IBM Db2 Adapter for z/OS Connect

Installation and User's Guide



SC27-6769

Notes

Before using this information and the product it supports, be sure to read the general information under "Notices" at the end of this information.

Subsequent editions of this PDF will not be delivered in IBM Publications Center. Always download the latest edition from PDF format manuals for Db2 11 for z/OS (Db2 Home).

2020-06-17 edition

This edition applies to IBM® Db2® Adapter for z/OS® Connect, part of Version 3.3 of Db2 Accessories Suite for z/OS, product number 5697-Q04, and to any subsequent releases to Db2 Adapter for z/OS Connect until otherwise indicated in new editions. Make sure that you are using the correct edition for the level of Db2 Adapter for z/OS Connect offering.

© Copyright International Business Machines Corporation 2015, 2015.
US Government Users Restricted Rights – Use, duplication or disclosure restricted by GSA ADP Schedule Contract with IBM Corp.

Contents

About this book v

Chapter 1. Liberty Profile for z/OS 1

Chapter 2. z/OS Connect 3

Chapter 3. REST APIs and JSON Data 5

Chapter 4. Data Studio 7

Chapter 5. Security of Db2 Adapter for z/OS Connect 9

Chapter 6. Installing and configuring Db2 Adapter for z/OS Connect 13

System requirements for enabling Db2 Adapter for z/OS Connect 14
Planning to install and configure Db2 Adapter and related products 14
Installing Db2 Adapter for z/OS Connect 17
Creating users and groups for a Liberty Profile server and angel process 17
Configuring a Liberty Profile angel process as a z/OS started task 19
Creating a Liberty Profile for z/OS server for Db2 Adapter 21
Configuring a Liberty Profile server as a z/OS started task 24
Enabling Db2 Adapter to use RACF PassTickets 27
Configuring SAF as the SSL keystore 28
Configuring SAF for user authentication and authorization 30
Enabling the z/OS Connect authorization interceptor 32
Configuring the Db2 Adapter data source 34
Enabling the z/OS Connect audit interceptor 37
Enabling SAF-based client certificates for authentication 40

Chapter 7. Working with Db2 Adapter services 43

Creating, deploying, or undeploying a Db2 Adapter service 44
Modifying a Db2 Adapter service 51
Discovering available Db2 Adapter services 53
Retrieving details of a Db2 Adapter service 54
Retrieving JSON request and response schemas of a Db2 Adapter service 56
Querying the status of a Db2 Adapter service 58
Starting a Db2 Adapter service 59
Stopping a Db2 Adapter service 60
Invoking a Db2 Adapter service 61

Chapter 8. Samples and reference 65

Sample `server.xml` file 65
Sample `db2zAdapterServices.xml` file 67
Sample `db2zAdapterDataSources.xml` file 68
Mapping of Db2 SQL and JSON data types in a Db2 Adapter service 70

Notices 75

Trademarks 76
Privacy policy considerations 76

Glossary **77**

Index **79**

About this information

This information describes the installation, configuration, and operation tasks for IBM Db2 Adapter for z/OS Connect.

This information is primarily intended for the following Db2 Adapter users:

- System administrators who install and configure Db2 Adapter for z/OS Connect.
- Application administrators who configure and manage Db2 Adapter services.
- Application developers who create, modify, deploy, or undeploy Db2 Adapter services.
- Anyone who discovers and invokes Db2 Adapter services from web, mobile, and cloud applications to access and manage Db2 objects in the z/OS environment.

Related concepts

Db2 Adapter for z/OS Connect (Deprecated)

Related tasks

“Installing and configuring Db2 Adapter for z/OS Connect” on page 13
Db2 Adapter for z/OS Connect is a complete solution that includes IBM WebSphere Application Server Liberty Profile for z/OS and the z/OS Connect feature. It also requires tooling support from the IBM Data Studio client. You must install and configure all the products and features before you can use Db2 Adapter.

“Working with Db2 Adapter services” on page 43
You can create, deploy, and undeploy Db2 Adapter services that interact with the underlying Db2 objects. You can then discover, invoke, start, stop, or query the status of these services through a set of REST APIs that Db2 Adapter provides.

Related information

“Samples and reference” on page 65
Samples and reference information can help you understand how a product is installed, configured, and used. You can use the following samples of server and service configuration, job input and output, embedded instructions, and other reference information to guide you through the installation, configuration, and operation of the Db2 Adapter for z/OS Connect and related products.

© Copyright IBM Corp. 2015, 2015

Chapter 1. Liberty Profile for z/OS

IBM WebSphere Application Server Liberty Profile for z/OS is a highly composable application server runtime environment. As a feature of IBM WebSphere Application Server for z/OS, Liberty Profile is lightweight and easy to install and use.

Coupled with associated development tools, Liberty Profile provides a dynamic, convenient, and capable platform for building web and OSGi applications without a full Java™ Enterprise Edition (Java EE) environment. You can build applications for Liberty Profile and deploy and run them on the full profile server. In addition, Liberty Profile enables you to leverage the enterprise capabilities of IBM Z and the z/OS platform to deliver the availability and security that your business applications depend on.

Liberty Profile provides the ability for your applications to use z/OS authorized services for System Authorization Facility (SAF) authorization, Workload Manager (WLM), and resource recovery services (RRS). You can set up a Liberty Profile angel process and authorize your Liberty server to use these services.

Related tasks

“Planning to install and configure Db2 Adapter and related products” on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

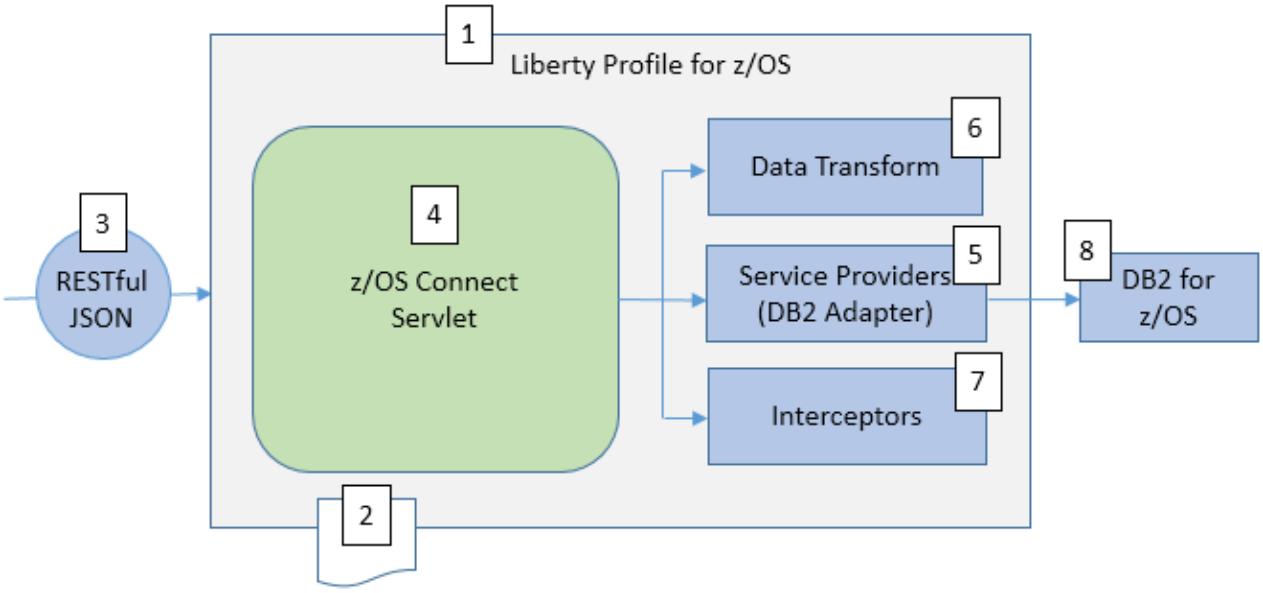
“Creating a Liberty Profile for z/OS server for Db2 Adapter” on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

© Copyright IBM Corp. 2015, 2015

Chapter 2. z/OS Connect

IBM z/OS Connect is a feature of IBM WebSphere Application Server Liberty Profile for z/OS. It provides a simple, consistent, and secure interface that connects applications in the web, mobile, and cloud environment to programs on the IBM Z and the z/OS platform.

As the following figure shows, z/OS Connect runs inside the Liberty Profile for z/OS and can run as a started task or as an automated z/OS operation. You can dynamically enable and configure z/OS Connect by updating the `server.xml` file. You can also enable multiple instances of Liberty Profile with z/OS Connect for availability. The Liberty Profile configuration model allows for sharing of common configuration elements between instances, so any update to a single configuration can automatically propagate to other instances.



1 z/OS Connect runs inside the Liberty Profile for z/OS.
2 z/OS Connect is described and configured in the Liberty `server.xml` file.
3 z/OS Connect accepts REST URIs with JSON data payloads.
4 Part of z/OS Connect is a servlet that runs in Liberty Profile for z/OS.
5 A service provider provides connectivity to the backend system.
6 z/OS Connect provides the ability to transform JSON to the format required by the backend system.
7 An interceptor is a callout point that invokes a program or application for its intended purpose, such as System Authorization Facility (SAF) for authorization and System Management Facility (SMF) for activity recording.
8 Db2 for z/OS in the z/OS environment.

z/OS Connect provides the ability to enable, discover, and invoke services that are configured to access z/OS assets through REST calls. The services are configurable so you control which backend programs or applications are exposed and accessible.

z/OS Connect understands and uses standardized interfaces and data, including REST APIs and JSON payloads. It accepts REST requests and JSON data, converts them to the format required by the backend z/OS programs, and transforms z/OS responses from their native format back to JSON. Optionally, you can configure the z/OS Connect interceptors to work with existing security facilities and utilities for authorization and authentication. For example, you can use SAF for access control and SMF to record service activities for auditing. You can also set up a Liberty Profile angel process and authorize your Liberty server to use z/OS authorized services for SAF authorization.

© Copyright IBM Corp. 2015, 2015

Related tasks

"Enabling the z/OS Connect authorization interceptor" on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

"Enabling the z/OS Connect audit interceptor" on page 37
z/OS Connect supplies an audit interceptor that writes 120.11 records to the z/OS System Management Facility (SMF) data store. You can configure and enable the supplied audit interceptor to track and audit the usage of z/OS Connect and thus Db2 Adapter for z/OS Connect.

Chapter 3. REST APIs and JSON Data

REST (Representational State Transfer) is a simple stateless architecture designed for web services. Applications that use REST APIs typically communicate over the HTTP network.

The REST protocol uses the same HTTP/HTTPS `GET`, `PUT`, `POST`, and `DELETE` verbs. For example, a REST server understands a `GET https://<host>:<host>/zosConnect/services` request and responds with a list of z/OS Connect services.

The Db2 Adapter implementation of REST supports the transfer of data in JSON (JavaScript Object Notation). JSON is used to encapsulate data in `name/value` pairs and to exchange that data over the network between frontend applications and backend systems.

Related tasks

“Retrieving JSON request and response schemas of a Db2 Adapter service” on page 56
Db2 Adapter uses JSON data for both HTTPS requests and responses for its service operations. You can retrieve the request and response JSON schemas of a Db2 Adapter service if you have the required authority.

Related reference

“Mapping of Db2 SQL and JSON data types in a Db2 Adapter service” on page 70
For each Db2 Adapter service, JSON data types are mapped to underlying Db2 SQL data types. When an HTTPS call is issued for a specific service, Db2 Adapter uses the mapping to convert the data types for the service requests and responses.

Related information

© Copyright IBM Corp. 2015, 2015

Chapter 4. Data Studio

Data Studio includes support for key tasks across the entire data management lifecycle. It enables database administrators to manage databases and perform basic health and performance monitoring. It also provides application developers with a single integrated development environment that can be used to create, deploy, and debug data-centric applications.

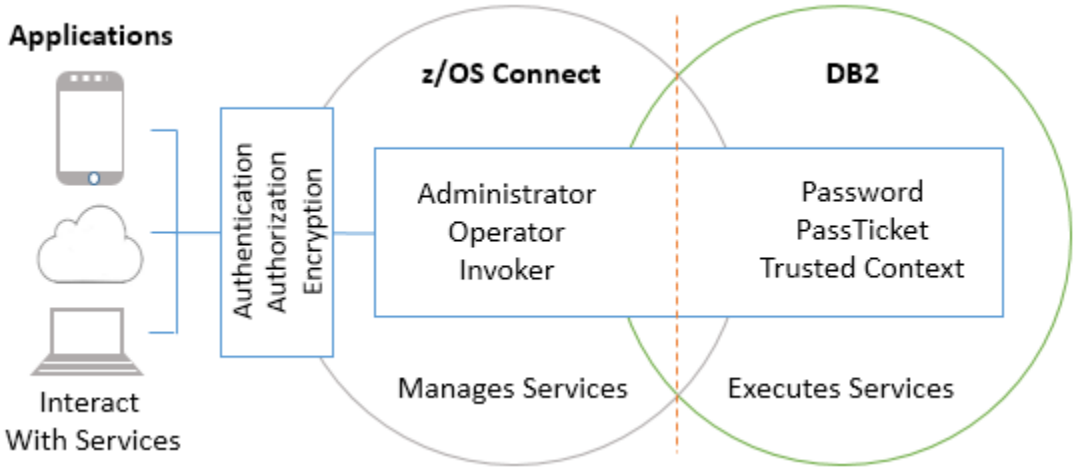
Built to extend the Eclipse framework and SQL model components, Data Studio combines Eclipse technology and shared repository extensions for database development and maintenance. Data Studio consist of the following components:

- The IBM Data Studio client is an Eclipse-based tool that provides an integrated development environment for database administration, application development, and query tuning. It can be installed with other IBM software products to share a common environment.
- The IBM Data Studio web console is a web-based tool for performing health and availability monitoring, job creation, and database administration tasks.

© Copyright IBM Corp. 2015, 2015

Chapter 5. Security of Db2 Adapter for z/OS Connect

Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.



z/OS Connect authentication

z/OS Connect can perform and manage user authentication for all its services, including Db2 Adapter services. You can configure z/OS Connect to authenticate users by using one of the following mechanisms:

- A flat list of user IDs and passwords
- System Authorization Facility (SAF) user authentication
- Client certificates

z/OS Connect authorization

z/OS Connect owns and manages all Db2 Adapter services. You can control access to those services in z/OS Connect through a list of individual users or SAF user groups. With SAF, you have the ability to manage authorization at the granular level of a specific service.

You can configure the z/OS Connect authorization interceptor to use SAF to authorize a user group one of the following levels of authority for each service

Administrator
: Users with the administrator authority can query services, perform operational tasks on the services, and invoke them.

Operator
: Users with the operator authority can perform tasks on services, but cannot invoke them.

Invoker
: Users with the invoker authority can invoke services, but do not have any other authority over them.

The z/OS Connect authorization interceptor implements the `com.ibm.wsspi.zos.connect.Interceptor()` service provider interface (SPI) and uses the `getGroupsforUser()` security API internally to determine the groups that the current user is in and compares these groups to the ones specified in the global or service definition.

At the global level, groups can be defined with the `zosConnectManager` element. When the `zosConnectManager` element is enabled, authorization applies to all configured services. If more granular security is needed, groups can also be defined at the service level with the

© Copyright IBM Corp. 2015, 2015

`zosConnectService` element that overrides the corresponding globally defined values. When the authorization interceptor is defined at the global level, authorization checks are done once for all services.

Db2 authorization

Db2 executes the Db2 Adapter services that z/OS Connect manages. You must specify in each service one of the following authorization methods with which Db2 uses to execute the service:

Running all Db2 Adapter services with the administrator ID as specified in the data source

This authorization method runs all user-defined services under the authority of the same user ID as defined in the Db2 Adapter data source. The Db2 Adapter data source ID, also known as the Db2 Adapter administrator ID, must have both the authority to connect to Db2 and the privileges required for executing user-defined services in Db2.

At run time, z/OS Connect authenticates the invoker of a service and checks if the invoker can run the service. If the invoker is authorized, the request is passed to Db2 Adapter for execution. Db2 Adapter then connects to Db2 and executes the service under the data source user ID. The data source user ID is also used as the schema name for an unqualified SQL statement.

Running a Db2 Adapter service with the service's owner or invoker ID when the RACF® PassTicket support is enabled

This authorization method allows you to run a user-defined service with the owner or invoker ID when you enable the RACF PassTicket support. When the service is deployed through the IBM Data Studio client, the deployer ID is assigned as the service owner in the service definition. The assigned ID must have both the authority to connect to Db2 and the privileges required for executing the SQL statement in a service inside Db2.

At run time, z/OS Connect authenticates the service's owner ID if the `serviceRunAs` property is set to "2" or the invoker ID if it is set to "3." If the specified ID is authorized, the request is passed to Db2 Adapter for execution. Db2 Adapter generates a PassTicket for the specified ID and creates a connection to Db2 by using the ID and the PassTicket. Db2 then uses the PassTicket to authenticate the ID. The specified ID is also used as the schema name for an unqualified SQL statement.

Running a Db2 Adapter service with the service's owner or invoker ID when the Db2 trusted context support is enabled

This authorization method allows you to run a user-defined service with the owner or invoker ID when you configure Db2 Adapter as a trusted service. You must define a Db2 trusted context and use it to control access to Db2. The trusted context object in Db2 determines the IDs that can execute Db2 Adapter services. As a result, Db2 Adapter can provide a pool of trusted connections to requesting IDs. This authorization method provides the strongest security and best performance.

Db2 Adapter uses the data source user ID to establish a trusted connection. The data source user ID must be the system authorization ID of the trusted context. The data source user ID is not used for authorization checking for executing the SQL statement in the service, but it must have the authority to connect to Db2.

When the service is deployed through the IBM Data Studio client, the deployer ID is assigned as the service owner in the service definition. The assigned ID must have the authority to run under the trusted context without authentication and the privileges required for executing user-defined services inside Db2. If you enable the RACF PassTicket support, Db2 Adapter establishes a trusted connection and generates a PassTicket for the data source user ID. Db2 uses the PassTicket to authenticate the data source user ID for the trusted connection.

At run time, Db2 Adapter switches the identity of a pooled connection to the specified ID of a service and associates the ID to a new or existing trusted connection. The specified ID is the service's owner ID if the `serviceRunAs` property is set to "2" or the invoker ID if it is set to "3." The specified ID is also used as the schema name for an unqualified SQL statement.

Related tasks

“Configuring the Db2 Adapter data source” on page 34

You must configure a Db2 Adapter data source in the Liberty Profile server to encapsulate all communications between Db2 Adapter and Db2.

“Planning to install and configure Db2 Adapter and related products” on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

“Enabling Db2 Adapter to use RACF PassTickets” on page 27
Instead of sending clear text passwords through the network, RACF provides the ability to generate PassTickets for a requesting application. Users of the application can then use the PassTickets to authenticate within a RACF-secured network. You can configure RACF to generate PassTickets for Db2 Adapter users and then enable Db2 Adapter to use the PassTickets.

“Enabling the z/OS Connect authorization interceptor” on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

“Enabling the z/OS Connect audit interceptor” on page 37
z/OS Connect supplies an audit interceptor that writes 120.11 records to the z/OS System Management Facility (SMF) data store. You can configure and enable the supplied audit interceptor to track and audit the usage of z/OS Connect and thus Db2 Adapter for z/OS Connect.

Chapter 6. Installing and configuring Db2 Adapter for z/OS Connect

Db2 Adapter for z/OS Connect is a complete solution that includes IBM WebSphere Application Server Liberty Profile for z/OS and the z/OS Connect feature. It also requires tooling support from the IBM Data Studio client. You must install and configure all the products and features before you can use Db2 Adapter.

Before you begin

Deprecated feature: IBM Db2 Adapter for z/OS Connect has been deprecated. Although this product is still supported, it will be removed from support at a future date. The preferred solution is Db2 REST Services. For information about the preferred solution, see Db2 REST services ().

__ • Meet all “System requirements for enabling Db2 Adapter for z/OS Connect” on page 14

Procedure

Complete the following tasks to install and configure Db2 Adapter for z/OS Connect and related products:

__ • “Planning to install and configure Db2 Adapter and related products” on page 14
__ • “Installing Db2 Adapter for z/OS Connect” on page 17
__ • “Creating users and groups for a Liberty Profile server and angel process” on page 17
__ • “Configuring a Liberty Profile angel process as a z/OS started task” on page 19
__ • “Creating a Liberty Profile for z/OS server for Db2 Adapter” on page 21
__ • “Configuring a Liberty Profile server as a z/OS started task” on page 24
__ • “Enabling Db2 Adapter to use RACF PassTickets” on page 27
__ • “Configuring SAF as the SSL keystore” on page 28
__ • “Configuring SAF for user authentication and authorization” on page 30
__ • “Enabling the z/OS Connect authorization interceptor” on page 32
__ • “Configuring the Db2 Adapter data source” on page 34
__ • “Enabling the z/OS Connect audit interceptor” on page 37
__ • “Enabling SAF-based client certificates for authentication” on page 40

Related concepts

Db2 Adapter for z/OS Connect (Deprecated)

Related tasks

“Working with Db2 Adapter services” on page 43
You can create, deploy, and undeploy Db2 Adapter services that interact with the underlying Db2 objects. You can then discover, invoke, start, stop, or query the status of these services through a set of REST APIs that Db2 Adapter provides.

Related information

“Samples and reference” on page 65
Samples and reference information can help you understand how a product is installed, configured, and used. You can use the following samples of server and service configuration, job input and output, embedded instructions, and other reference information to guide you through the installation, configuration, and operation of the Db2 Adapter for z/OS Connect and related products.

© Copyright IBM Corp. 2015, 2015

System requirements for enabling Db2 Adapter for z/OS Connect

Db2 Adapter for z/OS Connect is a feature of Db2 Accessories Suite for z/OS Version 3 Release 3. You must install all the software products and features required by Db2 Adapter, its operating environment, and tooling support.

Software requirements for Db2 Adapter

Db2 Adapter for z/OS Connect requires the following IBM software products and features that are bundled in the Db2 Accessories Suite for z/OS 3.3:

- IBM WebSphere Application Server Liberty Profile for z/OS 8.5.5.5 or later
- IBM Liberty Profile for z/OS Connect feature 1.0.8 or later.

Software requirements for IBM Z

You must install the following software products for the z/OS environment:

- Db2 10 for z/OS (with the IBM Data Server Driver for JDBC and SQLJ 4.0) or later
- z/OS 1.11 or later
- IBM 64-bit JDK 6 or later.

Software requirements for workstations

You must install the following software products for workstations:

- IBM Data Studio client 4.1.2 or later
- IBM Installation Manager 1.8.3 or later.

Related concepts

Db2 Adapter for z/OS Connect (Deprecated)

“Liberty Profile for z/OS” on page 1
IBM WebSphere Application Server Liberty Profile for z/OS is a highly composable application server runtime environment. As a feature of IBM WebSphere Application Server for z/OS, Liberty Profile is lightweight and easy to install and use.

“z/OS Connect” on page 3
IBM z/OS Connect is a feature of IBM WebSphere Application Server Liberty Profile for z/OS. It provides a simple, consistent, and secure interface that connects applications in the web, mobile, and cloud environment to programs on the IBM Z and the z/OS platform.

“Data Studio” on page 7
Data Studio includes support for key tasks across the entire data management lifecycle. It enables database administrators to manage databases and perform basic health and performance monitoring. It also provides application developers with a single integrated development environment that can be used to create, deploy, and debug data-centric applications.

Planning to install and configure Db2 Adapter and related products

Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

Procedure

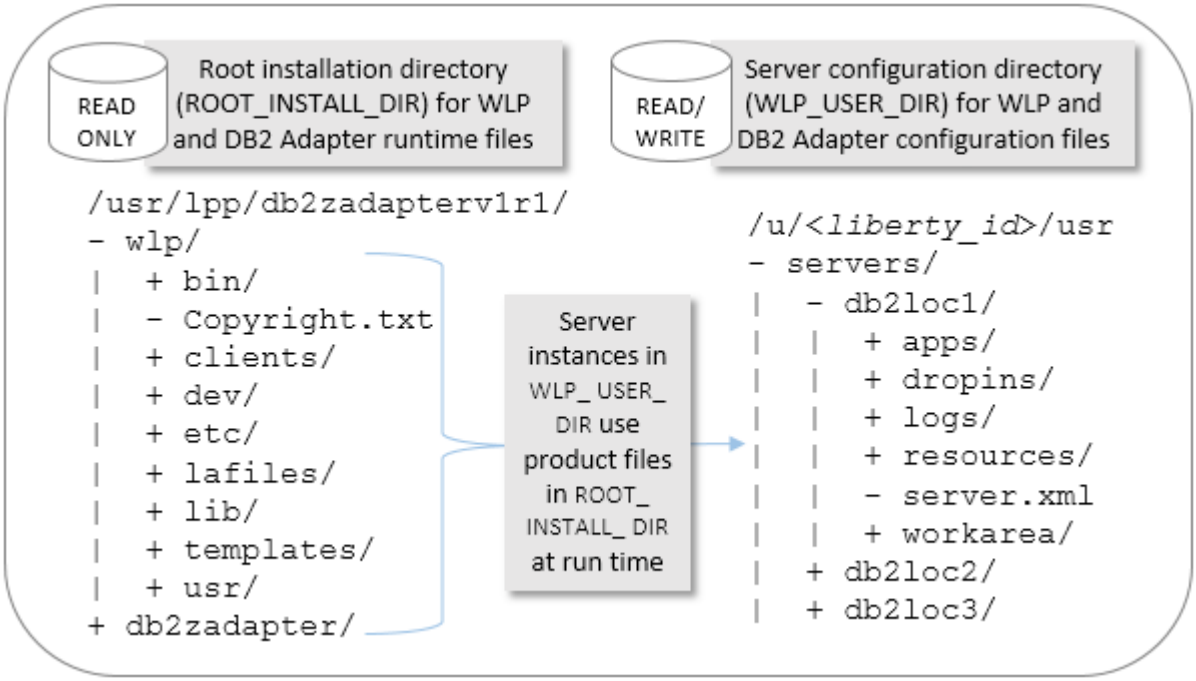
- Plan the directory structures and permissions that you will use to install Db2 Adapter and embedded products.

  Before you install Db2 Adapter with the embedded Liberty Profile and z/OS Connect, determine where you will store the product installation code and the server configuration files. Consider keeping the

product installation files separate from the server configuration files by putting them on different file systems.

Also, consider keeping all product installation files in a ROOT_INSTALL_DIR directory and all server configuration files in a WLP_USER_DIR directory. After the installation is complete, mount the ROOT_INSTALL_DIR directory as READ ONLY and the WLP_USER_DIR directory as READ/WRITE.

In the following example, the /usr/lpp/db2zadapterv1r1 directory is the ROOT_INSTALL_DIR and mounted as READ-ONLY. The wlp subdirectory is where the Liberty Profile product code is stored and is hereafter referred as the WLP_INSTALL_DIR. The db2zadapter subdirectory is where the Db2 Adapter product code is stored and hereafter referred as the ADAPTER_INSTALL_DIR.



The /u/<*liberty_id*>/usr directory is the WLP_USER_DIR directory, where <*liberty_id*> is the user ID under which the Liberty Profile server runs. Mounted as READ/WRITE, WLP_USER_DIR is where the server configuration and log files are stored. It is important that you set the permissions of this directory so that only authorized administrators can make changes to its content.

- Plan the users and groups under which will run Liberty Profile server and angel process.

  Before you create a new Liberty Profile server and enable the underlying angel process, determine the users and groups that will run the server. You also need to prepare your system environments, such as the JAVA_HOME and JCC_HOME variables, that are required for configuring the new Liberty Profile server. Record your decisions in the following chart:

Name	Description	Value
liberty_id	ID that the Liberty Profile server will run under	*liberty_id =*
angel_id	ID that the Liberty Profile Angel process will run under	*angel_id =*
lib_group	Group that the Liberty Profile ID and Angel ID will connect to	*lib_group =*
JAVA_HOME	UNIX path to a valid installation of IBM 64-bit JDK	*JAVA_HOME =*

Name	Description	Value
JCC_HOME	UNIX path to a valid installation of IBM Data Server Driver for JDBC and SQLJ driver	*JCC_HOME =*
profilePrefix	Prefix in the name of System Authorization Facility (SAF) resource profiles used for controlling access to the Liberty Profile server.	*profilePrefix =*

A Liberty Profile angel process is required when the Liberty Profile server needs to use z/OS authorized services. Only one angel process is allowed per LPAR, but all Liberty Profile servers on the partition can share the same process. If you have an angel process enabled in the environment where you plan to install Db2 Adapter, you already have the required *angel_id*, and you do not need to create a new one.

Also, a Liberty Profile server typically provides access to a single Db2 catalog. If you use SAF resource profiles to control access to a Db2 catalog from a Liberty Profile server, you need to establish a convention for the prefix of the profile names or *<profilePrefix>*. The default *<profilePrefix>* is BBGZDFLT. For example, you can use DB2TEST as the *<profilePrefix>* for the SAF resource profiles that control access to all of your non-production Db2 subsystems. Doing so helps reduce the number of required access administration tasks. For your production environment, consider using a *<profilePrefix>* that is specifically related to your individual Db2 systems or Db2 data sharing groups.

- Plan the security model that you will use to authenticate and authorize users to Db2 Adapter services.

  Before you install and configure Db2 Adapter, determine the authentication and authorization methods that you will use to secure the Db2 Adapter environment. Review with your security administrators, such as your SAF administrator, the security options that Db2 Adapter provides and choose one that best meets the needs of your business. You can adjust your decision and modify your Db2 Adapter security configurations at any time when your business needs change.

  Consider using the following questions to guide your review and planning:

  – Do you want to create and assign a Secure Socket Layer (SSL) certificate to be used by the Liberty Profile server? Do you want to use a local and unsigned SSL certificate that is generated by the Liberty Profile server itself?
  – Which z/OS Connect authentication methods do you want to enable?

    __ Basic authentication by using a flat list of user IDs and passwords
    __ SAF authentication by using a client-provided user ID and password
    __ SAF authentication by using SSL client certificates.
  – Which z/OS Connect authorization methods do you want to enable?

    __ Basic z/OS Connect service authorization by using a flat list of authorized user IDs
    __ SAF-managed authorization to control access to z/OS Connect services
    __ SAF-managed authorization to control role access at the individual service level (Recommended).
  – Which Db2 authorization methods do you want to enable?

    __ Running all user-defined services by using a single administrator ID (the data source ID)
    __ Enabling the SAF/RACF PassTicket support to run user-defined services by using the service's owner or invoker ID
    __ Enabling the Db2 trusted context support to run user-defined services by using the service's owner or invoker ID.

  If you plan to enable both the Db2 trusted context and RACF PassTicket support, Db2 Adapter will obtain a PassTicket to establish a trusted connection for the Db2 Adapter data source user ID. If you enable the Db2 trusted context but not the RACF PassTicket, you must specify a password for the Db2 Adapter data source user ID in the data source configuration.

Related tasks

"Installing Db2 Adapter for z/OS Connect" on page 17
Db2 Adapter for z/OS Connect is a feature of Db2 Accessories Suite for z/OS Version 3 Release 3. You must use System Modification Program Extended (SMP/E) to install Db2 Adapter.

"Creating a Liberty Profile for z/OS server for Db2 Adapter" on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

Related reference

"Security of Db2 Adapter for z/OS Connect" on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

Installing Db2 Adapter for z/OS Connect

Db2 Adapter for z/OS Connect is a feature of Db2 Accessories Suite for z/OS Version 3 Release 3. You must use System Modification Program Extended (SMP/E) to install Db2 Adapter.

Procedure

1. Locate the *Program Directory for IBM Db2 Accessories Suite for z/OS: Db2 Adapter for z/OS Connect* that is shipped with the Db2 Adapter product.
2. Follow the installation instructions in the program directory to install Db2 Adapter.

What to do next

After you complete the installation steps as described in the program directory, return to this collection and follow the instructions to configure Db2 Adapter and related products.

Related tasks

"Planning to install and configure Db2 Adapter and related products" on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

"Configuring the Db2 Adapter data source" on page 34
You must configure a Db2 Adapter data source in the Liberty Profile server to encapsulate all communications between Db2 Adapter and Db2.

"Creating a Liberty Profile for z/OS server for Db2 Adapter" on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

Related reference

"Security of Db2 Adapter for z/OS Connect" on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

Creating users and groups for a Liberty Profile server and angel process

Before you create a new Liberty Profile server and enable the underlying angel process, you must create the users, groups, and home directories that are required for the new server instance.

Before you begin

Determine the new users and groups that you will use to configure and run the new Liberty Profile server. Make sure that you review with your security administrator those users and groups and obtain the required privileges to create them.

Procedure

1. From a TSO session, issue the following System Authorization Facility (SAF) command to create the new *lib_group* group.

   ```
   ADDGROUP lib_group OMVS(GID(gid)) OWNER(SYS1)
   ```

   where *lib_group* is the value you have planned.
2. Issue the following SAF command to create the new *angel_id* user.

   Skip this step if you already have a Liberty Profile angel process ID. A Liberty Profile angel process is required when the Liberty Profile server needs to use z/OS authorized services. Only one angel process is allowed per LPAR, but all Liberty Profile servers on the partition can share the same process. If you have an angel process enabled in the environment where you install Db2 Adapter, you already have the required *angel_id*, and you do not need to create a new one.

   ```
   ADDUSER angel_id DFLTGRP(lib_group) OMVS(UID(uid)
       HOME(angel_id_home) PROGRAM(/bin/sh)) NAME('Liberty Angel')
           OWNER(lib_group) NOPASSWORD NOOIDCARD
   ```

   where *angel_id* is the value you have planned and *lib_group* is the new group that you have created.
3. Issue the following SAF command to create the new *liberty_id* user.

   ```
   ADDUSER liberty_id DFLTGRP(lib_group) OMVS(UID(uid)
       HOME(liberty_id_home) PROGRAM(/bin/sh)) NAME('Liberty Server')
           OWNER(lib_group) NOPASSWORD NOOIDCARD
   ```

   where *liberty_id* is the value you have planned and *lib_group* is the new group that you have created.
4. Create the *liberty_id_home* and *angel_id_home* directories for the *liberty_id* and *angel_id* users.

Related tasks

“Planning to install and configure Db2 Adapter and related products” on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

“Creating users and groups for a Liberty Profile server and angel process” on page 17
Before you create a new Liberty Profile server and enable the underlying angel process, you must create the users, groups, and home directories that are required for the new server instance.

“Configuring a Liberty Profile angel process as a z/OS started task” on page 19
You can configure a Liberty Profile angel process to run as a z/OS started task.

“Creating a Liberty Profile for z/OS server for Db2 Adapter” on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

“Configuring a Liberty Profile server as a z/OS started task” on page 24
You can configure a Liberty Profile server to run as a z/OS started task.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9

Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

Configuring a Liberty Profile angel process as a z/OS started task

You can configure a Liberty Profile angel process to run as a z/OS started task.

Before you begin

Wherever appropriate, you can skip steps in this task if you already have a Liberty Profile angel process enabled in the environment where you install Db2 Adapter. A Liberty Profile angel process is required when the Liberty Profile server needs to use z/OS authorized services. Only one angel process is allowed per LPAR, but all Liberty Profile servers on the partition can share the same process. You can configure the existing angel process to run a z/OS started task.

Procedure

1. Copy the `bbgzangl.jcl` file and modify the JCL start procedure.
   a) Locate the `bbgzangl.jcl` file in the `WLP_INSTALL_DIR/templates/zos/procs` directory.

      If you use the default directory for the Db2 Adapter installation, the `WLP_INSTALL_DIR` directory is `/usr/lpp/db2zadapterv1r1/wlp`.

   b) From a TSO session, issue the following command to copy the `bbgzangl.jcl` file to your JCL procedures library:

      ```
      OGET '/usr/lpp/db2zadapterv1r1/wlp/templates/zos/procs/bbgzangl.jcl'
          'SYS1.PROCLIB(BBGZANGL)'
      ```

   c) Open the `SYS1.PROCLIB(BBGZANGL)` file you just created and update the ROOT value in the following string:

      ```
      //*--------------------------------------
      // SET ROOT='/u/MSTONE1/wlp'
      //*--------------------------------------
      ```

      Set ROOT to the `/usr/lpp/db2zadapterv1r1/wlp` directory. Make sure to enclose the directory value inside single quotation marks. The updated string should look like this:

      ```
      //*--------------------------------------------
      // SET ROOT ='/usr/lpp/db2zadapterv1r1/wlp'
      //*--------------------------------------------
      ```

   d) Save and exit the `SYS1.PROCLIB(BBGZANGL)` file.
2. Create a new SAF STARTED profile to run the new Liberty Profile angel process as a z/OS started task.

   From a TSO session, issue the following RACF commands to create a SAF STARTED profile the Liberty Profile angel process:

   ```
   RDEF STARTED BBGZANGL.* UACC(NONE) STDATA(USER(angel_id)
       GROUP(lib_group) PRIVILEGED(NO) TRUSTED(NO) TRACE(YES))
   SETROPTS RACLIST(STARTED) REFRESH
   ```

   where *angel_id* and *lib_group* are the new user and group that you have created. If you have already RACLISTed the STARTED class, include the **SETROPTS** command with the REFRESH option.
3. Start the Liberty Profile angel process as a started task.

   From the z/OS operator console, issue the following MVS™ command:

   ```
   S BBGZANGL
   ```

If the command runs successfully, the angel process is invoked, and you should see a message like this:

```
.S BBGZANGL
IRR812I PROFILE BBGZANGL.* (G) IN THE STARTED CLASS WAS USED
    TO START BBGZANGL WITH JOBNAME BBGZANGL.
$HASP100 BBGZANGL ON STCINRDR
IEF695I START BBGZANGL WITH JOBNAME BBGZANGL IS ASSIGNED TO
    USER angel_id, GROUP lib_group
$HASP373 BBGZANGL STARTED
CWWKB0056I INITIALIZATION COMPLETE FOR ANGEL
```

4. Create the SAF SERVER profiles required for the Liberty Profile angel process.
   a) Check with your security administrator to see if the following SAF SERVER profiles already exist:
      - BBG.ANGEL
      - BBG.AUTHMOD.BBGZSAFM
      - BBG.AUTHMOD.BBGZSAFM.LOCALCOM
      - BBG.AUTHMOD.BBGZSAFM.TXRRS
      - BBG.AUTHMOD.BBGZSAFM.ZOSWLM
      - BBG.AUTHMOD.BBGZSAFM.ZOSDUMP
      - BBG.AUTHMOD.BBGZSCFM

   b) If the required SAF SERVER profiles do not exist, create them by issuing the following commands from a TSO session:

```
RDEF SERVER BBG.ANGEL UACC(NONE) OWNER(SYS1)
RDEF SERVER BBG.AUTHMOD.BBGZSAFM UACC(NONE) OWNER(SYS1)
RDEF SERVER BBG.AUTHMOD.BBGZSAFM.LOCALCOM UACC(NONE) OWNER(SYS1)
RDEF SERVER BBG.AUTHMOD.BBGZSAFM.TXRRS UACC(NONE) OWNER(SYS1)
RDEF SERVER BBG.AUTHMOD.BBGZSAFM.ZOSWLM UACC(NONE) OWNER(SYS1)
RDEF SERVER BBG.AUTHMOD.BBGZSAFM.ZOSDUMP UACC(NONE) OWNER(SYS1)
RDEF SERVER BBG.AUTHMOD.BBGZSCFM UACC(NONE) OWNER(SYS1)
SETROPTS RACLIST(SERVER) REFRESH
```

5. Authorize *liberty_id* access to the required SAF SERVER profiles by issuing the following commands:

```
PERMIT BBG.ANGEL CLASS(SERVER) ACCESS(READ) ID(liberty_id)
PERMIT BBG.AUTHMOD.BBGZSAFM CLASS(SERVER) ACCESS(READ) ID(liberty_id)
PERMIT BBG.AUTHMOD.BBGZSAFM.LOCALCOM CLASS(SERVER) ACCESS(READ) ID(liberty_id)
PERMIT BBG.AUTHMOD.BBGZSAFM.TXRRS CLASS(SERVER) ACCESS(READ) ID(liberty_id)
PERMIT BBG.AUTHMOD.BBGZSAFM.ZOSWLM CLASS(SERVER) ACCESS(READ) ID(liberty_id)
PERMIT BBG.AUTHMOD.BBGZSAFM.ZOSDUMP CLASS(SERVER) ACCESS(READ) ID(liberty_id)
PERMIT BBG.AUTHMOD.BBGZSCFM CLASS(SERVER) ACCESS(READ) ID(liberty_id)
SETROPTS RACLIST(SERVER) REFRESH
```

Related tasks

“Planning to install and configure Db2 Adapter and related products” on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

“Installing Db2 Adapter for z/OS Connect” on page 17
Db2 Adapter for z/OS Connect is a feature of Db2 Accessories Suite for z/OS Version 3 Release 3. You must use System Modification Program Extended (SMP/E) to install Db2 Adapter.

“Creating users and groups for a Liberty Profile server and angel process” on page 17
Before you create a new Liberty Profile server and enable the underlying angel process, you must create the users, groups, and home directories that are required for the new server instance.

“Creating a Liberty Profile for z/OS server for Db2 Adapter” on page 21

You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

“Configuring a Liberty Profile server as a z/OS started task” on page 24
You can configure a Liberty Profile server to run as a z/OS started task.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

Creating a Liberty Profile for z/OS server for Db2 Adapter

You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

Before you begin

Make sure that you have WRITE access to the `WLP_USER_DIR` directory where you will store server configuration and log files. The default `WLP_USER_DIR` directory is `/u/<liberty_id>/usr`, where *<liberty_id>* is the user ID under which the new Liberty Profile server runs. The instructions hereafter assume that you use this default directory.

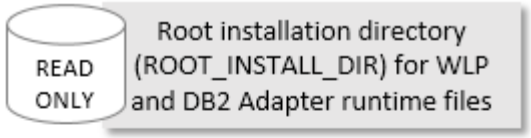
You can use either *<liberty_id>* or another ID that is explicitly permitted WRITE access to the `WLP_USER_DIR` (`/u/<liberty_id>/usr`) directory to create a new Liberty Profile server.

Procedure

In essence, creating a new Liberty Profile server consists of adding a new server configuration file to the Liberty Profile runtime environment. Db2 Adapter provides sample server configuration files. You can use the sample files to guide you through the configuration and customization of your new Liberty Profile servers.

1. Log in to an OMVS, Telnet, or SSH session and change to the `WLP_INSTALL_DIR/bin` directory.

   If you've chosen the default directory structure for the Db2 Adapter installation, the full path to the `WLP_INSTALL_DIR/bin` directory is `/usr/lpp/db2zadapterv1r1/wlp/bin`, as shown in the following figure:


   ```
   /usr/lpp/db2zadapterv1r1/
   - wlp/
   |   + bin/
   |   - Copyright.txt
   |   + clients/
   |   + dev/
   |   + etc/
   |   + lafiles/
   |   + lib/
   |   + templates/
   |   + usr/
   + db2zadapter/
   ```

2. Issue the **`export JAVA_HOME=`***<jdk_path>* command to set the `JAVA_HOME` system variable to a valid 64-bit JDK installation on your system.

3. Issue the **export WLP_USER_DIR=**<*user_dir*> command to set the WLP_USER_DIR system variable to the directory (/u/<*liberty_id*>/usr) where you want to create the new the Liberty Profile server.

   You can issue the **echo $WLP_USER_DIR** command to verify that WLP_USER_DIR is set to the intended directory.
4. Issue the following **create** command to create the new Liberty Profile server:

   ```
   ./server create <server_name> --template=db2zAdapterServer
   ```

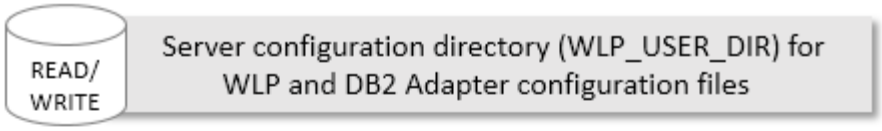
   where <*server_name*> is the name for the new Liberty Profile server. If the command runs successfully, the following message is returned:

   ```
   Server <server_name> created.
   ```

   For example, if you name your new Liberty Profile server db2loc1, you can issue the following command to create it:

   ```
   ./server create db2loc1 --template=db2zAdapterServer
   ```
5. Change to the WLP_USER_DIR directory and verify that the new db2loc1 server was created.

   If the new db2loc1 server is successfully created, a directory with the corresponding name will be generated under WLP_USER_DIR/servers directory, as shown in the following figure:




```
/u/<liberty_id>/usr
- servers/
|  - db2loc1/
|  |  + workarea/
|  |  - server.xml
|  |  - sampleSafZOSConnectAuthorization.xml
|  |  - sampleSafZOSConnectAuthentication.xml
|  |  - sampleSSLUsingSafCert.xml
|  |  - sampleDb2zAdapterDataSources.xml
|  |  - sampleBasicZOSConnectAuthorization.xml
|  |  - sampleBasicZOSConnectAuthentication.xml
|  |  - sampleBasicSSLUsingDefaultCert.xml
|  |  - db2zAdapterUserDefinedServices.xml
|  |  - db2zAdapterServices.xml
|  |  - bootstrap.properties
```

   When you specify the --template=db2zAdapterServer option, the **create** command also creates the following sample configuration files in the db2loc1 directory. Consider using these sample configuration files as a template and following the embedded instructions for defining and configuring a Liberty Profile server.

   db2zAdapterUserDefinedServices.xml
   A Db2 Adapter user-defined service template file that contains the service definitions for all Db2 Adapter user-defined services.

   bootstrap.properties
   A server bootstrap property template file that specifies system properties for the server.

server.xml
A server configuration template file that specifies the server configuration for Db2 Adapter. This primary server configuration file imports definitions from other configuration files.

sampleBasicZOSConnectAuthorization.xml
A z/OS Connect authorization template file that contains the basic configuration of z/OS Connect service authorization through a simple list of users.

sampleBasicZOSConnectAuthentication.xml
A z/OS Connect authentication template file that contains the basic configuration of z/OS Connect authentication through a simple list of users and passwords.

sampleBasicSSLUsingDefaultCert.xml
An SSL configuration template file that contains the basic SSL configuration that uses a server-generated default SSL certificate.

db2zAdapterServices.xml
A Db2 Adapter service template file that contains the definition of the Db2 Adapter deployment service.

sampleSafZOSConnectAuthorization.xml
A SAF z/OS Connect authorization template file that contains the configuration of SAF for managing z/OS Connect access authorization.

sampleSafZOSConnectAuthentication.xml
A SAF z/OS Connect authentication template file that contains the configuration of SAF for managing user authentication.

sampleDb2zAdapterDataSources.xml
A Db2 Adapter data source template file that contains the data source definition.

You can also find these sample configuration files in the `WLP_INSTALL_DIR/templates/servers/db2zAdapterServer` (`/usr/lpp/db2zadapterv1r1/templates/servers/db2zAdapterServer`) directory.

6. If necessary, update the ownership of Liberty Profile configuration files and directories.

   You have created a Liberty Profile server from the UNIX shell by using existing IDs that have the required authorities and privileges. The directories and files you created are currently owned by those IDs. If necessary, you can change the ownership of those directories and files to the IDs and groups under which you want to run the Liberty Profile server as a started task.

   a) From a USS or UNIX session, change to the `WLP_USER_DIR` directory.

      The `WLP_USER_DIR` directory is where you store server configuration and log files. The recommended directory structure for `WLP_USER_DIR` is `/u/<liberty_id>/usr`. Make sure that the ID that you use for the session has the authority to issue the **chown** command.

   b) Issue the following command to change the ownership of the `servers` directory and all its content, including files and subdirectories, to the new Liberty Profile ID and group that you have created:

      ```
      chown -R liberty_id:lib_group servers
      ```

      where *liberty_id* and *lib_group* are the new Liberty Profile ID and group that you just created.

   c) Verify that the new Liberty Profile ID and group are now the owner of the `servers` directory, subdirectories, and files.

What to do next
Follow the instructions in the `server.xml` file to continue configuring the new `db2loc1` server.
Related tasks
“Planning to install and configure Db2 Adapter and related products” on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for

protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

"Installing Db2 Adapter for z/OS Connect" on page 17
Db2 Adapter for z/OS Connect is a feature of Db2 Accessories Suite for z/OS Version 3 Release 3. You must use System Modification Program Extended (SMP/E) to install Db2 Adapter.

"Creating users and groups for a Liberty Profile server and angel process" on page 17
Before you create a new Liberty Profile server and enable the underlying angel process, you must create the users, groups, and home directories that are required for the new server instance.

"Configuring a Liberty Profile angel process as a z/OS started task" on page 19
You can configure a Liberty Profile angel process to run as a z/OS started task.

"Configuring a Liberty Profile server as a z/OS started task" on page 24
You can configure a Liberty Profile server to run as a z/OS started task.

Related reference

"Security of Db2 Adapter for z/OS Connect" on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

"Sample server.xml file" on page 65
The `server.xml` file describes the configuration details of the Liberty Profile for z/OS server in which Db2 Adapter for z/OS Connect runs. You may use the sample `server.xml` file to guide you through the configuration of the Liberty Profile server, the z/OS Connect feature, and related products.

"Sample db2zAdapterServices.xml file" on page 67
The `db2zAdapterServices.xml` file contains the definition of a DB2-supplied Db2 Adapter service that is used as a template for all user-defined services. The service is predefined, and you must not change it.

"Sample db2zAdapterDataSources.xml file" on page 68
The `sampleDb2zAdapterDataSources.xml` file contains a sample configuration of the Db2 Adapter data source. You must rename and customize the file before you can use it.

Configuring a Liberty Profile server as a z/OS started task

You can configure a Liberty Profile server to run as a z/OS started task.

Procedure

1. Copy the `bbgzsrv.jcl` file and modify the JCL start procedure.
   a) Locate the `bbgzsrv.jcl` file in the `WLP_INSTALL_DIR/templates/zos/procs` directory.

      If you use the default directory for the Db2 Adapter installation, the `WLP_INSTALL_DIR` directory is `/usr/lpp/db2zadapterv1r1/wlp`.

   b) From a TSO session, issue the following command to copy the `bbgzsrv.jcl` file to your JCL procedures library:

```
OGET '/usr/lpp/db2zadapterv1r1/wlp/templates/zos/procs/bbgzsrv.jcl'
    'SYS1.PROCLIB(BBGZSRV)'
```

   c) Open the `SYS1.PROCLIB(BBGZSRV)` file and update the `INSTDIR` and `USERDIR` values in the following strings:

```
//*-------------------------------------
// SET INSTDIR='/u/MSTONE1/wlp'
// SET USERDIR='/u/MSTONE1/wlp/usr'
//*-------------------------------------
```

Set INSTDIR to the /usr/lpp/db2zadapterv1r1/wlp directory and set USERDIR to the /u/<*liberty_id*>/usr directory. Make sure to enclose the directory values inside quotation marks. The updated strings should look like this:

```
//*-------------------------------------------
// SET INSTDIR='/usr/lpp/db2zadapterv1r1/wlp'
// SET USERDIR='/u/<liberty_id>/usr'
//*-------------------------------------------
```

If you use, or plan to use, the IBM Data Server Driver for JDBC and SQLJ driver for Type 2 connections, make sure that Db2 runtime DSNEXIT, SDSNLOAD2, and SDSNLOAD libraries are accessible to the Liberty Profile server. If these Db2 runtime load libraries are not in your system LINKLIST, include a STEPLIB DD statement in the BBGZSRV started task JCL, as follows:

```
//STEPLIB  DD    DISP=SHR,DSN=<DB2_subsystem_SDSNEXIT>
//         DD    DISP=SHR,DSN=<DB2_subsystem_SDSNLOD2>
//         DD    DISP=SHR,DSN=<DB2_subsystem_SDSNLOAD>
```

where

- <DB2_subsystem_SDSNEXIT> is the Db2 library that contains the tailored DSNHDECP module used by Type 2 driver.
- <DB2_subsystem_SDSNLOD2> is the Db2 library that contains DLL load modules used by Type 2 driver.
- <DB2_subsystem_SDSNLOAD> is the Db2 library that contains Db2 load modules used by the subsystem.

d) Save and exit the SYS1.PROCLIB(BBGZSRV) file.

2. Set the JAVA_HOME system variable in a new server.env server configuration file.

You set the JAVA_HOME variable by issuing the **export JAVA_HOME** command from an USS or UNIX session when you installed the Liberty Profile server. Now set the same variable in a server.env server configuration file so that a z/OS started task can use it to run the z/OS Connect feature. Unlike most z/OS server configuration files that use ASCII encoding, the server.env file requires EBCDIC encoding.

a) Create an EBCDIC server.env file in the WLP_USER_DIR/servers/<*server_name*>, where WLP_USER_DIR is the /u/<*liberty_id*>/usr directory and <*server_name*> is db2loc1.

b) Open the server.env file and add the following string:

```
JAVA_HOME=<jdk_path>
```

where <*jdk_path*> is the value that you have planned for the JAVA_HOME variable.

c) Save and close the server.env file.

d) Make sure that the new *liberty_id* and *lib_group* are the owners of the server.env file.

If necessary, issue the **chown** command to change the file's ownership.

3. Create a new SAF STARTED profile to run the new Liberty Profile server as a z/OS started task.

From a TSO session, issue the following RACF commands to create the SAF STARTED profiles for the new Liberty Profile server:

```
RDEF STARTED BBGZSRV.* UACC(NONE) STDATA(USER(liberty_id)
    GROUP(lib_group) PRIVILEGED(NO) TRUSTED(NO) TRACE(YES))

SETROPTS RACLIST(STARTED) REFRESH
```

where *liberty_id* and *lib_group* are the new user and group you have created. If you have already RACLISTed the STARTED class, include the **SETROPTS** command with the REFRESH option

.

What to do next

After you have completed the customization of the new Liberty Profile server, you can start the Liberty Profile server as a started task.

1. From a System Command Extension session, issue the following MVS command:

   ```
   START BBGZSRV,PARMS='<server_name>'
   ```

   where *<server_name>* is db2loc1 or the name of the Liberty Profile server.

   If the command runs successfully, it generates the following output:

   ```
   JOBNAME  StepName  ProcStep  JobID
   BBGZSRV  BBGZSRV   STEP1     STC04122
   ```

2. Verify that the Liberty Profile server is started and that the z/OS Connect feature is active.

   Open the WLP_USER_DIR/servers/*<server_name>*/logs/messages.log file and check for the following lines:

   ```
   SRVE0169I: Loading Web Module: z/OS Connect.
   SRVE0250I: Web Module z/OS Connect has been bound to default_host.
   ```

   These lines indicate that the z/OS Connect feature is installed and that the z/OS Connect servlet web module is being loaded and bound.

3. Check the status indicators in message CWWKB0103I for the following processes:

   ```
   CWWKB0103I: Authorized service group LOCALCOM is available.
   CWWKB0103I: Authorized service group TXRRS is available.
   CWWKB0103I: Authorized service group ZOSDUMP is available.
   CWWKB0103I: Authorized service group ZOSWLM is not available.
   ```

   The indicator for the LOCALCOM service group indicates that the Liberty Profile angel process is running and that the *liberty_id* has the required READ access to the LOCALCOM SERVER profile.

4. If necessary, stop the Liberty Profile server started task by issuing the MVS **P BBGZSRV** command at the z/OS operator console.

Related tasks

"Planning to install and configure Db2 Adapter and related products" on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

"Installing Db2 Adapter for z/OS Connect" on page 17
Db2 Adapter for z/OS Connect is a feature of Db2 Accessories Suite for z/OS Version 3 Release 3. You must use System Modification Program Extended (SMP/E) to install Db2 Adapter.

"Creating a Liberty Profile for z/OS server for Db2 Adapter" on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

"Creating users and groups for a Liberty Profile server and angel process" on page 17
Before you create a new Liberty Profile server and enable the underlying angel process, you must create the users, groups, and home directories that are required for the new server instance.

"Configuring a Liberty Profile angel process as a z/OS started task" on page 19
You can configure a Liberty Profile angel process to run as a z/OS started task.

Related reference

"Security of Db2 Adapter for z/OS Connect" on page 9

Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

Enabling Db2 Adapter to use RACF PassTickets

Instead of sending clear text passwords through the network, RACF provides the ability to generate PassTickets for a requesting application. Users of the application can then use the PassTickets to authenticate within a RACF-secured network. You can configure RACF to generate PassTickets for Db2 Adapter users and then enable Db2 Adapter to use the PassTickets.

Procedure

1. From a TSO session, issue the following commands to activate the RACF PassTicket class:

```
SETROPTS CLASSACT(PTKTDATA) RACLIST(PTKTDATA)
SETROPTS GENERIC(PTKTDATA)
```

2. Issue the following commands to define RACF profiles for the application in PTKTDATA:

```
RDEFINE PTKTDATA <applName> SSIGNON(KEYMASKED(<key>))
    APPLDATA('NO REPLAY PROTECTION')
```

   where and

   - *<applName>* is the name of the application that requests and uses the PassTickets. If necessary, issue the Db2 **-DISPLAY DDF** command to find out the application name as the value for *<applName>*.
     - If GENERICLU is defined, use the second part of GENERICLU for*<applName>*.
     - If GENERICLU is not defined, use the second part of LUNAME for*<applName>*.
     - If neither GENERICLU or LUNAME is defined, use the value of the IPNAME *<applName>*.
   - *<key>* is a session key with the value of 16 hexadecimal digits (for an 8-bit or 64-bit key). The session key must be identical to the key in the PassTicket definition in each RACF instance. The key for each application must be the same on all systems in the configuration.
   - APPLDATA('NO REPLAY PROTECTION') is the option that you can use to permit reuse of the same PassTicket multiple times.
3. Issue the following commands to define RACF profiles for PassTicket generation:

```
RDEFINE PTKTDATA IRRPTAUTH.<applName>.* UACC(NONE)
PERMIT IRRPTAUTH.<applName>.* ID(<liberty_id>) ACCESS(UPDATE) CLASS(PTKTDATA)
```

   where ID is the user ID under which the Liberty Profile server runs.
4. Issue the following command to refresh the PTKTDATA class:

```
SETROPTS RACLIST(PTKTDATA) REFRESH
```

5. Add the *<applName>* information to the Db2 Adapter data source that you have configured.

```
<?xml version="1.0" encoding="UTF-8"?>
<server>
    <db2zadapter_db2zAdapterDataSource
        id="db2zAdapterDataSource"
        databaseName="DBNAME1"
        serverName="xxxxx.xxxx.ibm.com"
        portNumber="446"
        driverType="4"
        applName="<applName>"
        user="admin1"
        trustedContext="true" />
</server>
```

   where *<applName>* is the value that you have defined in the RACF PTKTDATA class.

You do not need to specify the `password` attribute if you want to use PassTickets only.

Related tasks

"Configuring the Db2 Adapter data source" on page 34
You must configure a Db2 Adapter data source in the Liberty Profile server to encapsulate all communications between Db2 Adapter and Db2.

Related reference

"Security of Db2 Adapter for z/OS Connect" on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

"Sample db2zAdapterDataSources.xml file" on page 68
The `sampleDb2zAdapterDataSources.xml` file contains a sample configuration of the Db2 Adapter data source. You must rename and customize the file before you can use it.

Related information

Configuring SAF as the SSL keystore

You can configure and enable System Authorization Facility (SAF) as the Secure Sockets Layer (SSL) keystore for running the Liberty Profile server and z/OS Connect.

Before you begin

Issue the MVS **P BBGZSRV** command at the z/OS operator console to stop the Liberty Profile server started task if it is running.

Procedure

1. From a TSO session, issue the following RACF commands to generate a certificate authority (CA) certificate and SAF keyrings for the user IDs and group name under which the Liberty Profile server runs:

```
RACDCERT CERTAUTH GENCERT SUBJECTSDN(CN('CA for Liberty') OU('LIBERTY'))
    WITHLABEL('LibertyCA.LIBERTY') TRUST NOTAFTER(DATE(2018/12/31))
RACDCERT ADDRING(Keyring.LIBERTY) ID(liberty_id)
RACDCERT ID (liberty_id) GENCERT SUBJECTSDN(CN('yourhost.com')
    O('IBM') OU('LIBERTY')) WITHLABEL('DefaultCert.LIBERTY')
        SIGNWITH(CERTAUTH LABEL('LibertyCA.LIBERTY')) NOTAFTER(DATE(2018/12/31))
RACDCERT ID(liberty_id) CONNECT (LABEL('DefaultCert.LIBERTY')
    RING(Keyring.LIBERTY) DEFAULT)
RACDCERT ID(liberty_id) CONNECT (LABEL('LibertyCA.LIBERTY')
    RING(Keyring.LIBERTY) CERTAUTH)
SETROPTS RACLIST(FACILITY) REFRESH
```

   where *liberty_id* is the ID that you use to run the Liberty Profile server, and *yourhost.com* is the host name of your system.
2. Create and authorize *liberty_id* READ access to a RDATALIB class and permit theLiberty Profile server to list the contents of a specific keyring.

   If the keyring is named `Keyring.LIBERTY`, issue the following RACF commands:

```
RDEFINE RDATALIB liberty_id.Keyring.LIBERTY.LST OWNER(SYS1) UACC(NONE)
PERMIT liberty_id.Keyring.LIBERTY.LST CLASS(RDATALIB) ACCESS(READ)
    ID(liberty_id)
SETROPTS RACLIST(RDATALIB) REFRESH
```

   Make sure that both *liberty_id* and LST are specified in uppercase in the RDATALIB class name. The keyring name must match the name in the RACF profile and use the naming convention of `<liberty_id>.<ringName>.LST`.
3. Issue the following RACF commands to create a new SAF SERVER class profile and authorize *liberty_id* READ access to the profile.

```
RDEF SERVER BBG.AUTHMOD.BBGZSAFM.SAFCRED UACC(NONE) OWNER(SYS1)
PERMIT BBG.AUTHMOD.BBGZSAFM.SAFCRED CLASS(SERVER) ACCESS(READ) ID(liberty_id)
SETROPTS RACLIST(SERVER) REFRESH
```

4. Define the SSL certificate and SAF keyring information in the Liberty Profile server configuration.

   If you created the Liberty Profile server by using the Db2 Adapter configuration templates, follow the instructions embedded in the template files. Otherwise, follow these steps to update the `server.xml` file in the `WLP_USER_DIR/servers/<server_name>` directory. The default `WLP_USER_DIR` directory is `/u/<liberty_id>/usr`, where *<liberty_id>* is the ID you use to run the Liberty Profile server and *<server_name>* is `db2loc1`.

   a) Open the `server.xml` file and add the following highlighted lines.

```
<featureManager>
    <feature>jsp-2.2</feature>
    <feature>appSecurity-2.0</feature>
    <feature>zosConnect-1.0</feature>
    <feature>zosSecurity-1.0</feature>
    <feature>ssl-1.0</feature>
</featureManager>

<sslDefault sslRef="DefaultSSLSettings" />

<ssl id="DefaultSSLSettings"
    keyStoreRef="CellDefaultKeyStore"
    trustStoreRef="CellDefaultTrustStore" />

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

<keyStore id="CellDefaultTrustStore"
    location="safkeyring:///Keyring.LIBERTY"
    password="password" type="JCERACFKS"
    fileBased="false" readOnly="true" />
```

   b) Save and exit the `server.xml` file.

      The Liberty Profile server will automatically detect and implement the changes.

Related tasks

“Planning to install and configure Db2 Adapter and related products” on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

“Creating a Liberty Profile for z/OS server for Db2 Adapter” on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

“Configuring SAF for user authentication and authorization” on page 30
You can configure and enable System Authorization Facility (SAF) to authenticate and authorize users to the Db2 Adapter services z/OS Connect.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

“Sample server.xml file” on page 65

The `server.xml` file describes the configuration details of the Liberty Profile for z/OS server in which Db2 Adapter for z/OS Connect runs. You may use the sample `server.xml` file to guide you through the configuration of the Liberty Profile server, the z/OS Connect feature, and related products.

Configuring SAF for user authentication and authorization

You can configure and enable System Authorization Facility (SAF) to authenticate and authorize users to the Db2 Adapter services z/OS Connect.

Procedure

1. Define the SAF user registry information in the Liberty Profile server configuration to enable SAF authentication.

   If you created the Liberty Profile server by using the Db2 Adapter configuration templates, follow the instructions embedded in the template files. Otherwise, follow these steps to update the `server.xml` file in the `WLP_USER_DIR/servers/<server_name>` directory. The default `WLP_USER_DIR` directory is `/u/<liberty_id>/usr`, where *<liberty_id>* is the ID you use to run the Liberty Profile server and *<server_name>* is `db2loc1`.

   a) Open the `server.xml` file and add the following highlighted lines:

   ```
   <webAppSecurity allowFailOverToBasicAuth="true" />
   <safRegistry id="saf" />
   <safAuthorization id="saf" />
   <safCredentials unauthenticatedUser="WSGUEST"
       profilePrefix="<profilePrefix>" />
   ```

   where *<profilePrefix>* is the prefix that you chose for the names of your SAF security profiles and `unauthenticatedUser` is set to `WSGUEST`, which is the default for the APPL class profile.

   b) Save and exit the `server.xml` file.

   The Liberty Profile server will automatically detect and implement the changes.

2. Issue the following RACF commands to define the SAF EJBROLE resource for the *<profilePrefix>*`.zos.connect.access.roles.zosConnectAccess` authorization role.

   ```
   RDEFINE EJBROLE <profilePrefix>.zos.connect.access.roles.zosConnectAccess
   OWNER(SYS1) UACC(NONE)
   SETR RACLIST(EJBROLE) REFRESH
   ```

3. Issue the following RACF commands to permit users access to z/OS Connect and Db2 Adapter services.

   ```
   PERMIT <profilePrefix>.zos.connect.access.roles.zosConnectAccess
   CLASS(EJBROLE) ID(uid) ACCESS(READ)
   SETR RACLIST(EJBROLE) REFRESH
   ```

   When the commands run successfully, `ID(`*uid*`)` is granted READ access to the EJBROLE class. If multiple IDs need the same access to the same class, consider using and granting a group `ID(`*gid*`)` READ access. All IDs that are associated with the group will have the same access. You can add new users to the group, instead of authorizing them individually.

4. Issue the following RACF commands to create a new SAF SERVER class profile that can control access to the EJBROLE class:

   ```
   RDEFINE SERVER BBG.SECPFX.<profilePrefix> UACC(NONE)
   PERMIT BBG.SECPFX.<profilePrefix> CLASS(SERVER) ACCESS(READ) ID(liberty_id)
   SETROPTS RACLIST(SERVER) REFRESH
   ```

   where *liberty_id* is the ID that is used to run the Liberty Profile server. The *<profilePrefix>* profile controls whether *liberty_id* has the authority to access the EJBROLE definitions in SAF.

5. If you have not done so, issue the following RACF commands to create a new SAF SERVER class profile and authorize *liberty_id* READ access to the profile.

```
RDEF SERVER BBG.AUTHMOD.BBGZSAFM.SAFCRED UACC(NONE) OWNER(SYS1)
PERMIT BBG.AUTHMOD.BBGZSAFM.SAFCRED CLASS(SERVER) ACCESS(READ) ID(liberty_id)
SETROPTS RACLIST(SERVER) REFRESH
```

6. Issue the following RACF commands to create a new SAF APPL class profile to control access to the Liberty Profile server:

```
RDEFINE APPL <profilePrefix> UACC(NONE) OWNER(SYS1)
PERMIT <profilePrefix> CLASS(APPL) ACCESS(READ) ID(unauth_ID)
PERMIT <profilePrefix> CLASS(APPL) ACCESS(READ) ID(*)
SETR RACLIST(APPL) REFRESH
```

   where *unauth_ID* is the ID value that you set for `unauthenticatedUser=WSGUEST` in the `server.xml` file.

7. Verify that ID `WSGUEST` already exists in SAF.

   If the ID does not exist, issue the following RACF commands to create and authorize the ID:

```
ADDGROUP WSGUESTG OMVS(GID(gid))
ADDUSER WSGUEST RESTRICTED DFLTGRP(WSGUESTG) OMVS(UID(uid)
    HOME(/path) PROGRAM(/bin/sh)) NAME('UNAUTHENTICATED USER')
        NOPASSWORD NOOIDCARD
```

8. Issue the following MVS command to start the Liberty Profile server as a started task:

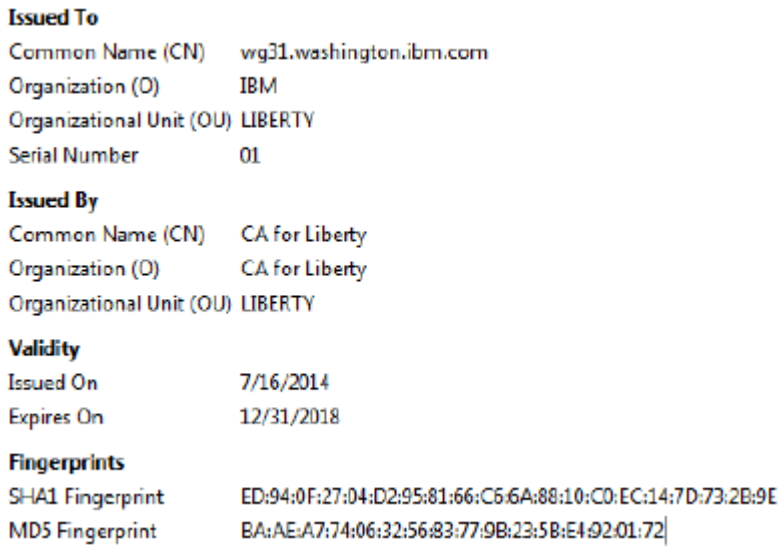
```
START BBGZSRV,PARMS='<server_name>'
```

   where *<server_name>* is `db2loc1`.

9. Open a browser and enter the following URL to accept the SSL certificate for authentication:

```
https://<host>:<port>/zosConnect/services
```

   Because this is the first time you are accessing the services after the SAF security configuration, you will be asked if you want to recognize the certificate. When prompted, click `View` the certificate. You should see certificate details similar to this:



   Accept the certificate.

10. When prompted, enter the user ID and password that you permitted READ access to the *<profilePrefix>*`.zos.connect.access.roles.zosConnectAccess` resource.

    After successful authentication, you should see a list of all available services like this:

```
{"zosConnectServices":[{"ServiceName":"DB2zAdapterDeploymentService",
    "ServiceDescription":"Deploy a new Db2 Adapter service or delete
    an existing Db2 Adapter service","ServiceProvider":"db2zadapter-1.0",
```

```
    "ServiceURL":"https://<host>:<port>/
    zosConnect/services/DB2zAdapterDeploymentService"}]}
```

What to do next

If you use SSL options in Liberty Profile and hardware cryptography, you may need to perform further WLP server configuration and grant additional CSFSERV access permissions. See the following resources for more information:

-
-
-
-

Related tasks

“Planning to install and configure Db2 Adapter and related products” on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

“Creating a Liberty Profile for z/OS server for Db2 Adapter” on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

“Configuring SAF as the SSL keystore” on page 28
You can configure and enable System Authorization Facility (SAF) as the Secure Sockets Layer (SSL) keystore for running the Liberty Profile server and z/OS Connect.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

“Sample server.xml file” on page 65
The `server.xml` file describes the configuration details of the Liberty Profile for z/OS server in which Db2 Adapter for z/OS Connect runs. You may use the sample `server.xml` file to guide you through the configuration of the Liberty Profile server, the z/OS Connect feature, and related products.

Enabling the z/OS Connect authorization interceptor

z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

Procedure

1. From a TSO session, issue the following RACF commands to give users UID1, UID2, and UID3 READ access to the EJBR0LE profile that controls access to the z/OS Connect servlet.

```
PERMIT <profilePrefix>.zos.connect.access.roles.zosConnectAccess
    CLASS(EJBROLE) ID(UID1) ACCESS(READ)
PERMIT <profilePrefix>.zos.connect.access.roles.zosConnectAccess
    CLASS(EJBROLE) ID(UID2) ACCESS(READ)
PERMIT <profilePrefix>.zos.connect.access.roles.zosConnectAccess
    CLASS(EJBROLE) ID(UID3) ACCESS(READ)
SETR RACLIST(EJBROLE) REFRESH
```

   where *<profilePrefix>* is the prefix that you have decided to use for the names of your SAF security profiles.
2. Issue the RACF ADDGROUP commands, similar to those in the following example, to define new SAF authorization groups:

```
ADDGROUP GADMIN OMVS(GID(gid))
ADDGROUP GOPERS OMVS(GID(gid))
ADDGROUP GINVOKE OMVS(GID(gid))
ADDGROUP SADMIN OMVS(GID(gid))
ADDGROUP SOPERS OMVS(GID(gid))
ADDGROUP SINVOKE OMVS(GID(gid))
```

The commands create three global authorization groups whose names start with G and three service-level authorization groups whose names start with S. Make sure that you work with your security administrator to use group names that are applicable to your environment.

3. Issue the following RACF commands to associate user UID1 with the GADMIN global group, user UID2 with the GOPERS global group, and user UID3 with the SINVOKE service level group:

```
CONNECT UID1 GROUP(GADMIN)
CONNECT UID2 GROUP(GOPERS)
CONNECT UID3 GROUP(SINVOKE)
```

Make sure that users UID1, UID2, and UID3 have the following authorities respectively:

- UID1 has the administration level authority and can query all available Db2 Adapter services, perform operational tasks on the services, and invoke them.
- UID2 has the operation level authority and can perform tasks on all Db2 Adapter services, but cannot invoke them.
- UID3 has the invocation level authority and can deploy or undeploy Db2 Adapter services, but does not have any other authority over them.

4. If you have not done so, issue the following RACF commands to create a new SAF SERVER class profile and authorize *liberty_id* READ access to the profile.

```
RDEF SERVER BBG.AUTHMOD.BBGZSAFM.SAFCRED UACC(NONE) OWNER(SYS1)
PERMIT BBG.AUTHMOD.BBGZSAFM.SAFCRED CLASS(SERVER) ACCESS(READ) ID(liberty_id)
SETROPTS RACLIST(SERVER) REFRESH
```

where *liberty_id* is the ID that you use to run the Liberty Profile server.

5. Define the new authorization groups in the Liberty Profile server configuration.

If you created the Liberty Profile server by using the Db2 Adapter configuration templates, follow the instructions embedded in the template files. Otherwise, follow these steps to update the `server.xml` file in the `WLP_USER_DIR/servers/<server_name>` directory. The default `WLP_USER_DIR` directory is `/u/<liberty_id>/usr`, where *<liberty_id>* is the ID you use to run the Liberty Profile server and *<server_name>* is `db2loc1`.

a) Open the `server.xml` file and add the following highlighted lines and strings:

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

<zosConnectManager
    globalAdminGroup="GADMIN"
    globalOperationsGroup="GOPERS"
    globalInvokeGroup="GINVOKE"
    globalInterceptorsRef="interceptorList_g" />

<authorizationInterceptor id="auth" />
<auditInterceptor id="audit" />

<zosConnectInterceptors
    id="interceptorList_g"
    interceptorRef="auth, audit"/>

zosConnectService id="DB2zAdapterDeploymentService"
    serviceName="DB2zAdapterDeploymentService"
    serviceDescription="Deploy a new Db2 Adapter service or
        delete an existing Db2 Adapter service"
    invokeGroup="SINVOKE"
    serviceRef="DB2zAdapterDB2zAdapterDeploymentService" />
```

b) Save and exit the `server.xml` file.

The Liberty Profile server will automatically detect and implement the changes.

Related tasks

“Planning to install and configure Db2 Adapter and related products” on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

“Configuring SAF as the SSL keystore” on page 28
You can configure and enable System Authorization Facility (SAF) as the Secure Sockets Layer (SSL) keystore for running the Liberty Profile server and z/OS Connect.

“Enabling the z/OS Connect audit interceptor” on page 37
z/OS Connect supplies an audit interceptor that writes 120.11 records to the z/OS System Management Facility (SMF) data store. You can configure and enable the supplied audit interceptor to track and audit the usage of z/OS Connect and thus Db2 Adapter for z/OS Connect.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

“Sample server.xml file” on page 65
The `server.xml` file describes the configuration details of the Liberty Profile for z/OS server in which Db2 Adapter for z/OS Connect runs. You may use the sample `server.xml` file to guide you through the configuration of the Liberty Profile server, the z/OS Connect feature, and related products.

Configuring the Db2 Adapter data source

You must configure a Db2 Adapter data source in the Liberty Profile server to encapsulate all communications between Db2 Adapter and Db2.

Before you begin

Db2 Adapter uses the IBM Data Server Driver for JDBC and SQLJ as the JDBC driver to interact with Db2. Make sure that you set the *JCC_HOME* system variable to a valid JDBC driver installation directory and specify the variable in the server property file (`bootstrap.properties`) of the Liberty Profile server.

You must use a Db2 authorization method for running the Db2 Adapter services. The authorization method that you choose affects the configuration of the Db2 Adapter data source. Make sure that you choose a Db2 authorization method before you configure the Db2 Adapter data source.

Procedure

1. Locate and make a copy of the `sampleDb2zAdapterDataSources.xml` file to create a `db2zAdapterDataSources.xml` file.

   The `sampleDb2zAdapterDataSources.xml` file is provided through the Db2 Adapter sample template files. If you specify the `--template=db2zAdapterServer` option for creating the Liberty Profile server, the **`create`** command copies the `sampleDb2zAdapterDataSources.xml` and other sample configuration files into the `WLP_USER_DIR/servers/<server_name>` directory, where *<server_name>* is the name of the Liberty Profile server that you create. If you use the default `WLP_USER_DIR` directory, the samples are in the `/u/<liberty_id>/usr/servers/db2loc1` directory, where *<liberty_id>* is the user ID under which the new Liberty Profile server runs, and `db2loc1` is the server name.

   You can also find these sample configuration files in the `WLP_INSTALL_DIR/templates/servers/db2zAdapterServer` (`/usr/lpp/db2zadapterv1r1/templates/servers/db2zAdapterServer`) directory.

2. Edit the new `db2zAdapterDataSources.xml` file by modifying the `db2zadapter_db2zAdapterDataSource` data source element.

   The `db2zadapter_db2zAdapterDataSource` element includes the following attributes:

   applName
   Specifies the name of the DB2®Db2 subsystem that Db2 Adapter uses to obtain RACF PassTickets. Specifying the `applName` attribute in the data source implicitly enables the RACF PassTicket support for Db2 Adapter; removing the attribute disables the PassTicket support. Make sure that you complete the configuration of Db2 Adapter to use RACF PassTickets.

   The `applName` value must match that specified for APPLNAME of the target Db2 subsystem. Consult with your Db2 system programmer to determine the correct APPLNAME value. A Db2 APPLNAME is either the generic LU name, the IPNAME assigned to each member of a serving data sharing group, or the LUNAME or IPNAME assigned to the serving non-data sharing subsystem.

   databaseName
   Specifies the location name of the target Db2 for z/OS database.

   driverType
   Specifies the type of the JDBC driver that Db2 Adapter uses to create connections. The default is Type 4.

   enableSysplexWLB
   Specifies if the sysplex workload balancing support is used by the data source. The sysplex workload balancing is only applicable when a Type 4 JDBC driver is specified.

   id
   Specifies the data source ID, which by default is `db2zAdapterDataSource`. Consider using this default data source ID because all Db2 Adapter service definitions reference the data source by using this default ID. If you choose to use a different ID, make sure to update the data source references in the service definitions.

   maxPoolSize
   Specifies the size for the connection pool. The default pool size is 40.

   maxStatements
   Specifies the maximum number of JDBC PreparedStatement objects that are pooled by each Db2 Connection. The default is 0.

   password
   Specifies the password for the user name or ID, which is required if you do not enable the RACF PassTicket support.

   portNumber
   Specifies the Db2 for z/OS port to which Db2 Adapter connects.

   serverName
   Specifies the host name or the IP address of the DB2 z/OS server or data sharing group for remote connections, which is required when a Type 4 JDBC driver is specified.

   serviceRunAs
   Specifies the user that a Db2 Adapter service uses for invocation or execution. This property is optional.

   0
   Indicates that the property is not specified in the Db2 Adapter service definition itself, which is the default setting. Instead, the service uses the setting of the property as defined in the data source.

   1
   Uses the user ID as defined in the data source. This is the default setting of the property in the data source definition.

2
Uses the service owner ID as defined in the Db2 Adapter service definition. This setting requires that the Db2 trusted context support, the RACF PassTicket support, or both are enabled and defined in the data source.

3
Uses the service invoker ID. This setting requires that the Db2 trusted context support, the RACF PassTicket support, or both are enabled and defined in the data source.

ssid
Specifies the Db2 subsystem ID or data sharing group name for local connections, which is required when a Type 2 JDBC driver is specified.

trustedContext
Specifies whether a Db2 for z/OS trusted context is enabled and used for connections between Db2 Adapter and Db2. If you enable the Db2 trusted context, the user name or ID you specify for the `user` attribute is used to establish the trusted connection with Db2.

user
Specifies the user name or ID that is used as the Db2 Adapter data source ID. The Db2 authorization method that you choose for service execution affects how this user name or ID is used. If you enable the Db2 trusted context, the ID is used to establish the trusted connection. If you do not enable the Db2 trusted context or the RACF PassTicket, the ID is used to run all Db2 Adapter services in Db2.

The following example `Db2zAdapterDataSources.xml` file shows the `db2zadapter_db2zAdapterDataSource` element and possible attributes:

```
<?xml version="1.0" encoding="UTF-8"?>
<server>
    <db2zadapter_db2zAdapterDataSource
        id="db2zAdapterDataSource"
        databaseName="DB2NAME1"
        serverName="xxxxx.xxxx.xxxx.xxx"
        portNumber="446"
        driverType="4"
        user="admin1"
        applName="APPLNAME1"
        trustedContext="true" />
</server>
```

In the example, the `driver`Type attribute is set to Type 4. If you plan to use a Type 2 JDBC driver, set `driverType="2"`. In addition, you must specify the `ssid` attribute, as shown in the following example:

```
<?xml version="1.0" encoding="UTF-8"?>
<server>
    <db2zadapter_db2zAdapterDataSource
        id="db2zAdapterDataSource"
        databaseName="DB2NAME1"
        driverType="2"
        ssid="VAIA"
        user="admin1"
        applName="APPLNAME1"
        trustedContext="true" />
</server>
```

3. Create a Db2 trusted context and establish trusted connections if you set `trustedContext="true"`.
   a) Work with your security administrator to obtain the authority required for creating trusted context objects.
   b) Issue the following SQL **CREATE** statement to create a trusted context and authorize users access to the object:

      If you set `driverType="4"`, the **CREATE** statement should look like this:

      ```
      CREATE TRUSTED CONTEXT MY_DB2_CTX
      BASED UPON CONNECTION USING SYSTEM AUTHID ADMIN1
      ```

```
ATTRIBUTES (ADDRESS 'x.xx.xxx.xxx')
ENABLE WITH USE FOR ADMF010,OEUSR05,0EUSR06 WITHOUT AUTHENTICATION
```

where

- ADDRESS is the IP address that originates in z/OS and is assigned to the client request. Typically, this IP address is the home address of the primary TCP/IP interface.
- ADMF010, OEUSR05, and OEUSR6 are a list of the invokers or owners of the user-defined service that are used to run the services. The list should include all IDs that can run each service.

If you set `driverType="2"`, the **CREATE** statement should look like this:

```
CREATE TRUSTED CONTEXT MY_DB2_CTX
BASED UPON CONNECTION USING SYSTEM AUTHID ADMIN1
ATTRIBUTES (JOBNAME 'XXXXXXX')
ENABLE WITH USE FOR ADMF010,OEUSR05,0EUSR06 WITHOUT AUTHENTICATION
```

where JOBNAME is the started task name for the Liberty Profile server.

Related concepts

Trusted contexts (Managing Security)

Related tasks

"Planning to install and configure Db2 Adapter and related products" on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

"Installing Db2 Adapter for z/OS Connect" on page 17
Db2 Adapter for z/OS Connect is a feature of Db2 Accessories Suite for z/OS Version 3 Release 3. You must use System Modification Program Extended (SMP/E) to install Db2 Adapter.

"Enabling Db2 Adapter to use RACF PassTickets" on page 27
Instead of sending clear text passwords through the network, RACF provides the ability to generate PassTickets for a requesting application. Users of the application can then use the PassTickets to authenticate within a RACF-secured network. You can configure RACF to generate PassTickets for Db2 Adapter users and then enable Db2 Adapter to use the PassTickets.

"Configuring a Liberty Profile server as a z/OS started task" on page 24
You can configure a Liberty Profile server to run as a z/OS started task.

Related reference

"Security of Db2 Adapter for z/OS Connect" on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

"Sample db2zAdapterDataSources.xml file" on page 68
The `sampleDb2zAdapterDataSources.xml` file contains a sample configuration of the Db2 Adapter data source. You must rename and customize the file before you can use it.

Enabling the z/OS Connect audit interceptor

z/OS Connect supplies an audit interceptor that writes 120.11 records to the z/OS System Management Facility (SMF) data store. You can configure and enable the supplied audit interceptor to track and audit the usage of z/OS Connect and thus Db2 Adapter for z/OS Connect.

Before you begin

The z/OS Connect audit interceptor implements the `com.ibm.wsspi.zos.connect.Interceptor` service provider interface (SPI) and generates SMF type 120, subtype 11 records. You can enable the interceptor on a single or group of z/OS Connect services. Make sure that the `PARMLIB SMFPRMxx` member in use can write 120.11 records and the Liberty Profile server ID *liberty_id* has at least `READ` access to the System Authorization Facility (SAF) `BPX.SMF` class.

Procedure

1. Define the supplied audit interceptor information in the Liberty Profile server configuration.

   If you created the Liberty Profile server by using the Db2 Adapter configuration templates, follow the instructions embedded in the template files. Otherwise, follow these steps to update the `server.xml` file in the `WLP_USER_DIR/servers/<server_name>` directory. The default `WLP_USER_DIR` directory is `/u/<liberty_id>/usr`, where *<liberty_id>* is the ID you use to run the Liberty Profile server and *<server_name>* is `db2loc1`.

   a) Open the `server.xml` file and add the following highlighted lines:

```
<featureManager>
    <feature>jsp-2.2/feature>
    <feature>appSecurity-2.0/feature>
    <feature>zosConnect-1.0/feature>
</featureManager>
<keyStore id="defaultKeyStore" password="Liberty"/>
<webAppSecurity allowFailOverToBasicAuth="true" />
<basicRegistry id="basic1" realm="zosConnect">
    <user name="userid" password="userpwd" />
</basicRegistry>
<authorization-roles id="zos.connect.access.roles">
    <security-role name="zosConnectAccess">
        <user name="userid"/>
    </security-role>
</authorization-roles>

<zosConnectManager
    globalInterceptorsRef="interceptorList_g" />

<auditInterceptor id="audit" />

<zosConnectInterceptors
    id="interceptorList_g"
    interceptorRef="audit"/>

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

   The `auditInterceptor` element defines the z/OS Connect-supplied SMF 120.11 audit interceptor. The `zosConnectInterceptors>` element is used to create an interceptor list that has a name (`id="interceptorList_g"`) and identifies the interceptor to be used (`interceptorRef="audit"`). The `zosConnectManager` element defines the global interceptor that provides a reference of the interceptor list (`id="interceptorList_g"`) to the backend process. This global definition indicates that the audit interceptor is enabled for all available services.

   b) Save and exit the `server.xml` file.

   The Liberty Profile server will automatically detect and implement the changes.

2. Verify that SMF 120.11 records are generated for HTTPS requests that come through the Liberty Profile server.

   a) From the z/OS console, issue the **/I SMF** command to switch the SMF data set.

   b) In a REST client, send the Liberty Profile server a few requests by entering URLs, such as the one in this example:

```
https://<host>:9443/zosConnect/services/service_name?action=status
```

   c) Switch the SMF data set again by issuing the **/I SMF** command.

   d) Use a SMF dump utility to dump that data set for reading or printing.

   e) Review the output and make sure that 120 records are processed as part of that dump operation.

3. Read SMF records by using the SMF browser.

The SMF browser is a free Java program that reads SMF dump data sets and formats them for improved readability. It does not replace some common SMF analysis tools that you use to analyze the data in SMF 120.11 records.

a) Download the free SMF browser from https://www-01.ibm.com/marketing/iwm/iwm/web/pickUrxNew.do?source=zosos390.

b) When prompted, sign in with your `IBM.COM` user ID and password.

   If you do not have an `IBM.COM` account yet, register for one by clicking the Register here link.

c) Accept the terms of use and proceed to download and save the `SMF Browser for WebSphere bbomsmfv.jar (795 KB)` file in any directory *smf_browser_dir* on your system.

4. Create a shell script `runSMF.sh` in a directory of your choice and populate it with the following strings:

```
export JAVA_HOME=/JAVA_HOME
export CLASSPATH=/smf_browser_dir/bbomsmfv.jar
export CLASSPATH=$CLASSPATH:/$JAVA_HOME/lib/ext/ibmjzos.jar
java com.ibm.ws390.sm.smfview.SMF "INFILE(SMF.DATASET)"
```

where *JAVA_HOME* is the path to a validate Java installation on your system, *smf_browser_dir* is the directory in which you store the SMF browser code, and *SMF.DATASET* is the SMF dump data set that contains the SMF 120.11 records.

5. Launch the SMF browser to access and read the SMF dump data set by running the `runSMF.sh` script.

   For each SMF 120.11 record in the data set, you should see output similar to the one in this example:

```
-------------------------------------------------------------------------------
------
Record#: 2;
    Type: 120; Size: 2212; Date: Tue Jul 15 14:13:06 EDT 2014;
    SystemID: WG31; SubsystemID: WAS; Flag: 94;
    Subtype: 11 (Liberty Request Activity);

    #Subtype Version: 1;
    Index of this record: 0;
    Total number of records: 1;
    record continuation token * 00000000 00000000 -------- -------- *
    #Triplets: 2;
    Triplet #: 1; offsetDec: 72; offsetHex: 48; lengthDec: 80; lengthHex: 50;
count: 1;
    Triplet #: 2; offsetDec: 152; offsetHex: 98; lengthDec: 2060; lengthHex: 80c;
count: 1;

Triplet #: 1; Type: LibertyServerInfoSection;
    Server Info Version   :     1;
    System Name (CVTSNAME): WG31;
    Sysplex Name          : WSLPLEX;
    JobID                 : STC00250;
    JobName               : BBGZSRV;
    Stoken                * 000000f8 00000014 ------- *

Triplet #: 2; Type: UserDataSection;
    Version               : 1;
    Data Type             : 102;
    Data Length           : 251;
    data version          : 1;
    arrival Time          * cd7507b4 fa0dc3b1 -------- -------- *
    completion Time       * cd7507b4 fd2e9129 -------- -------- *
    target URI            : /zosConnect/services/CICS-backend;
    input Length          : 62;
    service name          : CICS-backend;
    method name           : PUT;
    response Length       : 70;
    userid                : Fred;
-------------------------------------------------------------------------------
------
```

Related tasks

"Planning to install and configure Db2 Adapter and related products" on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

"Enabling the z/OS Connect authorization interceptor" on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

Related reference

"Security of Db2 Adapter for z/OS Connect" on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

"Sample server.xml file" on page 65
The `server.xml` file describes the configuration details of the Liberty Profile for z/OS server in which Db2 Adapter for z/OS Connect runs. You may use the sample `server.xml` file to guide you through the configuration of the Liberty Profile server, the z/OS Connect feature, and related products.

Enabling SAF-based client certificates for authentication

z/OS Connect uses client certificates as the default authentication mechanism. You can create SAF-based client certificates for users to import and use for authenticating with z/OS Connect.

Procedure

1. From a TSO session, issue the following RACF command to give user UID1 READ access to the EJBROLE profile that controls access to the z/OS Connect servlet.

```
PERMIT <profilePrefix>.zos.connect.access.roles.zosConnectAccess
    CLASS(EJBROLE) ID(UID1) ACCESS(READ)
SETR RACLIST(EJBROLE) REFRESH
```

2. Issue the following RACF command to create a new client certificate and a new CA (certificate authority) certificate for user UID1:

```
RACDCERT ID(FRED) GENCERT SUBJECTSDN(CN('User UID1 Client')
    O('IBM') OU('LIBERTY')) WITHLABEL('UID1')
        SIGNWITH(CERTAUTH LABEL('LibertyCA.LIBERTY')) SIZE(2048)
            NOTAFTER(DATE(2018/12/30))
```

3. Issue the following RACF command to export the new client certificate to a data set:

```
RACDCERT ID(UID1) EXPORT(LABEL('UID1'))
    DSN('userid.UID1.P12') FORMAT(PKCS12DER)
        PASSWORD('password')
```

   where *userid* is the ID that is used to issue this command and *password* is the password that is used to encrypt the client certificate. Remember this password, which is case sensitive, and keep it handy because you will need to use it when importing the client certificate. If you need to send both the *password* and the client certificate to another user, send them separately.

4. Issue the following RACF command to export the CA certificate to another data set:

```
RACDCERT CERTAUTH EXPORT(LABEL('LibertyCA.LIBERTY'))
    DSN(userid.CERTAUTH.CRT') FORMAT(CERTDER)
```

   where *userid* is the ID that is used to issue this command.

5. Use FTP to download the new certificates (*userid*`.UID1.p12` for data set `userid.UID1.P12` and *userid*`.certauth.crt` for data set `userid.CERTAUTH.CRT`) in binary onto your system.

6. Import the new CA certificate to a browser that you use to access z/OS Connect.
   a) Double-click the new CA certificate (*userid*.certauth.crt) to display the Certificate panel on your Windows system.
   b) Click Install Certificate to launch the Certificate Import Wizard.
   c) Click Next to skip the welcome message.
   d) Select Place all certificates in the following store to ensure that the new certificate is stored in the right place.
   e) Click Browse to select Trusted Root Certification Authorities as the certificate store and then Next.
   f) Click Finish and then Yes to acknowledge the security warning.
   g) Click OK on the confirmation panel to close the wizard.
7. Import the new client certificate to your browser.
   a) Double-click the new client certificate (*userid*.UID1.p12) to display the Certificate panel on your Windows system.
   b) Click Install Certificate to launch the Certificate Import Wizard.
   c) Click Next to skip welcome message.
   d) Click Next on the File to Import panel to display the Password panel.

      Remember that the *password* is case sensitive; enter exactly the same *password* that you used for exporting the client certificate and click Next to continue.
   e) Select Place all certificates in the following store to ensure that the new certificate is stored in the right place.
   f) Click Browse to select Personal as the certificate store and then Next.
   g) Click Finish and then Yes to acknowledge the security warning.
   h) Click OK on the confirmation panel to close the wizard.
8. Verify that your browser accepts and recognizes the new certificates in the certificate management settings.
9. Enable z/OS Connect to use certificate-based authentication by modifying the Liberty Profile server configuration.

   If you created the Liberty Profile server by using the Db2 Adapter configuration templates, follow the instructions embedded in the template files. Otherwise, follow these steps to update the server.xml file in the WLP_USER_DIR/servers/*<server_name>* directory. The default WLP_USER_DIR directory is /u/*<liberty_id>*/usr, where *<liberty_id>* is the ID you use to run the Liberty Profile server and *<server_name>* is db2loc1.

   a) Open the server.xml file and delete the following highlighted line, if it exists:

```
<webAppSecurity allowFailOverToBasicAuth="true" />
<safRegistry id="saf" />
<safAuthorization id="saf" />
<safCredentials unauthenticatedUser="WSGUEST"
    profilePrefix="profilePrefix" />
```

   Deleting the webAppSecurity element removes the basic role-based authentication if you have already configured it.

   b) Add the following highlighted lines right before the closing bracket for the <ssl> element to enable certificate-based authentication:

```
<sslDefault sslRef="DefaultSSLSettings" />

<ssl id="DefaultSSLSettings"
    keyStoreRef="CellDefaultKeyStore"
    trustStoreRef="CellDefaultTrustStore"
    clientAuthenticationSupported="true"
clientAuthentication="true" />
```

```
<keyStore id="CellDefaultKeyStore"
    location="safkeyring:///Keyring.LIBERTY"
    password="password" type="JCERACFKS"
    fileBased="false" readOnly="true" />

<keyStore id="CellDefaultTrustStore"
    location="safkeyring:///Keyring.LIBERTY"
    password="password" type="JCERACFKS"
    fileBased="false" readOnly="true" />
```

c) Save and exit the `server.xml` file.

The Liberty Profile server will automatically detect and implement the changes.

10. Verify that the new certificates are used to authenticate withz/OS Connect by entering the following URL in a browser:

```
https://<host>:<port>/zosConnect/services
```

When prompted for a client certificate, select user *UID1* and click 0K to complete the setup of certificate-based authentication. If you see a list of available services, it means that the new client certificate satisfies the z/OS Connect requirement for authentication. The certificate represents user UID1 who has the READ access to the EJBR0LE profile and the global administration level authority over all available services.

Related tasks

“Configuring SAF as the SSL keystore” on page 28
You can configure and enable System Authorization Facility (SAF) as the Secure Sockets Layer (SSL) keystore for running the Liberty Profile server and z/OS Connect.

“Enabling the z/OS Connect authorization interceptor” on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

“Enabling the z/OS Connect audit interceptor” on page 37
z/OS Connect supplies an audit interceptor that writes 120.11 records to the z/OS System Management Facility (SMF) data store. You can configure and enable the supplied audit interceptor to track and audit the usage of z/OS Connect and thus Db2 Adapter for z/OS Connect.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

“Sample server.xml file” on page 65
The `server.xml` file describes the configuration details of the Liberty Profile for z/OS server in which Db2 Adapter for z/OS Connect runs. You may use the sample `server.xml` file to guide you through the configuration of the Liberty Profile server, the z/OS Connect feature, and related products.

Chapter 7. Working with Db2 Adapter services

You can create, deploy, and undeploy Db2 Adapter services that interact with the underlying Db2 objects. You can then discover, invoke, start, stop, or query the status of these services through a set of REST APIs that Db2 Adapter provides.

Before you begin

You can use the Db2 Adapter REST APIs through a REST client in a web, mobile, or cloud environment. If you use a web browser to interact with the Db2 Adapter APIs, consider installing a REST client for your browser. REST clients for browsers are typically available as a plug-in, add-on, or extension.

Db2 Adapter uses z/OS Connect to authorize and authenticate users for performing service tasks. If System Authorization Facility (SAF) is configured for additional security, you need the appropriate authority to perform a specific Db2 Adapter service task. For example, you must have the administrator or operator authority to discover, start, or stop a service.

Procedure

You can perform the following Db2 Adapter service tasks:

__ • “Creating, deploying, or undeploying a Db2 Adapter service” on page 44

__ • “Modifying a Db2 Adapter service” on page 51

__ • “Discovering available Db2 Adapter services” on page 53

__ • “Retrieving details of a Db2 Adapter service” on page 54

__ • “Retrieving JSON request and response schemas of a Db2 Adapter service” on page 56

__ • “Querying the status of a Db2 Adapter service” on page 58

__ • “Starting a Db2 Adapter service” on page 59

__ • “Stopping a Db2 Adapter service” on page 60

__ • “Invoking a Db2 Adapter service” on page 61

Related concepts

Db2 Adapter for z/OS Connect (Deprecated)

Related tasks

“Installing and configuring Db2 Adapter for z/OS Connect” on page 13

Db2 Adapter for z/OS Connect is a complete solution that includes IBM WebSphere Application Server Liberty Profile for z/OS and the z/OS Connect feature. It also requires tooling support from the IBM Data Studio client. You must install and configure all the products and features before you can use Db2 Adapter.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9

Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

Related information

“Samples and reference” on page 65

Samples and reference information can help you understand how a product is installed, configured, and used. You can use the following samples of server and service configuration, job input and output, embedded instructions, and other reference information to guide you through the installation, configuration, and operation of the Db2 Adapter for z/OS Connect and related products.

© Copyright IBM Corp. 2015, 2015

Creating, deploying, or undeploying a Db2 Adapter service

With the required authority, you can create, deploy, or undeploy a Db2 Adapter service by using the IBM Data Studio client.

Before you begin

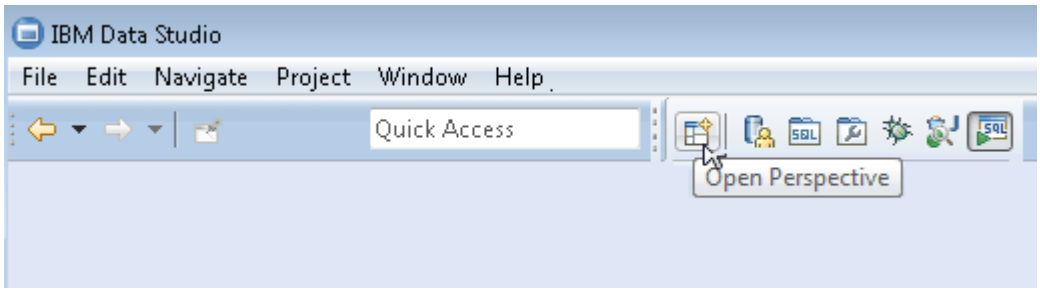
- Download and install Data Studio 4.1.2 or later. The Data Studio client provides the development tools that you need to create, deploy, or undeploy a Db2 Adapter service.
- Install, configure, and start the Liberty Profile for z/OS server.
- Obtain the authority or the user ID that is authorized to invoke the Db2 Adapter service deployment service (`DB2zAdapterDeploymentService`). The Data Studio client uses the same authority or user ID to deploy or undeploy a Db2 Adapter service.

Procedure

1. Launch the IBM Data Studio client and switch to the `IBM SQL and Routine Development` perspective.

   The IBM Data Studio client organizes functionality and tool sets into perspectives. The `IBM SQL and Routine Development` perspective is primarily for application development. The perspective opens several views, including `Data Source Explorer (DSE)`, `Data Project Explorer (DPE)`, and `Properties`.

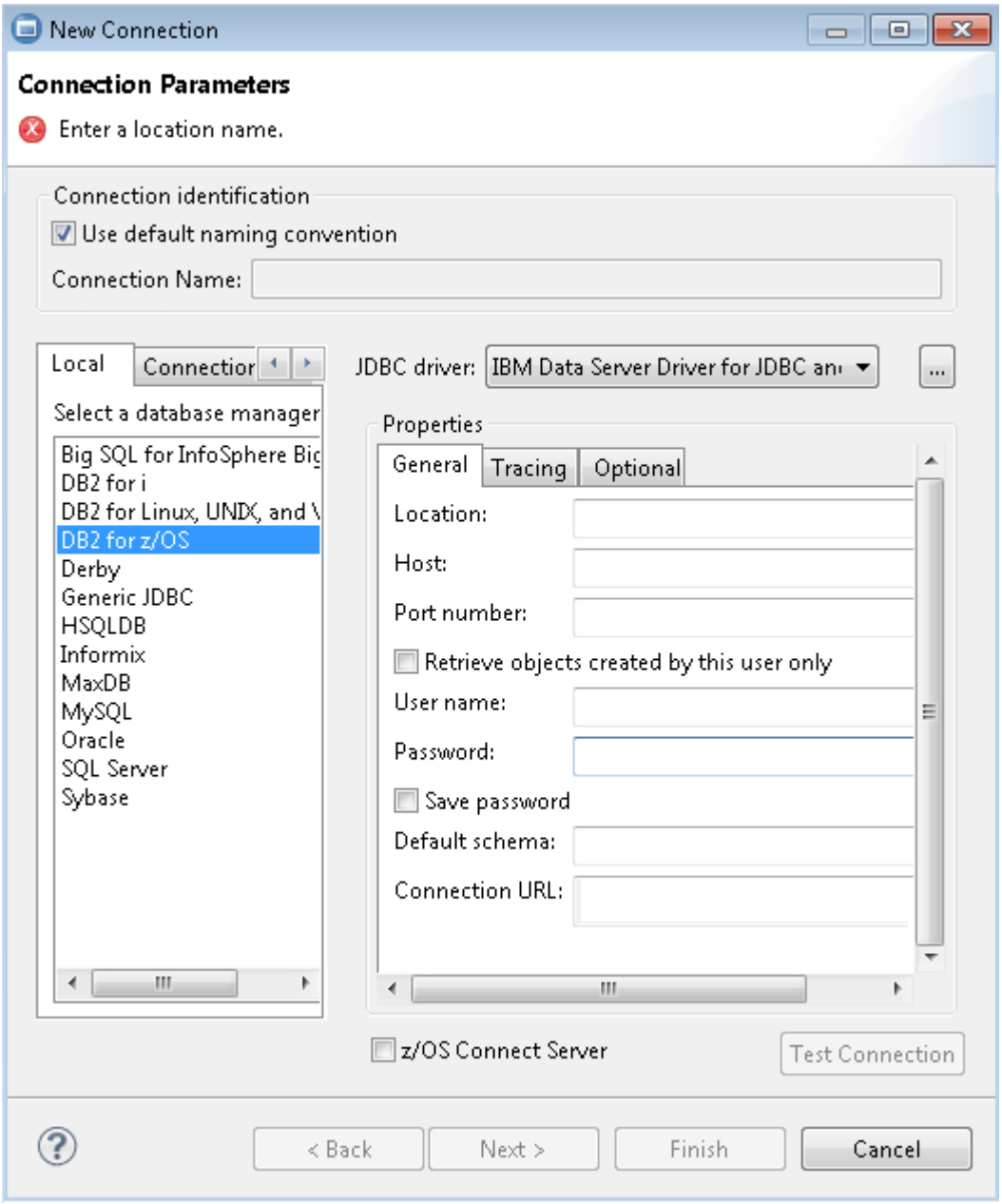
   You can click the `Open Perspective` icon or the `Window > Open Perspective` menu on the toolbar to open the perspective.

2. In the DSE view, create a new database connection by clicking the `New Connection Profile` icon or right-clicking `Database Connections` and then selecting New.

   This opens the `New Connection` window:

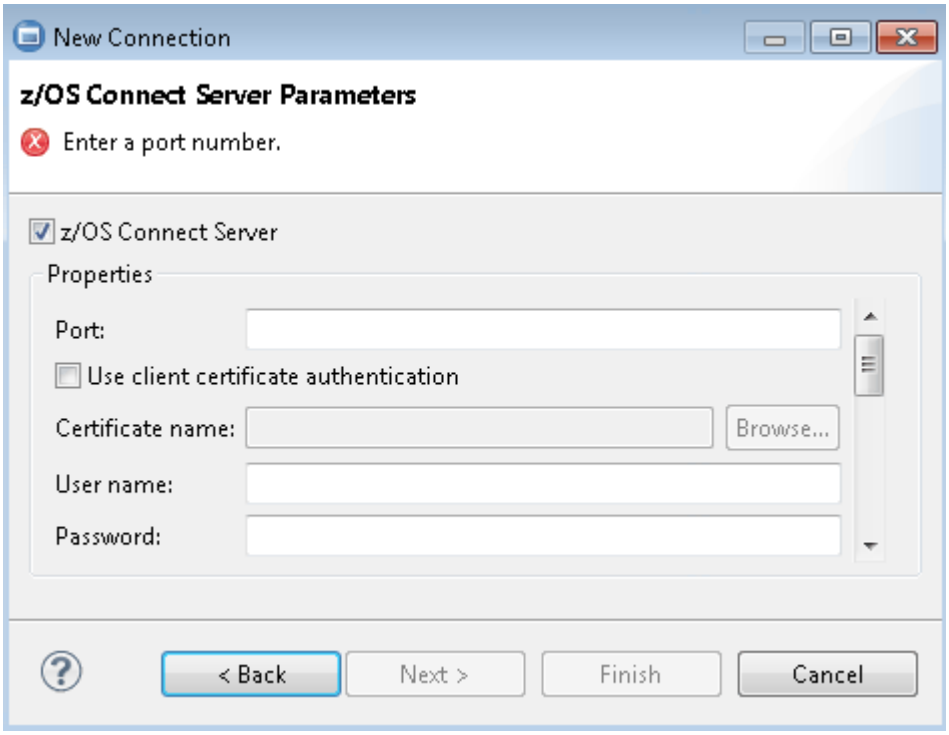


3. For the new connection, select a database manager and a JDBC driver, check z/OS Connect server, and specify all required connection parameters.
   a) For Connection identification, check the optional box for `Use default naming convention`.
   b) In the Local tab, select `DB2 for z/OS` as the database manager.
   c) For JDBC driver, select `IBM Data Server Driver for JDBC and SQLJ (JDBC 4.0) Default`.
   d) In the General tab for connect properties, enter a valid location name, host name, port number, user name, and password.

      Make sure that the connection properties match those for the Db2 subsystem or data sharing group as specified in the Db2 Adapter data source configuration. Complete other fields as needed.
   e) Click `Test Connection`.

      A "Connection succeeded" message is returned if all the information that you entered is valid.
   f) Check `z/OS Connect server` and then `Next` to display the z/OS Connect Server Parameters page.

Make sure the `z/OS Connect server` box remains checked.



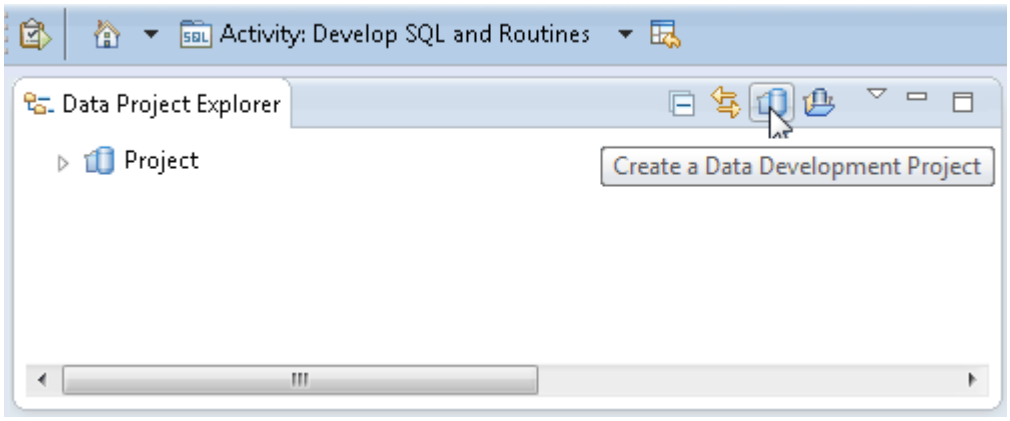
g) For Properties, enter the HTTPS port number of your Liberty Profile server. Specify a valid client certificate name if you select `Use client certificate authentication`; otherwise, enter a valid user name and password.

h) Click `Finish` or `Next` to complete the creation of the new connection.

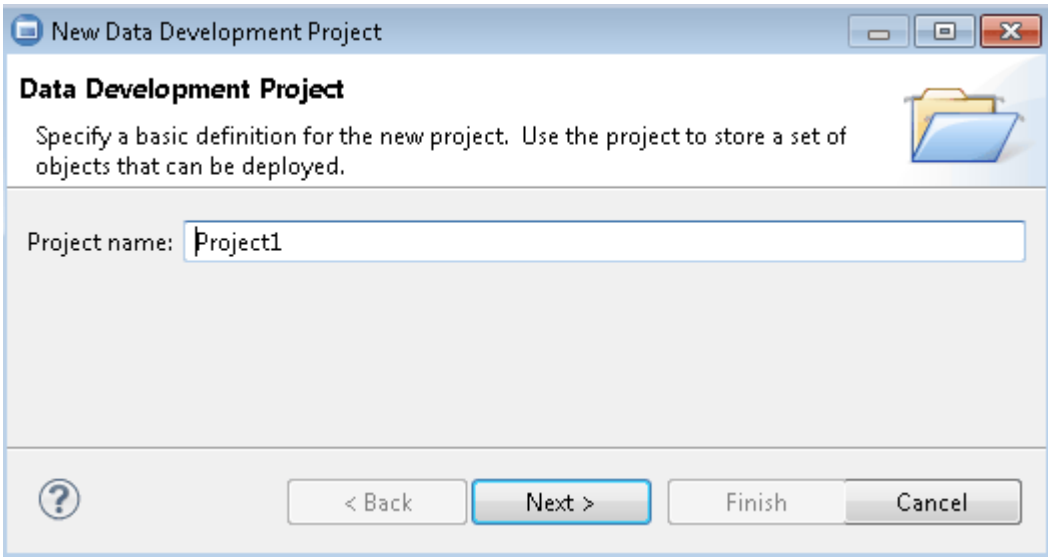
Make sure that connection *<connection_name>* is created and displayed in the `Database Connections` folder.

i) Review the z/OS Connect server connection information in the `Properties` view. If necessary, make and apply changes to the parameters in the `Properties` view.

4. In the DPE view, click the link or icon for `Create a New Data Development Project`.

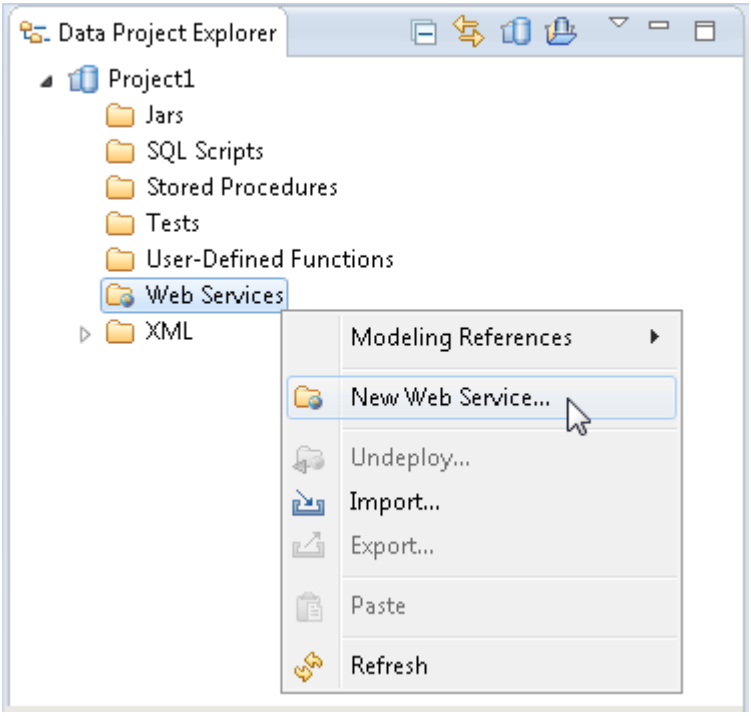


The `New Data Development Project` window displays:

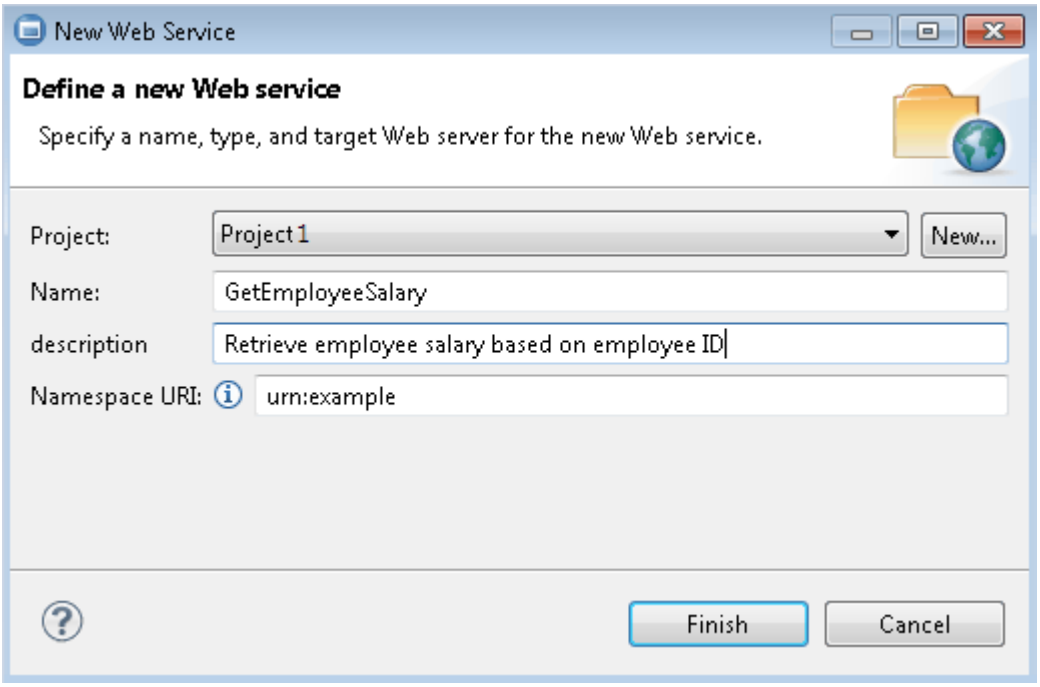


5. For the new data development project, specify a project name *<project_name>* and click `Next`. In the next panel, choose a connection profile *<connection_name>* that you created and click `Finish` or `Next` to complete the creation of the project.

   Make sure that project *<project_name>* is created and listed in the projects list.
6. Expand the project list and browse for the `Web Services` folder.
7. Create a new Db2 Adapter service by right-clicking `Web Services` and then selecting `New Web Service`.

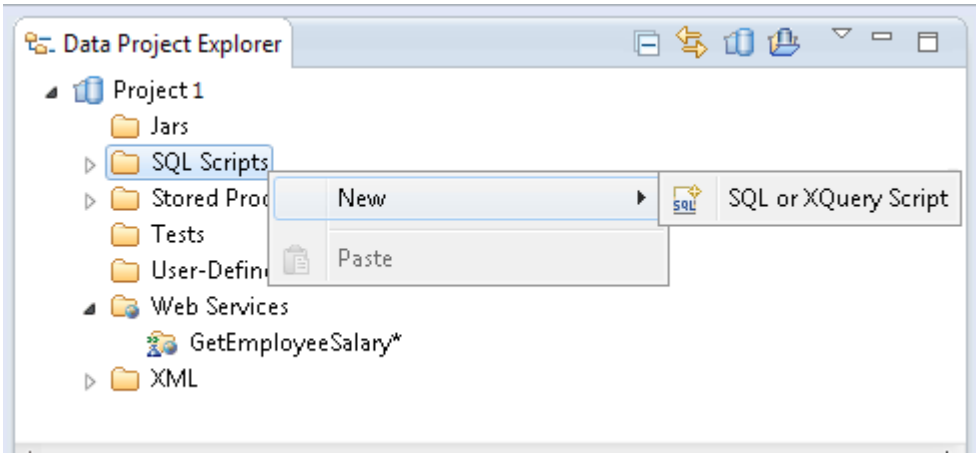


8. For the new web service, select a data development project, enter a valid service name *<webservice_name>* and service description. Keep the default *urn:example* value for the `Namespace URI` field. Click `Finish` to create the new service.



Make sure that service *<webservice_name>* is created and displayed in the `Web Services` folder. When this service is deployed, it becomes a Db2 Adapter service.

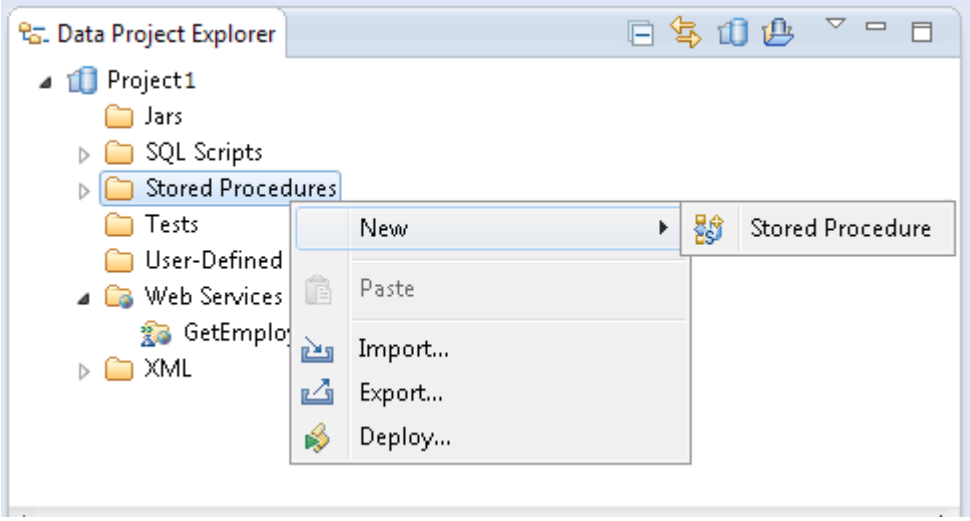
9. Create a SQL script for the new service *<webservice_name>* by right-clicking `SQL Scripts` and then selecting `New > SQL or XQuery`:



10. For the new SQL script, enter a name *<script_name>*, select `SQL Query Editor`, enter your statement and click `Finish` to create the SQL script.

    Make sure that the SQL statement is fully qualified. Verify that script *<script_name>* is created and displayed in the SQL Scripts folder. This script is the operation which you can associate with a Db2 Adapter service. Each Db2 Adapter service can support one operation.

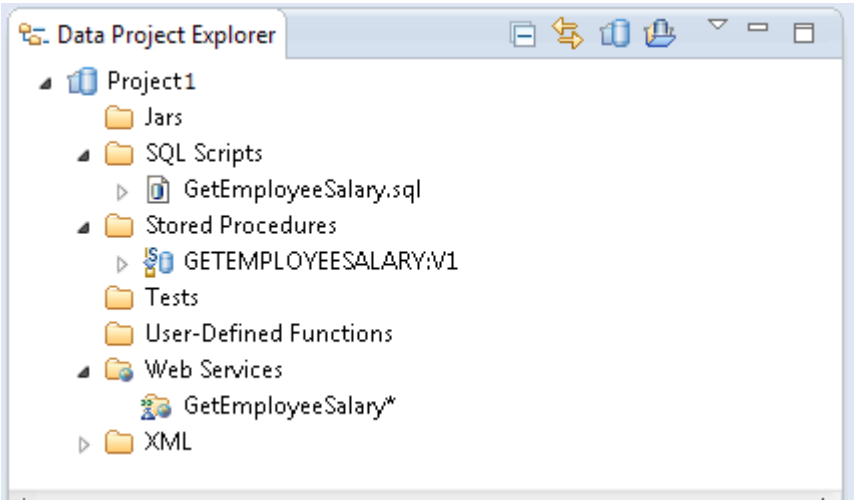
11. Create a new stored procedure for the new service *<webservice_name>* by right-clicking `Stored Procedures` and then selecting `New > Stored Procedure`.



12. For the new stored procedure, specify a name <*storedprocedure_name*>, select a language, and click `Finish` to create the stored procedure.

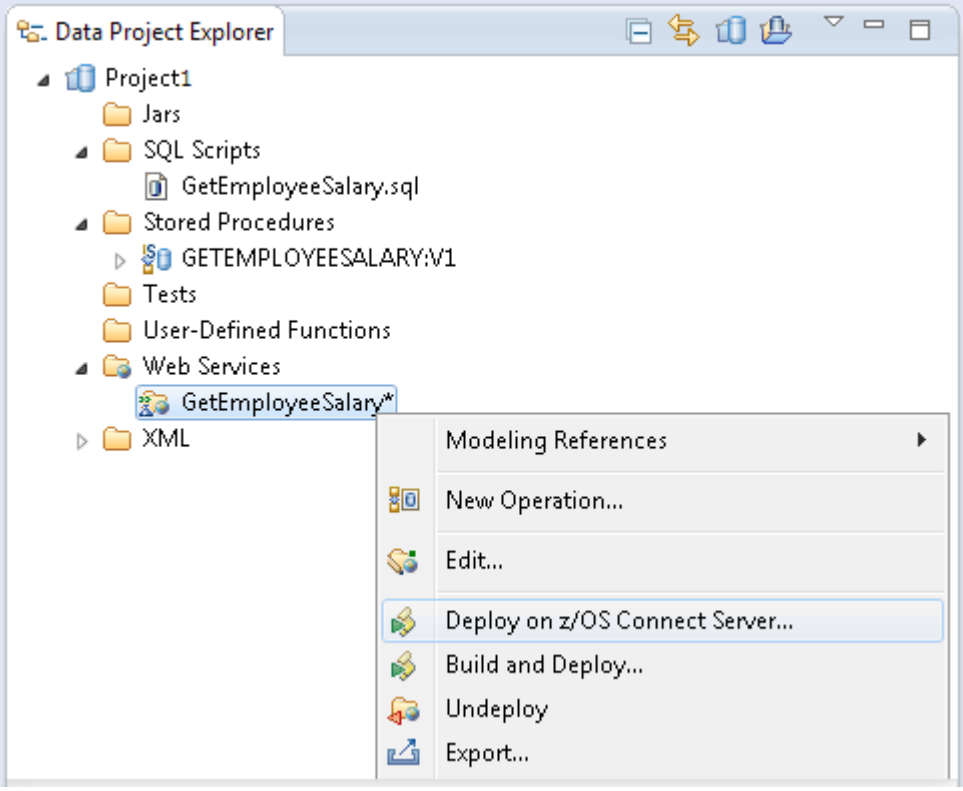
    Make sure that the stored procedure <*storedprocedure_name*> is created and displayed in the `Stored Procedures` folder. This stored procedure is the operation which you can associate with a Db2 Adapter service. This operation is a CALL statement to the stored procedure. Each Db2 Adapter service can support only one operation.

13. Associate the new service and the new SQL script or stored procedure by dragging and dropping <*script_name*> or <*storedprocedure_name*> onto <*webservice_name*>.



    You are ready to deploy the new web service <*webservice_name*> to the target z/OS Connect server.

14. Deploy the new service by right-clicking <*webservice_name*> and then selecting `Deploy on z/OS Connect Server`.



If the new service is deployed and ready for use, a "Deploy Success" message is returned.

15. If necessary, undeploy a web service from the z/OS Connect server.

    Make sure that the Db2 Adapter service is stopped. Undeploy the service by right clicking *<webservice_name>* and then selecting `Undeploy`. Click `Yes` on the `Confirm Undeployment of Web Service` window to confirm the service removal.

Related concepts

"Data Studio" on page 7
Data Studio includes support for key tasks across the entire data management lifecycle. It enables database administrators to manage databases and perform basic health and performance monitoring. It also provides application developers with a single integrated development environment that can be used to create, deploy, and debug data-centric applications.

Downloading and installing IBM Data Studio V4.1.x

Related tasks

"Creating a Liberty Profile for z/OS server for Db2 Adapter" on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

Related reference

"System requirements for enabling Db2 Adapter for z/OS Connect" on page 14
Db2 Adapter for z/OS Connect is a feature of Db2 Accessories Suite for z/OS Version 3 Release 3. You must install all the software products and features required by Db2 Adapter, its operating environment, and tooling support.

"Security of Db2 Adapter for z/OS Connect" on page 9

Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

Modifying a Db2 Adapter service

You can modify certain properties of a Db2 Adapter user-defined service if you have the required permission.

Before you begin

To modify a Db2 Adapter user-defined service, you must update the `db2zAdapterUserDefinedServices.xml` file in the `WLP_USER_DIR` directory. The `WLP_USER_DIR` directory contains the Liberty Profile server configuration and log files. Obtain WRITE access to the directory from an authorized administrator so that you can make changes to the `db2zAdapterUserDefinedServices.xml` file.

Procedure

1. Discover the services that are available to you by issuing the following HTTPS GET request through a REST client:

   ```
   GET https://<host>:<port>/zosConnect/services
   ```

   where *<host>* and *<port>* are the host name and port number that are specified for the z/OS Connect server where the target Db2 Adapter service is deployed.

   The response lists all the Db2 Adapter services that are available to you. The listing includes the name, description, provider, and full URL of each service, like the following:

   ```
   {
     "zosConnectServices":

     [
       {
         "ServiceName": "GetEmployeeSalary",
         "ServiceDescription": "Retrieve employee salary based on an employee ID.",
         "ServiceProvider": "db2zadapter-1.0",
         "ServiceURL": "https://<host>:<port>/zosConnect/services/GetEmployeeSalary"
       }
     ]
   }
   ```

2. Identify the service that you want to modify by its name as defined for the `serviceName` property, such as `GetEmployeeSalary`.
3. Open and search for "`GetEmployeeSalary`" in the `db2zAdapterUserDefinedServices.xml` file in the `WLP_USER_DIR` directory.

   You will find exact matches of the service name in the `db2zadapter_db2zAdapterService` and `zosConnectService` elements.

   ```
   <db2zadapter_db2zAdapterService
       serviceOwner="user01"
       dataSourceRef="db2zAdapterDataSource"
       serviceResponseRowCount="1"
       serviceRunAs="3"
       serviceName="GetEmployeeSalary"
       serviceDescription="Retrieve employee salary based on an employee ID."
       id="DB2zAdapterGetEmployeeSalary">
   </db2zadapter_db2zAdapterService>
   ```

4. Modify the `dataSourceRef`, `serviceResponseRowCount`, and `serviceRunAs`properties, as needed, in the `db2zadapter_db2zAdapterService` element only.

   Do not change other properties in the `db2zadapter_db2zAdapterService` element.

dataSourceRef
Specifies a dataSource definition for a Db2 Adapter service that is different from the default setting. The default value is "db2zAdapterDataSource." You can define a different data source by creating a new `db2zadapter_db2zAdapterDataSource` element, with a unique ID, in the `db2zAdapterDataSources.xml` file.

serviceResponseRowCount
Specifies the maximum number of rows that a Db2 Adapter service returns in the `ResultSet` response. This property is optional.

0
Indicates that this property is not specified, which is the default setting. A Db2 Adapter service return all rows in the `ResultSet` response.

n
Specifies an integer value in the range of 1 to 2147483647. A Db2 Adapter service returns a maximum of the specified number of rows in the `ResultSet` response. An 80001 `StatusCode` is issued if the `ResultSet` is truncated due to the setting.

serviceRunAs
Specifies the user that a Db2 Adapter service uses for invocation or execution. This property is optional.

0
Indicates that the property is not specified in the Db2 Adapter service definition itself, which is the default setting. Instead, the service uses the setting of the property as defined in the data source.

1
Uses the user ID as defined in the data source.

2
Uses the service owner ID as defined in the Db2 Adapter service definition. This setting requires that the Db2 trusted context support, the RACF PassTicket support, or both are enabled and defined in the data source.

3
Uses the service invoker ID. This setting requires that the Db2 trusted context support, the RACF PassTicket support, or both are enabled and defined in the data source.

5. Save and exit the `db2zAdapterUserDefinedServices.xml` file.

Related tasks

“Planning to install and configure Db2 Adapter and related products” on page 14
Before you begin the installation process, you must make some important decisions for installing and configuring Db2 Adapter and related products. You need to decide ahead of time the security model for protecting Db2 Adapter, the directory structure and permissions for installing Liberty Profile and z/OS Connect, and the users and groups for running the Liberty Profile server.

“Creating, deploying, or undeploying a Db2 Adapter service” on page 44
With the required authority, you can create, deploy, or undeploy a Db2 Adapter service by using the IBM Data Studio client.

“Discovering available Db2 Adapter services” on page 53
You can discover all available Db2 Adapter services if you have the required authority.

“Invoking a Db2 Adapter service” on page 61
You can invoke a Db2 Adapter service if you have the required authority.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9

Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

Discovering available Db2 Adapter services

You can discover all available Db2 Adapter services if you have the required authority.

Before you begin

Db2 Adapter uses z/OS Connect to authorize and authenticate users for performing service tasks. If System Authorization Facility (SAF) is also configured for additional security, you must have the administrator or operator authority to discover Db2 Adapter services.

Procedure

- To discover all available Db2 Adapter services, issue an HTTPS GET request through a REST client with the following URI:

  ```
  GET https://<host>:<port>/zosConnect/services
  ```

  where *<host>* and *<port>* are the host name and port number that you specified for the z/OS Connect server where you deployed the Db2 Adapter service.

Example

Enter an HTTPS GET request with the following URI:

```
GET https://<host>:<port>/zosConnect/services
```

The following example shows the ouput from Db2 Adapter in JSON format:

```
{
  "zosConnectServices":

  [
    {
      "ServiceName": "DB2zAdapterDeploymentService",
      "ServiceDescription": "Deploy a new Db2 Adapter service
                or remove an existing Db2 Adapter service",
      "ServiceProvider": "db2zadapter-1.0",
      "ServiceURL": "https://<host>:<port>/zosConnect/services/
                DB2zAdapterDeploymentService"
    },
    {
      "ServiceName": "UpdateTimeCard",
      "ServiceDescription": "Update employee time card with new start or stop
timestamp",
      "ServiceProvider": "db2zadapter-1.0",
      "ServiceURL": "https://<host>:<port>/zosConnect/services/UpdateTimeCard"
    },
    {
      "ServiceName": "GetEmployeeSalary",
      "ServiceDescription": "Retrieve employee salary based on an employee ID.",
      "ServiceProvider": "db2zadapter-1.0",
      "ServiceURL": "https://<host>:<port>/zosConnect/services/GetEmployeeSalary"
    }
  ]
}
```

The response lists all the Db2 Adapter services that are available to you. The listing includes the name, description, provider, and full URL of each service.

Related tasks

"Enabling the z/OS Connect authorization interceptor" on page 32

z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

“Creating, deploying, or undeploying a Db2 Adapter service” on page 44
With the required authority, you can create, deploy, or undeploy a Db2 Adapter service by using the IBM Data Studio client.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

“Sample db2zAdapterServices.xml file” on page 67
The `db2zAdapterServices.xml` file contains the definition of a DB2-supplied Db2 Adapter service that is used as a template for all user-defined services. The service is predefined, and you must not change it.

Retrieving details of a Db2 Adapter service

You can retrieve details of a Db2 Adapter service if you have the required authority.

Before you begin

Db2 Adapter uses z/OS Connect to authorize and authenticate users for performing service tasks. If System Authorization Facility (SAF) is configured for additional security, you must have the administrator or operator authority to retrieve the details of a Db2 Adapter service.

Procedure

- To retrieve details about a Db2 Adapter service, issue an HTTPS GET request through a REST client with the following URI:

  ```
  GET https://<host>:<port>/zosConnect/services/<service_name>
  ```

  where *<service_name>* is the name of the Db2 Adapter service whose details you want to retrieve.

Example

Enter an HTTPS GET request with the following URI:

```
GET https://<host>:<port>/zosConnect/services/GetEmployeeSalary
```

The following example shows the two-part ouput from Db2 Adapter in JSON format:

```
{
  "zosConnect": {
    "serviceName": "GetEmployeeSalary",
    "serviceDescription": "Retrieve employee salary based on an employee ID.",
    "serviceProvider": "db2zadapter-1.0",
    "serviceURL": "https://<host>:<port>/zosConnect/services/GetEmployeeSalary",
    "serviceInvokeURL": "https://<host>:<port>/zosConnect/services/GetEmployeeSalary?
            action=invoke",
    "dataXformProvider": "DATA_UNAVAILABLE"
  },
  "GetEmployeeSalary": {
    "DB2zAdapterServiceName": "GetEmployeeSalary",
    "DB2zAdapterServiceStatus": "Stopped",
    "DB2zAdapterService": {
      "RequestSchema": {
        "$schema": "http://json-schema.org/draft-04/schema#",
        "type": "object",
        "properties": {
          "1": {
            "type": "string",
```

```
            "maxLength": 8,
            "description": "CHARACTER(8)"
          }
        },
        "required": [
          "1"
        ],
        "description": "Service GetEmployeeSalary invocation HTTP request body"
      },
      "ResponseSchema": {
        "$schema": "http://json-schema.org/draft-04/schema#",
        "type": "object",
        "properties": {
          "ResultSet Output": {
            "type": "array",
            "items": {
              "type": "object",
              "properties": {
                "SALARY": {
                  "type": [
                    "null",
                    "number"
                  ],
                  "description": "Nullable DECIMAL"
                }
              },
              "required": [
                "SALARY"
              ],
              "description": "ResultSet Row"
            }
          },
          "StatusDescription": {
            "type": "string",
            "description": "Service invocation status description"
          },
          "StatusCode": {
            "type": "integer",
            "multipleOf": 1,
            "minimum": 100,
            "maximum": 600,
            "description": "Service invocation HTTP status code"
          },
          "DiagnosticsCodes": {
            "type": "array",
            "items": {
              "type": "integer",
              "multipleOf": 1,
              "minimum": -99999,
              "maximum": 99999,
              "uniqueItems": true,
              "description": "Service invocation diagnostic code"
            }
          }
        },
        "required": [
          "ResultSet Output",
      "StatusDescription",
          "StatusCode"
        ],
        "description": "Service GetEmployeeSalary invocation HTTP response body"
      }
    }
  }
}
```

The first part of the response contains the `zosConnect` information, including the name, description, provider, and URLs of the service. The second part provides detailed information about the service, including the name, status, request schema, and response schema of the service.

Related tasks

"Enabling the z/OS Connect authorization interceptor" on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

"Retrieving JSON request and response schemas of a Db2 Adapter service" on page 56
Db2 Adapter uses JSON data for both HTTPS requests and responses for its service operations. You can retrieve the request and response JSON schemas of a Db2 Adapter service if you have the required authority.

"Querying the status of a Db2 Adapter service" on page 58
You can query the status of a Db2 Adapter service if you have the required authority.

Related reference

"Security of Db2 Adapter for z/OS Connect" on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

"Sample db2zAdapterServices.xml file" on page 67
The `db2zAdapterServices.xml` file contains the definition of a DB2-supplied Db2 Adapter service that is used as a template for all user-defined services. The service is predefined, and you must not change it.

Retrieving JSON request and response schemas of a Db2 Adapter service

Db2 Adapter uses JSON data for both HTTPS requests and responses for its service operations. You can retrieve the request and response JSON schemas of a Db2 Adapter service if you have the required authority.

Before you begin

Db2 Adapter uses z/OS Connect to authorize and authenticate users for performing the service tasks. If System Authorization Facility (SAF) is configured for additional security, you must have the administrator or operator authority to retrieve the JSON schemas of a Db2 Adapter service.

Procedure

- To retrieve the request schema of a Db2 Adapter service, issue an HTTPS GET request through a REST client with the following URI:

  ```
  GET https://<host>:<port>/zosConnect/services/<service_name>?action=
      getRequestSchema
  ```

  where *<service_name>* is the name of the Db2 Adapter service whose schemas you want to retrieve.
- To retrieve the response schema of a Db2 Adapter service, issue an HTTPS GET request through a REST client with the following URI:

  ```
  GET https://<host>:<port>/zosConnect/services/<service_name>?action=
      getReponseSchema
  ```

Example

To retrieve the request JSON schema of a Db2 Adapter service, enter an HTTPS GET call with the following URI:

```
GET https://<host>:<port>/zosConnect/services/GetEmployeeSalary?action=
    getRequestSchema
```

The following example shows the ouput from Db2 Adapter in JSON format:

```
{
  "RequestSchema":
  {
    "$schema": "http://json-schema.org/draft-04/schema#",
    "type": "object",
    "properties":
    {
      "1":
      {
        "type": "string",
        "maxLength": 8,
        "description": "CHARACTER(8)"
      }
    },
    "required":
    [
      "1"
    ],
    "description": "Service GetEmployeeSalary invocation HTTP request body
  }
}
```

The response shows what this particular Db2 Adapter service's request needs for successful invocation. The response uses the JSON schema as specified in JSON-Schema Draft 4

To retrieve the response JSON schema of a Db2 Adapter service, enter an HTTPS GET call with the following URI:

```
GET https://<host>:<port>/zosConnect/services/GetEmployeeSalary?action=
        getResponseSchema
```

The following example shows the ouput from Db2 Adapter in JSON format:

```
{
  "ResponseSchema": {
    "$schema": "http://json-schema.org/draft-04/schema#",
    "type": "object",
    "properties": {
      "ResultSet Output": {
        "type": "array",
        "items": {
          "type": "object",
          "properties": {
            "SALARY": {
              "type": [
                "null",
                "number"
              ],
              "description": "Nullable DECIMAL"
            }
          },
          "required": [
            "SALARY"
          ],
          "description": "ResultSet Row"
        }
      },
      "StatusDescription": {
        "type": "string",
        "description": "Service invocation status description"
      },
      "StatusCode": {
        "type": "integer",
        "multipleOf": 1,
        "minimum": 100,
        "maximum": 600,
        "description": "Service invocation HTTP status code"
      },
      "DiagnosticsCodes": {
        "type": "array",
        "items": {
          "type": "integer",
          "multipleOf": 1,
          "minimum": -99999,
          "maximum": 99999,
```

```
          "uniqueItems": true,
          "description": "Service invocation diagnostic code"
        }
      }
    },
    "required": [
      "ResultSet Output",
      "StatusDescription",
      "StatusCode"
    ],
    "description": "Service GetEmployeeSalary invocation HTTP response body"
  }
}
```

The response of this particular Db2 Adapter service contains a `ResultSet Output` object. A typical `ResultSet Output` object has an array of items that represent the `ResultSet` row or rows. In this particular response, the row has only one object, "SALARY," which can be null or a number. Other objects in the response include `StatusDescription`, `StatusCode`, and, optionally, `DiagnosticsCodes`.

Related tasks

“Enabling the z/OS Connect authorization interceptor” on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

“Retrieving details of a Db2 Adapter service” on page 54
You can retrieve details of a Db2 Adapter service if you have the required authority.

“Querying the status of a Db2 Adapter service” on page 58
You can query the status of a Db2 Adapter service if you have the required authority.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

“Mapping of Db2 SQL and JSON data types in a Db2 Adapter service” on page 70
For each Db2 Adapter service, JSON data types are mapped to underlying Db2 SQL data types. When an HTTPS call is issued for a specific service, Db2 Adapter uses the mapping to convert the data types for the service requests and responses.

“Sample db2zAdapterServices.xml file” on page 67
The `db2zAdapterServices.xml` file contains the definition of a DB2-supplied Db2 Adapter service that is used as a template for all user-defined services. The service is predefined, and you must not change it.

Related information

Querying the status of a Db2 Adapter service

You can query the status of a Db2 Adapter service if you have the required authority.

Before you begin

Db2 Adapter uses z/OS Connect to authorize and authenticate users for performing service tasks. If System Authorization Facility (SAF) is configured for additional security, you must have the administrator or operator authority to query the status of a Db2 Adapter service.

Procedure

- To query the status of a Db2 Adapter service, issue an HTTPS GET request through a REST client with the following URI:

```
GET https://<host>:<port>/zosConnect/services/<service_name>?action=status
```

where <*service_name*> is the name of the Db2 Adapter service whose status you want to query.

Example

Enter an HTTPS GET request with the following URI:

```
GET https://<host>:<port>/zosConnect/services/GetEmployeeSalary?action=status
```

The following example shows the ouput from Db2 Adapter in JSON format:

```
{
  "zosConnect":
  {
    "serviceName": "GetEmployeeSalary",
    "serviceDescription": "Retrieve employee salary based on an employee ID.",
    "serviceProvider": "db2zadapter-1.0",
    "serviceURL": "https://<host>:<port>/zosConnect/services/GetEmployeeSalary",
    "serviceInvokeURL": "https://<host>:<port>/zosConnect/services/
           GetEmployeeSalary?action=invoke",
    "dataXformProvider": "DATA_UNAVAILABLE",
    "serviceStatus": "Started"
  }
}
```

The response shows that the current status of the Db2 Adapter service is "Started."

Related tasks

"Enabling the z/OS Connect authorization interceptor" on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

"Retrieving details of a Db2 Adapter service" on page 54
You can retrieve details of a Db2 Adapter service if you have the required authority.

Related reference

"Security of Db2 Adapter for z/OS Connect" on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

"Sample db2zAdapterServices.xml file" on page 67
The `db2zAdapterServices.xml` file contains the definition of a DB2-supplied Db2 Adapter service that is used as a template for all user-defined services. The service is predefined, and you must not change it.

Starting a Db2 Adapter service

You can start a Db2 Adapter service if you have the required authority.

Before you begin

Db2 Adapter uses z/OS Connect to authorize and authenticate users for performing service tasks. If System Authorization Facility (SAF) is configured for additional security, you must have the administrator or operator authority to start a Db2 Adapter service.

Procedure

- To start a Db2 Adapter service, issue an HTTPS POST request through a REST client with the following URI:

  ```
  POST https://<host>:<port>/zosConnect/services/<service_name>?action=start
  ```

  where <*service_name*> is the name of the Db2 Adapter service that you want to start.

Example

Enter an HTTPS POST request with the following URI:

```
POST https://<host>:<port>/zosConnect/services/GetEmployeeSalary?action=start
```

The following example shows the ouput from Db2 Adapter in JSON format:

```
{
  "zosConnect":
  {
    "serviceName": "GetEmployeeSalary",
    "serviceDescription": "Retrieve employee salary based on an employee ID.",
    "serviceProvider": "db2zadapter-1.0",
    "serviceURL": "https://<host>:<port>/zosConnect/services/GetEmployeeSalary",
    "serviceInvokeURL": "https://<host>:<port>/zosConnect/services/
           GetEmployeeSalary?action=invoke",
    "dataXformProvider": "DATA_UNAVAILABLE",
    "serviceStatus": "Started"
  }
}
```

The response shows that the Db2 Adapter service is successfully started.

Related tasks

“Enabling the z/OS Connect authorization interceptor” on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

“Querying the status of a Db2 Adapter service” on page 58
You can query the status of a Db2 Adapter service if you have the required authority.

“Stopping a Db2 Adapter service” on page 60
You can stop a Db2 Adapter service if you have the required authority.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

“Sample db2zAdapterServices.xml file” on page 67
The `db2zAdapterServices.xml` file contains the definition of a DB2-supplied Db2 Adapter service that is used as a template for all user-defined services. The service is predefined, and you must not change it.

Stopping a Db2 Adapter service

You can stop a Db2 Adapter service if you have the required authority.

Before you begin

Db2 Adapter uses z/OS Connect to authorize and authenticate users for performing service tasks. If System Authorization Facility (SAF) is configured for additional security, you must have the administrator or operator authority to stop a Db2 Adapter service.

Procedure

- To stop a Db2 Adapter service, issue an HTTPS POST request through a REST client with the following URI:

  ```
  POST https://<host>:<port>/zosConnect/services/<service_name>?action=stop
  ```

  where *<service_name>* is the name of the Db2 Adapter service that you want to stop.

Example

Enter an HTTPS POST request with the following URI:

```
POST https://<host>:<port>/zosConnect/services/GetEmployeeSalary?action=stop
```

The following example shows the ouput from Db2 Adapter in JSON format:

```
{
  "zosConnect":
  {
    "serviceName": "GetEmployeeSalary",
    "serviceDescription": "Retrieve employee salary based on an employee ID.",
    "serviceProvider": "db2zadapter-1.0",
    "serviceURL": "https://<host>:<port>/zosConnect/services/GetEmployeeSalary",
    "serviceInvokeURL": "https://<host>:<port>/zosConnect/services/
                GetEmployeeSalary?action=invoke",
    "dataXformProvider": "DATA_UNAVAILABLE",
    "serviceStatus": "Stopped"
  }
}
```

The response shows that the Db2 Adapter service is successfully stopped.

Related tasks

“Enabling the z/OS Connect authorization interceptor” on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

“Querying the status of a Db2 Adapter service” on page 58
You can query the status of a Db2 Adapter service if you have the required authority.

“Starting a Db2 Adapter service” on page 59
You can start a Db2 Adapter service if you have the required authority.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

“Sample db2zAdapterServices.xml file” on page 67
The `db2zAdapterServices.xml` file contains the definition of a DB2-supplied Db2 Adapter service that is used as a template for all user-defined services. The service is predefined, and you must not change it.

Invoking a Db2 Adapter service

You can invoke a Db2 Adapter service if you have the required authority.

Before you begin

Db2 Adapter uses z/OS Connect to authorize and authenticate users for performing service tasks. If System Authorization Facility (SAF) is configured for additional security, you must have the administrator or invoker authority to invoke a Db2 Adapter service.

Procedure

- To invoke a Db2 Adapter service, issue an HTTPS POST request through a REST client with the following URI:

  ```
  POST https://<host>:<port>/zosConnect/services/<service_name>?action=invoke
  ```

  where *<service_name>* is the name of the Db2 Adapter service that you want to invoke.

  For the REST API request, make sure that you specify the following HTTPS header fields:

- Set the `Accept` field to `application/json` or `application/json; charset=UTF-8`
- Set the `Content-Type` field to `application/json` or `application/json; charset=UTF-8`
- Set the `Accept-Charset` field to `UTF-8`

If an HTTPS request body is required as specified in the request schema, make sure that you include the required JSON object in the HTTPS request body.

Example

Enter an HTTPS POST request with the following URI:

```
POST https://<host>:<port>/zosConnect/services/GetEmployeeSalary?action=invoke
```

With the following HTTPS request body:

```
{
"1": "ID_00001"
}
```

The following example shows the ouput from Db2 Adapter in JSON format:

```
{
  "ResultSet Output":
  [
    {
      "SALARY": 99999.00
    }
  ],
  "StatusDescription": "Execution Successful",
  "StatusCode": 200
}
```

The response shows that the service invocation is successfully executed.

The response also returns the user-specified number of rows in the `ResultSet Ouput`. An `80001` `StatusCode` is issued if the `ResultSet` is truncated due to the setting of the `serviceResponseRowCount` property in the `db2zAdapterUserDefinedServices.xml` file.

Related tasks

“Enabling the z/OS Connect authorization interceptor” on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

“Discovering available Db2 Adapter services” on page 53
You can discover all available Db2 Adapter services if you have the required authority.

“Querying the status of a Db2 Adapter service” on page 58
You can query the status of a Db2 Adapter service if you have the required authority.

“Retrieving JSON request and response schemas of a Db2 Adapter service” on page 56
Db2 Adapter uses JSON data for both HTTPS requests and responses for its service operations. You can retrieve the request and response JSON schemas of a Db2 Adapter service if you have the required authority.

“Retrieving details of a Db2 Adapter service” on page 54
You can retrieve details of a Db2 Adapter service if you have the required authority.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

“Sample db2zAdapterServices.xml file” on page 67

The `db2zAdapterServices.xml` file contains the definition of a DB2-supplied Db2 Adapter service that is used as a template for all user-defined services. The service is predefined, and you must not change it.

Chapter 8. Samples and reference

Samples and reference information can help you understand how a product is installed, configured, and used. You can use the following samples of server and service configuration, job input and output, embedded instructions, and other reference information to guide you through the installation, configuration, and operation of the Db2 Adapter for z/OS Connect and related products.

Related concepts

Db2 Adapter for z/OS Connect (Deprecated)

Related tasks

“Installing and configuring Db2 Adapter for z/OS Connect” on page 13
Db2 Adapter for z/OS Connect is a complete solution that includes IBM WebSphere Application Server Liberty Profile for z/OS and the z/OS Connect feature. It also requires tooling support from the IBM Data Studio client. You must install and configure all the products and features before you can use Db2 Adapter.

“Working with Db2 Adapter services” on page 43
You can create, deploy, and undeploy Db2 Adapter services that interact with the underlying Db2 objects. You can then discover, invoke, start, stop, or query the status of these services through a set of REST APIs that Db2 Adapter provides.

Related reference

“Security of Db2 Adapter for z/OS Connect” on page 9
Db2 Adapter for z/OS Connect leverages the security strengths of Db2 and z/OS Connect to provide a complete security solution that enables you to authenticate, authorize, and audit the use of all its services.

Sample `server.xml` file

The `server.xml` file describes the configuration details of the Liberty Profile for z/OS server in which Db2 Adapter for z/OS Connect runs. You may use the sample `server.xml` file to guide you through the configuration of the Liberty Profile server, the z/OS Connect feature, and related products.

You can include all Liberty Profile server configuration information in a single `server.xml` file or separate it into several small files that are referenced by the `server.xml` file. The following sample is an example of the latter.

```
<?xml version="1.0" encoding="UTF-8"?>
<server description="DB2 RESTful services server that uses
    Db2 Adapter for z/OS Connect">

1     <featureManager>
       <feature>ssl-1.0</feature>
       <feature>zosConnect-1.0</feature>
       <feature>zosConnect-1.0</feature>
       <feature>appSecurity-2.0</feature>
    </featureManager>

2     <httpEndpoint id="defaultHttpEndpoint"
       host="*"
       httpPort="9180"
       httpsPort="9443" />

3     <include optional="false"
       location="${server.config.dir}/sslServerCertificate.xml" />

4     <include optional="false"
       location="${server.config.dir}/zosConnectAuthentication.xml" />

5     <include optional="false"
       location="${server.config.dir}/zosConnectAuthorization.xml" />

6     <include optional="false"
       location="${server.config.dir}/db2zAdapterServices.xml" />

7     <include optional="false"
```

© Copyright IBM Corp. 2015, 2015

```
        location="${server.config.dir}/db2zAdapterDataSources.xml" />

 8     <!-- <logging traceSpecification="*=info=enabled:com.ibm.db2.db2zadapter.*=all" /> -->
</server>
```

Comments and instructions:

- 1 List all the features that are enabled for the Liberty Profile server.
- 2 Specify the `host="*"` attribute to enable access to this server from remote clients. Remove the attribute if you do not want to enable access for remote clients. Modify the port values if the specified defaults are already in use at your site.
- 3 Configure the SSL Certificate to be used by the Liberty Profile server.
  - For a basic SSL configuration that uses a default Liberty Profile-generated certificate, use the following USS cp command to copy the `sampleBasicSSLUsingDefaultCert.xml` file:

    ```
    cp ${server.config.dir}/sampleBasicSSLUsingDefaultCert.xml
        ${server.config.dir}/sslServerCertificate.xml
    ```

  - For a SAF-generated SSL certificate, use the following USS cp command to copy the `sampleSSLUsingSafCert.xml` file:

    ```
    cp ${server.config.dir}/sampleSSLUsingSafCert.xml
        ${server.config.dir}/sslServerCertificate.xml
    ```

  - Review the content of the `${server.config.dir}/sslServerCertificate.xml` file that you just created for further customization instructions.
- 4 Configure the "authentication" method by creating the `zosConnectAuthentication.xml` file:
  - For the basic z/OS Connect authentication, use the following USS cp command to copy the `sampleBasicZOSConnectAuthentication.xml` file:

    ```
    cp ${server.config.dir}/sampleBasicZOSConnectAuthentication.xml
        ${server.config.dir}/zosConnectAuthentication.xml
    ```

  - For SAF authentication, use the following USS cp command to copy the `sampleSafZOSConnectAuthentication.xml` file:

    ```
    cp ${server.config.dir}/sampleSafZOSConnectAuthentication.xml
        ${server.config.dir}/zosConnectAuthentication.xml
    ```

  - Review the content of the `${server.config.dir}/zosConnectAuthentication.xml` file that you just created for further customization instructions.
- 5 Configure the "authorization" method for z/OS Connect and Db2 Adapter:
  - For the basic z/OS Connect authorization, use the following USS cp command to copy the `sampleBasicZOSConnectAuthorization.xml` file:

    ```
    cp ${server.config.dir}/sampleBasicZOSConnectAuthorization.xml
        ${server.config.dir}/zosConnectAuthorization.xml
    ```

  - For SAF EJBROLE authorization, use the following USS cp command to copy the `sampleSafZOSConnectAuthorization.xml` file:

    ```
    cp ${server.config.dir}/sampleSafZOSConnectAuthorization.xml
        ${server.config.dir}/zosConnectAuthorization.xml
    ```

  - Review the content of the `${server.config.dir}/zosConnectAuthorization.xml` file that you just created for further customization instructions.
- 6 Review the content of the `${server.config.dir}/db2zAdapterServices.xml` file for customization instructions.
- 7 Configure the Db2 Adapter data source:

- Use the following USS cp command to copy the `sampleDb2zAdapterDataSources.xml` file:

```
cp ${server.config.dir}/sampleDb2zAdapterDataSources.xml
    ${server.config.dir}/db2zAdapterDataSources.xml
```

- Review the content of the `${server.config.dir}/db2zAdapterDataSources.xml` file that you just created for further customization instructions.

- 8 Uncomment this line to enable Db2 Adapter tracing.

Related concepts

"z/OS Connect" on page 3
IBM z/OS Connect is a feature of IBM WebSphere Application Server Liberty Profile for z/OS. It provides a simple, consistent, and secure interface that connects applications in the web, mobile, and cloud environment to programs on the IBM Z and the z/OS platform.

Related tasks

"Creating a Liberty Profile for z/OS server for Db2 Adapter" on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

"Configuring SAF as the SSL keystore" on page 28
You can configure and enable System Authorization Facility (SAF) as the Secure Sockets Layer (SSL) keystore for running the Liberty Profile server and z/OS Connect.

"Enabling the z/OS Connect authorization interceptor" on page 32
z/OS Connect supplies an authorization interceptor that allows you to authorize users under the `zosConnectAccess` role. You can configure and enable the supplied authorization interceptor to control access to z/OS Connect at the global or service definition level.

"Enabling the z/OS Connect audit interceptor" on page 37
z/OS Connect supplies an audit interceptor that writes 120.11 records to the z/OS System Management Facility (SMF) data store. You can configure and enable the supplied audit interceptor to track and audit the usage of z/OS Connect and thus Db2 Adapter for z/OS Connect.

"Enabling SAF-based client certificates for authentication" on page 40
z/OS Connect uses client certificates as the default authentication mechanism. You can create SAF-based client certificates for users to import and use for authenticating with z/OS Connect.

Sample db2zAdapterServices.xml file

The `db2zAdapterServices.xml` file contains the definition of a DB2-supplied Db2 Adapter service that is used as a template for all user-defined services. The service is predefined, and you must not change it.

```
<?xml version="1.0" encoding="UTF-8"?>

1 <server>

    <featureManager>
        <feature>db2zadapter:db2zadapter-1.0</feature>
    </featureManager>

    <zosConnectService id="DB2zAdapterDeploymentService"
2           invokeGroup="${DB2zAdapterDeploymentServiceAdminGroup}"
        adminGroup="${DB2zAdapterDeploymentServiceAdminGroup}"
        operationsGroup="${DB2zAdapterDeploymentServiceAdminGroup}"
        serviceName="DB2zAdapterDeploymentService"
        serviceDescription="Deploy a new Db2 Adapter service or delete an
            existing Db2 Adapter service"
        serviceRef="DB2zAdapterDB2zAdapterDeploymentService"/>

    <db2zadapter_db2zAdapterService id="DB2zAdapterDB2zAdapterDeploymentService"
        serviceDescription="Deploy a new Db2 Adapter service or delete an
            existing Db2 Adapter service"
        serviceName="DB2zAdapterDeploymentService"
        dataSourceRef="db2zAdapterDataSource"/>
```

```
    <include optional="true" location="${server.config.dir}/
db2zAdapterUserDefinedServices.xml"/>

</server>
```

Comments and instructions:

- 1 This server configuration is used exclusively by the Data Studio tooling to deploy and undeploy Db2 Adapter user-defined services; do not customize any content in this file.
- 2 If the SAF service level authorization interceptor is enabled, only users associated with the DB2zAdapterDeploymentServiceAdminGroup group are authorized to deploy and undeployDb2 Adapter user-defined services. The *DB2zAdapterDeploymentServiceAdminGroup* is a server variable that is defined in the `zosConnectAuthorization.xml` file. Set the *DB2zAdapterDeploymentServiceAdminGroup* variable in the `zosConnectAuthorization.xml` file rather than modifying it in this file.

Related tasks

"Configuring the Db2 Adapter data source" on page 34
You must configure a Db2 Adapter data source in the Liberty Profile server to encapsulate all communications between Db2 Adapter and Db2.

"Enabling Db2 Adapter to use RACF PassTickets" on page 27
Instead of sending clear text passwords through the network, RACF provides the ability to generate PassTickets for a requesting application. Users of the application can then use the PassTickets to authenticate within a RACF-secured network. You can configure RACF to generate PassTickets for Db2 Adapter users and then enable Db2 Adapter to use the PassTickets.

"Creating a Liberty Profile for z/OS server for Db2 Adapter" on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

Sample db2zAdapterDataSources.xml file

The `sampleDb2zAdapterDataSources.xml` file contains a sample configuration of the Db2 Adapter data source. You must rename and customize the file before you can use it.

```
<?xml version="1.0" encoding="UTF-8"?>

1 <server>

2    <db2zadapter_db2zAdapterDataSource
      id="db2zAdapterDataSource"
      databaseName="DB2 location name"
      serverName="DB2 IP name or address"
      portNumber="DB2 port number"
      driverType="2|4"
      ssid="DB2 SSID or group attachment ID"
      serviceRunAs="1|2|3"
      user="DB2 userid for this server"
      password="Password for the DB2 userid"
      applName="DB2 APPLNAME"
      trustedContext="true|false"
      maxPoolSize="40"
      maxStatements="0"
      accountingInterval="COMMIT"
      enableSysplexWLB="true|false" />

3    <library id="db2zAdapterJccLib">
      <fileset dir="${JCC_HOME}/classes"
          includes="db2jcc4.jar db2jcc_license_cisuz.jar"/>
      <fileset dir="${JCC_HOME}/lib" />
      <fileset dir="/usr/include/java_classes" includes="IRRRacf.jar" />
      <fileset dir="/usr/lib" />
   </library>

</server>
```

Comments and instructions:

- 1 Make a copy of this sample file, rename it to `db2zAdapterDataSources.xml`, and place the new file in the `WLP_USER_DIR` server directory.
- 2 Update the following properties of the `db2zadapter_db2zAdapterDataSource` element in the new file:
  - Set `databaseName` to the location name of the target Db2 subsystem.
  - Set `portNumber` to the port of the target Db2 subsystem to which Db2 Adapter connects.
  - Set `user` to the Db2 user name or ID that is associated with this server. The Db2 authorization method that you choose for service execution affects how this user name or ID is used. If you enable the Db2 trusted context (`trustedContext="true"`), the ID is used to establish the trusted connection. If you do not enable the Db2 trusted context or the RACF PassTicket, the ID is used to run all Db2 Adapter services in Db2.
  - Set `driverType` to Type "4" or "2" JDBC driver that Db2 Adapter uses to create connections. The default is Type 4.
  - Set `ssid` to the Db2 subsystem ID or data sharing group name for local connections, which is required when a Type 2 JDBC driver is specified.
  - Set `maxPoolSize` to the maximum number of Db2 connections that are pooled by this data source. The default is 40.
  - Set `maxStatements` to the maximum number of JDBC PreparedStatement objects that are pooled by each Db2 connection. The default is 0.
  - Update the `enableSysplexWLB` to "true" or "false" value if the sysplex workload balancing support is used by this data source. The sysplex workload balancing is only applicable when a Type 4 JDBC driver is specified.
  - Set `serviceRunAs` to "1," "2," or "3" that specifies the user that a Db2 Adapter service uses for service execution. Specify "1" to use the user ID specified in the data source configuration, "2" to use the service owner ID, or "3" to use the service invoker ID.
  - Set `trustedContext` to "true" or "false" if the Db2 trusted context support is used by this data source. If you specify "true," make sure that you work with your Db2 administrator to create the necessary trusted context definitions for this server.
  - Set `password` to the password of the data source user, which is required if you do not enable the RACF PassTicket support.

    If you plan to enable the RACF PassTicket support, remove the `password` property from the configuration of this data source and set the `applName` property to the name of the Db2 subsystem that generates the RACF PassTickets. The `applName` value must match that specified for `APPLNAME` of the target Db2 subsystem. Work with your RACF administrator to create the PTKTDATA profiles for the specified `applName` and to permit UPDATE access to the profiles by the Liberty Profile server (*liberty_id*).

    If you do not plan to enable the RACF PassTicket support, remove the `applName` property from the configuration of this data source and set the `password` property to the password of the data source user. Consider encoding the password by using the Liberty Profile **securityUtility** command. The **securityUtility** command tool is available in the `ROOT_INSTALL_DIR/wlp/bin` directory.
- 3 Do not customize the library configuration element and properties. Set the *JCC_HOME* system property in the `bootstrap.properties` file for the server.
- Set

Related tasks

“Configuring the Db2 Adapter data source” on page 34
You must configure a Db2 Adapter data source in the Liberty Profile server to encapsulate all communications between Db2 Adapter and Db2.

“Modifying a Db2 Adapter service” on page 51

You can modify certain properties of a Db2 Adapter user-defined service if you have the required permission.

"Enabling Db2 Adapter to use RACF PassTickets" on page 27
Instead of sending clear text passwords through the network, RACF provides the ability to generate PassTickets for a requesting application. Users of the application can then use the PassTickets to authenticate within a RACF-secured network. You can configure RACF to generate PassTickets for Db2 Adapter users and then enable Db2 Adapter to use the PassTickets.

"Creating a Liberty Profile for z/OS server for Db2 Adapter" on page 21
You can create a new Liberty Profile server instance on which the z/OS Connect feature and Db2 Adapter run.

Mapping of Db2 SQL and JSON data types in a Db2 Adapter service

For each Db2 Adapter service, JSON data types are mapped to underlying Db2 SQL data types. When an HTTPS call is issued for a specific service, Db2 Adapter uses the mapping to convert the data types for the service requests and responses.

Db2 SQL Type	JSON Type	JSON Schema Properties	Comments
BIGINT	integer	"type": "integer", "multipleOf": 1, "minimum": -9223372036854775808, "maximum": 9223372036854775807, "description": "BIGINT"	A 64-bit signed integer that has a minimum value of -9223372036854775808 and a maximum value of 9223372036854775807 (inclusive).
BINARY(*n*)	string	"type": "string", "format": "base64", "maxLength": *m*, "description": "BINARY(*n*)" or "description": "BINARY"	A binary string with a maximum length of *n* bytes where *n* cannot be greater than 255. *m* is the maximum length of the string data after the Base64 encoding of the BINARY(*n*) data.
BLOB(*n*)	string	"type": "string", "format": "base64", "maxLength": *m*, "description": "BLOB(*n*)" or "description": "BLOB"	A varying-length binary string with a maximum length of *n* bytes where *n* cannot be greater than 2147483647. *m* is the maximum length of the string data after the Base64 encoding of the BLOB(*n*) data.
CHAR(*n*) FOR BIT DATA	string	"type": "string", "format": "base64", "maxLength": *m*, "description": "CHAR(*n*) FOR BIT DATA" "description": "CHAR FOR BIT DATA"	A bit string with a maximum length of *n* bytes where *n* cannot be greater than 255. *m* is the maximum length of the string data after the Base64 encoding of the CHAR(*n*) FOR BIT DATA.
CHARACTER(*n*)	string	"type": "string", "maxLength": *n*, "description": "CHARACTER(n)" or "description": "CHARACTER"	A character string with a maximum length of *n* bytes where *n* cannot be greater than 255.
CLOB(*n*)	string	"type": "string", "maxLength": *n*, "description": "CLOB(*n*)" or "description": "CLOB"	A varying-length character string with a maximum length of *n* bytes where *n* cannot be greater than 2147483647.
DATE	string	"type": "string", "minLength": 8, "maxLength": 10, "pattern": "^(?![0]{4})([0-9]{4})-(0?[1-9]| 1[0-2])-(0?[1-9]|[1-2][0-9]|3[0-1])$", "description": "DATE yyyy-[m]m-[d]d"	A date string with a three-part value representing a year, month, and day in the range of 0001-01-01 to 9999-12-31.

Db2 SQL Type	JSON Type	JSON Schema Properties	Comments
DBCLOB(*n*)	string	"type": "string", "maxLength": *n*, "description": "DBCLOB(*n*)" or "description": "DBCLOB"	A varying-length double-byte character string with a maximum length of *n* double-byte characters where *n* cannot be greater than 1073741824
DECFLOAT(*n*)	number	When *n* = 16 "type": "number", "minimum": -9.999999999999999E+384, "maximum": 9.999999999999999E+384, "description": "DECFLOAT(16)" or "description": "DECFLOAT" When *n* = 34 "type": "number", "minimum": -9.999999999999999999999999999999999E+6144, "maximum": 9.999999999999999999999999999999999E+6144, "description": "DECFLOAT(34)" or "description": "DECFLOAT"	An IEEE 754r number with a decimal point and precision of 16 digits (*n* = 16). It has a minimum value of -9.999999999999999E+384 and a maximum value of 9.999999999999999E +384(inclusive). An IEEE 754r number with a decimal point and precision of 34 digits (*n* = 34). It has a minimum value of -9.999999999999999999999999999999999E +6144 and a maximum value of 9.999999999999999999999999999999999E +6144 (inclusive). For HTTP requests, users can choose to use string input for the decimal float value for better precision.
DECIMAL(*p, s*) or NUMERIC(*p, s*)	number	"type": "number", "description": "DECIMAL" or "type": "number", "multipleOf": x, "minimum": -y, "maximum": y, "description": "DECIMAL(*p, s*)"	A packed decimal number with an implicit decimal point. The scale, which is the number of digits in the fractional part of the number, cannot be negative or greater than the precision. The maximum precision is 31 digits. *s* is the scale, and *p* is the precision. *x* is the smallest unit available (1/10s), and *y* is the maximum value that can be represented by the combination of *p* and *s*. For HTTP requests, users can choose to use string input for the decimal float value for better precision.
DISTINCT	Reserved	Reserved	Reserved
DOUBLE or FLOAT(*n*) 22<=*n*<=53	number	"type": "number", "minimum": -7.2E+75, "maximum": 7.2E+75, "description": "DOUBLE"	A double-precision floating-point number of 64 bits. It has a minimum value of about -7.2E+75 and a maximum value of about 7.2E+75 (inclusive).
GRAPHIC(*n*)	string	"type": "string", "maxLength": *n*, "description": "GRAPHIC(*n*)" or "description": "GRAPHIC"	A graphic string with a maximum length of *n* double-byte characters where *n* cannot be greater than 127.
INTEGER or INT	integer	"type": "integer", "multipleOf": 1, "minimum": -2147483648, "maximum": 2147483647, "description": "INTEGER"	A 32-bit signed integer that has a minimum value of -2147483648 and a maximum value of 2147483647 (inclusive).
REAL or FLOAT(*n*) 1<=*n*<=21	number	"type": "number", "minimum": -7.2E+75, "maximum": 7.2E+75, "description": "REAL"	A single-precision floating-point number of 32 bits. It has a minimum value of about -7.2E+75 and a maximum value of about 7.2E+75 (inclusive). Because Java Float limit is -3.4028235E+38 to 3.4028235E+38, Db2 Adapter will use Java Double to represent values outside the Java Float range. This promotion can change the precision of the REAL number.

Db2 SQL Type	JSON Type	JSON Schema Properties	Comments
ROWID	string	"type": "string", "format": "base64", "maxLength": *m*, "description": "ROWID"	A varying-length bit string with a maximum length of 40 bytes. It cannot be null. *m* is the maximum length of the string data after the Base64 encoding of the ROWID data.
SMALLINT	integer	"type": "integer", "multipleOf": 1, "minimum": -32768, "maximum": 32767, "description": "SMALLINT"	A 16-bit signed integer that has a minimum value of -32768 and a maximum value of 32767 (inclusive).
TIME	string	"type": "string", "minLength": 8, "maxLength": 8, "pattern": "^([0-1][0-9]|2[0-3]):([0-5][0-9]): ([0-5][0-9])$", "description": "TIME hh:mm:ss"	A time string with a three-part value representing a time of day in hours, minutes, and seconds, in the range of 00:00:00 to 23:59:59.
TIMESTAMP(*p*)	string	"type": "string", "minLength": 17, "maxLength": *m*, "pattern": "^(?![0]{4})([0-9]{4})-(0?[1-9]|1[0-2]) -(0?[1-9]|[1-2][0-9]|3[0-1])[ ](([0-1][0-9]|2[0-3]) :([0-5][0-9]):([0-5][0-9])[/.]?([0-9]{0,*p*}))$", "description": "TIMESTAMP(*p*) yyyy-[m]m-[d]d hh:mm:ss[.f...]" or "description": "TIMESTAMP yyyy-[m]m-[d]d hh:mm:ss[.f...]"	A timestamp string with a seven-part value representing a date and time by year, month, day, hour, minute, second, and microsecond, in the range of 0001-01-01 00:00:00.000000000 to 9999-12-31 23:59:59.999999999999 with nanosecond precision. *p* is the precision (0-12), and *m* is the maximum size of the string. *m* is 19 when *p* = 0, and *m* is 20 + *p* when *p* > 0.
TIMESTAMP(*p*) WITH TIMEZONE	string	"type": "string", "minLength": 23, "maxLength": *m*, "pattern": "^(?![0]{4})([0-9]{4})-(0?[1-9] |1[0-2])-(0?[1-9]|[1-2][0-9]|3[0-1])[ ] (([0-1][0-9]|2[0-3]):([0-5][0-9]):([0-5] [0-9])[/.]?([0-9]{0,*p*}))([/+]|[-])[0-9]? [0-9]:[0-9]{2}$", "description": "TIMESTAMP(*p*) WITH TIMEZONE yyyy-[m]m-[d]d hh:mm:ss[.f...][+/-] [h]h:mm" "description": "TIMESTAMP WITH TIMEZONE yyyy-[m]m-[d]d hh:mm:ss[.f...][+/-] [h]h:mm"	A timestamp with timezone string with an eight-part value representing a date and time by year, month, day, hour, minute, second, microsecond, in the range of 0001-01-01 00:00:00.000000000 to 9999-12-31 23:59:59.999999999999 with nanosecond precision and a timezone value. *p* is the precision (0-12), and *m* is the maximum size of the string. *m* is 25 when *p* = 0, and *m* is 26 + *p* when *p* > 0.
VARBINARY(*n*)	string	"type": "string", "format": "base64", "maxLength": *m*, "description": "VARBINARY(*n*)" or "description": "VARBINARY"	A varying-length binary string with a maximum length of *n* bytes where *n* cannot be greater than 32704. *m* is the maximum length of the string data after the Base64 encoding of the VARBINARY(*n*) data.
VARCHAR(*n*)	string	"type": "string", "maxLength": *n*, "description": "VARCHAR(*n*)" or "description": "VARCHAR"	A varying-length character string with a maximum length of *n* bytes where *n* cannot be greater than 32704.
VARCHAR(*n*) FOR BIT DATA	string	"type": "string", "format": "base64", "maxLength": *m*, "description": "VARCHAR(*n*) FOR BIT DATA" "description": "VARCHAR FOR BIT DATA"	A varying-length bit string with a maximum length of *n* bytes where *n* cannot be greater than 32704. *m* is the maximum length of the string data after the Base64 encoding of the VARCHAR(*n*) FOR BIT DATA.

Db2 SQL Type	JSON Type	JSON Schema Properties	Comments
VARGRAPHIC(*n*)	string	"type": "string", "maxLength": *n*, "description": "VARGRAPHIC(*n*)" "description": "VARGRAPHIC"	A varying-length graphic string with a maximum length of *n* double-byte characters where *n* cannot be greater than 16352.
XML	string	"type": "string", "maxLength": 2147483647, "description": "XML"	A well-formed XML string.

Note:

- The JSON properties that are used to represent or indicate DB2 nullable data are `"type": "null"` and `"description": "Nullable"`.
- The JSON properties that are used to represent or indicate DB2 nullable DB2 integer data `"type": ["integer", "null"]` and `"description": "Nullable INTEGER"`.
- ROWID cannot be null. In certain cases, the `minLength` or `maxLength` property is not specified if scale, precision, or length is not provided.
- If the 24:00:00 format is used to specify TIME, TIMESTAMP(p), or TIMESTAMP(p) WITH TIMEZONE, the actual time value is normalized as 00:00:00 for the next day.

Related concepts

“REST APIs and JSON Data” on page 5
REST (Representational State Transfer) is a simple stateless architecture designed for web services. Applications that use REST APIs typically communicate over the HTTP network.

Related tasks

“Retrieving JSON request and response schemas of a Db2 Adapter service” on page 56
Db2 Adapter uses JSON data for both HTTPS requests and responses for its service operations. You can retrieve the request and response JSON schemas of a Db2 Adapter service if you have the required authority.

Related reference

Date, time, and timestamp values that can cause problems in JDBC and SQLJ applications (Db2 Application Programming for Java)

Related information

Notices

This information was developed for products and services offered in the US. This material might be available from IBM in other languages. However, you may be required to own a copy of the product or product version in that language in order to access it.

IBM may not offer the products, services, or features discussed in this document in other countries. Consult your local IBM representative for information on the products and services currently available in your area. Any reference to an IBM product, program, or service is not intended to state or imply that only that IBM product, program, or service may be used. Any functionally equivalent product, program, or service that does not infringe any IBM intellectual property right may be used instead. However, it is the user's responsibility to evaluate and verify the operation of any non-IBM product, program, or service.

IBM may have patents or pending patent applications covering subject matter described in this document. The furnishing of this document does not give you any license to these patents. You can send license inquiries, in writing, to:

IBM Director of Licensing IBM Corporation
North Castle Drive, MD-NC119
Armonk, NY 10504-1785 US

For license inquiries regarding double-byte (DBCS) information, contact the IBM Intellectual Property Department in your country or send inquiries, in writing, to:

Intellectual Property Licensing Legal and Intellectual Property Law IBM Japan Ltd.
19-21, Nihonbashi-Hakozakicho, Chuo-ku
Tokyo 103-8510, Japan

INTERNATIONAL BUSINESS MACHINES CORPORATION PROVIDES THIS PUBLICATION "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESS OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Some jurisdictions do not allow disclaimer of express or implied warranties in certain transactions, therefore, this statement may not apply to you.

This information could include technical inaccuracies or typographical errors. Changes are periodically made to the information herein; these changes will be incorporated in new editions of the publication. IBM may make improvements and/or changes in the product(s) and/or the program(s) described in this publication at any time without notice.

Any references in this information to non-IBM websites are provided for convenience only and do not in any manner serve as an endorsement of those websites. The materials at those websites are not part of the materials for this IBM product and use of those websites is at your own risk.

IBM may use or distribute any of the information you supply in any way it believes appropriate without incurring any obligation to you.

Licensees of this program who wish to have information about it for the purpose of enabling: (i) the exchange of information between independently created programs and other programs (including this one) and (ii) the mutual use of the information which has been exchanged, should contact:

IBM Director of Licensing IBM Corporation
North Castle Drive, MD-NC119
Armonk, NY 10504-1785 US

Such information may be available, subject to appropriate terms and conditions, including in some cases, payment of a fee.

The licensed program described in this document and all licensed material available for it are provided by IBM under terms of the IBM Customer Agreement, IBM International Program License Agreement or any equivalent agreement between us.

© Copyright IBM Corp. 2015, 2015

This information contains examples of data and reports used in daily business operations. To illustrate them as completely as possible, the examples include the names of individuals, companies, brands, and products. All of these names are fictitious and any similarity to actual people or business enterprises is entirely coincidental.

COPYRIGHT LICENSE:

This information contains sample application programs in source language, which illustrate programming techniques on various operating platforms. You may copy, modify, and distribute these sample programs in any form without payment to IBM, for the purposes of developing, using, marketing or distributing application programs conforming to the application programming interface for the operating platform for which the sample programs are written. These examples have not been thoroughly tested under all conditions. IBM, therefore, cannot guarantee or imply reliability, serviceability, or function of these programs. The sample programs are provided "AS IS", without warranty of any kind. IBM shall not be liable for any damages arising out of your use of the sample programs.

Each copy or any portion of these sample programs or any derivative work must include a copyright notice as shown below:

© (*your company name*) (*year*).
Portions of this code are derived from IBM Corp. Sample Programs.
© Copyright IBM Corp. (*enter the year or years*).

Trademarks

IBM, the IBM logo, and ibm.com® are trademarks or registered marks of International Business Machines Corp., registered in many jurisdictions worldwide. Other product and service names might be trademarks of IBM or other companies. A current list of IBM trademarks is available on the web at "Copyright and trademark information" at: http://www.ibm.com/legal/copytrade.shtml.

Linux® is a registered trademark of Linus Torvalds in the United States, other countries, or both.

Microsoft, Windows, Windows NT, and the Windows logo are trademarks of Microsoft Corporation in the United States, other countries, or both.

UNIX is a registered trademark of The Open Group in the United States and other countries.

Java and all Java-based trademarks and logos are trademarks or registered trademarks of Oracle and/or its affiliates.

Privacy policy considerations

IBM Software products, including software as a service solutions, (“Software Offerings”) may use cookies or other technologies to collect product usage information, to help improve the end user experience, to tailor interactions with the end user, or for other purposes. In many cases no personally identifiable information is collected by the Software Offerings. Some of our Software Offerings can help enable you to collect personally identifiable information. If this Software Offering uses cookies to collect personally identifiable information, specific information about this offering’s use of cookies is set forth below.

This Software Offering does not use cookies or other technologies to collect personally identifiable information.

If the configurations deployed for this Software Offering provide you as customer the ability to collect personally identifiable information from end users via cookies and other technologies, you should seek your own legal advice about any laws applicable to such data collection, including any requirements for notice and consent.

For more information about the use of various technologies, including cookies, for these purposes, see IBM’s Privacy Policy at http://www.ibm.com/privacy and IBM’s Online Privacy Statement at http://www.ibm.com/privacy/details the section entitled “Cookies, Web Beacons and Other Technologies” and the “IBM Software Products and Software-as-a-Service Privacy Statement” at http://www.ibm.com/software/info/product-privacy.

Glossary

The glossary is available in IBM Knowledge Center.

See the Glossary topic for definitions of Db2 for z/OS terms.

© Copyright IBM Corp. 2015, 2015

Index

A

audit interceptor
    z/OS Connect 37
authorization interceptor
    z/OS Connect 32

C

client certificates 40
configuring
    data source 34
    Liberty Profile angel process 19
    Liberty Profile server 24
    SAF 28, 30
    SSL keystore 28
    user authentication 30
    user authorization 30
creating
    angel process 17
    Liberty Profile groups 17
    Liberty Profile users 17

D

data source 34
Data Studio
    overview 7
Db2 Adapter
    configuring 13
    installing 13
    overview v
Db2 Adapter for z/OS Connect 17
Db2 SQL types 70
deploying 44

E

enabling
    RACF PassTicket 27

I

installing 17

J

Java Object Notation 5
JSON 5
JSON schema
    retrieving 56
JSON types 70

L

Liberty Profile for z/OS 1
Liberty Profile server 21

M

mapping 70

O

overview
    Db2 Adapter v
    security 9

P

PassTicket 27
planning 14

Q

querying
    service details 54

R

reference 65
removing 44
Representational State Transfer 5
REST APIs 5
retrieving
    JSON schema 56

S

SAF
    SSL keystore 28
sample
    db2zAdapterDataSources.xml file 68
    db2zAdapterServices.xml file 67
    server.xml file 65
samples 65
security
    overview 9
service
    creating 44
    deploying 44
    discovering 53
    invoking 61
    modifying 51
    querying 54
    removing 44
    service status 58
    starting 59
    stopping 60
    undeploying 44
    using 43
SSL keystore

SSL keystore *(continued)*
SAF 28
started task
Liberty Profile angel process 19
Liberty Profile server 24
System requirements 14

U

undeploying 44
user authentication 30
user authorization 30

Z

z/OS Connect
authorization interceptor 32
overview 3



Product Number: 5697-Q04

SC27-6769

