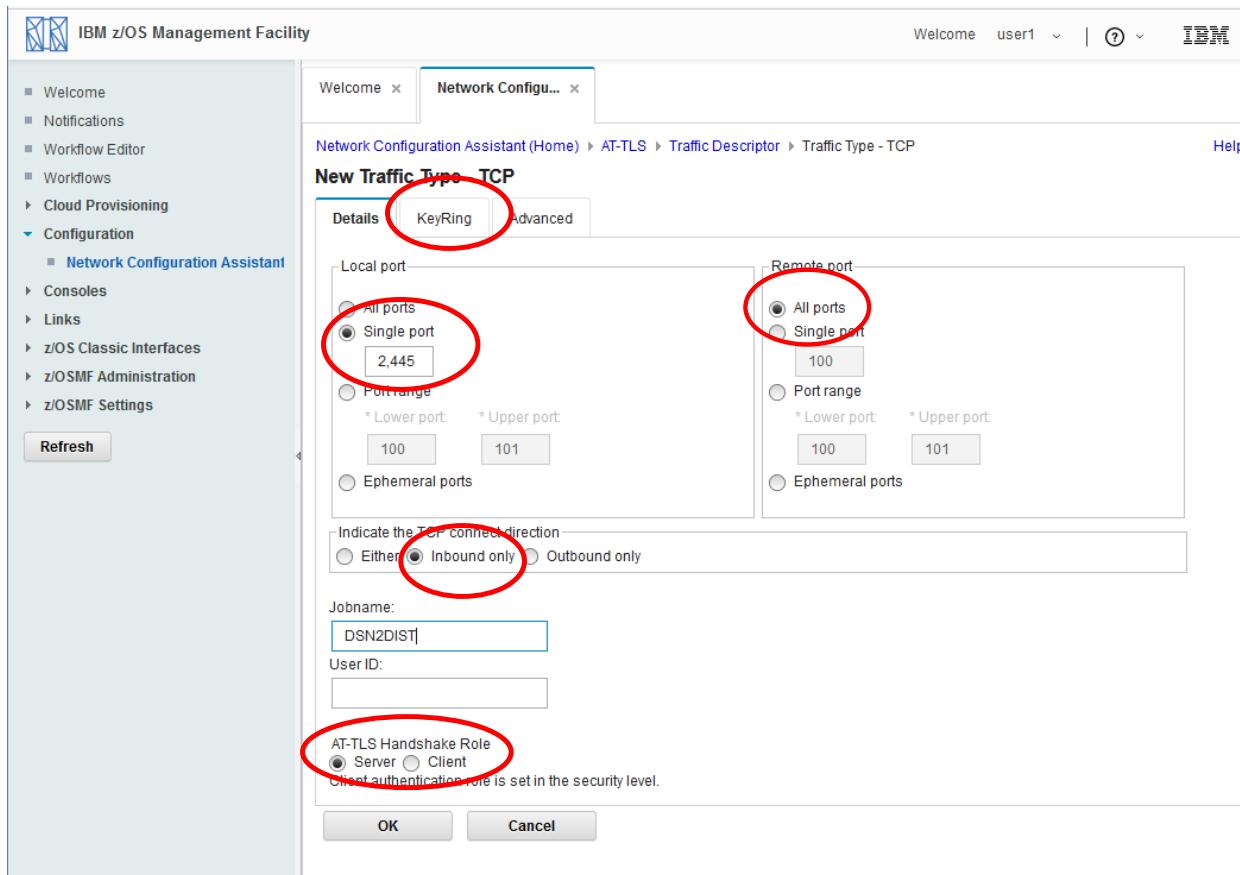
Note that DB2 is AT-TLS aware

🔑 Certificate with a private key

🔒 Certificate Authority (CA) certificate

AT-TLS – configuring an inbound policy

Using zOSMF Network Configuration Assistant



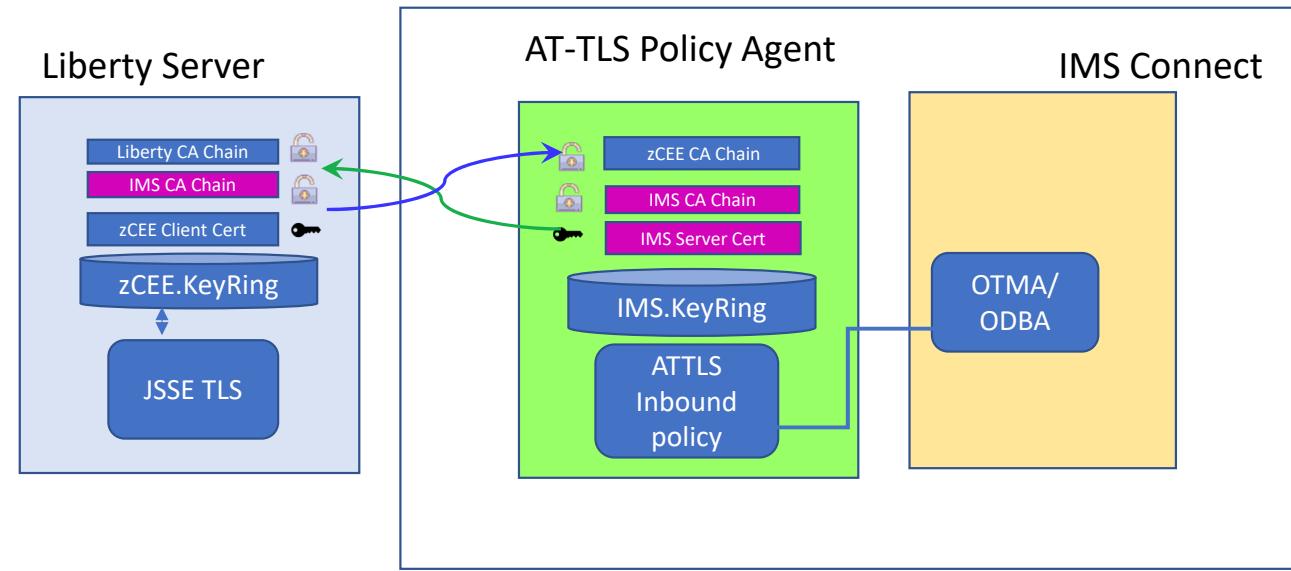
AT-TLS – configuring client authentication

Using zOSMF Network Configuration Assistant (mutual authentication)

The screenshot shows the IBM z/OS Management Facility interface. The left sidebar contains navigation links such as Welcome, Notifications, Workflow Editor, Workflows, Cloud Provisioning, Configuration (with Network Configuration Assistant selected), Consoles, and Links. The main content area is titled "Advanced AT-TLS Settings" and includes tabs for SSL Version 2 Ciphers, Client Authentication (which is selected), Tuning, Signature, Renegotiation, and Other. Under the Client Authentication tab, there is a section for "Client authentication handling" which states: "Meaningful only when mapped to a traffic descriptor with AT-TLS server handshake role." A checkbox labeled "Use client authentication" is checked. Below it, a section titled "Indicate the level of client authentication" has four radio button options: "Pass through" (unchecked), "Full" (unchecked), "Required" (selected), and "SAF check" (unchecked). There is also a section for "Certificate revocation status checking" with a checked checkbox labeled "Enabled" and a link "Configure certificate revocation status checking". At the bottom of the dialog are "OK" and "Cancel" buttons.

AT-TLS multiple policies handshake scenario (IMS)

Policy Agent uses both inbound and outbound policies and acts a surrogate TLS client with one and a TLS server with the other



Note that IMS is not AT-TLS aware

🔑 Certificate with a private key

🔒 Certificate Authority (CA) certificate



Question if this really needed, TLS encryption is independent of TLS authentication. Use PassTickets to assert identity.

Configuring TLS Encryption with JSSE

Ciphers



- During the TLS handshake, the TLS protocol and data exchange cipher are negotiated
- Choice of cipher and key length has an impact on performance
- You can restrict the protocol (TLS) and ciphers to be used
- Example setting server.xml file

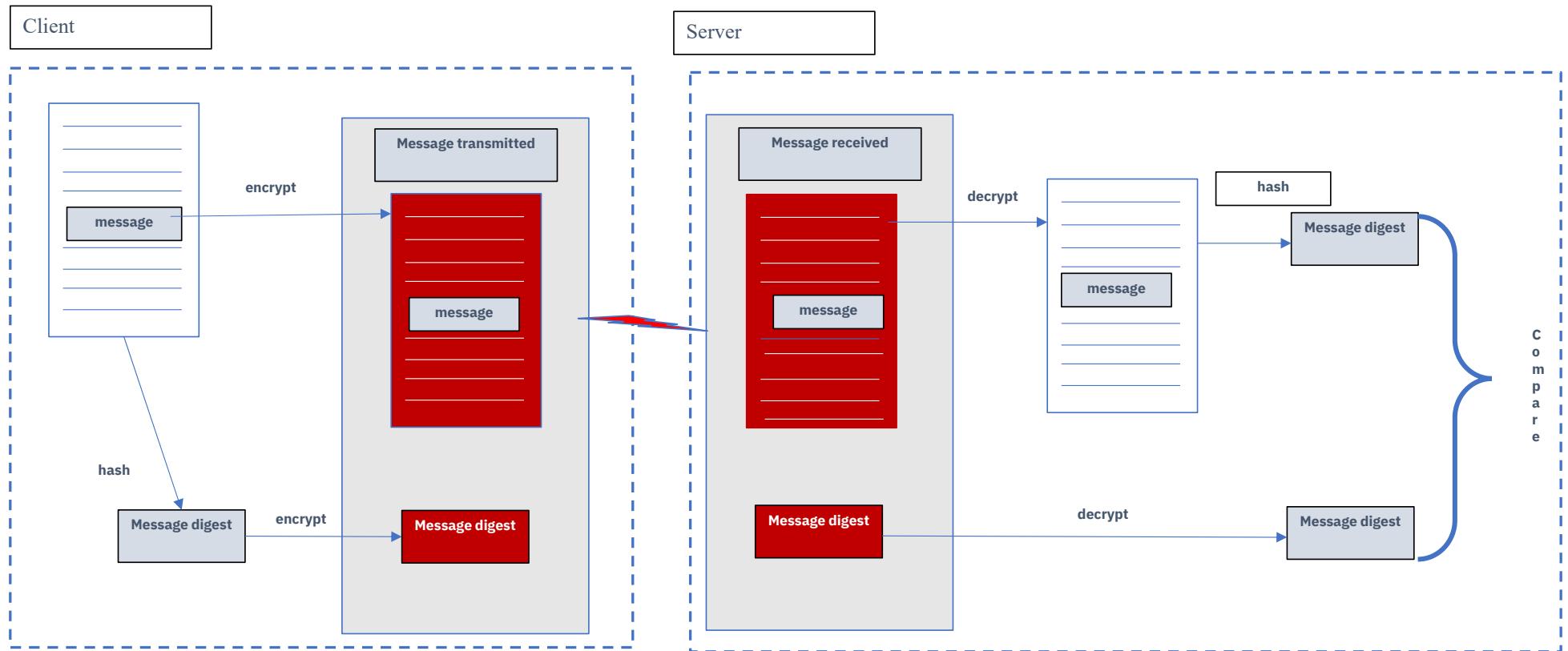
```
<ssl id="DefaultSSLSettings" keyStoreRef="defaultKeyStore"  
sslProtocol="TLSv1.2"  
enabledCiphers="TLS_RSA_WITH_AES_256_CBC_SHA256  
TLS_RSA_WITH_AES_256_GCM_SHA384"/>
```

- This configures use of TLS 1.2 and two supported ciphers
- It is recommended to control what ciphers can be used in the server rather than the client

For cipher details, see IBM SDK Java 8.0.0 Cipher Suites at URL

https://www.ibm.com/support/knowledgecenter/SSYKE2_8.0.0/com.ibm.java.security.component.80.doc/security-component/jsse2Docs/ciphersuites.html

Message Integrity and Encryption uses the cipher negotiated during the handshake





CICS IPIC using TLS

The server.xml file is the key configuration file:

The diagram illustrates the configuration of CICS IPIC using TLS across three different interfaces:

- inquireSingle Service**: A configuration interface showing the 'Configuration' tab with 'Required Configuration' (CCSID: 37, Connection reference: catalog) and 'Optional Configuration' (Transaction ID: empty, Transaction ID usage: dropdown menu).
- Liberty Admin Center**: A web-based administration interface showing the 'Server Config' for 'ipicSSLIDProp.xml'. The 'Source' tab displays the XML configuration for a server connection, specifically highlighting the 'zosconnect_cicsPicConnection' section.
- WG31**: A terminal window displaying the output of a TCP/IP configuration command. Several lines of the output are circled in red, likely corresponding to the configuration parameters defined in the other interfaces.

Tech/Tip: Cipher Suite numbers (CICS TCPIPSERVICE):

Table 2. 2-character and 4-character cipher suite definitions for SSL V3, TLS V1.0, TLS V1.1, TLS V1.2, and TLS V1.3

2-character cipher number	4-character cipher number	Short name	Description ¹	FIPS 140-2	Base security level	Security level 3 FMID > JCPT441 <
00	0000	TLS_NULL_WITH_NULL_NULL	No encryption or message authentication and RSA key exchange	X	X	
01	0001	TLS_RSA_WITH_NULL_MD5	No encryption with MD5 message authentication and RSA key exchange	X	X	
02	0002	TLS_RSA_WITH_NULL_SHA	No encryption with SHA-1 message authentication and RSA key exchange	X	X	
03	0003	TLS_RSA_EXPORT_WITH_RC4_40_MD5	40-bit RC4 encryption with MD5 message authentication and RSA (export) key exchange	X	X	
04	0004	TLS_RSA_WITH_RC4_128_MD5	128-bit RC4 encryption with MD5 message authentication and RSA key exchange		X	
05	0005	TLS_RSA_WITH_RC4_128_SHA	128-bit RC4 encryption with SHA-1 message authentication and RSA key exchange	X		^

https://www.ibm.com/support/knowledgecenter/SSLTBW_2.4.0/com.ibm.zos.v2r4.gska100/csdcwh.htm



MQ JMS using TLS

The server.xml file is the key configuration file:

Service Project Editor: Configuration

Required Configuration

- 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

LIBERTY.SSL.SVRCONN - Properties

SSL

CipherSpec
Set message security for this end of the channel
SSL Cipher Spec: TLS_RSA_WITH_AES_256_CBC_SHA256
TLS 1.2, 256-bit Secure Hash Algorithm, 256-bit AES encryption

Accept only certificates with Distinguished Names matching these values:

SSL Authentication: Required
Certificate label:

Server Config

mqClientTLS.xml

Design **Source**

```
<server description="MQ Service Provider">
  <featureManager>
    <feature>zosconnect:mqService-1.0</feature>
  </featureManager>
  <variable name="wmqJmsClient.rar.location"
    value="/u/johnson/jca/wmq.jmsra.rar"/>
  <wmqJmsClient nativeLibraryPath="/usr/lpp/mqm/V9R1M1/java/lib"/>
  <zosconnect_services>
    <service name="mqPutService">
      <property name="useCallerPrincipal" value="true"/>
    </service>
  </zosconnect_services>
  <connectionManager id="ConMgr1" maxPoolSize="5"/>
  <jmsConnectionFactory id="qmgrCf" jndiName="jms/qmgrCf">
    <connectionManagerRef>ConMgr1</connectionManagerRef>
    <properties.wmqJMS transportType="CLIENT"
      queueManager="ZMQ1"
      channel="LIBERTY.SSL.SVRCONN"
      hostName="wg31.washington.ibm.com"
      sslCipherSuite="SSL_RSA_WITH_AES_256_CBC_SHA256"
      port="1422"/>
  </jmsConnectionFactory>
  <jmsQueue id="q1" jndiName="jms/default">
    <properties.wmqJMS
      baseQueueName="ZCEE.DEFAULT.MQZCEE.QUEUE"
      CCSID="37"/>
  </jmsQueue>
</server>
```

The configuration details shown in the three interfaces are interconnected. The Service Project Editor's connection factory settings (JNDI name, request/reply destinations, etc.) correspond to the JMS Connection Factory configuration in the mqClientTLS.xml file. The SSL settings in the Liberty Properties interface (cipher spec, authentication) correspond to the SSL cipher suite and host name in the JMS Connection Factory section of the XML. The XML also includes properties for the queue manager, channel, and port.



Tech/Tip: API Requester - HTTP v HTTPS

MVS Batch and IMS with an outbound AT-TLS policy

```
CEE0PTS DD *
  POSIX(ON),
  ENVAR("BAQURI=wg31.washington.ibm.com",
  "BAQPORT=9080")
```

```
CEE0PTS DD *
  POSIX(ON),
  ENVAR("BAQURI=wg31.washington.ibm.com",
  "BAQPORT=9443")
```

CICS URIMAPS

The image shows two side-by-side CICS URIMAPS configuration screens. Both screens have a title bar 'WG31' and a menu bar 'File Edit Settings View Communication Actions Window Help'. The left screen is titled 'CICS RELEASE' and the right screen is titled 'CICS RELEASE = 0710'. Both screens show the 'OVERTYPE TO MODIFY' command followed by a CEDA ALTER URIMAP command. The configuration parameters are identical except for the port number:

- Left Screen (Port 9080):**
 - URimap : BAQURIMP
 - Group : SYSGRP
 - Description ==> URIMAP for z/OS Connect EE server
 - Status ==> Enabled
 - Usage ==> Client
 - DEscription ==> URIMAP for z/OS Connect EE server
 - POrt ==> 09120
 - HOST ==> wg31.washington.ibm.com
 - Path ==> /
 - (Mixed Case) ==>
 - ==>
 - ==>
 - ==>
- Right Screen (Port 9443):**
 - URimap : BAQURIMP
 - Group : SYSGRP
 - Description ==> URIMAP for z/OS Connect EE server
 - Status ==> Enabled
 - Usage ==> Client
 - DEscription ==> URIMAP for z/OS Connect EE server
 - POrt ==> 09443
 - HOST ==> wg31.washington.ibm.com
 - Path ==> /
 - (Mixed Case) ==>
 - ==>
 - ==>
 - ==>

Both screens also show '+ OUTBOUND CONNECTION POOLING' and 'SYSID=CICS APPL' at the bottom. The left screen has PF keys 1-11 and the right screen has PF keys 1-12.

Field BAQ-ZCON-SERVER-URI was added to BAQRINFO in V3.0.37.

MOVE "URIMAP01" TO BAQ-ZCON-SERVER-URI.



Persistent connections

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

```
<httpEndpoint host="*" httpPort="80" httpsPort="443" id="defaultHttpEndpoint"
httpOptionsRef="httpOpts"/>

<httpOptions id="httpOpts" keepAliveEnabled="true" maxKeepAliveRequests="500"
persistTimeout="1m"/>
```

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



TLS sessions

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

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

- This sets the timeout limit of an TLS session to **10 minutes** (default is 8640ms)
- TLS session ids are not shared across z/OS Connect servers

Tech/Tip: Enabling hardware cryptography key rings

jvm.options

```
-Djava.security.properties=${server.config.dir}/java.security
```

java.security

```
security.provider.1=com.ibm.crypto.hdwrCCA.provider.IBMJCECCA  
security.provider.2=com.ibm.crypto.provider.IBMJCE  
security.provider.3=com.ibm.jsse2.IBMJSSEProvider2  
security.provider.4=com.ibm.security.jgss.IBMJGSSProvider  
.....
```

Enabling the IBMJCECCA provider

```
<keyStore id="CellDefaultKeyStore"  
location="safkeyringhw://Liberty.KeyRing"  
password="password" type="JCECCARACFKS"  
fileBased="false" readOnly="true" />
```

Enabling the IBMJCEHYBRID provider

```
<keyStore id="CellDefaultKeyStore"  
location="safkeyringhybrid://Liberty.KeyRing"  
password="password" type="JCEHYBRIDRACFKS"  
fileBased="false" readOnly="true" />
```

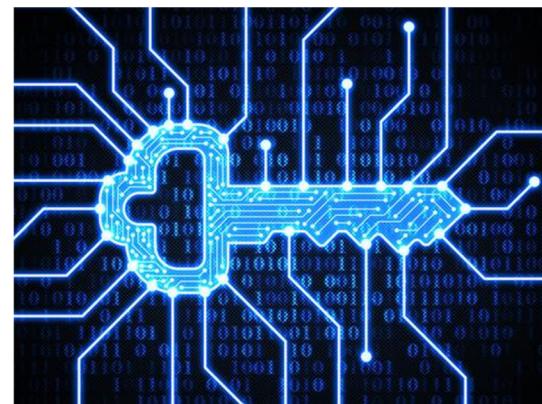
See URL <https://www.ibm.com/support/pages/node/6209109> for details on implementing IBMJCECCA and IBMJCEHYBRID hardware encryption providers

General security terms or considerations

Security involves

- Identifying who or what is requesting access (**Authentication**)
 - Basic Authentication
 - Mutual Authentication using Transport Layer Security (TLS), formerly known as SSL
 - Third Party Tokens
- Ensuring that the message has not been altered in transit (**Data Integrity**) and ensuring the confidentiality of the message in transit (**Encryption**)
 - TLS (encrypting messages and using a digital signature)

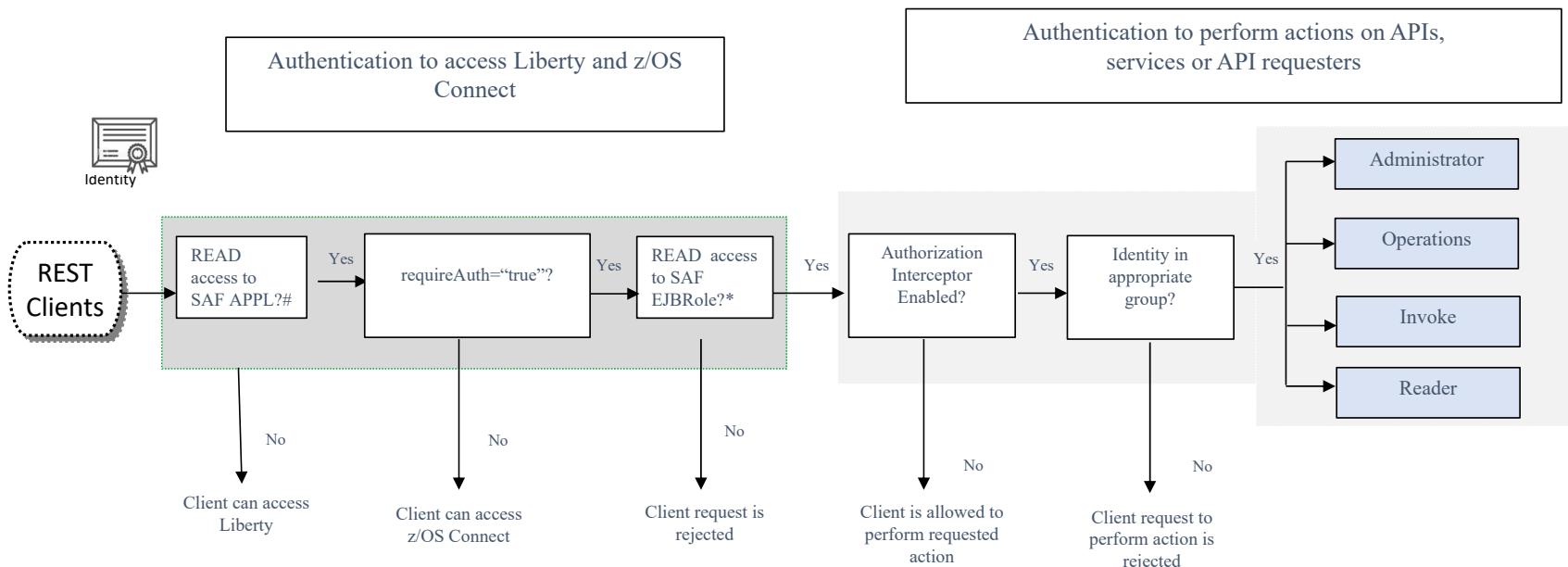
- Controlling access (**Authorization**)
 - Is the authenticated identity authorized to access to z/OS Connect
 - Is the authenticated identity authorized to access a specific API, Services, etc.



Authorization

Once we have an identity, then what?

Security flow with z/OS Connect EE



```

#RDEFINE APPL profilePrefix
*RDEFINE EJBROLE profilePrefix.zos.connect.access.roles.zosConnectAccess
  
```



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

z/OS Connect Authorization Functions



Operations - Ability to perform all z/OS Connect EE operations and actions except for function *Invoke*. The following operations/actions are allowed:

APIs:

- *To obtain a list of all APIs (GET).**
- For a specific API, get its details and API Swagger document (GET) and *deploy (POST)**, update (PUT), start(PUT), stop(PUT), and delete(DELETE) it.

Services:

- *To obtain a list of all services or statistics for all services (GET).**
- For a specific service, get its details, request and response schemas, statistics (GET) and *deploy(POST)**, update(PUT), start(PUT), stop(PUT), and delete(DELETE) it.

API Requesters:

- *To obtain a list of all API requesters (GET).**
- For a specific API requester, get its details (GET) and *deploy (POST)**, update(PUT), start(PUT), stop(PUT), and delete(DELETE) it.

*These APIs use either the POST or GET method to invoke the REST APIs whose URIs have no path parameter. Therefore, the name of the API, or service or API Requester is ignored. For authorization, only the default or global groups list can be used since no specific group list can be determined (for deployment, the name is embedded in the archive file).



z/OS Connect Authorization Levels

Reader - Ability for:

APIs:

- *To obtain a list of all APIs (GET) . **
- For a specific API, get its details and API Swagger document (GET).

Services:

- *To obtain a list of all services (GET). **
- For a specific service, get its details and request and response schemas (GET).

API Requesters:

- *To obtain a list of all API requesters (GET). **
- For a specific API requester, get its details (GET) .

Invoke - Ability to invoke user APIs, services and/or API requesters (POST,PUT,GET,DELETE,+).

Admin - All z/OS Connect EE actions are allowed, including all corresponding *Operations*, *Invoke*, and *Reader* actions configured for the same z/OS Connect resource.

*These APIs use either the POST or GET method to invoke the REST APIs whose URIs have no path parameter. Therefore, the name of the API, service or API Requester is not available. For authorization, only the default or global groups list since no specific group list can be determined (for deployment, the name is embedded in the archive file).

z/OS Connect RESTful Administrative APIs Security



z/OS Connect uses group security for controlling authorization for accessing APIs. There are sets of default global groups for functional roles are configured in a `zosConnectManager` configuration element as shown below:

```
<zosconnect_zosConnectManager  
    globalInterceptorsRef="interceptorList_g"  
    globalAdminGroup="SYSPGRP" globalOperationsGroup="GBLOPERS"  
    globalInvokeGroup="GBLINVKE" globalReaderGroup="GBLRDR"/>
```

There are four classes of groups available controlling z/OS Connect functions, administration, operations, invoking and reader in our server. An authenticated identity membership in one or more of these groups provides access to the corresponding function to that identity.

There is also a way to provide an alternative set of groups for functional roles for specific APIs, services, and API requesters in subordinate configuration elements in our server.

```
<zoscConnectAPI name="cscvinc"  
    adminGroup="CSCADMIN" operationsGroup="CSCOPERS"  
    invokeGroup="CSCINVKE" readerGroup="CSCREADR"/>  
  
<service name="cscvincSelectService"  
    adminGroup="CSCADMIN" operationsGroup="CSCOPERS"  
    invokeGroup="CSCINVKE" readerGroup="CSCREADR"/>  
  
<apiRequester name="cscvinc_1.0.0"  
    adminGroup="CSCADMIN" operationsGroup="CSCOPERS"  
    invokeGroup="CSCINVKE" readerGroup="CSCREADR"/>
```



Interceptor - server XML example

```
<zosconnect_zosConnectManager  
    globalInterceptorsRef="interceptorList_g"  
    globalAdminGroup="SYSPGRP"  
    globalOperationsGroup="GBLOPERS"  
    globalInvokeGroup="GBLINVKE"  
    globalReaderGroup="GBLRDR"/>  
  
<zosconnect_authorizationInterceptor id="auth"/>  
<zosconnect_auditInterceptor id="audit"/>  
<zosconnect_zosConnectInterceptors id="interceptorList_g"  
    interceptorRef="auth"/>  
<zosconnect_zosConnectInterceptors id="interceptorList_a"  
    interceptorRef="auth,audit"/>  
  
<zosconnect_zosConnectAPIs>  
    <zosConnectAPI name="catalog"  
        runGlobalInterceptorsRef="true"  
        adminGroup="aapigrp1,aapigrp2"  
        operationsGroup="oapigrp1,oapigrp2"  
        invokeGroup="iapigrp1,oapigrp2"  
        readerGroup="rapigrp1,rapigrp2"/>  
</zosconnect_zosConnectAPIs>  
  
<zosconnect_apiRequesters>  
    <apiRequester name="cscvincapi_1.0.0"  
        runGlobalInterceptorsRef="false"  
        interceptorsRef="interceptorList_a"  
        adminGroup="aaprgrp1,aaprgrp2"  
        operationsGroup="oaprgrp1,oaprgrp2"  
        invokeGroup="iaprgrp1,oaprgrp2"  
        readerGroup="raprgrp1,raprgrp2"/>  
</zosconnect_apiRequesters>  
  
<zosconnect_services>  
    <service id="selectByEmployee" name="selectEmployee"  
        runGlobalInterceptorsRef="false"  
        interceptorsRef="interceptorList_a"  
        adminGroup="asrvgrp1,asrvgrp2"  
        operationsGroup="osrvgrp1,osrvgrp2"  
        invokeGroup="isrvgrp1,isrvgrp2"  
        readerGroup="rsrvgrp1,rsrvgrp2"/>  
</zosconnect_services>
```

```
ADDGROUP SYSPGRP OMVS (AUTOGID)  
ADDGROUP GBLINVKE OMVS (AUTOGID)  
CONNECT FRED GROUP (SYSPGRP)  
CONNECT USER1 GROUP (GBLINVKE)
```

Global interceptor list –
authorization
interceptor only

Alternative interceptor
list – authorization and
audit interceptors

This avoids duplication
of interceptors

Note that these are z/OS
Connect configuration
elements. Documented in the
z/OS Connect KC

Tech/Tip: Server XML example – combining TLS/AUTH interceptor



```
<zosconnect_zosConnectManager  
    requireAuth="true"  
    requireSecure="true"  
    globalInterceptorsRef="interceptorList_g"  
    globalAdminGroup="SYSPGRP"  
    globalOperationsGroup="GBLOPERS"  
    globalInvokeGroup="GBLINVKE"  
    globalReaderGroup="GBLRDR"/>  
  
<zosconnect_authorizationInterceptor id="auth"/>  
<zosconnect_zosConnectInterceptors id="interceptorList_g"  
    interceptorRef="auth"/>  
  
<zosconnect_apiRequesters>  
    <apiRequester name="cscvincapi_1.0.0"  
        requireSecure="false"  
        invokeGroup="iaprgrp1"/>  
</zosconnect_apiRequesters>
```

Global TLS security and authentication are enabled.

TLS security is disabled for this API requester archive artifact. Avoiding the HTTP 302 REDIRECT error.

This configuration would allow a MVS batch job to authenticate to z/OS Connect and use HTTP for the protocol (when an AT-TLS outbound policy is not available). Only authorization identities which are members of groups identified as administrators or invokers would be authorized to invoke this API requester.

F BAQSTRT,ZCON,CLEARSAFCACHE

Example of z/OS Connect Authorization Levels (this config has issues)



```
<zosconnect_zosConnectManager>
    globalInterceptorsRef="interceptorList_g"
    globalAdminGroup="SYSPGRP" globalOperationsGroup="GBLOPERS"
    globalInvokeGroup="GBLINVKE" globalReaderGroup="GBLRDR"/>

<zosconnect_zosConnectAPIs>
    <zosConnectAPI name="cscvinc">
        adminGroup="CSCADMIN" operationsGroup="CSCOPERS"
        invokeGroup="CSCINVKE" readerGroup="CSCREADR"/>
    <zosConnectAPI name="db2employee">
        adminGroup="DB2ADMIN" operationsGroup="DB2OPERS"
        invokeGroup="DB2INVKE" readerGroup="DB2READR"/>
    </zosconnect_zosConnectAPIs>

    <zosconnect_services>
        <service name="cscvincSelectService">
            adminGroup="CSCADMIN" operationsGroup="CSCOPERS"
            invokeGroup="CSCINVKE" readerGroup="CSCREADR"/>
        <service name="selectEmployee">
            adminGroup="DB2ADMIN" operationsGroup="DB2OPERS"
            invokeGroup="DB2INVKE" readerGroup="DB2READR"/>
        </zosconnect_services>

    <zosconnect_apiRequesters>
        <apiRequester name="cscvincSelectService">
            adminGroup="CSCADMIN" operationsGroup="CSCOPERS"
            invokeGroup="CSCINVKE" readerGroup="CSCREADR"/>
        <apiRequester name="selectEmployee">
            adminGroup="DB2ADMIN" operationsGroup="DB2OPERS"
            invokeGroup="DB2INVKE" readerGroup="DB2READR"/>
        </zosconnect_apiRequesters>
```

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This works as you expect once the artifacts are deployed but:

- Only members of groups SYSPGRP, GBLOPERS or GBLRDR can connect to a z/OS server from the API toolkit (the tooling attempts a GET request for a list of all deployed services and APIs).
- Only members of groups SYSPGRP or GBLOPERS can deploy new z/OS Connect API, service or API requester artifacts (POST access for operations is not available until after the artifact is deployed)

Tech-Tip: When groups are specified for zosConnectAPI, service, or apiRequester configuration elements, the global groups are ignored for certain functions. Other functions, e.g., deploy new artifact, get a list or service statistics, only use the global group membership.

z/OS Connect Authorization Summary



- Members of groups SYSPGRP, GBLOPERS, DB2ADMIN or DB2OPERS can not manage (e.g., change, stop or delete) z/OS Connect artifacts *managed* by group CSCOPERS or CSCADMIN.
- Members of groups SYSPGRP, GBLOPERS, CSCADMIN or CSCOPERS can not manage (e.g., change, stop or delete) z/OS Connect artifacts *managed* by group DB2OPERS or DB2ADMIN.
- Only members of group CSCADMIN, CSCINV, DB2ADMIN or DB2INVKE can invoke the artifacts defined in the subordinate element:
 - Members of group CSCADMIN or CSCVINKE can invoke artifacts managed by CSCINVKE
 - Members of group DB2ADMIN or DB2INVKE can invoke artifacts managed by DB2INVKE
 - Members of groups SYSPGRP or GBLINVKE can not invoke any artifacts protected by these specific subordinate groups.
- Only members of groups SYSPGRP, GBLOPERS or GBLRDR can connect to a z/OS server from the API toolkit.
- Only members of groups SYSPGRP or GBLOPERS can deploy new z/OS Connect API, service or API requester artifacts.



Tech-Tip: Solution for z/OS Connect Authorization Levels

```
<zosconnect_zosConnectManager
    globalInterceptorsRef="interceptorList_g"
    globalAdminGroup="SYSPGRP" globalOperationsGroup="GBLOPERS , CSCOPERS , DB2OPERS"
    globalInvokeGroup="GBLINVKE" globalReaderGroup="GBLRDR"/>

<zosconnect_zosConnectAPIs>
    <zosConnectAPI name="cscvinc" operationsGroup="CSCOPERS" invokeGroup="CSCINV" />
    <zosConnectAPI name="db2employee" operationsGroup="DB2OPERS" invokeGroup="DB2INVKE" />
</zosconnect_zosConnectAPIs>

<zosconnect_services>
    <service name="cscvincSelectService" operationsGroup="CSCOPERS" invokeGroup="CSCINV" />
    <service name="selectEmployee" operationsGroup="DB2OPERS" invokeGroup="DB2INVKE" />
</zosconnect_services>

<zosconnect_apiRequesters>
    <apiRequester name="cscvincSelectService" operationsGroup="CSCOPERS" invokeGroup="CSCINV" />
    <apiRequester name="selectEmployee" operationsGroup="DB2OPERS" invokeGroup="DB2INVKE" />
</zosconnect_apiRequesters>
```

- Now members of groups SYSPGRP, GBLOPERS, **CSCOPERS**, **DB2OPERS** and GBLRDR can connect to a z/OS server from the API toolkit.
- Members of groups SYSPGRP, GBLOPERS, **CSCOPERS**, and **DB2OPERS** can deploy new artifacts.
- Only members of group **CSCOPERS** and **DB2OPERS** can manage artifacts after they are deployed.



Tech-Tip: z/OS Toolkit and authorization status

Members of CSCOPERS and DB2OPERS can now connect to a server from the API Toolkit

CSCOPERS

The screenshot shows the 'z/OS Connect EE Servers' interface with the 'Remote Systems' tab selected. Under the 'wg31:9443 (wg31.washington.ibm.com:9443)' node, the 'APIs (9)' section is expanded. It lists several services, with 'db2employee' highlighted by a red oval and labeled '(Not Authorized)'. Other listed services include cscvinc, filemgr, imsPhoneBook, jvtlvpDemoApi, miniloancics, mqapi, phonebook, and restadmin, all marked as 'Started'.

DB2OPERS

The screenshot shows the same 'z/OS Connect EE Servers' interface for DB2OPERS. In the 'APIs (9)' section, 'cscvinc' is highlighted by a red oval and labeled '(Not Authorized)'. Other services like db2employee, filemgr, imsPhoneBook, jvtlvpDemoApi, miniloancics, mqapi, phonebook, and restadmin are also listed as 'Started'. The 'Services' section below shows similar results for both users.



Tech-Tips: z/OS Connect Authorization Levels

Identity	Group
USER11	GMADMIN
USER12	GMOPERS
USER13	GMINVOKE
USER14	GMREADER
USER21	CSCADMIN
USER22	CSCOPERS
USER23	CSCINVKE
USER24	CSCREADR
USER31	DB2ADMIN
USER32	DB2OPERS
USER33	DB2INVKE
USER34	DB2READR



Tech-Tip: z/OS Connect Authorization Deploy Sample

Deploy a new service as USER11

```
c:\z\passticket>curl -X POST --user user11:Z4GG7V4H --data-binary @cscvincSelectService.sar --header "Content-Type: application/zip" --insecure https://wg31.washington.ibm.com:9443/zosConnect/services{"zosConnect":{"serviceName":"cscvincSelectService","serviceDescription":"","serviceProvider":"CICS-1.0","version":"1.0.0","serviceURL":"https://wg31.washington.ibm.com:9443/zosConnect/services/cscvincSelectService?action=invoke","dataXformProvider":"zosConnectWVXform-1.0","serviceStatus":"Started"},"cscvincSelectService": {"transidUsage":"EIB_ONLY","transid":"CSMI","program":"CSCVINC","connectionRef":"cscvinc","ccsid":"37"}}
```

This service is now managed by members of CSCADMIN and CSCOPERS

```
c:\z\passticket>curl -X PUT --user user11:V4BTUHV5 --insecure https://wg31.washington.ibm.com:9443/zosConnect/services/cscvincSelectService?status=stopped {"errorMessage":"BAQR0435W: The zosConnectAuthorization interceptor encountered an error while processing a request.", "errorDetails":"BAQR0409W: User user11 is not authorized to perform the request."}
```

```
c:\z\passticket>curl -X DELETE --user user11:V4BTUHV5 --insecure https://wg31.washington.ibm.com:9443/zosConnect/services/cscvincSelectService {"errorMessage":"BAQR0434W: The zosConnectAuthorization interceptor encountered an error while processing a request for service cscvincSelectService.", "errorDetails":"BAQR0409W: User user11 is not authorized to perform the request."}
```

```
c:\z\passticket>curl -X PUT --user user21:QLTNYHS7 --insecure https://wg31.washington.ibm.com:9443/zosConnect/services/cscvinc {"zosConnect":{"serviceName":"cscvincSelectService","serviceDesc1.0","version":"1.0.0","serviceURL":"https://wg31.washington.ibm.com:9443/zosConnect/services/cscvincSel1.0","serviceStatus":"Stopped"}}
```

```
<zosconnect_services>
  <service name="cscvincSelectService"
    adminGroup="CSCADMIN" operationsGroup="CSCOPERS"
    invokeGroup="CSCINVKE" readerGroup="CSCREADR"/>
</zosconnect_services>
```

InvokeURL": "htt
form-

```
c:\z\passticket>curl -X DELETE --user user21:QLTNYHS7 --insecure https://wg31.washington.ibm.com:9443/zosConnect/services/cscvincSelectService {"name":"cscvincSelectService"}
```



Tech-Tip: z/OS Connect Authorization Invoke Sample

```
c:\z\passticket>curl -X GET --user user11:MPSIJ0F2 --header "Content-Type: application/json"  
--insecure https://wg31.washington.ibm.com:9443/zosConnect/apis/cscvinc  
{"errorMessage":"BAQR0436W: The zosConnectAuthorization interceptor encountered an error  
while processing a request for API cscvinc.", "errorDetails":"BAQR0409W: User user11 is not  
authorized to perform the request."}
```

```
c:\z\passticket>curl -X GET --user user13:LSHWBUAK --header "Content-Type: application/json"  
--insecure https://wg31.washington.ibm.com:9443/cscvinc/employee/000100  
{"errorMessage":"BAQR0436W: The zosConnectAuthorization interceptor encountered an error  
while processing a request for API cscvinc.", "errorDetails":  
"BAQR0409W: User user13 is not authorized to perform the request."}
```

```
c:\z\passticket>curl -X GET --user user21:C8CGF4KA --header "Content-Type: application/json"  
--insecure https://wg31.washington.ibm.com:9443/cscvinc/employee/000100  
{"cscvincSelectServiceOperationResponse": {"cscvincContainer": {"response": {"CEIBRESP2": 0, "USE  
RID": "CICSUSER", "filea": {"date": "26 11 81", "amount": "$0100.11", "address": "SURREY,  
ENGLAND", "phoneNumber": "32156778", "name": "S. D.  
BORMAN", "employeeNumber": "000100"}, "CEIBRESP": 0}}}}
```

```
<zoscconnect_zosConnectAPIs>  
  <zoscConnectAPI name="cscvinc"  
    adminGroup="CSCADMIN" operationsGroup="CSCOPERS"  
    invokeGroup="CSCINVKE" readerGroup="CSCREADR"/>
```

```
c:\z\passticket>curl -X GET --user user23:5MDUPQIF --h  
--insecure https://wg31.washington.ibm.com:9443/cscvi</zoscconnect_zosConnectAPIs>  
{"cscvincSelectServiceOperationResponse": {"cscvincContainer": {"response": {"CEIBRESP2": 0, "USE  
RID": "CICSUSER", "filea": {"date": "26 11 81", "amount": "$0100.11", "address": "SURREY,  
ENGLAND", "phoneNumber": "32156778", "name": "S. D.  
BORMAN", "employeeNumber": "000100"}, "CEIBRESP": 0}}}}
```

```
c:\z\passticket>curl -X GET --user user31:VWIJW74F --header "Content-Type: application/json"  
--insecure https://wg31.washington.ibm.com:9443/cscvinc/employee/000100  
{"errorMessage": "BAQR0436W: The zosConnectAuthorization interceptor encountered an error  
while processing a request for API cscvinc.", "errorDetails":  
"BAQR0409W: User user31 is not authorized to perform the request."}
```

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Tech-Tip: Solution for z/OS Connect Authorization Levels

```
<zosconnect_zosConnectManager
    globalInterceptorsRef="interceptorList_g"
    globalAdminGroup="GMADMIN" globalOperationsGroup="GMOPERS, CSCOPERS, DB2OPERS"
    globalInvokeGroup="GMINVOKE" globalReaderGroup="GMREADER"/>

<zosconnect_zosConnectAPIs>
    <zosConnectAPI name="cscvinc" operationsGroup="CSCOPERS" invokeGroup="CSCINV"/>
    <zosConnectAPI name="db2employee" operationsGroup="DB2OPERS" invokeGroup="DB2INVKE"/>
</zosconnect_zosConnectAPIs>

<zosconnect_services>
    <service name="cscvincSelectService" operationsGroup="CSCOPERS" invokeGroup="CSCINV"/>
    <service name="selectEmployee" operationsGroup="DB2OPERS" invokeGroup="DB2INVKE"/>
</zosconnect_services>

<zosconnect_apiRequesters>
    <apiRequester name="cscvincSelectService" operationsGroup="CSCOPERS" invokeGroup="CSCINV"/>
    <apiRequester name="selectEmployee" operationsGroup="DB2OPERS" invokeGroup="DB2INVKE"/>
</zosconnect_apiRequesters>
```

- Now members of groups GMADMIN, GMOPERS, **CSCOPERS, DB2OPERS** and GMREADER can connect to a z/OS server from the API toolkit.

When a partial list of subordinate groups are provided, the corresponding default global groups for the absence groups are used.



Tech-Tip: z/OS Connect Authorization Get Sample

Deploy a new API Requester

```
c:\z\passticket>curl -X POST --user user12:ID1V0B4C --data-binary @cscvinc.ara --header "Content-Type: application/zip" --insecure https://wg31.washington.ibm.com:9443/zosConnect/apiRequesters
{"name":"cscvincapi_1.0.0","version":"1.0.0","description":"","status":"Started","apiRequesterUrl":"https://wg31.washington.ibm.com:9443/zosConnect/apiRequesters/cscvincapi_1.0.0","connection":"cscvincAPI"}
```

This API requester details is now accessible by members of GMREADER but not CSCREADR

```
c:\z\passticket>curl -X GET --user user14:XQIC6GB3 --header "Content-Type: application/json" --insecure https://wg31.washington.ibm.com:9443/zosConnect/apiRequesters/cscvincapi_1.0.0
{"name":"cscvincapi_1.0.0","version":"1.0.0","description":"","status":"Started","apiRequesterUrl":"https://wg31.washington.ibm.com:9443/zosConnect/apiRequesters/cscvincapi_1.0.0","connection":"cscvincAPI"}
```

```
c:\z\passticket>curl -X GET --user user24:UFX1XUKB --header "Content-Type: application/json" --insecure https://wg31.washington.ibm.com:9443/zosConnect/apiRequesters/cscvincapi_1.0.0
{"errorMessage":"BAQR1176W: The zosConnectAuthorization interceptor encountered an error while processing a request for API requester cscvincapi_1.0.0." * }
```

This API requester is now managed by members of CSCOPERS and GMADMIN

```
c:\z\passticket>curl -X PUT --user user12:N2AHSG71 --insecure https://wg31.washington.ibm.com:9443/zosConnect/apiRequesters/cscvincapi_1.0.0?status=stopped
{"errorMessage":"BAQR1176W: The zosConnectAuthorization interceptor encountered an error while processing a request for API requester cscvincapi_1.0.0."}
```

```
c:\z\passticket>curl -X PUT --user user22:RVWKLNZV --insecure https://wg31.washington.ibm.com:9443/zosConnect/apiRequesters/cscvincapi_1.0.0?status=stopped
{"name":"cscvincapi_1.0.0","version":"1.0.0","description":"","status":"Stopped","apiRequesterUrl":"https://wg31.washington.ibm.com:9443/zosConnect/apiRequesters/cscvincapi_1.0.0","connection":"cscvincAPI"}
```

```
c:\z\passticket>curl -X DELETE --user user22:WAHOKIGF --insecure https://wg31.washington.ibm.com:9443/zosConnect/apiRequesters/cscvincapi_1.0.0
{"name":"cscvincapi_1.0.0"}q
```

*BAQR0430W: User user24 is not authorized to perform the request on resource /zosConnect/apiRequesters/cscvincapi_1.0.0

Flowing identities to back-end z/OS systems



Basic authentication - Identity and Password

Server XML Configuration elements where basic authentication can be provided.

```
<connectionFactory id="imsTM"> containerAuthDataRef="IMScredentials">
<authData id="IMScredentials" user= "identity" password= "password"/>

<connectionFactory id="imsDB">
<properties.imsudbJLocal databaseName="DFSIVPA" user="identity" password="password"/>
</connectionFactory>

<zosconnect_cicsIpicConnection id="CICS" authDataRef="CICScredentials"/>
<zosconnect_authData id="CICScredentials" user= "identity" password= "password"/>

<zosconnect_zosConnectServiceRestClientConnection id="Db2" basicAuthRef="db2Auth"/>
<zosconnect_zosConnectServiceRestClientBasicAuth id="db2Auth"
    userName="identity" password="password"/>

<jmsQueueConnectionFactory jndiName="MQ">
    <properties.wasJms userName="identity" password="password" />
</jmsQueueConnectionFactory>
```

The value of the password can be encoded in the server XML configuration file. Using the **securityUtility** shipped with WebSphere Liberty Profile.



Using securityUtility to encrypt passwords

Best practice : use encryption for passwords instead of base64 encoding

- **securityUtility** – located in <wlp_install_dir>/wlp/bin

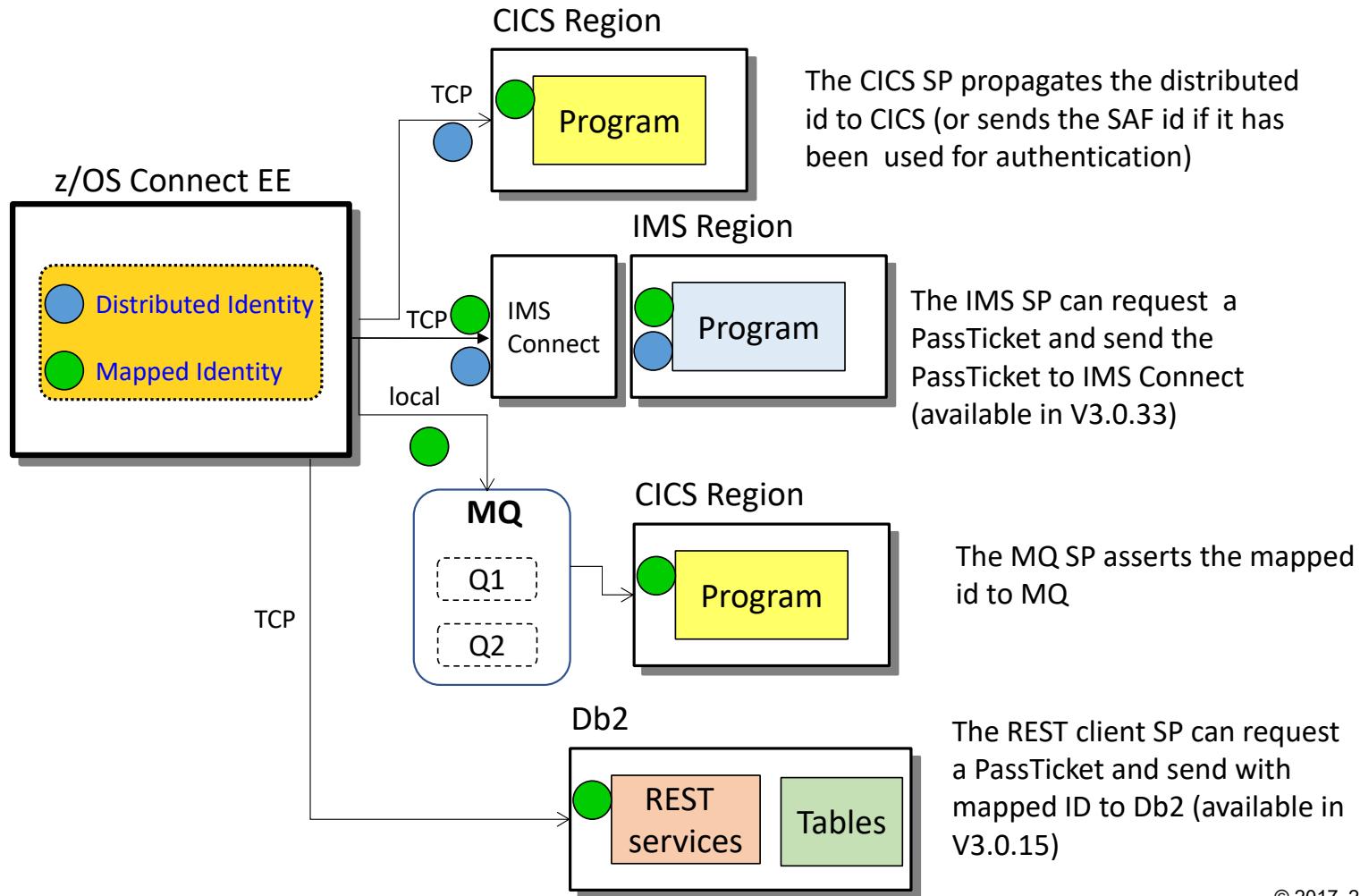
- Usage: securityUtility {encode|createSSLCertificate|createLTPAKeys|help} [options]
- For encryption, use encode --key=encryption_key
 - Specifies the key to be used when encoding using AES encryption. This string is hashed to produce an encryption key that is used to encrypt and decrypt the password. The key can be provided to the server by defining the variable **wlp.password.encryption.key** whose value is the key. If this option is not provided, a default key is used.

```
./securityUtility encode --encoding=aes --key=myKey passW0rd  
{aes}AHO0aXdiVD96u4oMRhoKeYH3U7aDqtFXTuHFBsO98Wlb  
• Also supports 1-way hash encoding – for passwords in server.xml with basicRegistry  
• For hash, use encode --encoding=hash  
./securityUtility encode --encoding=hash XXXXXXXX  
{hash}ATAAAAAAIcqTmHn5qZahAAAAAIMjzy+hP8YFaIO6LiCreVe4etRLUS9a25eVuYtx6WKiv
```

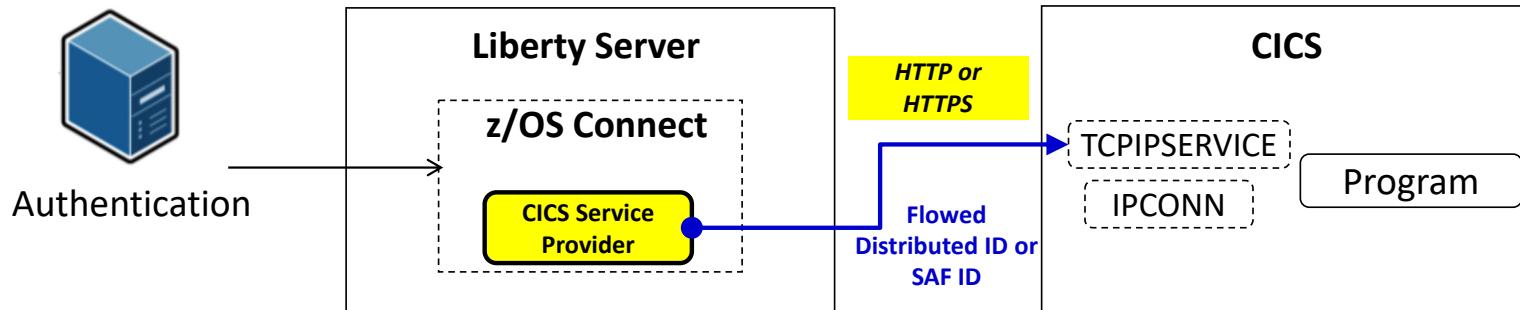
See the WebSphere Application Server for z/OS Liberty at URL:

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

Flowing an identity to a back-end subsystem



Flowing a user ID with CICS service provider



Distributed identities can be propagated to CICS and then mapped to a RACF user ID by CICS. You can then view the distinguished name and realm for a distributed identity in the association data of the CICS task. **Important:** If the z/OS Connect EE server is not in the same Sysplex as the CICS system, you must use an IPIC TLS (JSSE) connection that is configured with client authentication.

If a SAF ID is used for authentication (e.g., basic authentication with a SAF registry) then the SAF ID is passed to CICS.



Flowing an identity to CICS

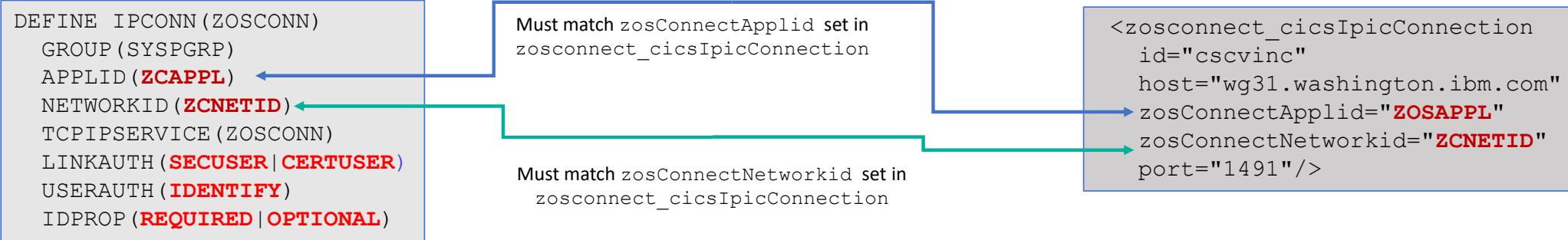
The server.xml file is the key configuration file:

The diagram illustrates the process of defining identity propagation to CICS. It shows three main components:

- Liberty Admin Center:** A browser window titled "Server Config" showing the XML configuration file `ipicSSLIDProp.xml`. The XML code includes sections for `<server>`, `<featureManager>`, and `<zosconnect_cicsIpicConnection id="catalog">`. The connection reference "catalog" is highlighted with a red oval.
- Configuration Dialog:** A "Configuration" dialog box for "inquireSingle Service". It has two tabs: "Required Configuration" and "Optional Configuration". Under "Required Configuration", there is a "Coded character set identifier (CCSID)" field set to 37 and a "Connection reference" field set to "catalog". Under "Optional Configuration", there is a "Transaction ID" field and a "Transaction ID usage" dropdown menu.
- Terminal Session:** Two terminal windows titled "WG31" showing command-line output. The top window shows the command `I TCPIPS` and its results, including the creation of a service named "cicsService(CSCVINC)". The bottom window shows the command `I IPCCONN` and its results, including the creation of a connection named "zosconnect_cicsIpicConnection". Both windows have a red oval highlighting the connection name "zosconnect_cicsIpicConnection".

A large red arrow points from the "catalog" connection reference in the Admin Center XML to the "zosconnect_cicsIpicConnection" entry in the terminal session output. Another red arrow points from the "zosconnect_cicsIpicConnection" entry in the terminal session output back to the "catalog" connection reference in the Admin Center XML. A callout box at the bottom right says "Define identity propagation to CICS".

CICS IPCONN Resource



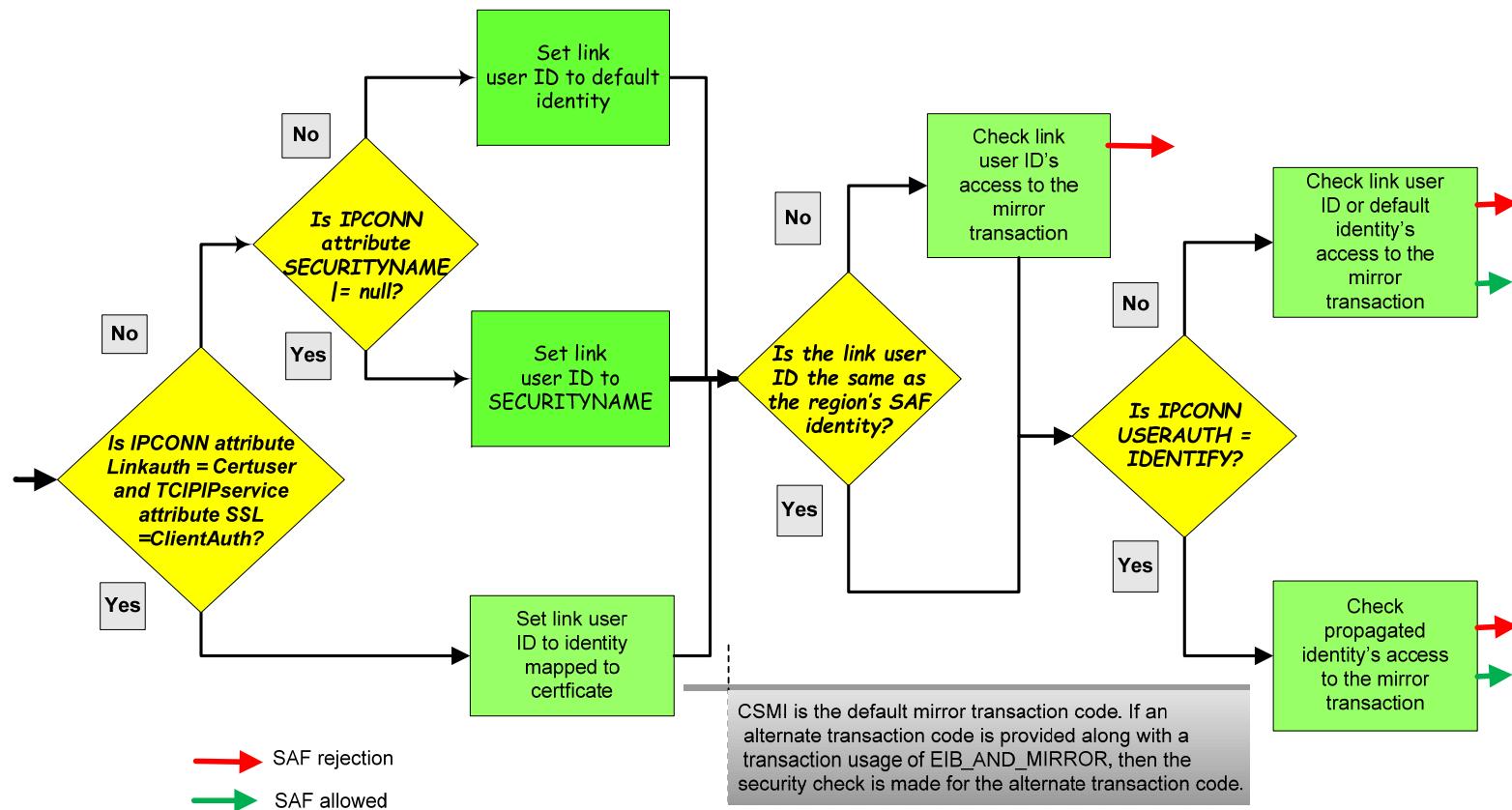
LINKAUTH Determines the user identity to be used for link security. The value is either **CERTUSER** or **SECUSER**. A value of **CERTUSER** sets the link identity to the identity associated with the client certificate received from the client endpoint (TLS mutual authentication is required). A value of **SECUSER** sets the link identity to the value of the *SECURITYNAME* attribute as defined in the IPCONN resource.

USERAUTH Identifies how the identity under which the attached transaction attach security will run. Since a password is not available, a value of **VERIFY** is not possible. A value of **LOCAL** means the current link identity is used. A value of **DEFAULTUSER** means the CICS default identity is used. For identity propagation purposes, the value of **USERAUTH** should be **IDENTIFY** (no password will be required) so the identity provided by the client is used for executing the attached transaction. TLS must be used if the client is in a different Sysplex.

IDPROP Determines whether the original distributed identity authenticated by the z/OS Connect server is also propagated to CICS in addition to the mapped identity used for z/OS Connect authorization checks. A value of **NOTALLOWED** does not propagate the original distributed identity. A value of **OPTIONAL** will propagate to CICS the original distributed identity, if available. A value of **REQUIRED** requires that the original distributed identity be propagated to CICS. TLS must be used if the client is in a different Sysplex.

CERTIFICATE Provides the label of the certificate connected to the CICS key ring to be used for server endpoint certificate during a TLS handshake.

Tech/Tip: CICS IPIC Security with USERAUTH(VERIFY)





Identity Propagation and CICS High Availability

Assume the service installed in a server files use the following *Connection reference* values:

- cscvinc
- catalog
- miniloan

If identity propagation is required for all connection, then the CICS IPCONN resources defined in the CICs that correspond to a `zosconnect_cicsIpicConnection` configuration elements must be dedicated to that z/OS Connect server and connection reference can not be reused.

Simplify administration by still sharing a common `cicsIpicConnection` XML configuration element by using variables and a bootstrap properties file or “variables” XML file

Server baqsvr1's bootstrap.properties

```
ipicPort=1491  
cicsHost=dvipa.washington.ibm.com  
serverPrefix=baqsvr1
```

Server baqsvr2's bootstrap.properties

```
cicsHost=dvipa.washington.ibm.com  
ipicPort=1491  
serverPrefix=baqsvr2
```

Server baqsvr3's bootstrap.properties

```
cicsHost=dvipa.washington.ibm.com  
ipicPort=1491  
serverPrefix=baqsvr3
```

ipicIDProp.xml

```
<zosconnect_cicsIpicConnection id="cscvinc"  
host="${cicsHost}"  
zosConnectNetworkid="${wlp.server.name}"  
zosConnectApplid="${wlp.server.name}"  
sharedPort="true" port="${ipicPort}"/>  
<zosconnect_cicsIpicConnection id="catalog"  
host="${cicsHost}"  
zosConnectNetworkid="${serverPrefix}C"  
zosConnectApplid="${serverPrefix}C"  
sharedPort="true" port="${ipicPort}"/>  
<zosconnect_cicsIpicConnection id="miniloan"  
host="${cicsHost}"  
zosConnectNetworkid="${serverPrefix}M"  
zosConnectApplid="${serverPrefix}M"  
sharedPort="true" port="${ipicPort}"/>
```

→ baqsvr1 or baqsvr2

→ baqsvr1C or baqsvr2C

→ baqsvr1M or baqsvr2M



CICS IPConn and TCPIPSERVICE resources for HA

CICS Specific TCPIPSERVICE - IPIC

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

CICS Generic TCPIPSERVICE - IPICG

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

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

I IPConn ACQ

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

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

PassTickets and IMS

- Basic authentication to IMS Connect using a PassTicket depends on the APPL parameters configured in IMS Connect.

```
HWS=(ID=IMS15HWS,XIBAREA=100,RACF=Y,RRS=Y)
TCPIP=(HOSTNAME=TCPIP,PORTID=(4000,LOCAL),RACFID=JOHNSON,TIMEOUT=5000)
DATASTORE=(GROUP=OTMAGRP, ID=IVP1, MEMBER=HWSMEM, DRU=HWSYDRU0,
TMEMBER=OTMAMEM,APPL=IMSTMPL)
ODACCESS=(DBMAUTOCONN=Y, IMSPLEX=(MEMBER=IMS15HWS, TMEMBER=PLEX1),
DRDAPORT=(ID=5555, PORTMOT=6000), ODBMTMOT=6000,APPL=IMSDBAPL)
```

```
RDEFINE PTKTDATA IMSTMPL SSIGNON(0123456789ABCDEF) APPLDATA('NO REPLAY PROTECTION') UACC(NONE)
```

```
RDEFINE PTKTDATA IRRPTAUTH.IMSTMPL.* UACC(NONE)
```

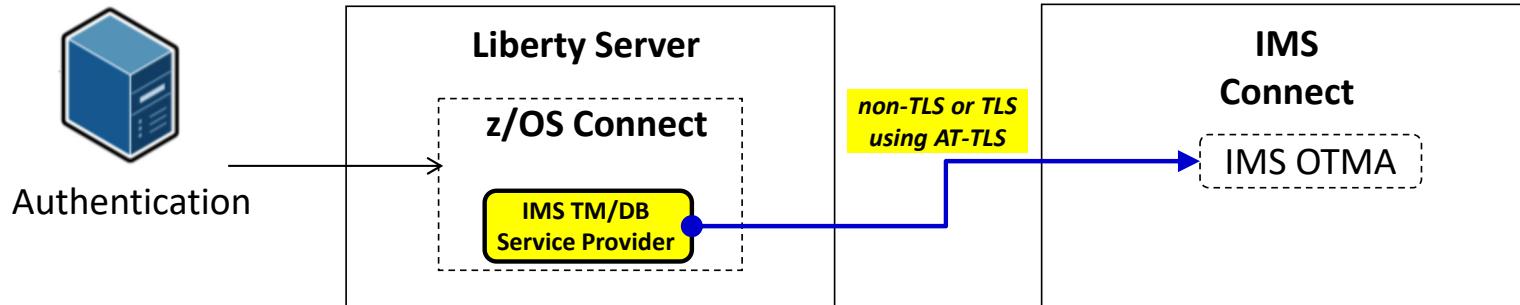
```
PERMIT IRRPTAUTH.IMSTMPL ID(LIBSERV) CLASS(PTKTDATA) ACCESS(UPDATE)
```

```
RDEFINE PTKTDATA IMSDBAPL SSIGNON(0123456789ABCDEF) APPLDATA('NO REPLAY PROTECTION') UACC(NONE)
```

```
RDEFINE PTKTDATA IRRPTAUTH.IMSDBAPL.* UACC(NONE)
```

```
PERMIT IRRPTAUTH.IMSDBAPL ID(LIBSERV) CLASS(PTKTDATA) ACCESS(UPDATE)
```

Flowing an identity to IMS Connect (TM)



```
HWS=(ID=IMS15HWS,XIBAREA=100,RACF=Y,RRS=Y)  
TCPIP=(HOSTNAME=TCPIP,PORTID=(4000,LOCAL),RACFID=JOHNSON,TIMEOUT=5000)  
DATASTORE=(GROUP=OTMAGRP,ID=IVP1, MEMBER=HWSMEM, DRU=HWSYDRU0,  
TMEMBER=OTMAMEM,APPL=IMSTMAPL)
```

- Authentication options:**
1. User ID / password
 2. PassTicket support

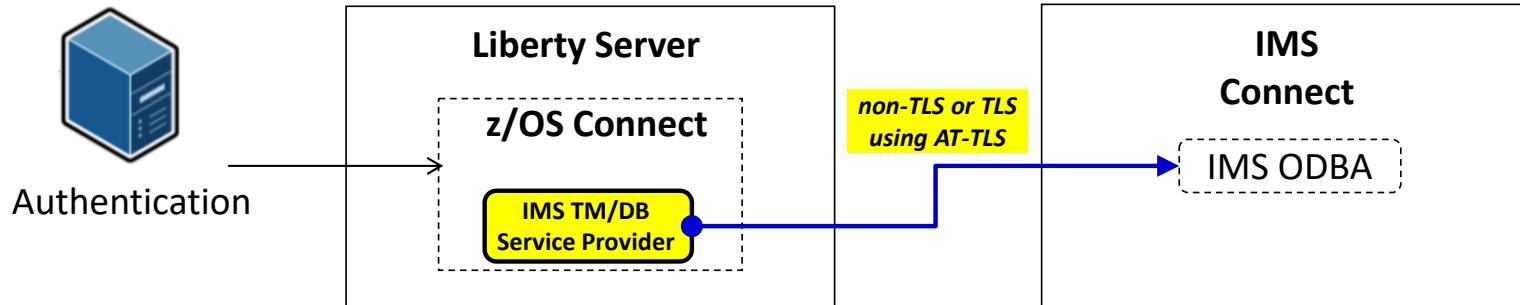
```
<connectionFactory containerAuthDataRef="Connection1_Auth" id="IVP1">  
<properties.gmoa hostName="wg31.washington.ibm.com" portNumber="4000"/>  
</connectionFactory>  
<authData id="Connection1_Auth" user="USER1" password="{xor}GhIPExAGDwg="/>
```

Specify a user identity and password to be used in the request to IMS Connect

```
<connectionFactory containerAuthDataRef="Connection1_Auth" id="IVP1">  
<properties.gmoa hostName="wg31.washington.ibm.com" portNumber="4000"  
applicationName="IMSTMAPL"/>  
</connectionFactory>
```

Request a PassTicket
And use it in the request to IMS Connect

Flowing an identity to IMS Connect (DB)



```
HWS=(ID=IMS15HWS,XIBAREA=100,RACF=Y,RRS=Y)
TCPIP=(HOSTNAME=TCPIP,PORTID=(4000,LOCAL),RACFID=JOHNSON,TIMEOUT=5000)
ODACCESS=(ODBMAUTOCONN=Y,IMSPLEX=(MEMBER=IMS15HWS,TMEMBER=PLEX1),
DRDAPORT=(ID=5555,PORTTMOT=6000),ODBMTMOT=6000,APPL=IMSDBAPL)
```

- Authentication options:**
1. User ID / password
 2. PassTicket support

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

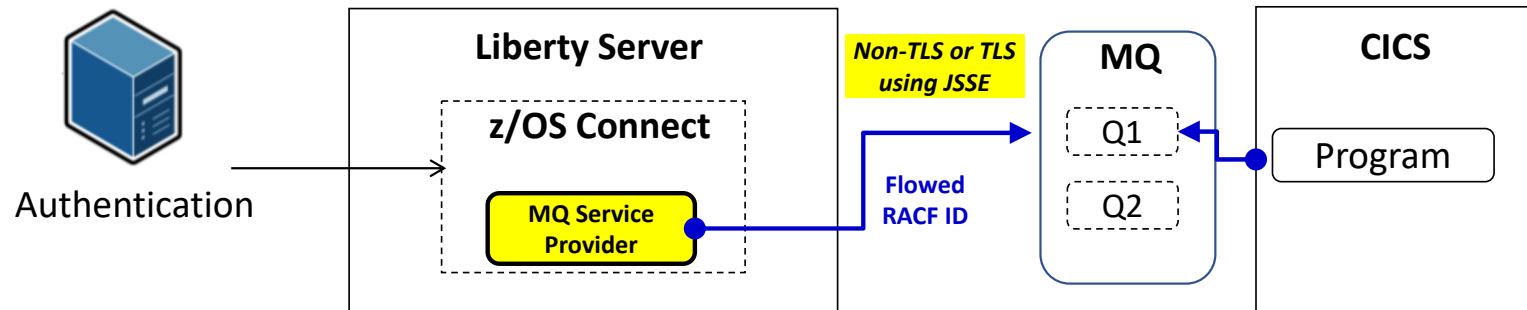
Specify a user identity and password to be used in the request to IMS Connect

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

Request a PassTicket
And use it in the request to IMS Connect



Flowing a user ID with MQ service provider



Set `useCallerPrincipal=true` to flow the authenticated RACF user ID

```
<zosconnect_services>
  <service name="mqPut">
    <property name="destination" value="jms/default"/>
    <property name="useCallerPrincipal" value="true"/>
  </service>
</zosconnect_services>
```

Define identity propagation to MQ

PassTickets and Db2

- ❑ Basic authentication Db2 using a PassTicket depends on the Db2 configuration.

```
DSNL080I -DSN2 DSNLDDF DISPLAY DDF REPORT FOLLOWS:  
DSNL081I STATUS=STARTD  
DSNL082I LOCATION          LUNAME          GENERICCLU  
DSNL083I DSN2LOC           USIBMWZ.DSN2APPL  USIBMWZ.DSN0APPL  
DSNL084I TCPPORT=2446    SECPORT=2445   RESPORT=2447  IPNAME==NONE  
DSNL085I IPADDR=:192.168.17.201  
DSNL086I SQL    DOMAIN=WG31.WASHINGTON.IBM.COM  
DSNL105I CURRENT DDF OPTIONS ARE:  
DSNL106I PKGREL = COMMIT  
DSNL106I SESSIDLE = 001440  
DSNL099I DSNLDDF DISPLAY DDF REPORT COMPLETE
```

```
DSNL080I -DSNC DSNLDDF DISPLAY DDF REPORT FOLLOWS:  
DSNL081I STATUS=STARTD  
DSNL082I LOCATION          LUNAME          GENERICCLU  
DSNL083I DSN2LOC           -NONE          -NONE  
DSNL084I TCPPORT=2446    SECPORT=2445   RESPORT=2447  IPNAME=DB2IPNM  
DSNL085I IPADDR=:192.168.17.252  
DSNL086I SQL    DOMAIN=WG31.WASHINGTON.IBM.COM  
DSNL086I RESYNC DOMAIN=WG31.WASHINGTON.IBM.COM  
DSNL089I MEMBER IPADDR=:192.168.17.252  
DSNL105I CURRENT DDF OPTIONS ARE:  
DSNL106I PKGREL = COMMIT  
DSNL106I SESSIDLE = 001440  
DSNL099I DSNLDDF DISPLAY DDF REPORT COMPLETE
```

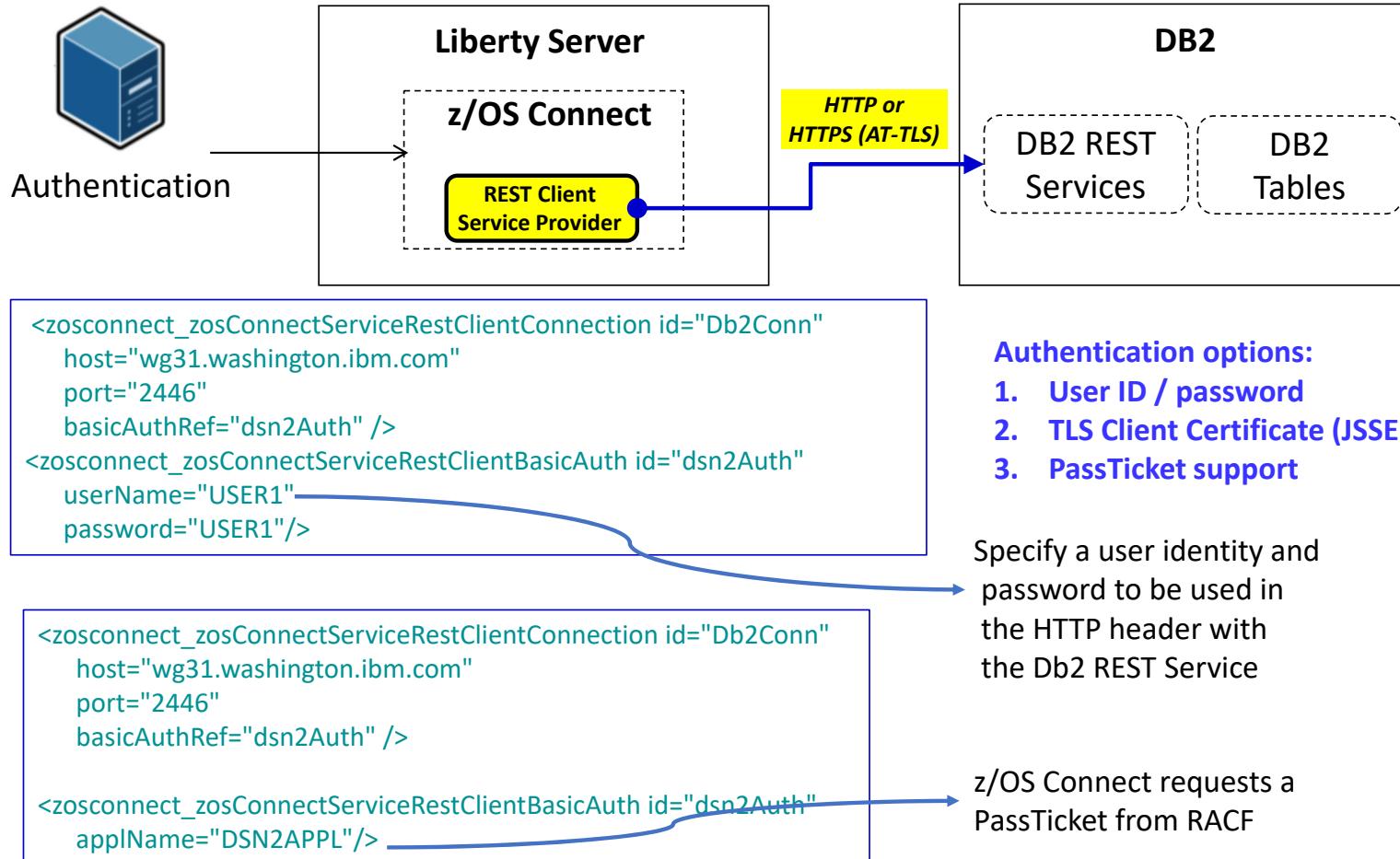
Which value should be used for *appName* is determined for use in RACF resources is determined as shown below.

- ❑ If *GENERICLU* is defined, use the second part of *GENERICLU* for *appName*, e.g., ***DSN0APPL***
- ❑ If *GENERICLU* is not defined, use the second part of *LUNAME* for *appName*, e.g., ***DSN2APPL***
- ❑ If neither *GENERICLU* or *LUNAME* is defined, use the value of the *IPNAME* for *appName*, e.g., ***DB2IPNM***

```
RDEFINE PTKTDATA DSN2APPL SSIGNON(0123456789ABCDEF)  APPLDATA('NO REPLAY PROTECTION') UACC(NONE)  
RDEFINE PTKTDATA IRRPTAAUTH.DSN2APPL.* UACC(NONE)  
PERMIT IRRPTAAUTH.DSN2APPL ID(LIBSERV) CLASS(PTKTDATA) ACCESS(UPDATE)
```



Flowing the identity for the REST client SP (Db2)



Tech/Tip: Db2 REST Security

- ❑ Access to Db2 REST services requires READ access to the Db2 subsystem DSNR REST resource. i.e., permit READ access to this resource to the identity in question, for example

```
PERMIT DSN2.REST CLASS(DSNR) ID(USER2) ACC(READ) where DSN2 is the Db2 subsystem ID  
SETROPTS RACLIST(DSNR) REFRESH
```

- ❑ Db2 package access is also required. If a user is not able to display a valid Db2 REST services in the z/OS Connect Db2 services development tooling or by using a **POST** to the Db2 provided REST interface URL of <http://wg31.washington.ibm.com:2446/services/DB2ServiceDiscover>, then they may not have sufficient access to the package containing the service.

For example, if service *zCEEService.selectEmployee* is defined to Db2 but not visible in the z/OS Connect tooling or if a **GET** request to URL <http://wg31.washington.ibm.com:2446/services/zCEEService/selectEmployee> fails with message:

```
{  
  "StatusCode": 500,  
  "StatusDescription": "Service zCEEService.selectEmployee discovery failed due to  
  SQLCODE=-551 SQLSTATE=42501, USER2 DOES NOT HAVE THE PRIVILEGE TO PERFORM OPERATION EXECUTE  
  PACKAGE ON OBJECT zCEEService.selectEmployee. Error Location:DSNLJACC:35"  
}
```

The user needs to be granted execute authority on package *zCEEService.selectEmployee* with command:

```
GRANT EXECUTE ON PACKAGE "zCEEService"."selectEmployee" TO USER2  or  
GRANT EXECUTE ON PACKAGE "zCEEService".*" TO USER2
```



WOLA Security

❑ MVS Batch

```
<zosLocalAdapters wolaGroup="ZCEESRVR"
    wolaName2="ZCEESRVR"
    wolaName3="ZCEESRVR"/>
```

```
RDEFINE CBIND BBG.WOLA.ZCEESRVR.ZCEESRVR.ZCEESRVR UACC(NONE) OWNER(SYS1)
PERMIT BBG.WOLA.ZCEESRVR.ZCEESRVR.ZCEESRVR CLASS(CBIND) ACCESS(READ) ID(USER1,START1)
SETROPTS RACLIST(CBIND) REFRESH
```

❑ Data Virtualization Manager

```
"DEFINE ZCPATH",
  "  NAME(ZCEE)           ", 
  "  RNAME(ZCEEDVM)      ", 
  "  WNAME(ZCEEDVM)      ", 
  ""
```

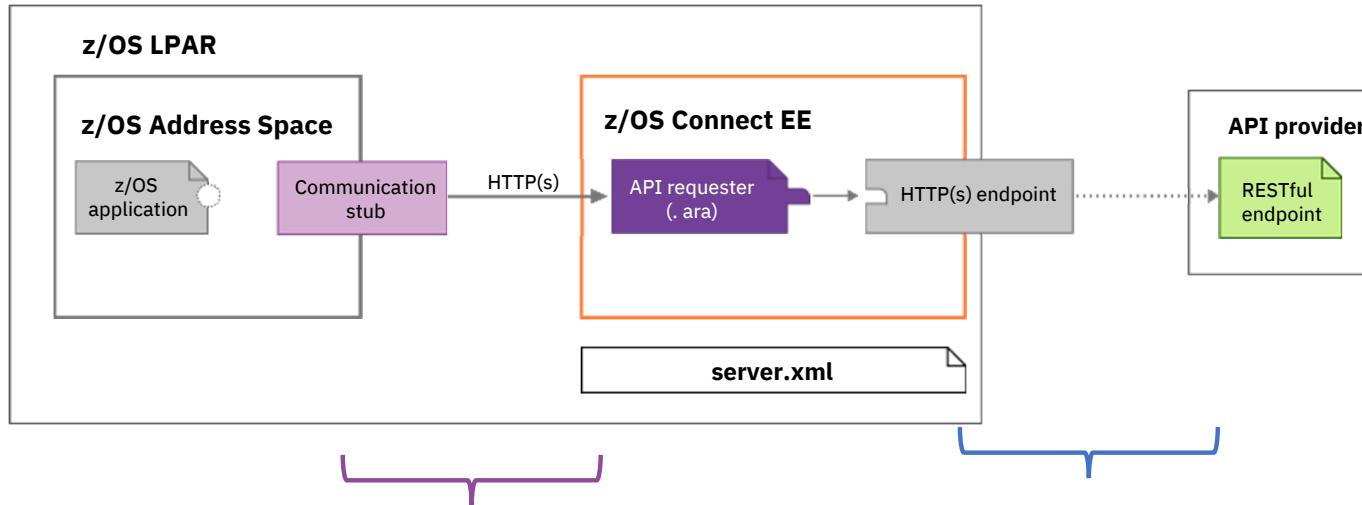
```
<!-- Adapter Details with WOLA Group Name (ZCEEDVM) -->
<zosLocalAdapters wolaName3="NAME3"
    wolaName2="NAME2"
    wolaGroup="ZCEEDVM"/>
```

```
RDEFINE CBIND BBG.WOLA.ZCEEDVM.** UACC(NONE)
PERMIT BBG.WOLA.ZCEEDVM.** CLASS(CBIND) ID(LIBSERV) ACC(READ)
SETROPTS RACLIST(CBIND) REFRESH
```

z/OS Connect API Requester Security

Details

Authentication

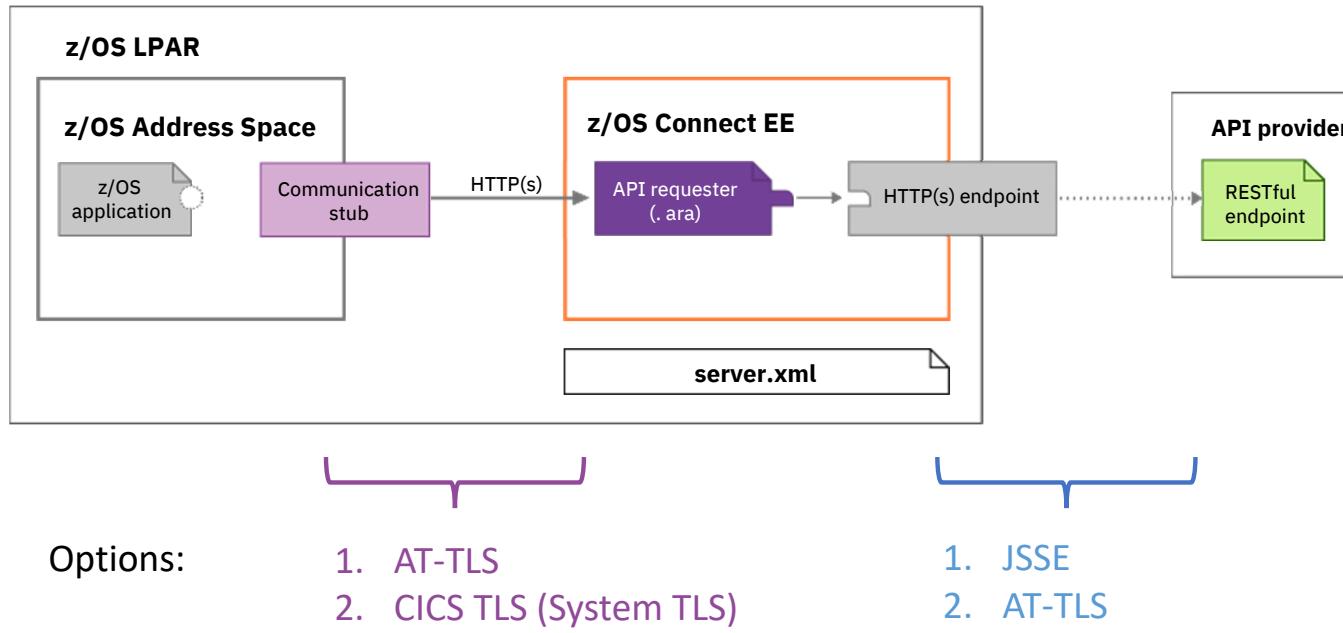


Options:

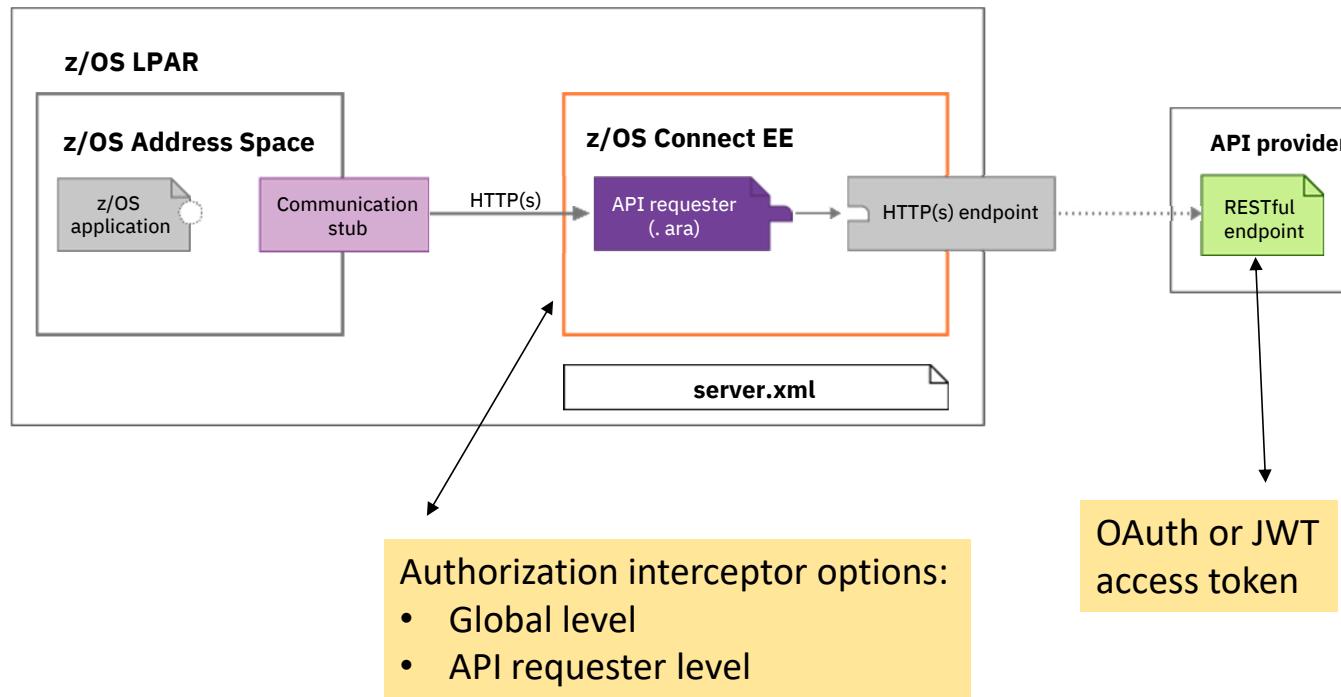
- 1. Basic Authentication
- 2. TLS Client/Server
- 1. Basic Authentication
- 2. TLS Client/Server
- 3. Third Party token



Encryption



Authorization

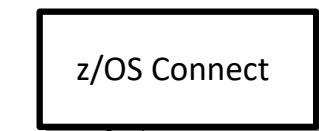




Application to z/OS Connect API Requester

Two options for providing credentials for authentication

Basic Authentication



ID/PW
Okay!

API Provider Client

**Application provides
ID/PW or ID/PassTicket**

Client Certificate



TLS Client Cert
Okay!

TLS Client Cert
Okay!

AT/TLS

CICS API Provider Client

Batch API Provider Client

**z/OS Connect requests a
client certificate**

**CICS or AT/TLS supplies a
client certificate**

API Requester - API Provider Authentication



Several different ways this can be accomplished:

Basic Authentication



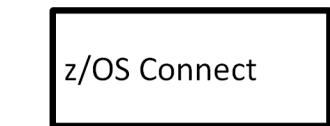
ID/PW



Okay!



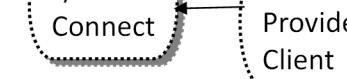
Client Certificate



TLS
Client
Cert



Okay!

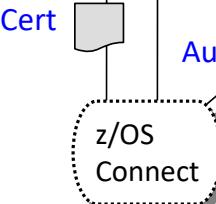


Third Party Authentication



Identity Mapping
Green circle = 'FRED'

Token (JWT)



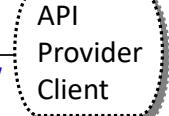
Cert

ID/PW

Auth

3rd Party

Okay



**zCEE server supplies
ID/PW or ID/PassTicket**

**Server requests a
client certificate**

**zCEE supplies a client
certificate**

**zCEE Server authenticates to 3rd party
server**

**zCEE Server receives a trusted 3rd party
token**

Token flows to API Provider

Configuring Basic and/or TSL support – z/OS Connect API Requester



Basic with HTTP protocol

```
<zosconnect_endpointConnection id="cscvincAPI"  
    host="http://wg31.washington.ibm.com" port="9080"  
    authenticationConfigRef="myAuthData" />  
  
<zosconnect_authData id="myAuthData"  
    user="zCEEClient" password="secret"/>
```

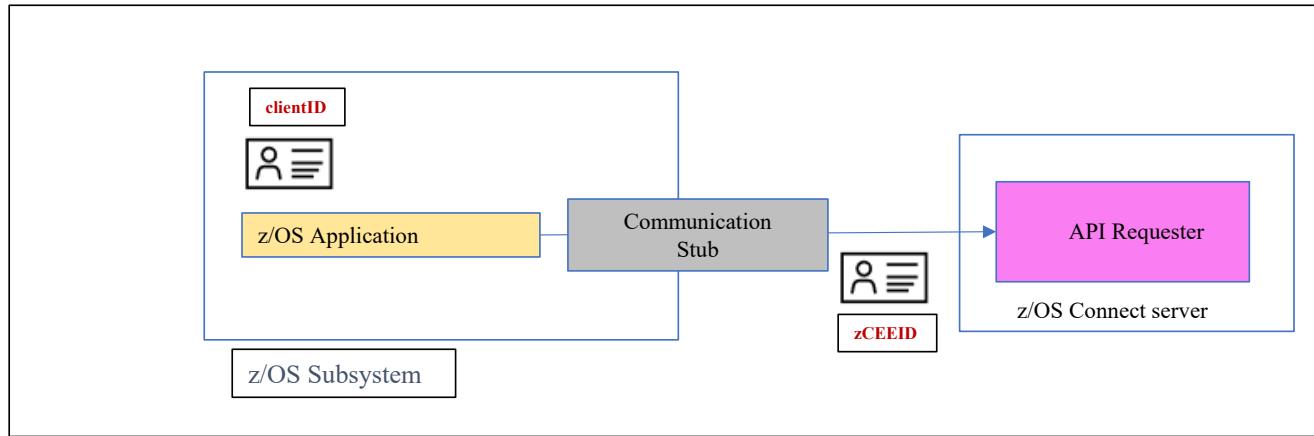
TLS with HTTPS protocol

```
<zosconnect_endpointConnection id="cscvincAPI"  
    host="https://wg31.washington.ibm.com" port="9443"  
    authenticationConfigRef="myAuthData" 1  
    sslCertsRef="OutboundSSLSettings" />  
  
<zosconnect_authData id="myAuthData" 1  
    user="zCEEClient" password="secret"/>
```

¹ Optional, if mutual authentication is enabled by the server endpoint



API Requester - basic authentication and identity assertion



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

requireAuth	idAssertion	Actions performed by z/OS Connect
true	OFF	Identity assertion is disabled. The zCEE server authenticates <i>zCEEID</i> and checks whether <i>zCEEID</i> has the authority to invoke an API requester.
	ASSERT_SURROGATE	Identity assertion is enabled. The zCEE server authenticates <i>zCEEID</i> and checks whether <i>zCEEID</i> is a surrogate of <i>clientID</i> . If <i>zCEEID</i> is a surrogate of <i>clientID</i> , the server further checks whether <i>clientID</i> has the authority to invoke an API requester; otherwise, a BAQR7114E message occurs.
	ASSERT_ONLY	Identity assertion is enabled. The zCEE server authenticates <i>zCEEID</i> and directly checks whether <i>clientID</i> has the authority to invoke an API requester
false	OFF	Identity assertion is disabled. A BAQR0407W message occurs.
	ASSERT_SURROGATE	Identity assertion is enabled. The zCEE server checks whether <i>clientID</i> has the authority to invoke an API requester, and a warning message occurs to indicate that the ASSERT_ONLY value is used instead of the ASSERT_SURROGATE value.
	ASSERT_ONLY	Identity assertion is enabled. The zCEE server checks whether <i>clientID</i> has the authority to invoke an API requester

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



Identity assertion requires setting a program control extended attribute

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*

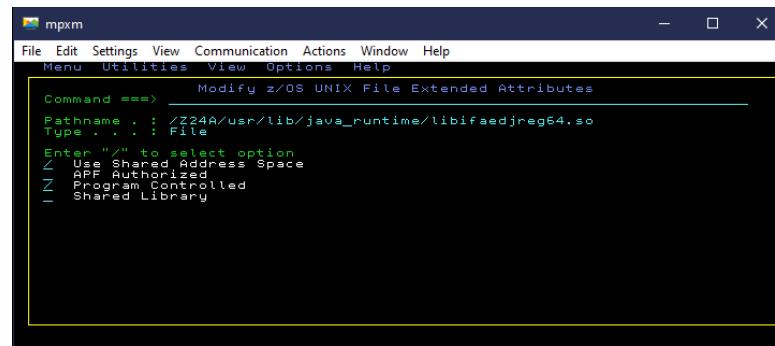
RDEFINE SURROGAT **clientID.BAQASSRT UACC(NONE) OWNER(SYS1)**
PERMIT clientID.BAQASSRT CLASS(SURROGAT) ACCESS(READ) ID(*zCEEID*)

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, titled 'WG31 - 3270', shows the 'UNIX System Services' menu with the 'Setup' option circled in red. A sub-menu is open, listing options 1 through 8, with options 5, 6, and 7 circled in red. A message box in the center states: 'Some choices (*) require superuser or the "special" attribute for full function, or both'. The right window, titled 'mpxm', shows a command-line interface with several environment variables and a copyright notice from IBM. The bottom of each window shows a command prompt and connection information.

```
WG31 - 3270
File Edit Settings View Communication Actions Window Help
File Directory Special_file Tools File_systems Options Setup Help
UNIX System Services
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
EUID=200000

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

mpxm
File Edit Settings View Communication Actions Window Help
IBM
Licensed Material - Property of IBM
5650-ZDS 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.
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: >
====>
ESC=< 1=Help 2=SubCmd 3=HlpRtrn 4=Top 5=Bottom 6=TSO
7=BackScr 8=Scroll 9=NextSess 10=Refresh 11=FwdRtrn 12=Retrieve
M A G 40/007
Connected to remote server/host mpxm using lu/pool TCP00027 Adobe PDF on Documents\*.pdf
```

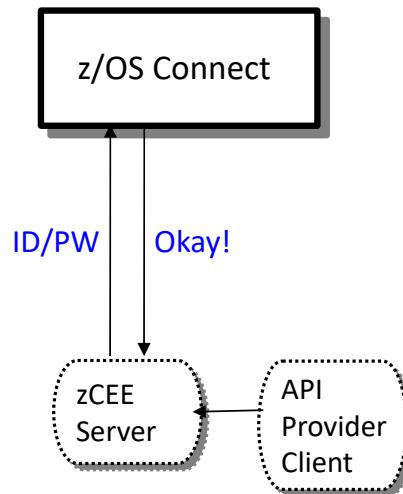
Tech-Tip: Super user is required to set the program control extended attribute (`extattr +p`) bit for the Java shared object ***ifaedjreg64.so***. This extended attribute must be set for identity assertion in certain situations.

API Requester- API Provider Authentication



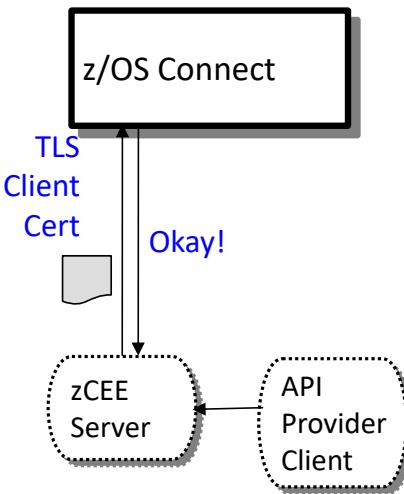
Several different ways this can be accomplished:

Basic Authentication



zCEE server supplies ID/PW or ID/PassTicket

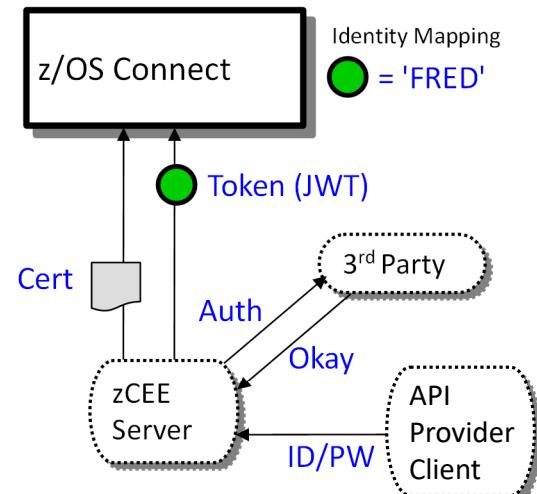
Client Certificate



Server requests a client certificate

zCEE supplies a client certificate

Third Party Authentication



zCEE Server authenticates to 3rd party server

zCEE Server receives a trusted 3rd party token

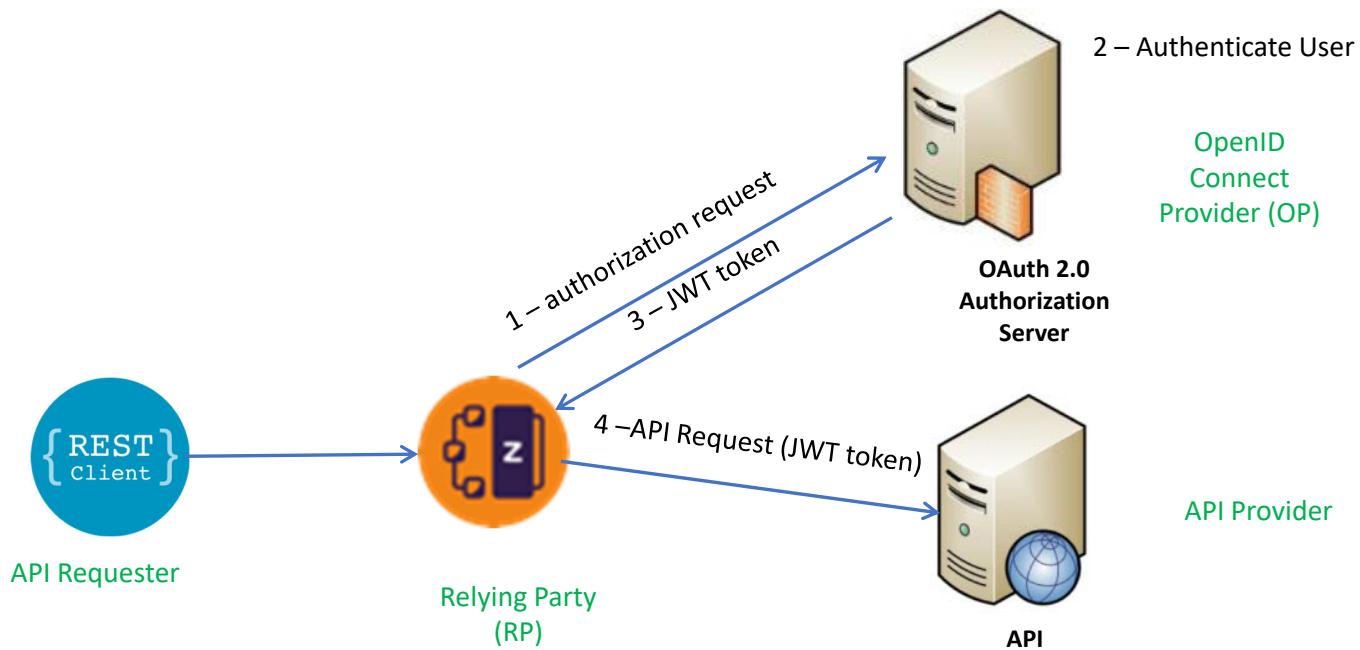
Token flows to API Provider

z/OS Connect API Requester - Token Support

z/OS Connect EE provides *three* ways of calling an API secured with a token

1. Use the OAuth 2.0 support when the request is part of an OAuth 2.0 flow. With OAUTH configured, the token can be an opaque token or a JWT token.
2. In a non-OAuth 2.0 scenario, a JWT token is used in a custom flow, for example: when you need to specify the HTTP verb that is used in the request to the authentication server.
 - When you need to specify the HTTP verb that is used in the request to the authentication server
 - When you need to specify how the JWT is returned from the authentication server (for example, in an HTTP header or in a custom field in a JSON response message).
 - When you need to use a custom header name for sending the JWT to the request endpoint.
3. Use the locally generated JWT support when you need to send a JWT that is generated by the z/OS Connect EE server.

z/OS Connect OAuth Flow for API requester

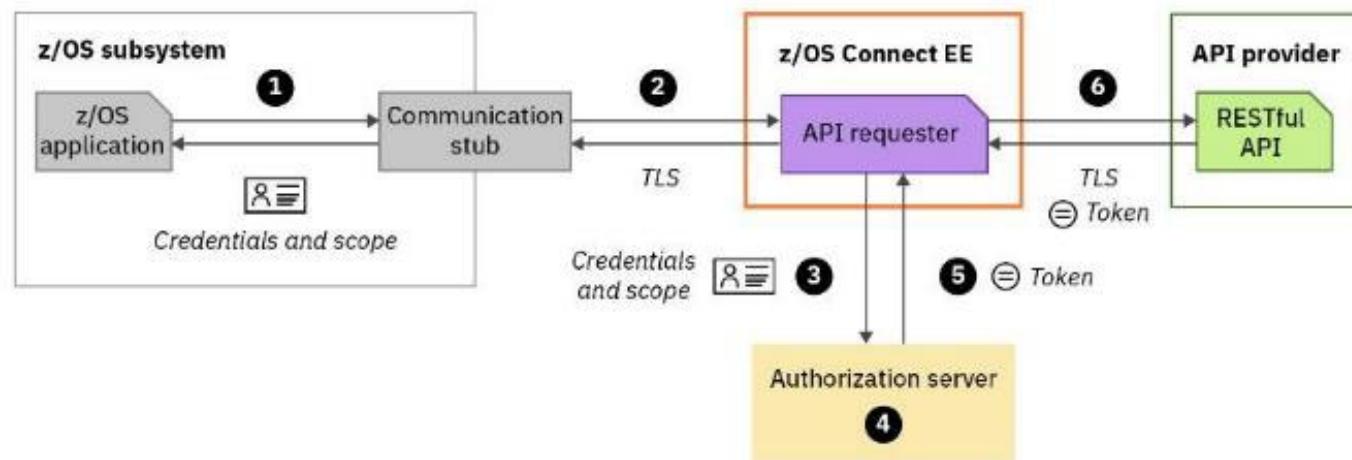


Grant Types:

- client_credentials
- password



Calling an API with OAuth 2.0 support



z/OS Connect OpenID Connect terms

Resource owner - An entity capable of granting access to a protected resource. When the resource owner is a person, it is referred to as an end user. *In a z/OS Connect EE API requester scenario, the resource owner might be the user of the CICS, IMS, or z/OS application.*

Resource server - The server that hosts the protected resources and accepts and responds to protected resource requests by using access tokens. *In a z/OS Connect EE API requester scenario, the resource server is the request endpoint for the remote RESTful API.*

Client - An application that makes protected resource requests on behalf of the resource owner and with its authorization. *In a z/OS Connect EE API requester scenario, the client is a combination of the CICS, IMS, or z/OS application and the z/OS Connect EE server that calls the RESTful API on behalf of the CICS, IMS, or z/OS application.*

Authorization server - The server that issues access tokens to the client after authenticating the resource owner and obtaining authorization. *In a z/OS Connect EE API requester scenario, the authorization server is called by the z/OS Connect EE server to retrieve an access token.*



OAuth Grant Types Supported by z/OS Connect

client_credentials - the identity associated with the combination of the CICS, IMS, or z/OS application, and the z/OS Connect EE server that calls the RESTful API on behalf of the CICS, IMS, or z/OS application When this grant type is used, the z/OS Connect EE server sends the client credentials and the access scope to the authorization server.

```
<zosconnect_oAuthConfig id="myoAuthConfig"  
    grantType="client_credentials"  
    authServerRef="myoAuthServer"/>
```

password - The identity of the user of the CICS, IMS, or z/OS application, or it might be another entity. When this grant type is used, the z/OS Connect EE server sends the resource owner's credentials, the client credentials, and the access scope to the authorization server.

```
<zosconnect_oAuthConfig id="myoAuthConfig"  
    grantType="password"  
    authServerRef="myoAuthServer"/>
```

Configuring OAuth support – BAQRINFO copy book



```
05 BAQ-OAUTH.  
07 BAQ-OAUTH-USERNAME          PIC X(256) .  
07 BAQ-OAUTH-USERNAME-LEN      PIC S9(9) COMP-5 SYNC VALUE 0.  
07 BAQ-OAUTH-PASSWORD          PIC X(256) .  
07 BAQ-OAUTH-PASSWORD-LEN      PIC S9(9) COMP-5 SYNC VALUE 0.  
07 BAQ-OAUTH-CLIENTID          PIC X(256) .  
07 BAQ-OAUTH-CLIENTID-LEN      PIC S9(9) COMP-5 SYNC VALUE 0.  
07 BAQ-OAUTH-CLIENT-SECRET     PIC X(256) .  
07 BAQ-OAUTH-CLIENT-SECRET-LEN PIC S9(9) COMP-5 SYNC VALUE 0.  
07 BAQ-OAUTH-SCOPE-PTR        USAGE POINTER.  
07 BAQ-OAUTH-SCOPE-LEN        PIC S9(9) COMP-5 SYNC.
```

Grant Type: *client_credentials* - the identity associated with the combination of the CICS, IMS, or z/OS application, and the z/OS Connect EE server that calls the RESTful API on behalf of the CICS, IMS, or z/OS application

Grant Type: *password* - The identity of the user provided by the CICS, IMS, or z/OS application, or it might be another entity. Client_credentials can be supplied by the program or in the server XML configuration.

Scope is always required.

OAuth 2.0 specification entity	password	client_credentials	Where Set
Client ID	required	Required	server.xml or by application
Client Secret	optional	Required	server.xml or by application
Username	required	N/A	by application
Password	required	N/A	by application



Sample program and JCL

COBOL Application

```
MOVE "ATSOAUTHUSERNAME" to envVariableName.  
PERFORM CALL-CEEENV THRU CALL-CEEENV-END  
MOVE VAR(1:valueLength) to BAQ-OAUTH-USERNAME  
MOVE valueLength TO BAQ-OAUTH-USERNAME-LEN  
MOVE "ATSOATHPASSWORD" to envVariableName.  
PERFORM CALL-CEEENV THRU CALL-CEEENV-END  
MOVE VAR(1:valueLength) to BAQ-OAUTH-PASSWORD  
MOVE valueLength TO BAQ-OAUTH-PASSWORD-LEN  
MOVE " " to BAQ-OAUTH-CLIENTID.  
MOVE 0 to BAQ-OAUTH-CLIENTID-LEN.  
MOVE " " to BAQ-OAUTH-CLIENT-SECRET.  
MOVE 0 to BAQ-OAUTH-CLIENT-SECRET-LEN.  
MOVE "openid" to BAQ-OAUTH-SCOPE.  
MOVE 6 to BAQ-OAUTH-SCOPE-LEN.  
SET BAQ-OAUTH-SCOPE-PTR TO ADDRESS OF BAQ-OAUTH-SCOPE.
```

Note that this example is using environment variables to provide OAuth credentials, as documented in the z/OS Connect Advanced Topics Guide.

Execution JCL

```
//GETAPI EXEC PGM=GETAPIPT,PARM='111111'  
//STEPLIB DD DISP=SHR,DSN=USER1.ZCEE30.LOADLIB  
//          DD DISP=SHR,DSN=ZCEE30.SBAQLIB  
//          DD DISP=SHR,DSN=JOHNSON.ZCEE.SDFHLOAD  
//SYSOUT DD SYOUT=*  
//SYSPRINT DD SYOUT=*  
//CEEOPTS DD *  
POSIX(ON),  
ENVAR ("BAQURI=wg31.washington.ibm.com",  
"BAQPORT=9080",  
"BAQUSERNAME=USER1",  
"ATSAPPL=BBGZDFLT",  
"ATSOAUTHUSERNAME=distuser1",  
"ATSOATHPASSWORD=pwd")
```

Configuring OAuth support – z/OS Connect API Requester



```
<zosconnect_endpointConnection id="cscvincAPI"
    host="http://wg31.washington.ibm.com" port="9080"
    authenticationConfigRef="myoAuthConfig"/>

<zosconnect_oAuthConfig id="myoAuthConfig"
    grantType="client_credentials|password"
    authServerRef="myoAuthServer"/>

<zosconnect_authorizationServer id="myoAuthServer"
    tokenEndpoint="https://wg31.washington.ibm.com:59443/oidc/endpoint/OP/token1
    basicAuthRef="tokenCredential" 2
    sslCertsRef="OutboundSSLSettings" />

<zosconnect_authData id="tokenCredential" 2
    user="zCEEClient" password="secret"/>

openidConnectProvider id="OP"
    signatureAlgorithm="RS256"
    keyStoreRef="jwtStore"
    oauthProviderRef="OIDCssl" >
</openidConnectProvider>
```

¹See URL https://www.ibm.com/support/knowledgecenter/SS7K4U_liberty/com.ibm.websphere.wlp.zseries.doc/ae/twlp_oidc_token_endpoint.html

² These credentials can be specified by the application



Security Scenarios

```
BAQ-OAUTH-USERNAME: distuser1  
BAQ-OAUTH-PASSWORD: pwd  
EmployeeNumber: 111111  
EmployeeName: C. BAKER  
USERID: USER1
```

distuser1 is mapped to RACF identity USER1 who has full access

```
BAQ-OAUTH-USERNAME: distuserx  
BAQ-OAUTH-PASSWORD: pwd  
Error code: 00000500  
Error msg:{ "errorMessage": "BAQR1092E: Authentication or authorization failed for the z/OS Connect EE server." }
```

distuserx is unknown by the OAuth Provider

```
BAQ-OAUTH-USERNAME: auser  
BAQ-OAUTH-PASSWORD: pwd  
Error code: 0000000403  
rror msg:{ "errorMessage": "BAQR1144E: Authentication or authorization failed for the z/OS Connect EE server." }  
Syslog:  
ICH408I USER(ATSSERV ) GROUP(ATSGRP ) NAME(LIBERTY SERVER  
DISTRIBUTED IDENTITY IS NOT DEFINED:  
auser zCEERealm
```

auser is not mapped to a valid RACF identity

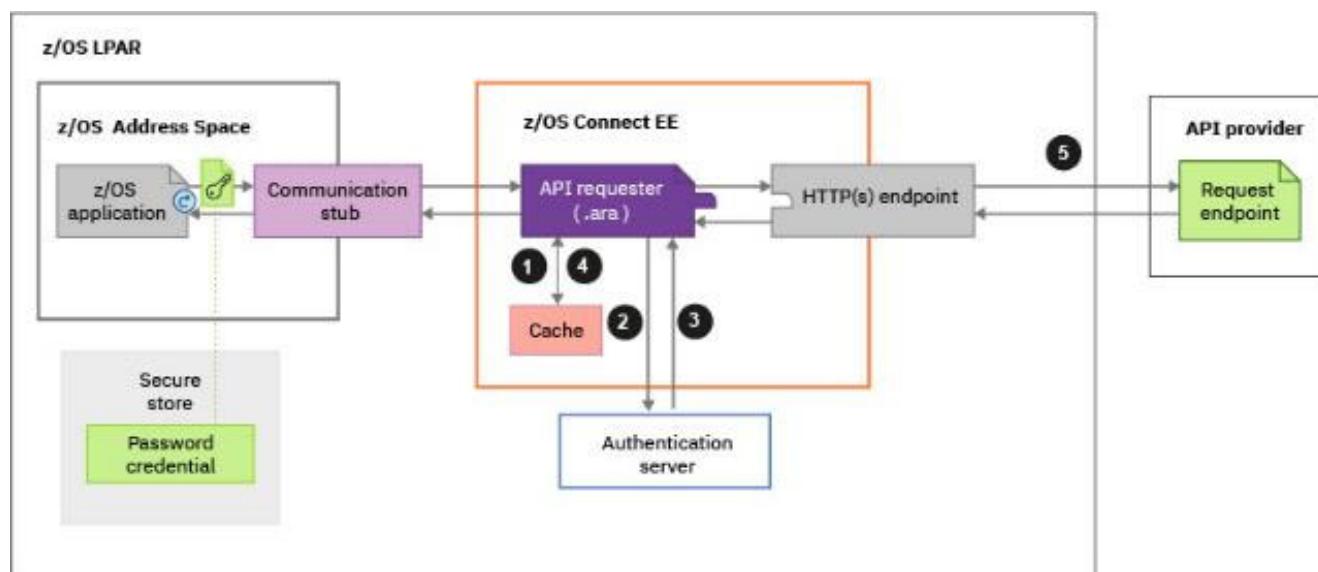
```
BAQ-OAUTH-USERNAME: distuser2  
BAQ-OAUTH-PASSWORD: pwd  
Error code: 0000000403  
Error msg:{ "errorMessage": "BAQR1144E: Authentication or authorization failed for the z/OS Connect EE server." }  
Syslog:  
ICH408I USER(USER2 ) GROUP(SYS1 ) NAME(WORKSHOP USER2  
ATSZDFLT.zos.connect.access.roles.zosConnectAccess  
CL(EJBROLE )  
INSUFFICIENT ACCESS AUTHORITY  
ACCESS INTENT(READ ) ACCESS ALLOWED(NONE )
```

distuser2 is mapped to RACF identity USER2 which has no access to the EJBRole protecting z/OS Connect

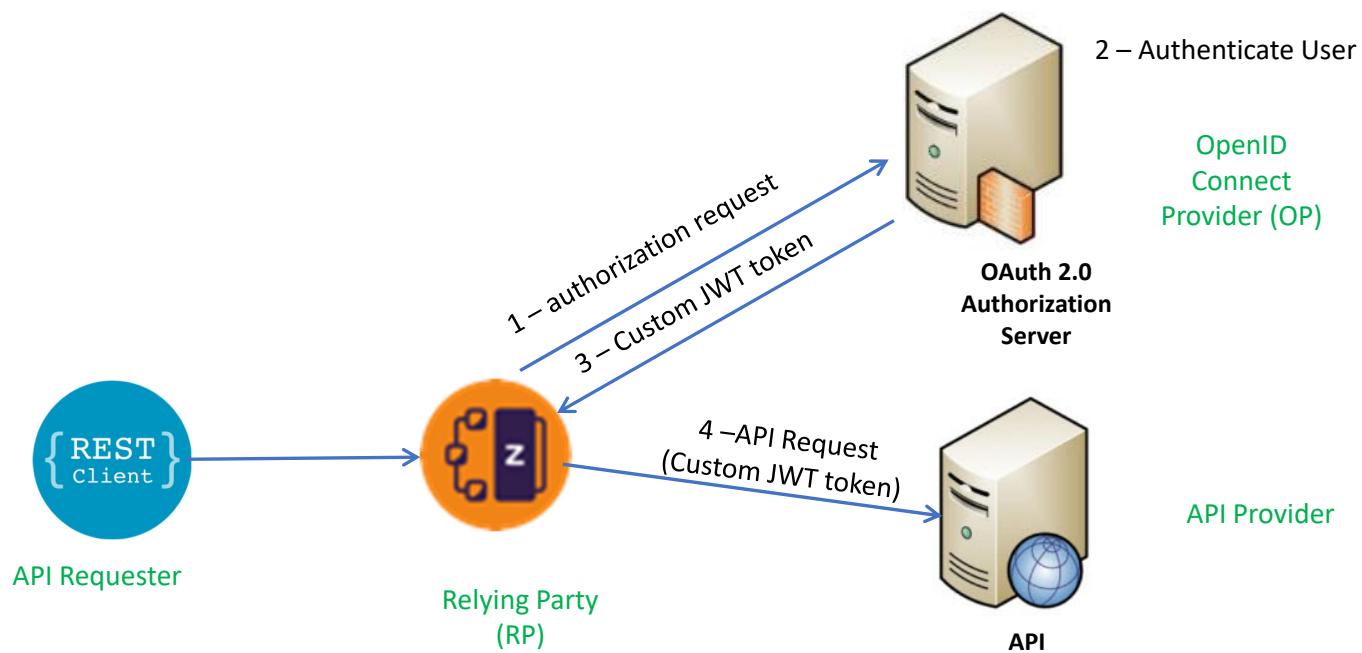


Calling an API with using a JWT custom flow

- ❑ In a non-OAuth 2.0 scenario, a JWT token is used in a custom flow, for example:
 - When you need to specify the HTTP verb that is used in the request to the authentication server.
 - When you need to specify how the JWT is returned from the authentication server (for example, in an HTTP header or in a custom field in a JSON response message).
 - When you need to use a custom header name for sending the JWT to the request endpoint.



z/OS Connect OAuth Customer Flow





API Requester – JWT Custom flow

BAQRINFO copy book

```
05 BAQ-AUTHTOKEN.  
  07 BAQ-TOKEN-USERNAME          PIC X(256).  
  07 BAQ-TOKEN-USERNAME-LEN      PIC S9(9) COMP-5 SYNC VALUE 0.  
  07 BAQ-TOKEN-PASSWORD          PIC X(256).  
  07 BAQ-TOKEN-PASSWORD-LEN      PIC S9(9) COMP-5 SYNC VALUE 0.
```

COBOL application

```
MOVE "ATSTOKENUSERNAME" to envVariableName.  
PERFORM CALL-CEEENV THRU CALL-CEEENV-END  
MOVE VAR(1:valueLength) to BAQ-TOKEN-USERNAME  
MOVE valueLength TO BAQ-TOKEN-USERNAME-LEN  
MOVE "ATSTOKENPASSWORD" to envVariableName.  
PERFORM CALL-CEEENV THRU CALL-CEEENV-END  
MOVE VAR(1:valueLength) to BAQ-TOKEN-PASSWORD  
MOVE valueLength to BAQ-TOKEN-PASSWORD-LEN
```

Note that this example is using environment variables to provide token credentials, as documented in the z/OS Connect Advanced Topics Guide.



Configuring JWT Custom flow

```
<zosconnect_endpointConnection id="cscvincAPI"
    host="http://wg31.washington.ibm.com" port="9080"
    authenticationConfigRef="myJWTConfig"/>

<zosconnect_authToken id="myJWTConfig" authServerRef="myJWTServer"
    header="myJWT-header-name"
    <tokenRequest/>      See next slide
    <tokenReponse/>     See next slide
</zosconnect_authToken>

<zosconnect_authorizationServer id="myJWTServer"
    tokenEndpoint=https://wg31.washington.ibm.com:59443/oidc/endpoint/OP/token1
    basicAuthRef="tokenCredential" 2
    sslCertsRef="OutboundSSLSettings" />

<zosconnect_authData id="tokenCredential" 2
    user="zCEEClient" password="secret"/>
```

¹See URL https://www.ibm.com/support/knowledgecenter/SS7K4U_liberty/com.ibm.websphere.wlp.zseries.doc/ae/twlp_oidc_token_endpoint.html

² These credentials can be specified by the application



Configuring Custom JWT flow

Request Token Example 1

```
<tokenRequest  
    credentialLocation="header"  
    header="Authorization"  
    requestMethod="GET" />
```

Response Token

```
<tokenResponse  
    tokenLocation="header"  
    header="JWTAuthorization" />
```

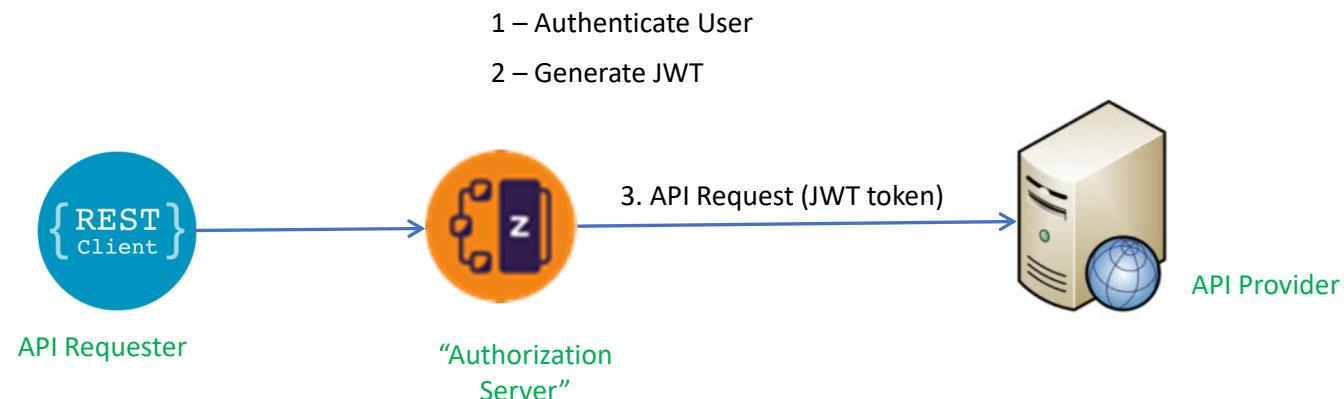
Response Token Example 2

```
<tokenRequest credentialLocation="body"  
    requestMethod="POST"  
    // Use XML escaped characters in requestBody  
    requestBody="
```

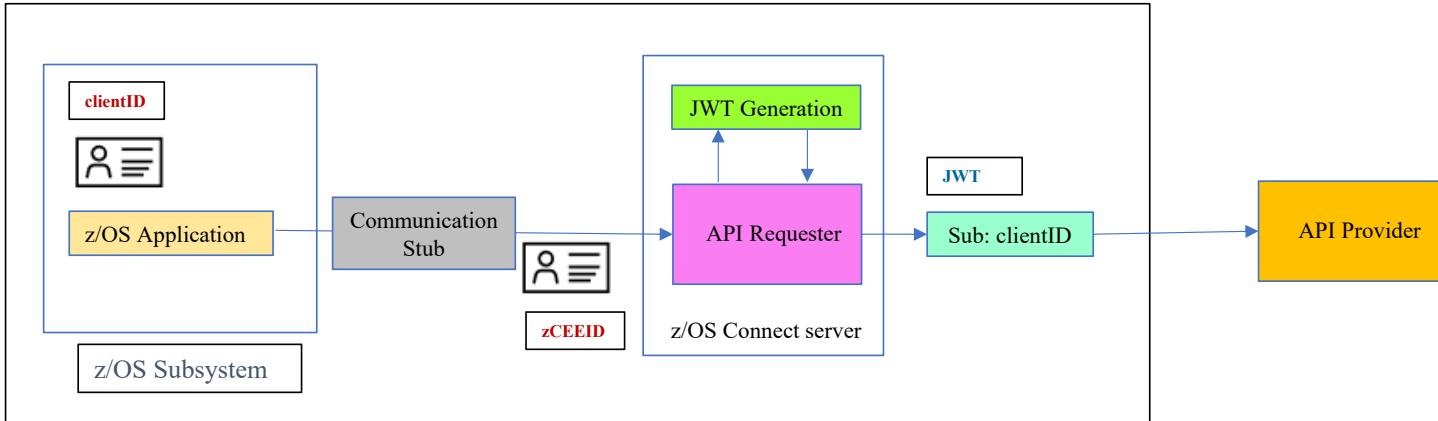
Response Token

```
<tokenResponse  
    tokenLocation="body"  
    responseFormat="JSON"  
    tokenPath="$&.tokenname" />
```

z/OS Connect JWT Generation – V3.0.43



API Requester – 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

requireAuth	idAssertion	Actions performed by z/OS Connect
true	ASSERT_SURROGATE	Identity assertion is enabled. The zCEE server authenticates <i>zCEEID</i> and checks whether <i>zCEEID</i> is a surrogate of <i>clientID</i> . If <i>zCEEID</i> is a surrogate of <i>clientID</i> , the server further checks whether <i>clientID</i> has the authority to invoke an API requester; otherwise, a BAQR7114E message occurs.
	ASSERT_ONLY	Identity assertion is enabled. The zCEE server authenticates <i>zCEEID</i> and directly checks whether <i>clientID</i> has the authority to invoke an API requester
false	ASSERT_SURROGATE	Identity assertion is enabled. The zCEE server checks whether <i>clientID</i> has the authority to invoke an API requester, and a warning message occurs to indicate that the ASSERT_ONLY value is used instead of the ASSERT_SURROGATE value.
	ASSERT_ONLY	Identity assertion is enabled. The zCEE server checks whether <i>clientID</i> has the authority to invoke an API requester



JWT generation requires setting a program control extended attribute

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*

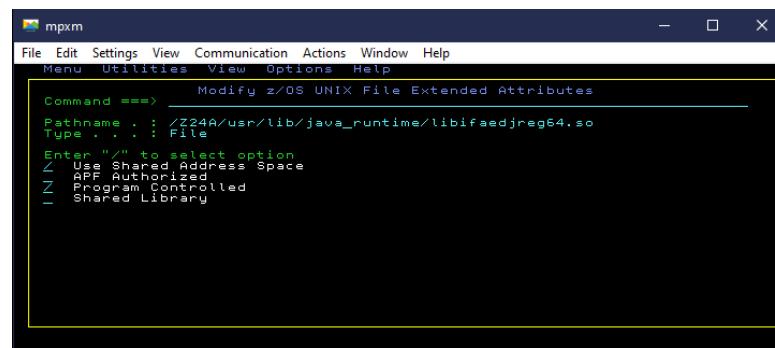
RDEFINE SURROGAT **clientID.BAQASSRT UACC(NONE) OWNER(SYS1)**
PERMIT clientID.BAQASSRT CLASS(SURROGAT) ACCESS(READ) ID(*zCEEID*)

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 shows two terminal windows side-by-side. The left window is titled 'WG31 - 3270' and displays the 'UNIX System Services' interface. The right window is titled 'mpxm' and displays the 'File' menu.

WG31 - 3270 (Left Window):

- File Edit Settings View Communication Actions Window Help
- File Directory Special_file Tools File_systems Options **Setup** Help

UNIX System Services

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
```

EUID=200000

Command ==> **M** B 03/047

Connected to remote server/host wg31a using lu/pool TCP00110 Adobe PDF on Documents*.pdf

mpxm (Right Window):

- File Edit Settings View Communication Actions Window Help
- IBM
Licensed Material - Property of IBM
5650-ZDS 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.

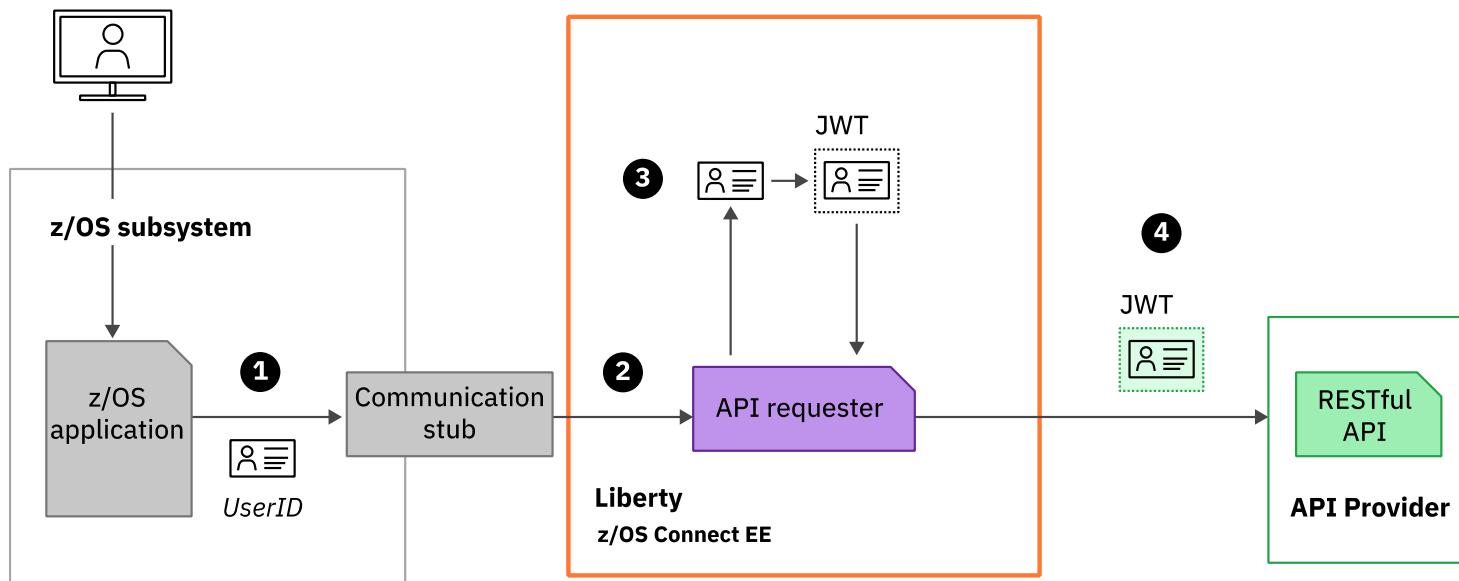
```
JOHNSON:/u/johnson: >id
uid=990016(JOHNSON) gid=0(SYS1)
JOHNSON:/u/johnson: su
JOHNSON:/u/johnson: >>id
uid=0(OMVSKERN) gid=0(SYS1)
JOHNSON:/u/johnson: >
```

==>
ESC=& 1=Help 2=SubCmd 3=HlpRtrn 4=Top 5=Bottom 6=TSO
7=BackScr 8=Scroll 9=NextSess 10=Refresh 11=FwdRtrn 12=Retrieve
RUNNING
M G 40/007

Connected to remote server/host mpxm using lu/pool TCP00027 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.

JWT Generation



- 1** Communication stub extracts the ID from the application environment
- 2** z/OS Connect generates a JWT token containing the z/OS application asserted user ID
- 3** The JWT is used to authorise the request to the API endpoint



Configuring JWT Generation support

```
<zosconnect_endpointConnection id="conn"
    host="http://api.server.com" port="8080"
    authenticationConfigRef="jwtConfig" />

<zosconnect_authTokenLocal id="jwtConfig"
    tokenGeneratorRef="jwtBuilder"
    header="Authorization" >
    <claims>{ "name":"JohnSmith",
        "ID":"1234567890" }
    </claims> One or more Public claim (e.g., aud,exp,nbf,iat,jti) or
one or more private claims

<jwtBuilder id="jwtBuilder"
    scope="scope1"
    audiences="myApp1"
    jti="true"
    signatureAlgorithm="RS256"
    keyStoreRef="myKeyStore"
    keyAlias="jwtsigner"
    issuer="z/OS Connect EE Default"/>
```

The "sub" claim value will be application asserted user ID.

Configuring JWT Generation support



```
<zosconnect_endpointConnection id="conn1"
    host="http://api.server.com" port="8080"
    authenticationConfigRef="jwtConfig" />
<zosconnect_endpointConnection id="conn2"
    host="http://api.server.com" port="8080"
    authenticationConfigRef="jwtConfig" />
<zosconnect_authTokenLocal id="jwtConfig"
    tokenGeneratorRef="jwtBuilder"
    header="Authorization" >
    <claims>{"scope":"Scope1"}</claims>
<zosconnect_authTokenLocal id="jwtConfig"
    tokenGeneratorRef="jwtBuilder"
    header="Authorization" >
    <claims>{"scope":"Scope2"}</claims>
<jwtBuilder id="jwtBuilder"
    scope="scope"
    audiences="myApp1"
    jti="true"
    signatureAlgorithm="RS256"
    keyStoreRef="myKeyStore"
    keyAlias="jwtsigner"
    issuer="z/OS Connect EE Default"/>
```

server XML Configuration

```
→<jwtBuilder id="jwtBuilder"
  scope="scope1"
  audiences="myApp1"
  jti="true"
  signatureAlgorithm="RS256"
  keyStoreRef="myKeyStore"
  keyAlias="jwtSigner"
  issuer="z/OS Connect EE Default"/>

→<zosconnect_authTokenLocal id="jwtConfig"
  tokenGeneratorRef="jwtBuilder"
  header="JWTAuthorization" >
  <claims>{"name":"JohnSmith,
    "ID":"1234567890"}</claims>
</zosconnect_authTokenLocal >
<zosconnect_endpointConnection id="conn"
  host="http://api.server.com" port="8080"
  authenticationConfigRef="jwtConfig" />
```

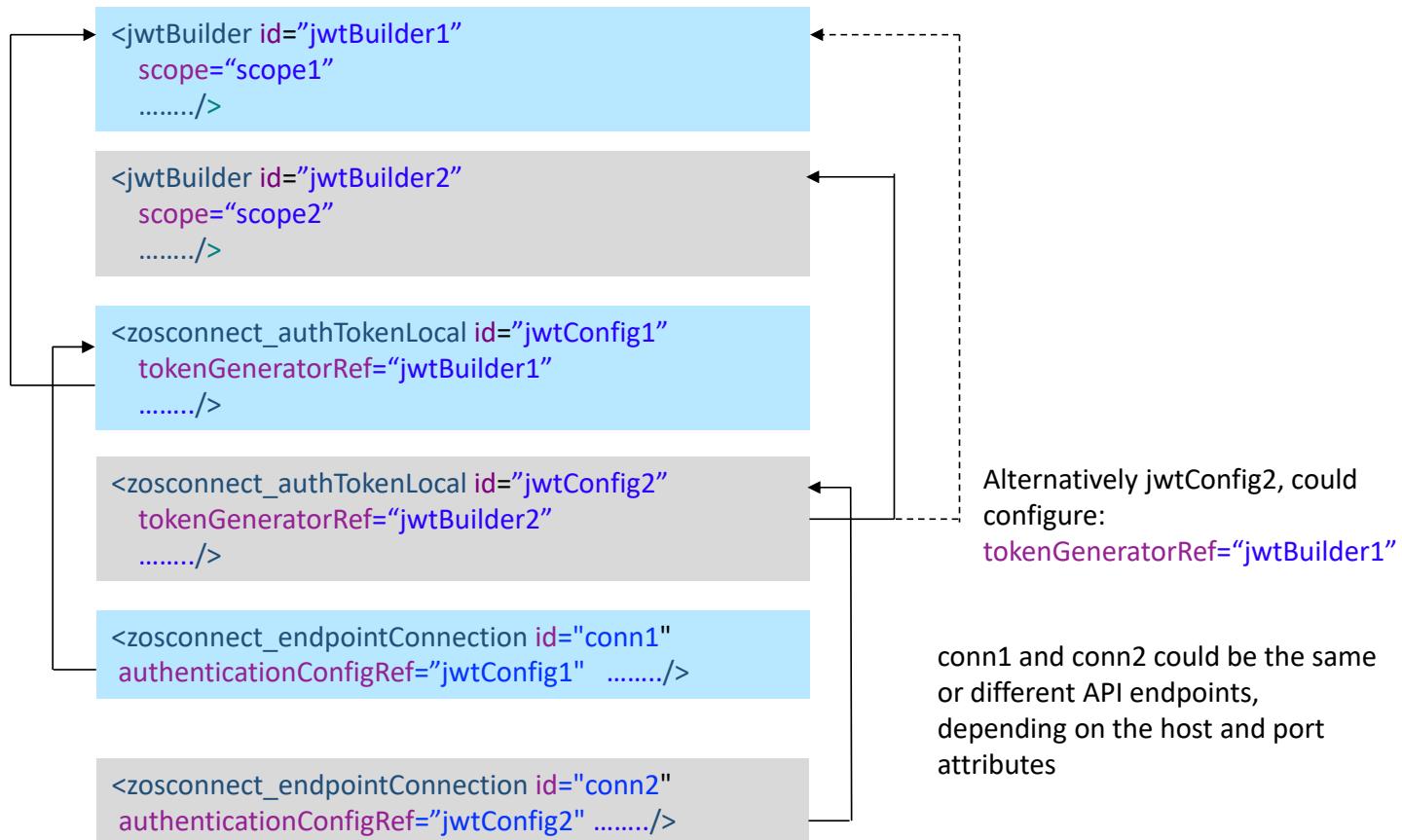
Configure the Liberty jwtBuilder element in server.xml.

Configure the zosconnect_authTokenLocal element, specifying any additional private claims required and the name of the header used to send the JWT to the endpoint.

header default value is Authorization

Finally, reference the JWT configuration from the zosconnect_endpointConnection element.

Using different claims for different API endpoints



In this presentation we covered

- Liberty and z/OS Connect Security Overview
- Authentication
 - Basic Authentication
 - Mutual Authentication using TLS
 - Third Party Tokens
- Encryption and Message Integrity using TLS
- Authorization
- Propagating identities to z/OS subsystems
- z/OS Connect API Requester and third-party tokens

Summary

- Remember that because z/OS Connect EE is based on Liberty, it benefits from a wide range of Liberty security capabilities
- Security design needs to consider
 - Authentication
 - Encryption
 - Authorization
- Understand your security requirements, identify the waypoints and their security requirements.
- Consider security requirements from ending to beginning (not necessarily from beginning to end), e.g.
 - Do you need to flow the original authenticated identity all the way to the end?
 - Do you need to map individual identities to an application or server identity?

Step by step exercises available on GitHub

<https://ibm.biz/Bdf8BZ>

The screenshot displays two side-by-side GitHub repository interfaces. The left interface shows the 'Code' tab for the 'zCONNEE-Wildfire-Workshop' repository. In the sidebar, the 'security' folder is highlighted with a red oval. The right interface shows the contents of the 'security' folder. It lists several files added by 'emitchj' via upload, including PDFs and JCL scripts, all uploaded within the last 24 days.

File	Description	Last Updated
Delete ZCEEGRPS.jcl	Deleted JCL file	24 days ago
zCEE Customization Basic Configuration.pdf	PDF file	24 days ago
zCEE Customization Basic Security.pdf	PDF file	16 days ago
zCEE Customization Security and CICS.pdf	PDF file	16 days ago
zCEE Customization Security and DB2.pdf	PDF file	16 days ago
zCEE Customization Security and JWT Tokens.pdf	PDF file	16 days ago
zCEE Customization Security and MQ.pdf	PDF file	24 days ago
zCEE Customization Security when accessing an IMS Data...	PDF file	16 days ago
zCEE Customization Security when accessing an IMS Tran...	PDF file	16 days ago
zCEE Customization Security with MVS Batch.pdf	PDF file	16 days ago
zOS Connect EE V3 Advanced Topics Guide.pdf	PDF file	24 days ago

Contact your IBM representative to schedule access to these exercises

mitchj@us.ibm.com

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