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Oracle® REST Data Services

Installation, Configuration, and Development Guide

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Oracle REST Data Services Installation, Configuration, and Development Guide, Release 17.3

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Preface

Oracle REST Data Services Installation, Configuration, and Development Guide explains how to install and configure Oracle REST Data Services. (Oracle REST Data Services was called *Oracle Application Express Listener* before Release 2.0.6.)

Note:

Effective with Release 3.0, the title of this book is *Oracle REST Data Services Installation, Configuration, and Development Guide*. The addition of "Development" to the title reflects the fact that material from a previous separate unofficial "Developer's Guide" has been included in this book in Developing Oracle REST Data Services Applications (page 3-1).

Topics:

Audience

This document is intended for system administrators or application developers who are installing and configuring Oracle REST Data Services. This guide assumes you are familiar with web technologies, especially REST (Representational State Transfer), and have a general understanding of Windows and UNIX platforms.

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Related Documents

For more information and resources relating to Oracle REST Data Services, see the following the Oracle Technology Network (OTN) site:

`http://www.oracle.com/technetwork/developer-tools/rest-data-services/`

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
`monospace`	Monospace type indicates commands within a paragraph, URLs, code in examples, text that is displayed on the screen, or text that you enter.

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Installing Oracle REST Data Services

This section describes how to install and deploy Oracle REST Data Services. (REST stands for Representational State Transfer.)

Note:

Oracle REST Data Services was called *Oracle Application Express Listener* before Release 2.0.6.

Topics:

1.1 About Oracle REST Data Services

Oracle REST Data Services is a Java EE-based alternative for Oracle HTTP Server and `mod_plsql`. The Java EE implementation offers increased functionality including a command line based configuration, enhanced security, file caching, and RESTful web services. Oracle REST Data Services also provides increased flexibility by supporting deployments using Oracle WebLogic Server, GlassFish Server, Apache Tomcat, and a standalone mode.

The Oracle Application Express architecture requires some form of web server to proxy requests between a web browser and the Oracle Application Express engine. Oracle REST Data Services satisfies this need but its use goes beyond that of Oracle Application Express configurations. Oracle REST Data Services simplifies the deployment process because there is no Oracle home required, as connectivity is provided using an embedded JDBC driver.

1.2 Understanding the Installation Process

This section offers an overview of Oracle REST Data Services and provides information about supported Java Platform, Enterprise Edition (Java EE) application servers and system requirements.

Topics:

- Supported Java EE Application Servers (page 1-2)
- System Requirements (page 1-2)

1.2.1 Supported Java EE Application Servers

Oracle REST Data Services supports the following Java EE application servers:

Application Server	Supported Release
Oracle WebLogic Server	11g Release 1 (10.3.6) or later
GlassFish Server	Release 4.1.2 or later
Apache Tomcat	Release 8.5 or later

1.2.2 System Requirements

Oracle REST Data Services system requirements are as follows:

- Oracle Database (Enterprise Edition, Standard Edition or Standard Edition One) release 11.1 or later, or Oracle Database 11*g* Release 2 Express Edition.
- Java JDK 1.7 or later.
- Web browser requirements:
  - Microsoft Internet Explorer 8.0 or later.
  - Mozilla Firefox 3.0 or later.
  - Google Chrome 2.0 or later.

Note:

Oracle Application Express is *not* a prerequisite for using Oracle REST Data Services.

If Oracle Application Express is installed and if RESTful services have been configured during the installation (see the step "Configure RESTful Services" in *Oracle Application Express Installation Guide*), then Oracle REST Data Services supports it, including executing the RESTful services defined in Oracle Application Express.

1.2.3 About Installing Oracle REST Data Services

To install Oracle REST Data Services:

1. Download, install, and configure Oracle REST Data Services.
2. Deploy Oracle REST Data Services. Deployment options include:
    - **Standalone Mode**.
    - **Oracle WebLogic Server**.
    - **GlassFish Server**.
    - **Apache Tomcat**.

Related Topics:

- Running in Standalone Mode (page 1-12)
- Deploying to Oracle WebLogic Server (page 1-15)
- Deploying to GlassFish Server (page 1-19)
- Deploying to Apache Tomcat (page 1-22)

1.3 Configuring and Installing Oracle REST Data Services

Before you deploy Oracle REST Data Services, you must install and configure it using a command-line interface.

Topics:

- About Using the Command-Line Interface (page 1-4)
- About the Database Users Used by Oracle REST Data Services (page 1-4)
- Privileges Granted by Oracle REST Data Services (page 1-5)
- Downloading, Configuring and Installing Oracle REST Data Services (page 1-6)
- Using SQL Developer Oracle REST Data Services Administration (Optional) (page 1-10)
- Using OAuth2 in Non-HTTPS Environments (page 1-11)

See Also:

If you plan to use Oracle REST Data Services with a NoSQL Database store, refer to NoSQL Store Installation and Registration (page 4-4) for more information.

To use the Oracle REST API for JSON Data Persistence, you must also install the Oracle REST API. See "Oracle REST API Installation" in *Oracle REST Data Services SODA for REST Developer's Guide*.

1.3.1 About Using the Command-Line Interface

Oracle REST Data Services provides several command line commands. For example, you can configure the location where Oracle REST Data Services stores configuration files, configure the database Oracle REST Data Services uses, and start Oracle REST Data Services in standalone mode.

To display a full list of available commands, go to the directory or folder containing the `ords.war` file and execute the following command:

```
java -jar ords.war help
```

A list of the available commands is displayed. To see instructions on how to use each of these commands, enter help followed by the command name, for example:

```
java -jar ords.war help configdir
```

1.3.2 About the Database Users Used by Oracle REST Data Services

Oracle REST Data Services uses the following database users:

User Name	Required	Description
`APEX_PUBLIC_USER`	Only if using Oracle REST Data Services with Oracle Application Express	If you use Oracle REST Data Services with Oracle Application Express, this is the database user used when invoking PL/SQL Gateway operations, for example, all Oracle Application Express operations. For information on unlocking the APEX_PUBLIC_USER, see "Configure APEX_PUBLIC_USER Account" in *Oracle Application Express Installation Guide*.
`APEX_REST_PUBLIC_USER`	Only if using RESTful Services defined in Application Express	The database user used when invoking Oracle Application Express RESTful Services if RESTful Services defined in Application Express workspaces are being accessed
`APEX_LISTENER`	Only if using RESTful Services defined in Application Express	The database user used to query RESTful Services definitions stored in Oracle Application Express if RESTful Services defined in Application Express workspaces are being accessed
`ORDS_METADATA`	Yes	Owner of the PL/SQL packages used for implementing many Oracle REST Data Services capabilities. ORDS_METADATA is where the metadata about Oracle REST Data Services-enabled schemas is stored. It is not accessed directly by Oracle REST Data Services; the Oracle REST Data Services application never creates a connection to the ORDS_METADATA schema. The schema password is set to a random string, connect privilege is revoked, and the password is expired.

User Name	Required	Description
ORDS_PUBLIC_USER	Yes	User for invoking RESTful Services in the Oracle REST Data Services-enabled schemas.

The APEX_<xxx> users are created during the Oracle Application Express installation process.

1.3.3 Privileges Granted by Oracle REST Data Services

As part of the Oracle REST Data Services installation, privileges are granted to several users:

- PUBLIC is granted SELECT on many ORDS_METADATA tables and views.
- PUBLIC is granted EXECUTE on PL/SQL packages that are available for users to invoke.
- ORDS_METADATA is granted EXECUTE on the following:
  - SYS.DBMS_ASSERT
  - SYS.DBMS_CRYPTO
  - SYS.DBMS_LOB
  - SYS.DBMS_OUTPUT
  - SYS.DBMS_REGISTRY
  - SYS.DBMS_SESSION
  - SYS.DBMS_UTILITY
  - SYS.VALIDATE_ORDS
  - SYS.HTF
  - SYS.HTP
  - SYS.OWA
  - SYS.WPG_DOCLOAD
- ORDS_METADATA is granted SELECT on the following:
  - SYS.DBA_DIRECTORIES
  - SYS.DBA_OBJECTS
- ORDS_METADATA is granted the following system privileges:
  - ALTER USER
  - CREATE TRIGGER
- ORDS_METADATA is granted the necessary object privileges to migrate Application Express REST data to ORDS_METADATA tables.

1.3.4 Downloading, Configuring and Installing Oracle REST Data Services

The procedures in this topic apply to installing Oracle REST Data Services in a traditional (non-CDB) database. If you want to install and use Oracle REST Data Services in a multitenant database environment, see Using the Multitenant Architecture with Oracle REST Data Services section.

> **Note:**
>
> You must complete the configuration steps in this topic before deploying to an application server.

To install and configure Oracle REST Data Services:

1. Download the file `ords.`*`version.number`*`.zip` from the Oracle REST Data Services download page.

   Note that the *`version.number`* in the file name reflects the current release number.
2. Unzip the downloaded zip file into a directory (or folder) of your choice:
   - UNIX and Linux: unzip `ords.`*`version.number`*`.zip`
   - Windows: Double-click the file `ords.`*`version.number`*`.zip` in Windows Explorer
3. Choose one of the following installation options:
   - Simple Installation Using Parameters File.
   - Advanced Installation Using Command-Line Prompts.
4. You can reinstall or uninstall Oracle REST Data Services if required.

Related Topics:

- Using the Multitenant Architecture with Oracle REST Data Services (page G-1)
- About the Database Users Used by Oracle REST Data Services (page 1-4)
- If You Want to Reinstall or Uninstall (Remove) Oracle REST Data Services (page 1-10)

> **See Also:**
>
> `http://www.oracle.com/technetwork/developer-tools/rest-data-services/downloads/index.html`

1.3.4.1 Simple Installation Using a Parameters File

You can perform a simple installation using the parameters specified in the `<path-to-params-file>/ords_params.properties` file under the location where you installed Oracle REST Data Services. You can edit that file beforehand to change default values to reflect your environment and preferences. If a parameter is missing in the file, you will be prompted for it.

To perform a simple installation using the parameters file:

1. Optionally, if you want to use the database default and temporary tablespaces, you can remove the following tablespace-related entries in the `ords_params.properties` file:

   ```
   schema.tablespace.default=SYSAUX
   schema.tablespace.temp=TEMP
   user.tablespace.default=USERS
   user.tablespace.temp=TEMP
   ```

2. Make any desired values to default values to reflect your environment and preferences. If you change any of the tablespace-related values, you must ensure that the tablespaces you specify already exist in the database.

   The default `ords_params.properties` file includes the following:

   ```
   db.hostname=localhost
   db.port=1521
   db.servicename=
   db.sid=
   db.username=APEX_PUBLIC_USER
   migrate.apex.rest=false
   rest.services.apex.add=
   rest.services.ords.add=true
   schema.tablespace.default=SYSAUX
   schema.tablespace.temp=TEMP
   standalone.http.port=8080
   standalone.mode=true
   standalone.static.images=
   user.tablespace.default=USERS
   user.tablespace.temp=TEMP
   ```

   Note:

   On Microsoft Windows systems, if you specify an Application Express static images location for standalone.static.images, use the backslash (escape character) before the colon, and use a forward slash as the folder separator. Example: `standalone.static.images=d\:/test/apex426/apex/images/`

3. Enter either of the following commands:

   ```
   java -jar ords.war
   java -jar ords.war install simple
   ```

   (You can omit `install simple` because the simple installation is the default.)

When you install Oracle REST Data Services for the first time, you are prompted for passwords for these users: the PL/SQL gateway database user and ORDS_PUBLIC_USER. The encrypted passwords are stored in the parameter file (for example, `user.public.password=@0585904F6C9B442532D5212962835D00C8`).

If you later want to change the passwords, you must remove the encrypted passwords from the parameter file. For security reasons, readable (non-encrypted) passwords are not allowed in the parameter file.

1.3.4.2 Advanced Installation Using Command-Line Prompts

You can perform an advanced installation in which you are prompted for the necessary parameter values, after which your choices are stored in the `params/ords_params.properties` file under the location where you installed Oracle REST Data Services.

To perform an advanced installation, enter the following command:

```
java -jar ords.war install advanced
```

During installation, Oracle REST Data Services checks if configuration files already exist in your specified configuration folder:

- If configuration files do not exist in that folder, they are created (examples: `defaults.xml`, `apex_pu.xml`).
- If configuration files from an earlier release exist in that folder, Oracle REST Data Services checks if `<name>_pu.xml` is present; and if it is not, you are prompted for the password for the ORDS_PUBLIC_USER account. If the configuration files `<name>_al.xml` and `<name>_rt.xml` from Release 2.0.n exist, they are preserved. (However, in Releases 2.0.n RESTful Services was optional, and therefore the files might not exist in the configuration folder.)
- If multiple configuration files exist from a previous release (examples: `apex.xml`, `apex_al.xml`, `apex_rt.xml`, `sales.xml`, `sales_al.xml`, `sales_rt.xml`, …), and if `<name>_pu.xml` does not exist, then you are prompted to select the database configuration so that the ORDS schema can be created in that database.

The following shows an example advanced installation. In this example, if you accepted the default value of 1 for `Enter 1 if you wish to start in standalone mode or 2 to exit [1]`, the remaining prompts are displayed; and if you will be using Oracle Application Express, you must specify the `APEX static resources location`.

```
d:\ords>java -jar ords.war install advanced
This Oracle REST Data Services instance has not yet been configured.
Please complete the following prompts
Enter the location to store configuration data:d:\path\to\config\
Enter the name of the database server [localhost]:
Enter the database listen port [1521]:
Enter 1 to specify the database service name, or 2 to specify the database SID [1]:2
Enter the database SID [xe]:
Enter 1 if you want to verify/install Oracle REST Data Services schema or 2 to skip
this step [1]:
Enter the database password for ORDS_PUBLIC_USER:
Confirm password:
Please login with SYSDBA privileges to verify Oracle REST Data Services schema.
Installation may be required.
Enter the username with SYSDBA privileges to verify the installation [SYS]:
Enter the database password for SYS:
Confirm password:
Oracle REST Data Services schema does not exist and will be created.
Enter the default tablespace for ORDS_METADATA [SYSAUX]:
Enter the temporary tablespace for ORDS_METADATA [TEMP]:
Enter the default tablespace for ORDS_PUBLIC_USER [USERS]:
Enter the temporary tablespace for ORDS_PUBLIC_USER [TEMP]:
Enter 1 if you want to use PL/SQL Gateway or 2 to skip this step [1]:
Enter the PL/SQL Gateway database user name [APEX_PUBLIC_USER]:
Enter the database password for APEX_PUBLIC_USER:
```

```
Confirm password:
Enter 1 to specify passwords for Application Express RESTful Services database users
(APEX_LISTENER, APEX_REST_PUBLIC_USER) or 2 to skip this step [1]:
Enter the database password for APEX_LISTENER:
Confirm password:
Enter the database password for APEX_REST_PUBLIC_USER:
Confirm password:
Enter 1 if you wish to start in standalone mode or 2 to exit [1]:
Enter the APEX static resources location:d:\apex426\apex\images\
Enter 1 if using HTTP or 2 if using HTTPS [1]:
Enter the HTTP port [8080]:
  OR
Enter 1 if using HTTP or 2 if using HTTPS [1]:2
Enter the HTTPS port [8443]:
Enter the SSL hostname:
Enter 1 to use the self-signed certificate or 2 if you will provide the SSL
certificate [1]:
```

1.3.4.3 Validating the Oracle REST Data Services Installation

If you want to check that the Oracle REST Data Services installation is valid, go to the directory or folder containing the `ords.war` file and enter the `validate` command in the following format:

```
java -jar ords.war validate [--database <dbname>]
```

Note:

When you install ORDS, it attempts to find the Oracle Application Express (APEX) schema and creates a view. This view joins the relevant tables in the APEX schema to the tables in the ORDS schema. If you install ORDS before APEX, then ORDS cannot find the APEX schema and it creates a stub view in place of the missing APEX tables.

Oracle highly recommends that you install ORDS after APEX to ensure that the APEX objects, which ORDS needs to query, are present. If you install ORDS before APEX, then use the `validate` command to force ORDS to reconstruct the queries against the APEX schema.

If `--database` is specified, *<dbname>* is the pool name that is stored in the Oracle REST Data Services configuration files.

You are prompted for any necessary information that cannot be obtained from the configuration of pool name, such as host, port, SID or service name, and the name and password of a user with SYSDBA privilege (such as SYS AS SYSDBA).

Note:

If the validate command is run against a CDB, then it will validate the CDB and all of its PDBs.

1.3.4.4 If You Want to Reinstall or Uninstall (Remove) Oracle REST Data Services

If you want to reinstall Oracle REST Data Services, you must first uninstall the existing Oracle REST Data Services; and before you uninstall, ensure that Oracle REST Data Services is stopped.

Uninstalling Oracle REST Data Services removes the ORDS_METADATA schema, the ORDS_PUBLIC_USER user, and Oracle REST Data Services-related database objects (including public synonyms) if they exist in the database. To uninstall (remove, or deinstall) Oracle REST Data Services, go to the directory or folder containing the `ords.war` file and enter the `uninstall` command as follows:

```
java -jar ords.war uninstall
```

The `uninstall` command prompts you for some necessary information (host, port, SID or service name, username, password).

See Also:

To uninstall Oracle REST Data Services from a CDB, see Using the Multitenant Architecture with Oracle REST Data Services (page G-1).

1.3.5 Using SQL Developer Oracle REST Data Services Administration (Optional)

This section describes how to use Oracle SQL Developer to administer Oracle REST Data Services.

See Also:

"Oracle REST Data Services Administration" in *Oracle SQL Developer User's Guide*

Topics:

- About SQL Developer Oracle REST Data Services Administration (page 1-10)
- Configuring an Administrator User (page 1-11)

1.3.5.1 About SQL Developer Oracle REST Data Services Administration

Oracle SQL Developer enables you to administer Oracle REST Data Services using a graphical user interface. To take full advantage of these administration capabilities, you must use SQL Developer Release 4.1 or later. Using SQL Developer for Oracle REST Data Services administration is optional.

Using this graphical user interface, you can update the database connections, JDBC settings, URL mappings, RESTful connections, security (allowed procedures, blocked procedures, validation function and virus scanning), Caching, Pre/Post Processing Procedures, Environment, and Excel Settings. Oracle SQL Developer also provides statistical reporting, error reporting, and logging.

See Also:

"Oracle REST Data Services Administration" in *Oracle SQL Developer User's Guide*

1.3.5.2 Configuring an Administrator User

If you want to be able to administer Oracle REST Data Services using SQL Developer, then you must configure an administrator user as follows:

- Execute the following command:

  ```
  java -jar ords.war user adminlistener "Listener Administrator"
  ```

- Enter a password for the `adminlistener` user.
- Confirm the password for the `adminlistener` user.
- If you are using Oracle REST Data Services without HTTPS, follow the steps listed under the section,**Using OAuth2 in Non-HTTPS Environments**.

When using SQL Developer to retrieve and/or upload an Oracle REST Data Services configuration, when prompted, enter the credentials provided in the preceding list.

1.3.6 Using OAuth2 in Non-HTTPS Environments

RESTful Services can be protected with the OAuth2 protocol to control access to nonpublic data. To prevent data snooping, OAuth2 requires all requests involved in the OAuth2 authentication process to be transported using HTTPS. The default behavior of Oracle REST Data Services is to verify that all OAuth2 related requests have been received using HTTPS. It will refuse to service any such requests received over HTTP, returning an HTTP status code of 403 Forbidden.

This default behavior can be disabled in environments where HTTPS is not available as follows:

1. Locate the folder where the Oracle REST Data Services configuration is stored.
2. Edit the file named `defaults.xml`.
3. Add the following setting to the end of this file just before the `</properties>` tag.

   ```
   <entry key="security.verifySSL">false</entry>
   ```

4. Save the file.
5. Restart Oracle REST Data Services if it is running.

Note that it is only appropriate to use this setting in development or test environments. It is never appropriate to use this setting in production environments because it will result in user credentials being passed in clear text.

> **Note:**
>
> Oracle REST Data Services must be restarted after making configuration changes. See your application server documentation for information on how to restart applications.

1.4 Running in Standalone Mode

Although Oracle REST Data Services supports the Java EE application servers, you also have the option of running in standalone mode. This section describes how to run Oracle REST Data Services in standalone mode.

Standalone mode is suitable for development use and is supported in production deployments. Standalone mode, however, has minimal management capabilities when compared to most Java EE application servers and may not have adequate management capabilities for production use in some environments.

Topics:

- Starting in Standalone Mode (page 1-12)
- Stopping the Server in Standalone Mode (page 1-14)
- Configuring a Doc Root for Non-Application Express Static Resources (page 1-14)

Related Topics:

- Supported Java EE Application Servers (page 1-2)

1.4.1 Starting in Standalone Mode

To launch Oracle REST Data Services in standalone mode:

1. To start Standalone mode, execute the following command:

   ```
   java -jar ords.war standalone
   ```

   If you have not yet completed the standalone configuration, you are prompted to do so.

> **Tip:**
>
> To see help on standalone mode options, execute the following command:
>
> ```
> java -jar ords.war help standalone
> ```

> **Note:**
>
> If you want to use RESTful services that require secure access, you should use HTTPS.

2. When prompted, specify the location of the folder containing the Oracle Application Express static resources used by Oracle REST Data Services, or press **Enter** if you do not want to specify this location.
3. When prompted select if you want Oracle REST Data Services to generate a self-signed certificate automatically or if you want to provide your own certificate. If you want to use your own certificate, provide the path for the Certificate and DER encoded related private key when prompted.

   If the private key has not already been converted to DER, see section, **Converting a Private Key to DER (Linux and Unix)** before you enter the values here.

   You are only prompted for these values the first time you launch standalone mode.

Note:

Ensure that no other servers are listening on the port you choose. The default port `8080` is commonly used by HTTP or application servers, including the embedded PL/SQL gateway; the default secure port `8443` is commonly used by HTTPS.

Related Topics:

- Using OAuth2 in Non-HTTPS Environments (page 1-11)
- Converting a Private Key to DER (Linux and Unix) (page 1-13)

1.4.1.1 Converting a Private Key to DER (Linux and Unix)

Usually, you would have created a private key and a Certificate Signing Request before obtaining your signed certificate. The private key needs to be converted into DER in order for Oracle REST Data Services to read it properly.

For example, assume that the original private key was created using the OpenSSL tool with a command similar to either of the following:

```
openssl req -new -newkey rsa:2048 -nodes -keyout yourdomain.key -out yourdomain.csr
```

or

```
openssl genrsa -out private.em 2048
```

In this case, you must run a command similar to the following to convert it and remove the encryption: openssl pkcs8 -topk8 -inform PEM -outform DER -in yourdomain.key -out yourdomain.der -nocrypt

```
openssl pkcs8 -topk8 -inform PEM -outform DER -in yourdomain.key -out yourdomain.der
-nocrypt
```

After doing this, you can include the path to `yourdomain.der` when prompted by Oracle REST Data Services, or you can modify the following entries in `conf/ords/standalone/standalone.properties`:

```
ssl.cert=<path to yourdomain.crt>
ssl.cert.key=<path to yourdomain.der>
ssl.host=yourdomain
```

Also, ensure that `jetty.secure.port` is set.

1.4.2 Stopping the Server in Standalone Mode

To stop the Oracle REST Data Services server in standalone mode, at a command prompt press **Ctrl+C**.

1.4.3 Configuring a Doc Root for Non-Application Express Static Resources

You can configure a doc root for standalone mode to deploy static resources that are outside the `/i` folder that is reserved for Application Express static resources.

To do so, specify the `--doc-root` parameter with the standalone mode command, as in the following example:

```
java -jar ords.war standalone --doc-root /var/www/html
```

The preceding example makes any resource located within `/var/www/html` available under `http://`*`server:port`*`/`. For example, if the file `/var/www/html/hello.txt` exists, it will be accessible at `http://`*`server:port`*`/hello.txt`.

The value specified for `--doc-root` is stored in `${config.dir}/ords/standalone/standalone.properties` in the `standalone.doc.root` property. If a custom doc root is not specified using `--doc-root`, then the default `doc-root` value of `${config.dir}/ords/standalone/doc_root` is used. Any file placed within this folder will be available at the root context.

This approach has the following features and considerations:

- HTML resources can be addressed without their file extension. For example, if a file named `hello.html` exists in the doc root, it can be accessed at the URI `http://`*`server:port`*`/hello`.
- Attempts to address a HTML resource with its file extension are redirected to the location without an extension. For example, if the URI `http://`*`server:port`*`/hello.html` is accessed, then the client is redirected to `http://`*`server:port`*`/hello`.

  The usual practice is to serve HTML resources without their file extensions, so this feature facilitates that practice, while the redirect handles the case where the resource is addressed with its file extension.
- Index pages for folders are supported. If a folder contains a file named `index.html` or `index.htm`, then that file is used as the index page for the folder. For example, if `/var/www/html` contains `/abc/xyz/index.html`, then accessing `http://`*`server:port`*`/abc/xyz/` displays the contents of `index.html`.
- Addressing a folder without a trailing slash causes a redirect to the URI with a trailing slash. For example, if a client accesses `http://server:port/abc/xyz`, then the server issues a redirect to `http://server:port/abc/xyz/`.
- Resources are generated with weak etags based on the modification stamp of the file and with a Cache Control header that causes the resources to be cached for 1 hour.

1.5 Deploying to Oracle WebLogic Server

This section describes how to deploy Oracle REST Data Services on Oracle WebLogic Server. It assumes that you have completed the installation process and are familiar with Oracle WebLogic Server. If you are unfamiliar with domains, managed servers, deployment, security, users and roles, refer to your Oracle WebLogic Server documentation.

Topics:

1.5.1 About Oracle WebLogic Server

You can download Oracle WebLogic Server from Oracle Technology Network.

To learn more about installing Oracle WebLogic Server, see *Oracle Fusion Middleware Getting Started With Installation for Oracle WebLogic Server* and *Oracle Fusion Middleware Installation Guide for Oracle WebLogic Server*.

See Also:

`http://www.oracle.com/technetwork/middleware/weblogic/downloads/index.html`

1.5.2 Downloading, Installing, and Configuring Oracle REST Data Services

You must complete this step before deploying Oracle REST Data Services on WebLogic.

Related Topics:

- Configuring and Installing Oracle REST Data Services (page 1-3)

1.5.3 Configuring Oracle Application Express Images

If you are using Oracle Application Express, you must create a web archive to reference the Oracle Application Express, image files. However, if you are **not** using Oracle Application Express, you may skip the rest of this section about configuring Oracle Application Express images.

Before you begin, you must create a web archive (WAR) file to reference the Oracle Application Express image files. Use the static command to create a web archive file named `i.war`:

```
java -jar ords.war static <apex directory>\images
```

Where:

- *<apex directory>* is the directory location of Oracle Application Express.

This command runs the `static` command contained in the `ords.war` file. It packages the Application Express static images into an archive file named `i.war`.

The created images WAR does not contain the static resources; instead, it references the location where the static resources are stored. Therefore the static resources must be available at the specified path on the server where the WAR is deployed.

Tip:

Use `java -jar ords.war help static` to see the full range of options for the `static` command.

Use the `i.war` file to deploy to WebLogic in the following steps:

1. Launching the Administration Server Console
2. Installing the Oracle WebLogic Server Deployment
3. Configuring WebLogic to Handle HTTP Basic Challenges Correctly

1.5.4 Launching the Administration Server Console

To launch the Administration Server console:

1. Start an Administration Server.
2. Launch the WebLogic Administration Console by typing the following URL in your web browser:

   ```
   http://<host>:<port>/console
   ```

   Where:

   - *<host>* is the DNS name or IP address of the Administration Server.
   - *<port>* is the port on which the Administration Server is listening for requests (port `7001` by default).
3. Enter your WebLogic Administrator username and password.
4. If your domain is in *Production* mode, click the **Lock & Edit** button on the left-pane below the submenu Change Center. If your domain is in *Development* mode, this button does not appear.

1.5.5 Installing the Oracle WebLogic Server Deployment

> **Tip:**
>
> The Oracle REST Data Services files, `ords.war` and `i.war`, must be available before you start this task.

To install the deployment:

1. Go to the WebLogic Server Home Page. Below Domain Configuration, select **Deployments**.

   The Summary of Deployments is displayed.

2. Click **Install**.
3. Specify the location of the `ords.war` file and click **Next**.

   The `ords.war` file is located in the folder where you unzipped the Oracle REST Data Services ZIP file.

   > **Tip:**
   >
   > WebLogic Server determines the context root from the file name of a WAR archive. If you need to keep backward compatibility, so that URLs are of the form *http://server/apex/...* rather than *http://server/ords/...*, then you must rename `ords.war` to `apex.war` before the deployment.

   The Install Application assistant is displayed.

4. Select **Install this deployment as an application** and click **Next**.
5. Select the servers and/or clusters to which you want to deploy the application or module and click **Next**.

   > **Tip:**
   >
   > If you have not created additional Managed Servers or clusters, you do not see this assistant page.

6. In the Optional Settings, specify the following:
   a. Name - Enter:

      ```
      ords
      ```

   b. Security - Select the following:

      Custom Roles: Use roles that are defined in the Administration Console; use policies that are defined in the deployment descriptor

   c. Source accessibility - Select:

      Use the defaults defined by the deployment's targets

7. Click **Next**.

   A summary page is displayed.

8. Under Additional configuration, select one of the following:

   - **Yes, take me to the deployment's configuration** - Displays the Configuration page.
   - **No I will review the configuration later** - Returns you to the Summary of Deployments page.

9. Review the summary of configuration settings that you have specified.
10. Click **Finish**.
11. Repeat the previous steps to deploy the `i.war` file.

    In the optional settings, specify the following:

    a. Name - Enter:

       ```
       i
       ```

    b. Security - Select:

       Custom Roles: Use roles that are defined in the Administration Console; use policies that are defined in the deployment descriptor

    c. Source Accessibility - Select:

       Use the defaults defined by the deployment's targets

12. If your domain is in Production Mode, then on the Change Center click **Activate Changes**.

Related Topics:

- Configuring and Installing Oracle REST Data Services (page 1-3)
- Configuring Oracle Application Express Images (page 1-15)

1.5.6 Configuring WebLogic to Handle HTTP Basic Challenges Correctly

By default WebLogic Server attempts to intercept all HTTP Basic Authentication challenges. This default behavior needs to be disabled for Oracle REST Data Services to function correctly. This is achieved by updating the `enforce-valid-basic-auth-credentials` flag. The WebLogic Server Administration Console does not display the `enforce-valid-basic-auth-credentials` setting. You can use WebLogic Scripting Tool (WLST) commands to check, and edit the value in a running server.

The following WLST commands display the domain settings:

```
connect('weblogic','weblogic','t3://localhost:7001')
cd('SecurityConfiguration')
cd('mydomain')
ls()
```

If the domain settings displayed, contains the following entry:

```
-r--   EnforceValidBasicAuthCredentials            true
```

Then you must set this entry to `false`.

To set the entry to `false`, use the WLST commands as follows:

```
connect('weblogic', 'weblogic', 't3://localhost:7001')
edit()
startEdit()
cd('SecurityConfiguration')
cd('mydomain')
set('EnforceValidBasicAuthCredentials','false')
save()
activate()
disconnect()
exit()
```

Note:

WebLogic Server must be restarted for the new settings to take effect.

In the preceding example:

- `weblogic` is the WebLogic user having administrative privileges
- `weblogic` is the password
- `mydomain` is the domain
- The AdminServer is running on the `localhost` and on port `7001`

Related Topics:

- WebLogic Server Command Reference

1.5.7 Verifying the State and Health of ords and i

In the Summary of Deployments, select the **Control** tab and verify that both the `ords` and `i` State are Active and the Health status is OK.

If `ords` and/or `i` are not Active, then enable them. In the Deployments table, select the check box next to `ords` and/or `i`. Click **Start** and select **Servicing all requests** to make them active.

1.6 Deploying to GlassFish Server

This section describes how to deploy Oracle REST Data Services on GlassFish Server.

Topics:

- About GlassFish Server (page 1-20)
- Downloading, Installing, and Configuring Oracle REST Data Services (page 1-20)
- Configuring Oracle Application Express Images (page 1-20)
- Launching the Administration Server Console (page 1-21)
- Installing the GlassFish Server Deployment (page 1-21)

Tip:

This section assumes that you have completed the installation process and are familiar with GlassFish Server. If you are unfamiliar with domains, servers, applications, security, users and roles, see your GlassFish Server documentation.

1.6.1 About GlassFish Server

You can install Oracle REST Data Services with GlassFish Server. GlassFish Server is available for download from the Oracle Technology Network.

Related Topics:

- Downloading, Installing, and Configuring Oracle REST Data Services (page 1-20)

See Also:

`http://www.oracle.com/us/products/middleware/application-server/oracle-glassfish-server/index.html`

1.6.2 Downloading, Installing, and Configuring Oracle REST Data Services

You must complete this step before deploying Oracle REST Data Services on GlassFish.

1.6.3 Configuring Oracle Application Express Images

If you are using Oracle Application Express, you must create a web archive to reference the Oracle Application Express, image files. However, if you are **not** using Oracle Application Express, you may skip the rest of this section about configuring Oracle Application Express images.

Before you begin, you must create a web archive (WAR) file to reference the Oracle Application Express image files. Use the `static` command to create a web archive file named `i.war`:

```
java -jar ords.war static <apex directory>\images
```

Where:

- *<apex directory>* is the directory location of Oracle Application Express.

The created images WAR does not contain the static resources; instead, it references the location where the static resources are stored. Therefore the static resources must be available at the specified path on the server where the WAR is deployed.

Tip:

Use `java -jar ords.war help static` to see the full range of options for the `static` command.

Use the `i.war` file to deploy to GlassFish in the following steps:

1. Launching the Administration Server Console
2. Installing the GlassFish Server Deployment

1.6.4 Launching the Administration Server Console

At least one GlassFish server domain must be started before you start the Administration Console.

To launch the Administration Console:

1. Launch the Administration Console by typing the following URL in your web browser:

   ```
   http://localhost:4848
   ```

2. If prompted, log in to the Administration Console.

Tip:

You are prompted to log in if you chose to require an administration password at the time GlassFish server was installed.

1.6.5 Installing the GlassFish Server Deployment

Tip:

The Oracle REST Data Services files, `ords.war` and `i.war` must be available before you start this task.

To install the deployment:

1. On the navigation tree, click the **Application** node.

   The Applications page is displayed.
2. Click the **Deploy** button.

   The Deploy Applications or Modules page is displayed.
3. Select **Packaged File to be Uploaded to the Server** and click **Browse**.
4. Navigate to the location of the `ords.war` file, select the file, and click **Open**.

   The Deploy Applications or Modules page is displayed.

5. On the Deploy Applications or Modules page, specify the following:
   a. Type: **Web Application**
   b. Context Root: **ords**

   > **Tip:**
   >
   > The Context Root value defaults to *ords*. However you can change it to *apex* if you need to keep backward compatibility, so that URLs are of the form *http://server/apex/...* rather than *http://server/ords/...*.

   c. Application Name: **ords**
   d. Status: **Enabled**
   e. Description: **Oracle REST Data Services**
   f. Accept all other default settings and click **OK**.
6. Repeat the previous steps to deploy the `i.war` file. Clear the Context Root field so that the context root set in the `sun-web.xml` is used.

The Applications page is displayed. A check mark should appear in the Enabled field for **ords**

> **Tip:**
>
> If a check mark does not appear in the Enabled column for **ords**, then select the check box next to **ords** and click **Enable**.

Related Topics:

- Configuring and Installing Oracle REST Data Services (page 1-3)
- Configuring Oracle Application Express Images (page 1-20)

1.7 Deploying to Apache Tomcat

This section describes how to deploy Oracle REST Data Services on Apache Tomcat.

Topics:

- About Apache Tomcat (page 1-23)
- Downloading, Installing, and Configuring Oracle REST Data Services (page 1-23)
- Configuring Oracle Application Express Images (page 1-23)
- Installing the Apache Tomcat Deployment (page 1-24)

1.7.1 About Apache Tomcat

Tip:

This section assumes that you have completed the installation process and are familiar with Apache Tomcat. If you are unfamiliar with domains, servers, applications, security, users and roles, see your Apache Tomcat documentation.

You can download Apache Tomcat from:

See Also:

`tomcat_apache_org`

1.7.2 Downloading, Installing, and Configuring Oracle REST Data Services

You must complete this step before deploying Oracle REST Data Services on Apache Tomcat.

Related Topics:

- Configuring and Installing Oracle REST Data Services (page 1-3)

1.7.3 Configuring Oracle Application Express Images

If you are using Oracle Application Express, you must create a web archive to reference the Oracle Application Express, image files. However, if you are **not** using Oracle Application Express, you may skip the rest of this section about configuring Oracle Application Express images.

To configure Oracle Application Express Images on Apache Tomcat:

- Copy the contents of the `<apex directory>/images` folder to `<Tomcat directory>/webapps/i/`.

  Where:

  – `<apex directory>` is the directory location of the Oracle Application Express distribution.

  – `<Tomcat directory>` is the folder where Apache Tomcat is installed.

1.7.4 Installing the Apache Tomcat Deployment

> **Tip:**
>
> The Oracle REST Data Services file `ords.war` must be available before you start this task.

To install the Apache Tomcat deployment:

1. Move the `ords.war` file into the `webapps` folder where Apache Tomcat is installed.

   > **Tip:**
   >
   > Apache Tomcat determines the context root from the file name of a WAR archive. If you need to keep backward compatibility, so that URLs are of the form *http://server/apex/...* rather than *http://server/ords/...*, then you must rename `ords.war` to `apex.war` before moving it into to the `webapps` folder.

2. Access Oracle Application Express by typing the following URL in your web browser:

   ```
   http://<hostname>:<port>/ords/
   ```

   Where:

   - `<hostname>` is the name of the server where Apache Tomcat is running.
   - `<port>` is the port number configured for Apache Tomcat application server.

Related Topics:

- Configuring and Installing Oracle REST Data Services (page 1-3)
- Configuring Oracle Application Express Images (page 1-23)

1.8 Upgrading Oracle REST Data Services

If you want to upgrade to a new release of Oracle REST Data Services, you must do the following:

1. Stop the Oracle REST Data Services instance.
   - If you are running Oracle REST Data Services on your application server (such as Oracle WebLogic Server, GlassFish Server, or Apache Tomcat), stop Oracle REST Data Services.
   - If you are running Oracle REST Data Services in standalone mode, refer to section, **Stopping the Server in Standalone Mode**.
2. Go to the folder where you unzipped the new Oracle REST Data Services release distribution.
3. Enter the following on the command line:

   ```
   java -jar ords.war install advanced
   ```

or

```
java -jar ords.war
```

4. When prompted for the configuration folder, use the configuration folder where the Oracle REST Data Services configuration files are stored. (The configuration location will be stored in the `ords.war` file.)
   - If you specified an existing Oracle REST Data Services configuration folder that contains the configuration files, Oracle REST Data Services will attempt to connect to each database defined in the configuration folder and check the installed version.
   - If you specified an Oracle REST Data Services configuration folder that does not exist, you will be prompted for the database connection information, the ORDS_PUBLIC_USER credentials, and additional configuration information. Oracle REST Data Services will attempt to connect to this database and check the installed version.

When Oracle REST Data Services checks the installed version, it does the following, depending on whether an earlier 3.0.*n* version is already installed in the database.

- If the installed version is an earlier 3.0.*n* version of Oracle REST Data Services, you are prompted for the SYS credentials to enable Oracle REST Data Services to apply the in-place upgrade. The in-place upgrade will modify the existing installation to add the updated schema objects and packages. The existing metadata stored in the ORDS schema will remain intact.
- If Oracle REST Data Services is not already installed in the database (or if you are upgrading from Release 2.0.*n*), you are prompted for the SYS credentials to enable Oracle REST Data Services to perform the installation, and you will also be prompted for the default and temporary tablespaces for the ORDS_METADATA schema and ORDS_PUBLIC_USER.

When the upgrade or installation completes, you can re-deploy the `ords.war` file to your application server or start Oracle REST Data Services in standalone mode.

Related Topics:

- Troubleshooting Oracle REST Data Services (page E-1)
- Stopping the Server in Standalone Mode (page 1-14)

1.9 Using a Bequeath Connection to Install, Upgrade, Validate, or Uninstall Oracle REST Data Services

You can use the bequeath connection to install, upgrade, validate, or uninstall Oracle REST Data Services. The installer will not prompt you for the SYS username and password for the operation

In the parameter file, add the property: `bequeath.connect=true`

Using a bequeath connection for installing, validating, or uninstalling Oracle REST Data Services is supported on Linux and Windows systems for Oracle Database Release 12, but only on Linux systems for Oracle Database Release 11.

The command used must be run by an operating system user that is a member of the DBA group. Example of installing Oracle REST Data Services:

```
java -jar ords.war
```

Bequeath Connection Using Linux

On a Linux system, you must set the following environment variables to use the bequeath connection:

- ORACLE_HOME
- ORACLE_SID
- LD_LIBRARY_PATH (to point to `ORACLE_HOME/lib`)

For Oracle Database Release 11 (but not for Release 12), you must specify the option `-DuseOracleHome=true`. Examples of installing Oracle REST Data Services on a Linux system:

- For Oracle Database Release **11**: `java -DuseOracleHome=true -jar ords.war`
- For Oracle Database Release **12**: `java -jar ords.war`

Related Topics:

- Simple Installation Using a Parameters File (page 1-6)

2 Configuring Oracle REST Data Services (Advanced)

This section explains how to configure Oracle REST Data Services for connecting to multiple databases for routing requests, and it refers to other documentation sources for other configuration information.

> **Note:**
>
> Oracle REST Data Services must be restarted after making configuration changes. See your application server documentation for information on how to restart applications.

Topics:

2.1 Configuring Multiple Databases

Oracle REST Data Services supports the ability to connect to more than one database. This section describes different strategies for routing requests to the appropriate database.

Topics:

2.1.1 About the Request URL

Oracle REST Data Services supports a number of different strategies for routing requests to the appropriate database. All of these strategies rely on examining the request URL and choosing the database based on some kind of match against the URL. It is useful to recap the pertinent portions of a request URL. Consider the following URL:

```
https://www.example.com/ords/sales/f?p=1:1
```

This URL consists of the following sections:

- Protocol: `https`
- Host Name: `www.example.com`
- Context Root: `/ords`

  The context root is the location at which Oracle REST Data Services is deployed on the application server.
- Request Path: `/sales/f?p=1.1`

  This is the portion of the request URL relative to the context root.

For different applications, it may be important to route requests based on certain prefixes in the request path or certain prefixes in the full request URL.

There are two steps to configuring multiple databases:

1. Configuring the database connection information
2. Configuring which requests are routed to which database

2.1.2 Configuring Additional Databases

When you first configure Oracle REST Data Services, you configure a default database connection named: `apex`. You can create additional database connections using the `setup` command.

Tip:

To see full help for the `setup` command type:

```
java -jar ords.war help setup
```

To create a database connection type the following:

```
java -jar ords.war setup --database <database name>
```

Where:

- `<database name>` is the name you want to give the database connection.

You are prompted to enter the information required to configure the database. After you have configured the additional databases, define the rules for how requests are routed to the appropriate database.

Related Topics:

- Configuring and Installing Oracle REST Data Services (page 1-3)
- Routing Based on the Request Path Prefix (page 2-3)
- Routing Based on the Request URL Prefix (page 2-4)

2.1.3 Routing Based on the Request Path Prefix

You create request routing rules using the `map-url` command.

> **Tip:**
>
> To see full help for the `map-url` command type:
>
> ```
> java -jar ords.war help map-url
> ```

If you want to route requests based just on matching a prefix in the request path portion of the URL, use the `map-url` command as follows:

```
java -jar ords.war map-url --type base-path --workspace-id <workspace name> <path
prefix> <database name>
```

Where:

- *`<workspace name>`* is the name of the Oracle Application Express workspace where RESTful services for this connection are defined. This may be omitted if RESTful Services are not being used.
- *`<path prefix>`* is the prefix that must occur at the start of the request path.
- *`<database name>`* is the name of the database connection configured in the previous step.

Related Topics:

- Configuring Additional Databases (page 2-2)

2.1.3.1 Example of Routing Based on the Request Path Prefix

Assuming Oracle REST Data Services is deployed on a system named `example.com` at the context path `/ords`, then create the following rule:

```
java -jar ords.war map-url --type base-path --workspace-id sales_rest /sales sales_db
```

This rule means that any requests matching `https://example.com/ords/sales/...` are routed to the `sales_db` database connection. The `sales_rest` workspace defined within the `sales_db` database is searched for RESTful Services definitions.

The previous rule matches all of the following requests:

```
https://example.com/ords/sales/f?p=1:1
https://example.com/ords/sales/leads/
https://www.example.com/ords/sales/forecasting.report?month=jan  (If www.example.com
resolves to the same system as example.com.)
```

The previous rule does not match of any of the following requests:

```
http://example.com/ords/sales/f?p=1:1  (The protocol is wrong.)
https://example.com:8080/ords/sales/f?p=1:1  (The port is wrong: 443 is default for
https, but don't specify if using default.)
https://example.com/ords/f?p=1:1  (Missing the /sales prefix.)
https://example.com/pls/sales/leads/  (The context path is wrong.)
```

2.1.4 Routing Based on the Request URL Prefix

If you want to route requests based on a match of the request URL prefix, use the `map-url` command as follows:

```
java -jar ords.war map-url --type base-url --workspace-id <workspace name> <url
prefix> <database name>
```

Where:

- `<workspace name>` is the name of the Oracle Application Express workspace where RESTful services for this connection are defined. This may be omitted if RESTful Services are not being used.
- `<url prefix>` is the prefix with which the request URL must start.
- `<database name>` is the name of the database connection.

2.1.4.1 Example of Routing Based on the Request URL Prefix

Assuming Oracle REST Data Services is deployed on a system named `example.com` at the context path `/ords`, then create the following rule:

```
java -jar ords.war map-url --type base-url --workspace-id sales_rest https://
example.com/ords/sales sales_db
```

This rule means that any requests matching `https://example.com/ords/sales/...` are routed to the `sales_db` database connection. The `sales_rest` workspace defined within the `sales_db` database is searched for RESTful Services definitions.

The previous rule matches all of the following requests:

```
https://example.com/ords/sales/f?p=1:1
https://example.com/ords/sales/leads/
https://example.com/ords/sales/forecasting.report?month=jan
```

The previous rule does not match of any of the following requests:

```
http://example.com/ords/sales/f?p=1:1  (The protocol is wrong.)
https://example.com:8080/ords/sales/f?p=1:1  (The port is wrong: 443 is default for
https, but don't specify if using default.)
https://example.com/ords/f?p=1:1  (Missing the /sales segment of the base URL.)
https://example.com/pls/sales/leads/  (The context path is wrong.)
https://www.example.com/ords/sales/forecasting.report?month=jan  (The host name is
wrong.)
```

2.2 Support for RAC Fast Connection Failover

Oracle REST Data Service (ORDS) supports the Fast Connection Failover (FCF) feature of Oracle Real Application Clusters (Oracle RAC).

Oracle REST Data Service runs with the Universal Connection Pool (UCP) in all the Application Server environments that it supports, such as WebLogic, Tomcat, GlassFish. UCP in turn supports Fast Connection Failover . To enable FCF, Oracle Notification Service (ONS) must to be enabled. To enable ONS, add entries to the list of properties in the Oracle REST Data Services `defaults.xml` configuration file as shown in the following code snippet:

```
<entry key="jdbc.enableONS">true</entry>
<entry key= "jdbc.ONSConfig">nodes=racnode1:4200,racnode2:4200\nwalletfile=/oracle11/
onswalletfile</entry>
```

ONS is the messaging facility used to send the Fast Application Notification (FAN) events. When ONS is enabled, ORDS automatically enables FCF. To Enable specific FCF capabilities such as fail over or other advanced FCF capabilities such as load balancing, you need to add entries in the configuration file for the custom connection as shown in the following code snippet:

```
<entry key="db.connectionType">customurl</entry>
<entry key="db.customURL">jdbc:oracle:thin:@(DESCRIPTION=(FAILOVER=ON)(ADDRESS_LIST=
        (LOAD_BALANCE=ON)(ADDRESS=(PROTOCOL=TCP)(HOST=prod_scan.example.com)
(PORT=1521)))
        (CONNECT_DATA=(SERVICE_NAME=ISPRD)))|</entry>
```

After updating the `defaults.xml` configuration file, ORDS need to be restarted for the changes to take effect.

UCP supports Fast Connection Failover. FCF listens and responds to FAN events to deal with the following two scenarios:

- **Unplanned outages**: When RAC detects an instance failure, it generates a FAN Down event which FCF picks up. FCF then terminates all connections to the failed instance and directs all future requests to the surviving RAC instances.
- **Planned outages**: For instance, when a Database Administrator (DBA) wants to gracefully shut down a RAC instance for performing some maintenance activity. The instance shutdown generates a FAN Planned Down event which FCF picks up. FCF then directs all new requests to other RAC instances and **drains** or allows currently active transactions to complete.

Note:

Long running transactions may need to be terminated forcefully.

2.3 Configuring Security, Caching, Pre- and Post Processing, Environment, and Excel Settings

To configure security, caching, pre- and post- processing, environment, and Excel settings, see Using SQL Developer Oracle REST Data Services Administration (Optional) (page 1-10).

2.4 Configuring REST Enabled SQL Service Settings

This section explains how to configure the REST Enabled SQL service.

> **Note:**
>
> Enabling the REST Enabled SQL service enables authentication against the ORDS enabled database schemas. This makes the database schemas accessible over HTTPS, using the database password. Oracle highly recommends that you provide strong secure database passwords

REST Enabled SQL service is a feature of Oracle REST Data Service (ORDS). By default, the REST Enabled SQL service is turned off. To enable the REST Enabled SQL service and the REST Enabled SQL Export service, perform the following steps:

1. Locate the folder where the Oracle REST Data Services configuration is stored.
2. Open the `defaults.xml` file and add the following entry: `<entry key="restEnabledSql.active">true</entry>`.
3. Save the file.
4. Restart Oracle REST Data Services for the changes to take effect.

2.5 Configuring Maximum Number of Rows Returned from a Query

This section explains how to configure the maximum number of rows returned from a query.

To configure maximum number of rows returned from a query, perform the following steps:

1. Locate the folder where the Oracle REST Data Services configuration is stored.
2. Open the `defaults.xml` file and update the value of the `jdbc.maxRows` parameter as follows:`<entry key=”jdbc.maxRows”>1500</entry>`

> **Note:**
>
> Default value for `jdbc.maxRows` is 500.

3. Save the file.
4. Restart Oracle REST Data Services for the changes to take effect.

2.6 Developing RESTful Services for Use with Oracle REST Data Services

For more information on how to develop RESTful Services for use with Oracle REST Data Services, see Developing Oracle REST Data Services Applications (page 3-1).

3

Developing Oracle REST Data Services Applications

This section explains how to develop applications that use Oracle REST Data Services. It includes guidance and examples.

Note:

If you want to get started quickly, you can try the tutorial in Getting Started with RESTful Services (page H-1) now. However, you should then return to this chapter to understand the main concepts and techniques.

Note:

Ensure that you have installed and configured both Oracle Application Express 4.2 or later, and Oracle REST Data Services 3.0 or later, before attempting to follow any of the tutorials and examples.

To use the Oracle REST API for JSON Data Persistence, you must first install the Oracle REST API. See "Oracle REST API Installation" in *Oracle REST Data Services SODA for REST Developer's Guide*.

It is assumed that you are familiar with Oracle Application Express. If you are new to Oracle Application Express, see the Oracle Application Express documentation.

Topics:

You may also want to review Development Tutorial: Creating an Image Gallery (page F-1), a supplementary extended example that uses Oracle Application Express to build an application.

3.1 Introduction to Relevant Software

This section explains some key relevant software for developing applications that use Oracle REST Data Services.

Topics:

- About Oracle Application Express (page 3-2)
- About RESTful Web Services (page 3-2)

Related Topics:

- About Oracle REST Data Services (page 1-1)

3.1.1 About Oracle Application Express

Oracle Application Express is a declarative, rapid web application development tool for the Oracle database. It is a fully supported, no cost option available with all editions of the Oracle database. Using only a web browser, you can develop and deploy professional applications that are both fast and secure.

3.1.2 About RESTful Web Services

Representational State Transfer (REST) is a style of software architecture for distributed hypermedia systems such as the World Wide Web. An API is described as RESTful when it conforms to the tenets of REST. Although a full discussion of REST is outside the scope of this document, a RESTful API has the following characteristics:

- Data is modelled as a set of resources. Resources are identified by URIs.
- A small, uniform set of operations are used to manipulate resources (for example, PUT, POST, GET, DELETE).
- A resource can have multiple representations (for example, a blog might have an HTML representation and an RSS representation).
- Services are stateless and since it is likely that the client will want to access related resources, these should be identified in the representation returned, typically by providing hypertext links.

Release 4.2 of Oracle Application Express leverages the capabilities of Oracle REST Data Services to provide developers with an easy to use graphical user interface for defining and testing RESTful Web Services.

3.2 Getting Started with RESTful Services

This section introduces RESTful Services, and provides guidelines and examples for developing applications that use RESTful Services.

Topics:

- RESTful Services Terminology (page 3-3)

Related Topics:

- Developing Oracle REST Data Services Applications (page 3-1)

3.2.1 RESTful Services Terminology

This section introduces some common terms that are used throughout this document:

- **RESTful service**: An HTTP web service that conforms to the tenets of the RESTful architectural style.
- **Resource module**: An organizational unit that is used to group related resource templates.
- **Resource template**: An individual RESTful service that is able to service requests for some set of URIs (Universal Resource Identifiers). The set of URIs is defined by the URI Pattern of the Resource Template
- **URI pattern**: A pattern for the resource template. Can be either a route pattern or a URI template, although you are encouraged to use route patterns.
- **Route pattern**: A pattern that focuses on decomposing the path portion of a URI into its component parts. For example, a pattern of `/:object/:id?` will match `/emp/101` (matches a request for the item in the `emp` resource with `id` of `101`) and will also match `/emp/` (matches a request for the `emp` resource, because the `:id` parameter is annotated with the `?` modifier, which indicates that the `id` parameter is optional).

  For a detailed explanation of route patterns, see `docs\javadoc\plugin-api\route-patterns.html`, under `<sqldeveloper-install>\ords` and under the location (if any) where you manually installed Oracle REST Data Services.
- **URI template**: A simple grammar that defines the specific patterns of URIs that a given resource template can handle. For example, the pattern `employees/{id}` will match any URI whose path begins with `employees/`, such as `employees/2560`.
- **Resource handler**: Provides the logic required to service a specific HTTP method for a specific resource template. For example, the logic of the GET HTTP method for the preceding resource template might be:

  ```
  select empno, ename, dept from emp where empno = :id
  ```
- **HTTP operation**: HTTP (HyperText Transport Protocol) defines standard methods that can be performed on resources: `GET` (retrieve the resource contents), `POST` (store a new resource), `PUT` (update an existing resource), and `DELETE` (remove a resource).

Related Topics:

- About RESTful Web Services (page 3-2)

3.2.2 About Request Path Syntax Requirements

To prevent path-based attacks, Oracle REST Data Services performs a number of validation checks on the syntax of the path element of each request URL.

Each path must conform to the following rules:

- Is not empty or whitespace-only
- Does not contain any of the following characters: ?, #, ;, %
- Does not contain the null character (\u0000)
- Does not contain characters in the range: \u0001-\u0031
- Does not end with white space or a period (.)
- Does not contain double forward slash (//) or double back slash(\\)
- Does not contain two or more periods in sequence (.., ..., and so on)
- Total length is {@value #MAX_PATH_LENGTH} characters or less
- Does not match any of the following names (case insensitive), with or without file extensions: CON, PRN, AUX, CLOCK$, NUL, COM0, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, COM9, LPT0, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9

If you intend to auto-REST enable objects, then avoid object names that do not comply with these requirements. For example, do not create a table named #EMPS. If you do want to auto-REST enable objects that have non-compliant names, then you must use an alias that complies with the requirements.

These requirements are applied to the URL decoded form of the URL, to prevent attempted circumvention of percent encodings.

3.2.3 "Getting Started" Documents Included in Installation

When you install Oracle REST Data Services, an examples folder is created with subfolders and files that you may find helpful. The installation folder hierarchy includes this:

```
ords
  conf
  docs
  examples
    soda
    getting-started
    getting-started-nosql
  ...
```

In this hierarchy:

- `examples\soda`: Contains sample JSON documents used in some examples included in *Oracle REST Data Services SODA for REST Developer's Guide*.
- `examples\getting-started`: Double-click `index.html` for a short document about how to get started developing RESTful Services using Oracle REST Data Services. This document focuses on using SQL Developer to get started. (SQL Developer is the primary tool for managing Oracle REST Data Services. For example, the ability

to auto-enable REST support for schemas and tables is available only in SQL Developer.)

- `examples\getting-started-nosql`: Double-click `index.html` for a short document about how to get started accessing NoSQL stores using Oracle REST Data Services

3.2.4 About cURL and Testing RESTful Services

Other sections show the testing of RESTful Services using a web browser. However, another useful way to test RESTful Services is using the command line tool named cURL.

This powerful tool is available for most platforms, and enables you to see and control what data is being sent to and received from a RESTful service.

```
curl -i https://server:port/ords/workspace/hr/employees/7369
```

This example produces a response like the following:

```
HTTP/1.1 200 OK
Server: Oracle-REST-Data-Services/2.0.6.78.05.25
ETag: "..."
Content-Type: application/json
Transfer-Encoding: chunked
Date: Thu, 28 Mar 2014 16:49:34 GMT

{
 "empno":7369,
 "ename":"SMITH",
 "job":"CLERK",
 "mgr":7902,
 "hiredate":"1980-12-17T08:00:00Z",
 "sal":800,
 "deptno":20
}
```

The `-i` option tells cURL to display the HTTP headers returned by the server.

Related Topics:

- Exploring the Sample RESTful Services in Application Express (Tutorial) (page 3-54)

See Also:

cURL
The example in this section uses cURL with the services mentioned in Exploring the Sample RESTful Services in Application Express (Tutorial) (page 3-54)

3.2.5 Automatic Enabling of Schema Objects for REST Access (AutoREST)

If Oracle REST Data Services has been installed on the system associated with a database connection, you can use the AutoREST feature to conveniently enable or disable Oracle REST Data Services access for specified tables and views in the schema associated with that database connection. Enabling REST access to a table, view or PL/SQL function, procedure or package allows it to be accessed through RESTful services.

AutoREST is a quick and easy way to expose database tables as REST resources. You sacrifice some flexibility and customizability to gain ease of effort. AutoRest lets you quickly expose data but (metaphorically) keeps you on a set of guide rails. For example, you cannot customize the output formats or the input formats, or do extra validation.

On the other hand, manually created resource modules require you to specify the SQL and PL/SQL to support the REST resources. Using resource modules requires more effort, but offers more flexibility; for example, you can customize what fields are included, do joins across multiple tables, and validate the incoming data using PL/SQL.

So, as an application developer you must make a choice: use the "guide rails" of AutoREST, or create a resource module to do exactly what you need. If you choose AutoREST, you can just enable a table (or set of tables) within a schema.

Note that enabling a schema is not equivalent to enabling all tables and views in the schema. It just means making Oracle REST Data Services aware that the schema exists and that it may have zero or more resources to expose to HTTP. Those resources may be AutoREST resources or resource module resources.

You can automatically enable Oracle REST Data Services queries to access individual database schema objects (tables, views, and PL/SQL) by using a convenient wizard in Oracle SQL Developer. (Note that this feature is only available for Oracle REST Data Services- enabled schemas, not for Oracle Application Express workspaces.)

To enable Oracle REST Data Services access to one or more specified tables or views, you must do the following in SQL Developer:

1. Enable the schema (the one associated with the connection) for REST access.

   Schema level: To enable Oracle REST Data Services access to selected objects (that you specify in the next step) in the schema associated with a connection, right-click its name in the Connections navigator and select **REST Services**, then **Enable REST Services**.

   (To drop support for Oracle REST Data Services access to objects in the schema associated with a connection, right-click its name in the Connections navigator and select **REST Services**, then **Drop REST Services**.)

2. Individually enable REST access for the desired objects.

   Table or view level: To enable Oracle REST Data Services access to a specified table or view, right-click its name in the Connections navigator and select **Enable REST Services**.

For detailed usage information, click the **Help** button in the wizard or dialog box in SQL Developer.

3.2.5.1 Examples: Accessing Objects Using RESTful Services

This section provides examples of using Oracle REST Data Services queries and other operations against tables and views after you have REST-enabled them.

You can automatically expose table and view objects as RESTful services using SQL Developer. This topic provides examples of accessing these RESTful services.

> **Tip:**
>
> Although these examples illustrate the URL patterns used to access these resources, clients should avoid hard coding knowledge of the structure of these URLs; instead clients should follow the hyperlinks in the resources to navigate between resources. The structure of the URL patterns may evolve and change in future releases.

This topic provides examples of accessing objects using RESTful Services.

- Get Schema Metadata (page 3-7)
- Get Object Metadata (page 3-8)
- Get Object Data (page 3-10)
- Get Table Data Using Paging (page 3-11)
- Get Table Data Using Query (page 3-12)
- Get Table Row Using Primary Key (page 3-13)
- Insert Table Row (page 3-14)
- Update/Insert Table Row (page 3-15)
- Delete Using Filter (page 3-16)
- Post by Batch Load (page 3-16)

3.2.5.1.1 Get Schema Metadata

This example retrieves a list of resources available through the specified schema alias. It shows RESTful services that are created by automatically enabling a table or view, along with RESTful Services that are created by resource modules.

This example retrieves a list of resources available through the specified schema alias.

Pattern: `GET http://<HOST>:<PORT>/ords/<SchemaAlias>/metadata-catalog/`

Example: `GET http://localhost:8080/ords/ordstest/metadata-catalog/`

Result:

```
{
  "items": [
 {
   "name": "EMP",
   "links": [
  {
    "rel": "describes",
    "href": "http://localhost:8080/ords/ordstest/emp/"
  },
  {
    "rel": "canonical",
    "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/",
    "mediaType": "application/json"
  }
   ]
 },
 {
   "name": "oracle.examples.hello",
   "links": [
  {
    "rel": "describes",
    "href": "http://localhost:8080/ords/ordstest/examples/hello/"
  },
  {
    "rel": "canonical",
    "href": "http://localhost:8080/ords/ordstest/metadata-catalog/examples/hello/",
    "mediaType": "application/json"
  }
   ]
 }
  ],
  "hasMore": false,
  "limit": 25,
  "offset": 0,
  "count": 2,
  "links": [
 {
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/"
 },
 {
   "rel": "first",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/"
 }
  ]
}
```

The list of resources includes:

- Resources representing tables or views that have been REST enabled.
- Resources defined by resource modules. Note that only resources having a concrete path (that is, not containing any parameters) will be shown. For example, a resource with a path of `/module/some/path/` will be shown, but a resource with a path of `/module/some/:parameter/` will not be shown.

Each available resource has two hyperlinks:

- The link with relation `describes` points to the actual resource.
- The link with relation `canonical` describes the resource.

3.2.5.1.2 Get Object Metadata

This example retrieves the metadata (which describes the object) of an individual object. The location of the metadata is indicated by the `canonical` link relation.

Pattern: `GET http://<HOST>:<PORT>/ords/<SchemaAlias>/metadata-catalog/<ObjectAlias>/`

Example: `GET http://localhost:8080/ords/ordstest/metadata-catalog/emp/`

Result:

```
{
    "name": "EMP",
    "primarykey": [
        "empno"
    ],
    "members": [
        {
            "name": "empno",
            "type": "NUMBER"
        },
        {
            "name": "ename",
            "type": "VARCHAR2"
        },
        {
            "name": "job",
            "type": "VARCHAR2"
        },
        {
            "name": "mgr",
            "type": "NUMBER"
        },
        {
            "name": "hiredate",
            "type": "DATE"
        },
        {
            "name": "sal",
            "type": "NUMBER"
        },
        {
            "name": "comm",
            "type": "NUMBER"
        },
        {
            "name": "deptno",
            "type": "NUMBER"
        }
    ],
    "links": [
        {
            "rel": "collection",
            "href": "http://localhost:8080/ords/ordstest/metadata-catalog/",
            "mediaType": "application/json"
        },
        {
            "rel": "canonical",
            "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/"
        },
        {
            "rel": "describes",
            "href": "http://localhost:8080/ords/ordstest/emp/"
        }
    ]
}
```

3.2.5.1.3 Get Object Data

This example retrieves the data in the object. Each row in the object corresponds to a JSON object embedded within the JSON array

Pattern: `GET http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/`

Example: `GET http://localhost:8080/ords/ordstest/emp/`

Result:

```
{
 "items": [
  {
   "empno": 7499,
   "ename": "ALLEN",
   "job": "SALESMAN",
   "mgr": 7698,
   "hiredate": "1981-02-20T00:00:00Z",
   "sal": 1600,
   "comm": 300,
   "deptno": 30,
   "links": [
    {
     "rel": "self",
     "href": "http://localhost:8080/ords/ordstest/emp/7499"
    }
   ]
  },
  ...
  {
   "empno": 7934,
   "ename": "MILLER",
   "job": "CLERK",
   "mgr": 7782,
   "hiredate": "1982-01-23T00:00:00Z",
   "sal": 1300,
   "comm": null,
   "deptno": 10,
   "links": [
    {
     "rel": "self",
     "href": "http://localhost:8080/ords/ordstest/emp/7934"
    }
   ]
  }
 ],
 "hasMore": false,
 "limit": 25,
 "offset": 0,
 "count": 13,
 "links": [
  {
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/"
  },
  {
   "rel": "edit",
   "href": "http://localhost:8080/ords/ordstest/emp/"
  },
  {
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/"
  },
  {
   "rel": "first",
   "href": "http://localhost:8080/ords/ordstest/emp/"
  }
 ]
}
```

3.2.5.1.4 Get Table Data Using Paging

This example specifies the `offset` and `limit` parameters to control paging of result data.

Pattern: `GET http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/?offset=<Offset>&limit=<Limit>`

Example: `GET http://localhost:8080/ords/ordstest/emp/?offset=10&limit=5`

Result:

```
{
 "items": [
  {
   "empno": 7900,
   "ename": "JAMES",
   "job": "CLERK",
   "mgr": 7698,
   "hiredate": "1981-12-03T00:00:00Z",
   "sal": 950,
   "comm": null,
   "deptno": 30,
   "links": [
    {
     "rel": "self",
     "href": "http://localhost:8080/ords/ordstest/emp/7900"
    }
   ]
  },
  ...
  {
   "empno": 7934,
   "ename": "MILLER",
   "job": "CLERK",
   "mgr": 7782,
   "hiredate": "1982-01-23T00:00:00Z",
   "sal": 1300,
   "comm": null,
   "deptno": 10,
   "links": [
    {
     "rel": "self",
     "href": "http://localhost:8080/ords/ordstest/emp/7934"
    }
   ]
  }
 ],
 "hasMore": false,
 "limit": 5,
 "offset": 10,
 "count": 3,
 "links": [
  {
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/"
  },
  {
   "rel": "edit",
   "href": "http://localhost:8080/ords/ordstest/emp/"
  },
  {
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/"
  },
  {
   "rel": "first",
   "href": "http://localhost:8080/ords/ordstest/emp/?limit=5"
  },
  {
   "rel": "prev",
   "href": "http://localhost:8080/ords/ordstest/emp/?offset=5&limit=5"
  }
 ]
}
```

3.2.5.1.5 Get Table Data Using Query

This example specifies a filter clause to restrict objects returned.

Pattern: `GET http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/?q=<FilterClause>`

Example: `GET http://localhost:8080/ords/ordstest/emp/?q={"deptno":{"$lte":20}}`

Result:

```
{
 "items": [
  {
   "empno": 7566,
   "ename": "JONES",
   "job": "MANAGER",
   "mgr": 7839,
   "hiredate": "1981-04-01T23:00:00Z",
   "sal": 2975,
   "comm": null,
   "deptno": 20,
   "links": [
    {
     "rel": "self",
     "href": "http://localhost:8080/ords/ordstest/emp/7566"
    }
   ]
  },
  ...
  {
   "empno": 7934,
   "ename": "MILLER",
   "job": "CLERK",
   "mgr": 7782,
   "hiredate": "1982-01-23T00:00:00Z",
   "sal": 1300,
   "comm": null,
   "deptno": 10,
   "links": [
    {
     "rel": "self",
     "href": "http://localhost:8080/ords/ordstest/emp/7934"
    }
   ]
  }
 ],
 "hasMore": false,
 "limit": 25,
 "offset": 0,
 "count": 7,
 "links": [
  {
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/?q=%7B%22deptno%22:%7B%22%24lte
%22:20%7D%7D"
  },
  {
   "rel": "edit",
   "href": "http://localhost:8080/ords/ordstest/emp/?q=%7B%22deptno%22:%7B%22%24lte
%22:20%7D%7D"
  },
  {
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/"
  },
  {
   "rel": "first",
   "href": "http://localhost:8080/ords/ordstest/emp/?q=%7B%22deptno%22:%7B%22%24lte
%22:20%7D%7D"
  }
 ]
}
```

3.2.5.1.6 Get Table Row Using Primary Key

This example retrieves an object by specifying its identifying key values.

Pattern: `GET http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/<KeyValues>`

Where `<KeyValues>` is a comma-separated list of key values (in key order).

Example: `GET http://localhost:8080/ords/ordstest/emp/7839`

Result:

```
{
 "empno": 7839,
 "ename": "KING",
 "job": "PRESIDENT",
 "mgr": null,
 "hiredate": "1981-11-17T00:00:00Z",
 "sal": 5000,
 "comm": null,
 "deptno": 10,
 "links": [
  {
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/7839"
  },
  {
   "rel": "edit",
   "href": "http://localhost:8080/ords/ordstest/emp/7839"
  },
  {
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/item"
  },
  {
   "rel": "collection",
   "href": "http://localhost:8080/ords/ordstest/emp/"
  }
 ]
}
```

3.2.5.1.7 Insert Table Row

This example inserts data into the object. The body data supplied with the request is a JSON object containing the data to be inserted.

If the object has a primary key, then there must be an insert trigger on the object that populates the primary key fields. If the table does not have a primary key, then the ROWID of the row will be used as the item's identifier.

If the object lacks a trigger to assign primary key values, then the PUT operation described in next section,**Update/Insert Table Row** should be used instead.

Pattern: `POST http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/`

Example:

```
curl -i -H "Content-Type: application/json" -X POST -d "{ \"empno\" :7, \"ename\":
\"JBOND\", \"job\":\"SPY\", \"deptno\" :11 }" "http://localhost:8080/ords/ordstest/
emp/
Content-Type: application/json

{ "empno" :7, "ename": "JBOND", "job":"SPY", "deptno" :11 }
```

Result:

```
{
 "empno": 7,
 "ename": "JBOND",
 "job": "SPY",
 "mgr": null,
 "hiredate": null,
 "sal": null,
 "comm": null,
 "deptno": 11,
 "links": [
  {
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/7"
  },
  {
   "rel": "edit",
   "href": "http://localhost:8080/ords/ordstest/emp/7"
  },
  {
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/item"
  },
  {
   "rel": "collection",
   "href": "http://localhost:8080/ords/ordstest/emp/"
  }
 ]
}
```

3.2.5.1.8 Update/Insert Table Row

This example inserts or updates (sometimes called an "upsert") data in the object. The body data supplied with the request is a JSON object containing the data to be inserted or updated.

Pattern: `PUT http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/<KeyValues>`

Example:

```
curl -i -H "Content-Type: application/json" -X PUT -d "{ \"empno\" :7, \"ename\":
\"JBOND\", \"job\":\"SPY\", \"deptno\" :11 }" "http://localhost:8080/ords/
ordstest/emp/7
Content-Type: application/json

{ "empno" :7, "ename": "JBOND", "job":"SPY", "deptno" :11 }
```

Result:

```
{
 "empno": 7,
 "ename": "JBOND",
 "job": "SPY",
 "mgr": null,
 "hiredate": null,
 "sal": null,
 "comm": null,
 "deptno": 11,
 "links": [
  {
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/7"
  },
  {
   "rel": "edit",
   "href": "http://localhost:8080/ords/ordstest/emp/7"
  },
  {
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/item"
  },
  {
   "rel": "collection",
   "href": "http://localhost:8080/ords/ordstest/emp/"
  }
 ]
}
```

3.2.5.1.9 Delete Using Filter

This example deletes object data specified by a filter clause.

Pattern: `DELETE http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/?q=<FilterClause>`

Example: `curl -i -X DELETE "http://localhost:8080/ords/ordstest/emp/?q={"deptno":11}"`

Result:

```
{
    "itemsDeleted": 1
}
```

3.2.5.1.10 Post by Batch Load

This example inserts object data using the batch load feature. The body data supplied with the request is a CSV file. The behavior of the batch operation can be controlled using the optional query parameters, which are described in Table 3-1 (page 3-16).

Pattern: `POST http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/batchload?<Parameters>`

Parameters:

Table 3-1 Parameters for batchload

Parameter	Description
batchesPerCommit	Sets the frequency for commits. Optional commit points can be set after a batch is sent to the database. The default is every 10 batches. 0 indicates commit deferred to the end of the load. Type: Integer.
batchRows	Sets the number of rows in each batch to send to the database. The default is 50 rows per batch. Type: Integer.
dateFormat	Sets the format mask for the date data type. This format is used when converting input data to columns of type date. Type: String.
delimiter	Sets the field delimiter for the fields in the file. The default is the comma (,).
enclosures	embeddedRightDouble
errors	Sets the user option used to limit the number of errors. If the number of errors exceeds the value specified for `errorsMax` (the service option) or by `errors` (the user option), then the load is terminated. To permit no errors at all, specify 0. To indicate that all errors be allowed (up to errorsMax value), specify UNLIMITED (-1) .
errorsMax	A service option used to limit the number of errors allowed by users. It intended as an option for the service provider and not to be exposed as a user option. If the number of errors exceeds the value specified for `errorsMax` (the service option) or by `errors` (the user option), then the load is terminated. To permit no errors at all, specify 0. To indicate that all errors be allowed, specify UNLIMITED (-1).
lineEnd	Sets the line end (terminator). If the file contains standard line end characters (\r. \r\n or \n), then `lineEnd` does not need to be specified.

Table 3-1 (Cont.) Parameters for batchload

Parameter	Description
lineMax	Sets a maximum line length for identifying lines/rows in the data stream. A `lineMax` value will prevent reading an entire stream as a single line when the incorrect `lineEnd` character is being used. The default is unlimited.
locale	Sets the locale.
responseEncoding	Sets the encoding for the response stream.
responseFormat	Sets the format for response stream. This format determines how messages and bad data will be formatted. Valid values: `RAW`, `SQL`.
timestampFormat	Sets the format mask for the time stamp data type. This format is used when converting input data to columns of type time stamp.
timestampTZFormat	Sets the format mask for the time stamp time zone data type. This format is used when converting input data to columns of type time stamp time zone.
truncate	Indicates if and/or how table data rows should be deleted before the load. `False` (the default) does not delete table data before the load; `True` causes table data to be deleted with the DELETE SQL statement; `Truncate` causes table data to be deleted with the TRUNCATE SQL statement.

Example:

```
POST http://localhost:8080/ords/ordstest/emp/batchload?batchRows=25
Content-Type: text/csv

empno,ename,job,mgr,hiredate,sal,comm,deptno
0,M,SPY MAST,,2005-05-01 11:00:01,4000,,11
7,J.BOND,SPY,0,2005-05-01 11:00:01,2000,,11
9,R.Cooper,SOFTWARE,0,2005-05-01 11:00:01,10000,,11
26,Max,DENTIST,0,2005-05-01 11:00:01,5000,,11
```

Result:

```
#INFO Number of rows processed: 4
#INFO Number of rows in error: 0
#INFO Elapsed time: 00:00:03.939 - (3,939 ms) 0 - SUCCESS: Load processed without
errors
```

3.2.5.2 Filtering in Queries

This section describes and provides examples of filtering in queries against REST-enabled tables and views.

Filtering is the process of limiting a collection resource by using a per-request dynamic filter definition across multiple page resources, where each page contains a subset of items found in the complete collection. Filtering enables efficient traversal of large collections.

To filter in a query, include the parameter `q=`*FilterObject*, where *FilterObject* is a JSON object that represents the custom selection and sorting to be applied to the resource. For example, assume the following resource:

```
https://example.com/ords/scott/emp/
```

The following query includes a filter that restricts the ENAME column to "JOHN":

```
https://example.com/ords/scott/emp/?q={"ENAME":"JOHN"}
```

3.2.5.2.1 FilterObject Grammar

The `FilterObject` must be a JSON object that complies with the following syntax:

```
FilterObject { orderby , asof, wmembers }
```

The `orderby`, `asof`, and `wmembers` attributes are optional, and their definitions are as follows:

```
orderby
  "$orderby": {orderByMembers}

orderByMembers
    orderByProperty
    orderByProperty , orderByMembers

orderByProperty
    columnName : sortingValue

sortingValue
  "ASC"
  "DESC"
  "-1"
  "1"
   -1
   1

asof
  "$asof": date
  "$asof": "datechars"
  "$asof": scn
  "$asof": +int

wmembers
    wpair
    wpair , wmembers

wpair
    columnProperty
    complexOperatorProperty

columnProperty
    columnName : string
    columnName : number
    columnName : date
    columnName : simpleOperatorObject
columnName : complexOperatorObject
    columnName : [complexValues]

columnName
  "\p{Alpha}[[\p{Alpha}]]([[\p{Alnum}]#$_])*$"

complexOperatorProperty
    complexKey : [complexValues]
    complexKey : simpleOperatorObject

complexKey
```

```
  "$and"
  "$or"

complexValues
    complexValue , complexValues

complexValue
    simpleOperatorObject
    complexOperatorObject
    columnObject

columnObject
    {columnProperty}

simpleOperatorObject
    {simpleOperatorProperty}

complexOperatorObject
    {complexOperatorProperty}

simpleOperatorProperty
   "$eq" : string | number | date
   "$ne" : string | number | date
   "$lt" :  number | date
   "$lte" : number | date
   "$gt" : number | date
   "$gte" : number | date
   "$instr" : string
   "$ninstr" : string
   "$like" : string
   "$null" : null
   "$notnull" : null
   "$between" : betweenValue

betweenValue
    [null , betweenNotNull]
    [betweenNotNull , null]
    [betweenRegular , betweenRegular]

betweenNotNull
    number
    date

betweenRegular
    string
    number
    date
```

Data type definitions include the following:

```
string
       JSONString
number
       JSONNumber
date
       {"$date":"datechars"}
scn
       {"$scn": +int}
```

Where:

```
datechars is an RFC3339 date format in UTC (Z)


JSONString
          ""
          " chars "
chars
         char
         char chars
char
         any-Unicode-character except-"-or-\-or-control-character
          \"
          \\
           \/
          \b
          \f
          \n
          \r
          \t
          \u four-hex-digits


JSONNumber
    int
    int frac
    int exp
    int frac exp
int
    digit
    digit1-9 digits
    - digit
    - digit1-9 digits
frac
    . digits
exp
    e digits
digits
    digit
    digit digits
e
    e
    e+
    e-
    E
    E+
    E-
```

The `FilterObject` must be encoded according to Section 2.1 of RFC3986.

3.2.5.2.2 Examples: FilterObject Specifications

The following are examples of operators in `FilterObject` specifications.

`ORDER BY property ($orderby)`

`Order by with literals`

```
{
 "$orderby": {"SALARY":  "ASC","ENAME":"DESC"}
}
```

Order by with numbers

```
{
 "$orderby": {"SALARY":  -1,"ENAME":  1}
}
```

ASOF property ($asof)

With SCN (Implicit)

```
{
  "$asof": 1273919
}
```

With SCN (Explicit)

```
{
  "$asof": {"$scn": "1273919"}
}
```

With Date (Implicit)

```
{
  "$asof": "2014-06-30T00:00:00Z"
}
```

With Date (Explicit)

```
{
  "$asof": {"$date": "2014-06-30T00:00:00Z"}
}
```

EQUALS operator ($eq)

(Implicit and explicit equality supported._

Implicit (Support String and Dates too)

```
{
 "SALARY": 1000
}
```

Explicit

```
{
 "SALARY": {"$eq": 1000}
}
```

Strings

```
{
 "ENAME": {"$eq":"SMITH"}
}
```

Dates

```
{
  "HIREDATE": {"$date": "1981-11-17T08:00:00Z"}
}
```

NOT EQUALS operator ($ne)

Number

```
{
 "SALARY": {"$ne": 1000}
}
```

String

```
{
 "ENAME": {"$ne":"SMITH"}
}
```

Dates

```
{
  "HIREDATE": {"$ne": {"$date":"1981-11-17T08:00:00Z"}}
}
```

LESS THAN operator ($lt)
(Supports dates and numbers only)

Numbers

```
{
  "SALARY": {"$lt": 10000}
}
```

Dates

```
{
  "SALARY": {"$lt": {"$date":"1999-12-17T08:00:00Z"}}
}
```

LESS THAN OR EQUALS operator ($lte)
(Supports dates and numbers only)

Numbers

```
{
  "SALARY": {"$lte": 10000}
}
```

Dates

```
{
  "HIREDATE": {"$lte": {"$date":"1999-12-17T08:00:00Z"}}
}
```

GREATER THAN operator ($gt)
(Supports dates and numbers only)

Numbers

```
{
  "SALARY": {"$gt": 10000}
}
```

```
Dates

{
  "SALARY": {"$gt": {"$date":"1999-12-17T08:00:00Z"}}
}


GREATER THAN OR EQUALS operator ($gte)
(Supports dates and numbers only)

Numbers

{
  "SALARY": {"$gte": 10000}
}

Dates

{
  "HIREDATE": {"$gte": {"$date":"1999-12-17T08:00:00Z"}}
}


In string operator ($instr)
(Supports strings only)

{
  "ENAME": {"$instr":"MC"}
}


Not in string operator ($ninstr)
(Supports strings only)

{
  "ENAME": {"$ninstr":"MC"}
}


#### LIKE operator ($like)
(Supports strings. Eescape character not supported to try to match expressions with
_ or % characters.)

{
  "ENAME": {"$like":"AX%"}
}


#### BETWEEN operator ($between)
(Supports string, dates, and numbers)

Numbers

{
  "SALARY": {"$between": [1000,2000]}
}

Dates

{
  "SALARY": {"$between": [{"$date":"1989-12-17T08:00:00Z"},
{"$date":"1999-12-17T08:00:00Z"}]}
}
```

Strings

```
{
  "ENAME": {"$between": ["A","C"]}
}
```

Null Ranges ($lte equivalent)
(Supported by numbers and dates only)

```
{
  "SALARY": {"$between": [null,2000]}
}
```

Null Ranges ($gte equivalent)
(Supported by numbers and dates only)

```
{
  "SALARY": {"$between": [1000,null]}
}
```

NULL operator ($null)

```
{
  "ENAME": {"$null": null}
}
```

NOT NULL operator ($notnull)

```
{
  "ENAME": {"$notnull": null}
}
```

AND operator ($and)
(Supports all operators, including $and and $or)

Column context delegation
(Operators inside $and will use the closest context defined in the JSON tree.)

```
{
  "SALARY": {"$and": [{"$gt": 1000},{"$lt":4000}]}
}
```

Column context override
(Example: salary greater than 1000 and name like S%)

```
{
  "SALARY": {"$and": [{"$gt": 1000},{"ENAME": {"$like":"S%"}} ] }
}
```

Implicit and in columns

```
{
  "SALARY": [{"$gt": 1000},{"$lt":4000}]
}
```

~~~~
```

High order AND
(All first columns and or high order operators -- $and and $ors -- defined at the
first level of the JSON will be joined and an implicit AND)
(Example: Salary greater than 1000 and name starts with S or T)

{
  "SALARY": {"$gt": 1000},
  "ENAME": {"$or": [{"$like":"S%"}, {"$like":"T%"}]}
}

Invalid expression (operators $lt and $gt lack column context)

{
   "$and": [{"$lt": 5000},{"$gt": 1000}]
}

Valid alternatives for the previous invalid expression

{
   "$and": [{"SALARY": {"$lt": 5000}}, {"SALARY": {"$gt": 1000}}]
}

{
   "SALARY": [{"$lt": 5000},{"$gt": 1000}]
}

{
   "SALARY": {"$and": [{"$lt": 5000},{"$gt": 1000}]}
}


OR operator ($or)
(Supports all operators including $and and $or)

Column context delegation
(Operators inside $or will use the closest context defined in the JSON tree)

{
  "ENAME": {"$or": [{"$eq":"SMITH"},{"$eq":"KING"}]}
}

Column context override
(Example: name starts with S or salary greater than 1000)

{
  "SALARY": {"$or": [{"$gt": 1000},{"ENAME": {"$like":"S%"}} ] }
}
~~~~

3.2.5.3 Auto PL/SQL

This section explains how PL/SQL is made available through HTTP(S) for Remote Procedure call (RPC).

The auto PL/SQL feature uses a standard to provide consistent encoding and data transfer in a stateless web service environment. Using this feature, you can enable Oracle Database stored PL/SQL functions and procedures at package level through ORDS, similar to how you enable the views and tables.

Auto Enabling PL/SQL Subprograms

ORDS supports auto enabling of the following PL/SQL objects, based on their catalog object identifier:

- PL/SQL Procedure
- PL/SQL Function
- PL/SQL Package

The functions, and procedures within the PL/SQL package cannot be individually enabled as they are named objects within a PL/SQL package object. Therefore, the granularity level enables the objects at the package level. This granularity level enables to expose all of its public functions and procedures.

If you want to *only* enable a subset of functions and procedures, then you must create a separate delegate package and enable it to expose only that subset of functions and procedures.

Note:

Overloaded package functions and procedures are not supported.

3.2.5.3.1 Method and Content Type Supported for Auto Enabling PL/SQL Objects

This section discusses the method and content-type supported by this feature.

The auto enabling of the PL/SQL Objects feature supports POST as the HTTP method. In POST method, input parameters are encoded in the payload and output parameters are decoded from the response.

Note:

The standard data CRUD to HTTP method mappings are not applicable as this feature provides an RPC-style interaction.

The content-type supported is `application/json`.

3.2.5.3.2 Auto-Enabling the PL/SQL Objects

This section explains how to auto-enable the PL/SQL objects through ORDS.

You can enable the PL/SQL objects in one of the following ways:

- Auto-Enabling Using the ORDS PL/SQL API (page 3-26)
- Auto-Enabling the PL/SQL Objects Using SQL Developer (page 3-27)

3.2.5.3.2.1 Auto-Enabling Using the ORDS PL/SQL API

You can enable a PL/SQL object using the ORDS PL/SQL API.

To enable the PL/SQL package, use the ORDS PL/SQL API as shown in following sample code snippet:

```
BEGIN
  ords.enable_object(
    p_enabled => TRUE,
    p_schema => 'MY_SCHEMA',
    p_object => 'MY_PKG',
    p_object_type => 'PACKAGE',
    p_object_alias => 'my_pkg',
    p_auto_rest_auth => FALSE);
   commit;
END;
/
```

Example 3-1   Enabling the PL/SQL Function

To enable the PL/SQL function, use the ORDS PL/SQL API as shown in following sample code snippet:

```
BEGIN
  ords.enable_object(
    p_enabled => TRUE,
    p_schema => 'MY_SCHEMA',
    p_object => 'MY_FUNC',
    p_object_type => 'FUNCTION',
    p_object_alias => 'my_func',
    p_auto_rest_auth => FALSE);

    commit;
END;
/
```

Example 3-2   Enabling the PL/SQL Procedure

To enable the PL/SQL procedure, use the ORDS PL/SQL API as shown in following sample code snippet:

```
BEGIN
  ords.enable_object(
    p_enabled => TRUE,
    p_schema => 'MY_SCHEMA',
    p_object => 'MY_PROC',
    p_object_type => 'PROCEDURE',
    p_object_alias => 'my_proc',
    p_auto_rest_auth => FALSE);

    commit;
END;
/
```

3.2.5.3.2.2 Auto-Enabling the PL/SQL Objects Using SQL Developer

This section describes how to enable the PL/SQL objects using SQL Developer 4.2 and above.

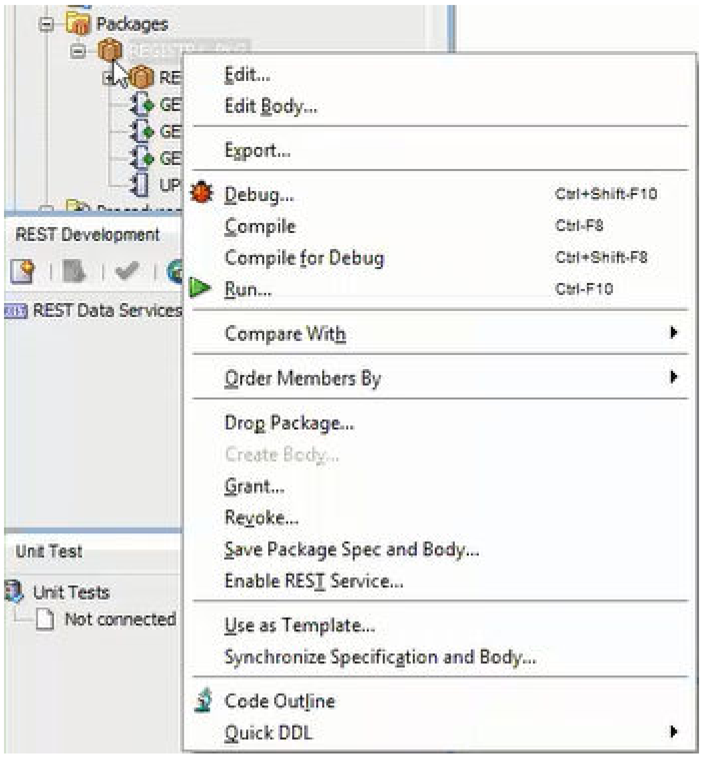
To enable the PL/SQL objects (for example, package) using SQL Developer, perform the following steps:

Note:

You can now enable, packages, functions and procedures. However, the granularity of enabling is either at the whole package level, standalone function level, or at the standalone procedure level.

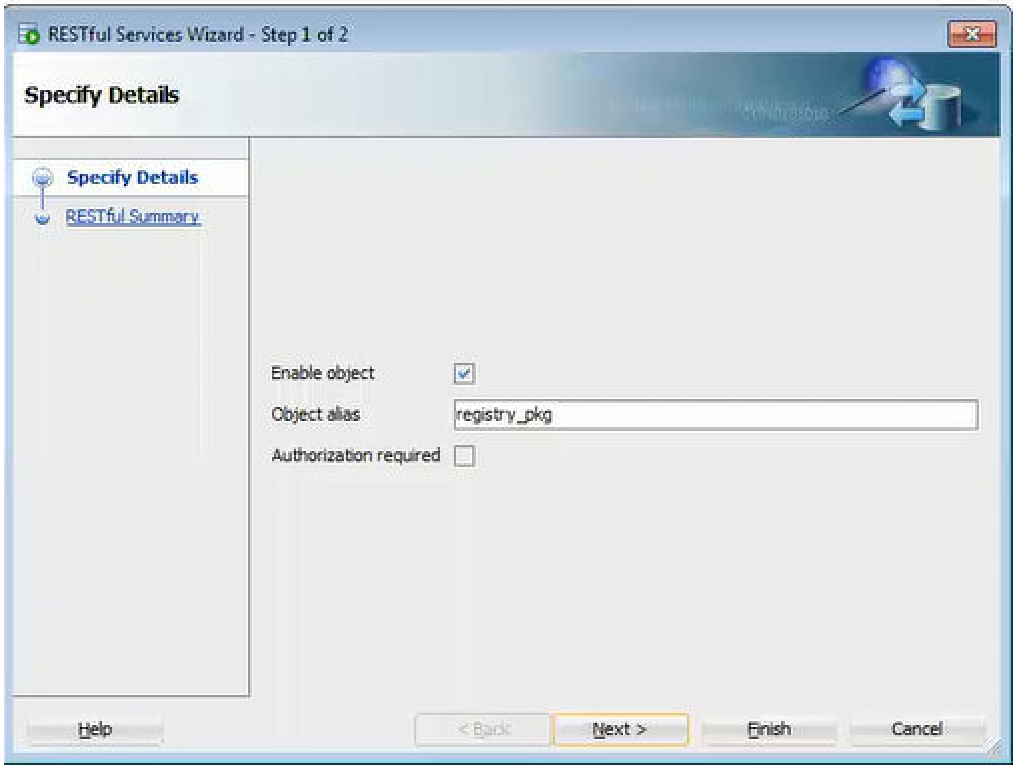
1. In SQL Developer, right-click on a package as shown in the following figure:

Figure 3-1 Selecting the Enable REST Service Option



2. Select **Enable RESTful Services** to display the following wizard page:

Figure 3-2   Auto Enabling the PL/SQL Package Object



Enable object ✓
Object alias registry_pkg
Authorization required ☐

- **Enable object**: Enable this option (that is, enable REST access for the package).
- **Object alias**: Accept `registry_pkg` for the object alias.
- **Authorization required**: For simplicity, disable this option.
- On the RESTful Summary page of the wizard, click **Finish**.

3.2.5.3.3 Generating the PL/SQL Endpoints

HTTP endpoints are generated dynamically per request for the enabled database objects. ORDS uses the connected database catalog to generate the endpoints using a query.

The following rules apply for all the database objects for generating the HTTP endpoints:

- All names are converted to lowercase
- An endpoint is generated if it is not already allocated

Stored Procedure and Function Endpoints

The function or procedure name is generated into the URL in the same way as tables and views in the same namesspace.

Example 3-3   Generating an Endpoint for the Stored Procedure

```
CREATE OR REPLACE PROCEDURE MY_SCHEMA.MY_PROC IS
BEGIN
  NULL;
END;
```

Following endpoint is generated:

```
http://localhost:8080/ords/my_schema/my_proc/
```

Example 3-4 Package Procedure and Function Endpoints

The package, function, and procedure endpoints are generated with package name as a parent. Endpoints for functions and procedures that are not overloaded or where the lowercase name is not already in use are generated.

If you have a package, MY_PKG as defined in the following code snippet:

```
CREATE OR REPLACE  PACKAGE MY_SCHEMA.MY_PKG AS
  PROCEDURE MY_PROC;
  FUNCTION MY_FUNC RETURN VARCHAR2;
  PROCEDURE MY_PROC2;
  PROCEDURE "my_proc2";
  PROCEDURE MY_PROC3(P1 IN VARCHAR);
  PROCEDURE MY_PROC3(P2 IN NUMBER);
END MY_PKG;
```

Then the following endpoints are generated:

```
http://localhost:8080/ords/my_schema/my_pkg/MY_PROC
http://localhost:8080/ords/my_schema/my_pkg/MY_FUNC
```

Note:

Endpoints for the procedure `my_proc2` is not generated because its name is not unique when the name is converted to lowercase, and endpoints for the procedure `my_proc3` is not generated because it is overloaded.

3.2.5.3.4 Resource Input Payload

The input payload is a JSON document with values adhering to the REST standard.

The payload should contain a name/value pair for each IN or IN OUT parameter as shown in the following code snippet:

```
{
  "p1": "abc",
  "p2": 123,
  "p3": null
}
```

Note:

Where there are no IN or IN OUT parameters, an empty JSON body is required as shown in the following code snippet:

```
{

}
```

ORDS uses the database catalog metadata to unmarshal the JSON payload into Oracle database types, which is ready to be passed to the database through JDBC.

3.2.5.3.5 Resource Payload Response

When the PL/SQL object is executed successfully, it returns a JSON body.

The JSON body returned, contains all OUT and IN OUT output parameter values. ORDS uses the database catalog metadata to marshal the execution of the result back into JSON as shown in the following code snippet:

```
{
  "p3" : "abc123",
  "p4" : 1
}
```

Where there are no OUT or IN OUT parameters, an empty JSON body is returned as shown in the following code snippet:

```
{

}
```

3.2.5.3.6 Function Return Value

The return value of functions do not have an associated name.

As the return value of functions do not have an associated name, the name `"~ret"` is used as shown in the following code snippet:

```
{
  "~ret" : "abc123"
}
```

3.2.6 Manually Creating RESTful Services Using SQL and PL/SQL

This section describes how to manually create RESTful Services using SQL and PL/SQL and shows how to use a JSON document to pass parameters to a stored procedure in the body of a REST request.

This section includes the following topics:

- About Oracle REST Data Services Mechanisms for Passing Parameters (page 3-31)
- Using SQL/JSON Database Functions with ORDS (page 3-42)

3.2.6.1 About Oracle REST Data Services Mechanisms for Passing Parameters

This section describes the main mechanisms that Oracle REST Data Services supports for passing parameters using REST HTTP to handlers that are written by the developer:

- Using JSON to Pass Parameters (page 3-32)

  You can use JSON in the body of REST requests, such as the `POST` or `PUT` method, where each parameter is a JSON name/value pair.

- Using Route Patterns to Pass Parameters (page 3-36)

  You can use route patterns for required parameters in the URI to specify parameters for REST requests such as the `GET` method, which does not have a body, and in other special cases.
- Using Query Strings for Optional Parameters (page 3-40)

  You can use query strings for optional parameters in the URI to specify parameters for REST requests, such as the `GET` method, which does not have a body, and in other special cases.

Prerequisite Setup Tasks To Be Completed Before Performing Tasks for Passing Parameters

This prerequisite setup information assumes you have completed steps 1 and 2 in **Getting Started with RESTful Services** section, where you have REST-enabled the `ordstest` schema and `emp` database table (Step 1) and created and tested the RESTful service from a SQL query (Step 2). You must complete these two steps before performing the tasks about passing parameters described in the subsections that follow.

Related Topics:

- Getting Started with RESTful Services (page 3-2)

3.2.6.1.1 Using JSON to Pass Parameters

This section shows how to use a JSON document to pass parameters to a stored procedure in the body of a REST request, such as `POST` or `PUT` method, where each parameter is a name/value pair. This operation performs an update on a record, which in turn returns the change to the record as an `OUT` parameter.

Perform the following steps:

1

Note:

The following stored procedure performs an update on an existing record in the `emp` table to promote an employee by changing any or all of the following: job, salary, commission, department number, and manager. The stored procedure returns the salary change as an `OUT` parameter.

```
create or replace procedure promote ( l_empno IN number,  l_job IN varchar2,
           l_mgr IN number, l_sal IN number,  l_comm IN number,  l_deptno IN
number,
           l_salarychange OUT number)
        is
            oldsalary   number;
        begin
            select nvl(e.sal, 0)into oldsalary FROM emp e
                    where e.empno = l_empno;
            update emp e set
                e.job = nvl(l_job, e.job),
                e.mgr = nvl(l_mgr, e.mgr),
                e.sal = nvl(l_sal, e.sal),
                e.comm = nvl(l_comm, e.comm),
                e.deptno = nvl(l_deptno, e.deptno)
                        where e.empno = l_empno;
            l_salarychange := nvl(l_sal, oldsalary) - oldsalary;
        end;
```

As a privileged `ordstest` user, connect to the `ordstest` schema and create the `promote` stored procedure.

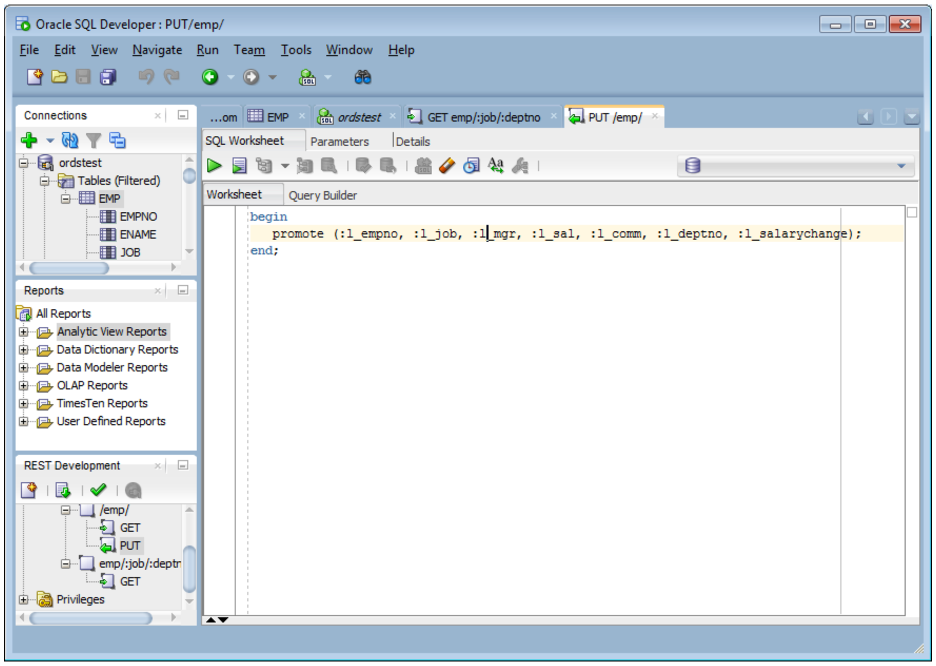
2. Perform the following steps to setup a handler for a `PUT` request on the `emp` resource to pass parameters in the body of the `PUT` method in a JSON document to the `promote` stored procedure.

   a. Using Oracle SQL Developer, in the REST Development section, right click on the `emp` template and select **Add Handler** for the `PUT` method.

   b. In the **Create Resource Handler** dialog, click the green plus symbol to add the MIME type `application/json` and then click **Apply** to send it a JSON document in the body of the `PUT` method.

   c. Using the SQL Worksheet, add the following anonymous PL/SQL block: `begin promote (:l_empno, :l_job, :l_mgr, :l_sal, :l_comm, :l_deptno, :l_salarychange); end;` as shown in the following figure.

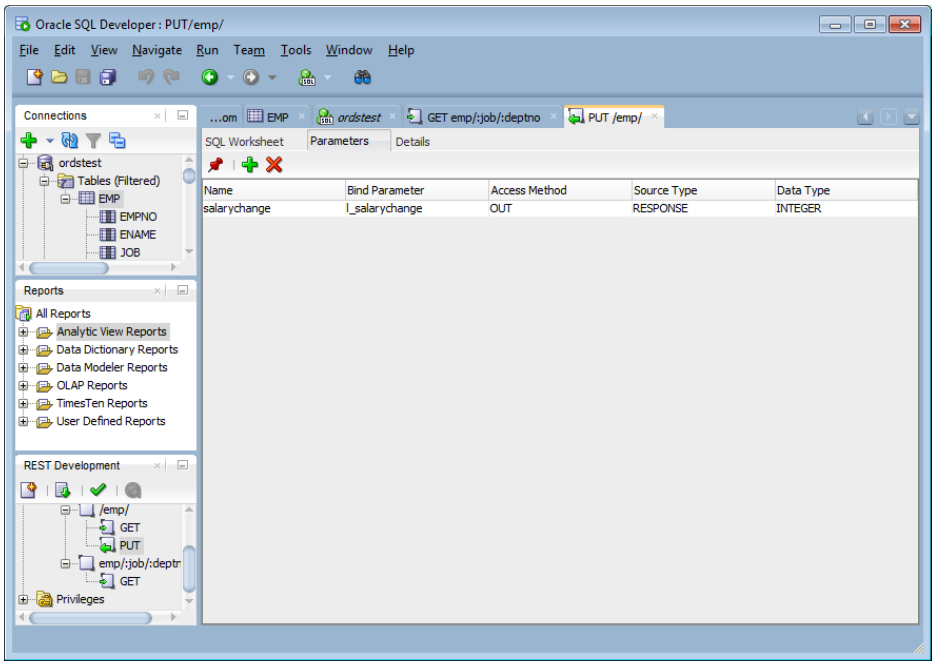
Figure 3-3 Adding an Anonymous PL/SQL Block to the Handler for the PUT Method



```
begin
   promote (:l_empno, :l_job, :l_mgr, :l_sal, :l_comm, :l_deptno, :l_salarychange);
end;
```

d. Click the **Parameters** tab to set the **Bind Parameter** as `l_salarychange` , the **Access Method** as an `OUT` parameter, the **Source Type** as `RESPONSE`, and **Data Type** as `INTEGER` as shown in the following figure. This is the promote procedure's output which is an integer value equal to the change in salary in a JSON name/value format.

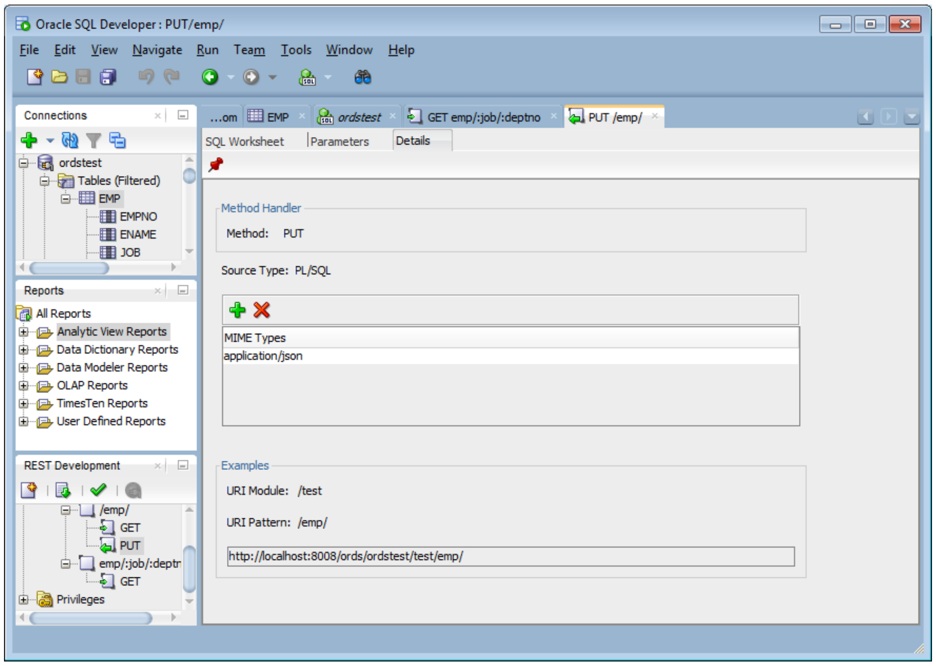
Figure 3-4 Setting the Bind Parameter l_salarychange to Pass for the PUT Method



Name	Bind Parameter	Access Method	Source Type	Data Type
salarychange	l_salarychange	OUT	RESPONSE	INTEGER

e. Click the **Details** tab to get the URL to call as shown in the **Examples** section of the following figure. Copy this URL to your clipboard.

Figure 3-5 Obtaining the URL to Call from the Details Tab



Method Handler
Method: PUT

Source Type: PL/SQL

MIME Types
application/json

Examples
URI Module: /test
URI Pattern: /emp/
http://localhost:8008/ords/ordstest/test/emp/

f. Right click on the `test` module to upload the module. Do not forget this step.

3. To test the RESTful service, execute the following cURL command in the command prompt:`curl -i -H "Content-Type: application/json" -X PUT -d "{ \"l_empno\" : 7499, \"l_sal\" : 9999, \"l_job\" : \"Director\", \"l_comm \" : 300}`

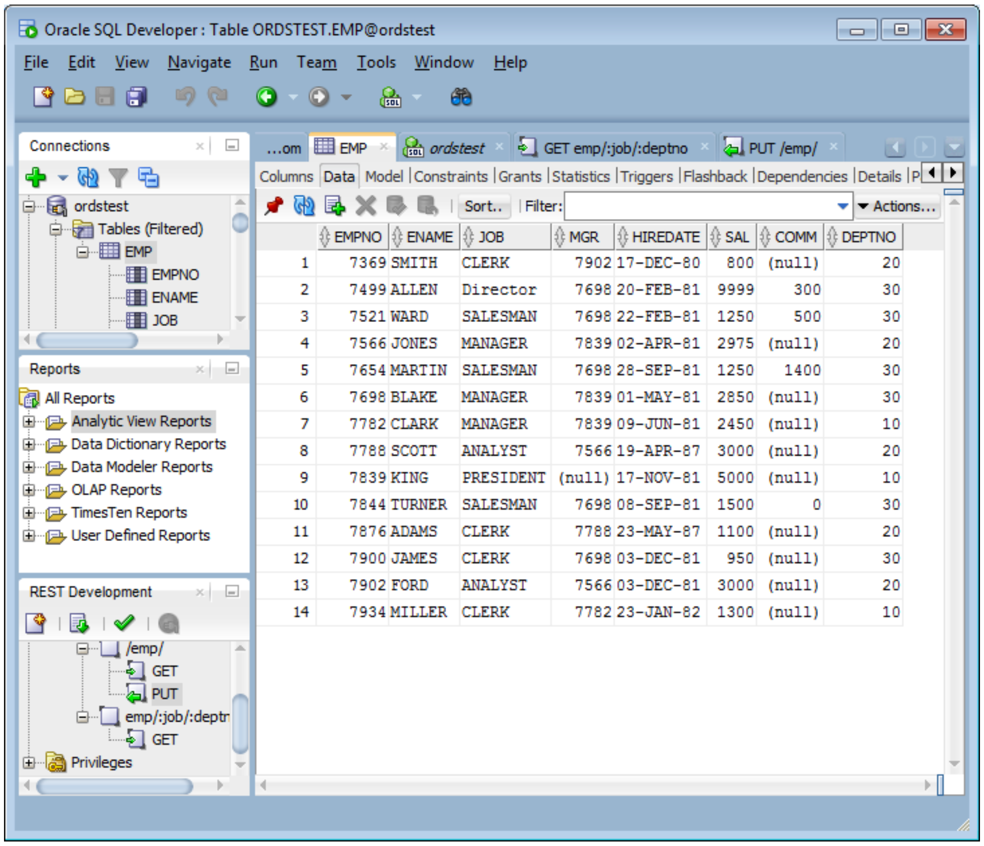
> **Note:**
>
> You can also use any REST client available to test the RESTful service.

The cURL command returns the following response:

```
HTTP/1.1 200 OK
Content-Type: application/json Transfer-Encoding: chunked
{"salarychange":8399}
```

4. In SQL Developer SQL Worksheet, perform the following `SELECT` statement on the `emp` table: `SELECT * from emp` to see that the `PUT` method was executed, then select the **Data** tab to display the records for the `EMP` table.

Figure 3-6   Displaying the Results from a SQL Query to Confirm the Execution of the PUT Method



	EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO
1	7369	SMITH	CLERK	7902	17-DEC-80	800	(null)	20
2	7499	ALLEN	Director	7698	20-FEB-81	9999	300	30
3	7521	WARD	SALESMAN	7698	22-FEB-81	1250	500	30
4	7566	JONES	MANAGER	7839	02-APR-81	2975	(null)	20
5	7654	MARTIN	SALESMAN	7698	28-SEP-81	1250	1400	30
6	7698	BLAKE	MANAGER	7839	01-MAY-81	2850	(null)	30
7	7782	CLARK	MANAGER	7839	09-JUN-81	2450	(null)	10
8	7788	SCOTT	ANALYST	7566	19-APR-87	3000	(null)	20
9	7839	KING	PRESIDENT	(null)	17-NOV-81	5000	(null)	10
10	7844	TURNER	SALESMAN	7698	08-SEP-81	1500	0	30
11	7876	ADAMS	CLERK	7788	23-MAY-87	1100	(null)	20
12	7900	JAMES	CLERK	7698	03-DEC-81	950	(null)	30
13	7902	FORD	ANALYST	7566	03-DEC-81	3000	(null)	20
14	7934	MILLER	CLERK	7782	23-JAN-82	1300	(null)	10

Note:

- All parameters are optional. If you leave out a name/value pair for a parameter in your JSON document, the parameter is set to `NULL`.
- The name/value pairs can be arranged in any order in the JSON document. JSON allows much flexibility in this regard in the JSON document.
- Only one level of JSON is supported. You can not have nested JSON objects or arrays.

3.2.6.1.2 Using Route Patterns to Pass Parameters

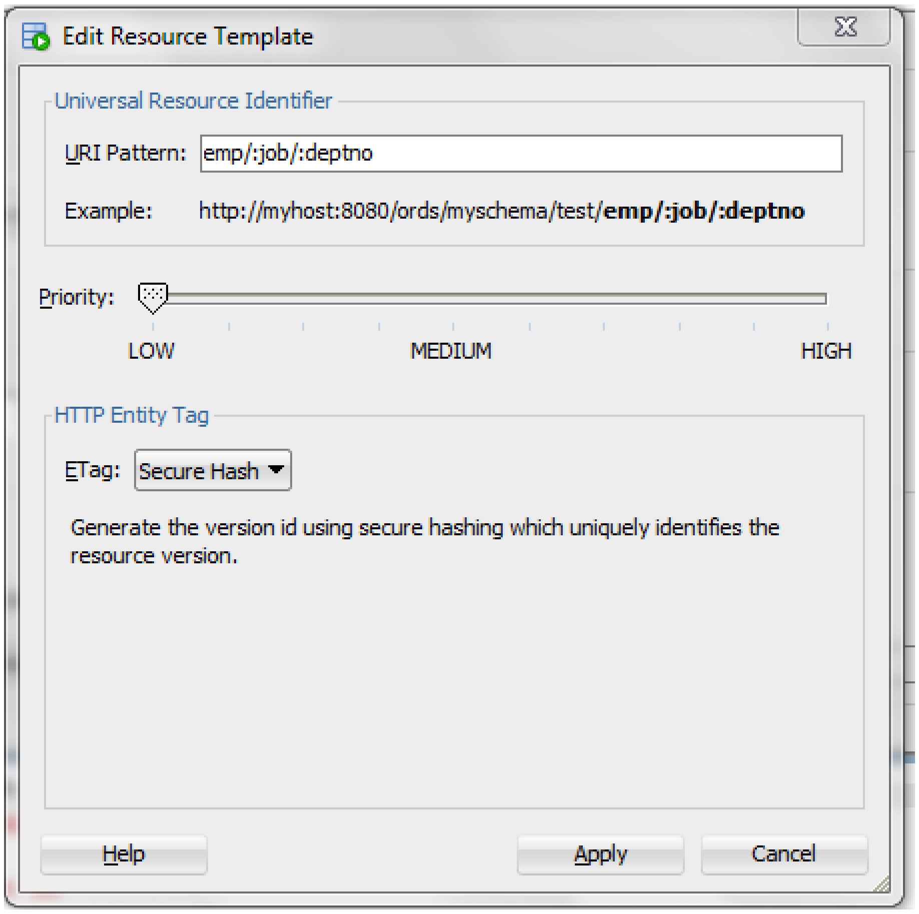
This section describes how to use route patterns in the URI to specify parameters for REST requests, such as with the `GET` method, which does not have a body.

First create a `GET` method handler for a query on the `emp` table that has many bind variables. These steps use a route pattern to specify the parameter values that are required.

Perform the following steps to use a route pattern to send a `GET` method with some required parameter values:

1. In SQL Developer, right click on the test module and select **Add Template** to create a new template that calls `emp`; however, in this case the template definition includes a route pattern for the parameters or bind variables that is included in the URI rather than in the body of the method. To define the required parameters, use a route pattern by specifying a `/:` before the `job` and `deptno` parameters. For example, for the URI pattern, enter: `emp/:job/:deptno` as shown in the following figure.

Figure 3-7 Creating a Template Definition to Include a Route Pattern for Some Parameters or Bind Variables



URI Pattern: emp/:job/:deptno

Example: http://myhost:8080/ords/myschema/test/**emp/:job/:deptno**

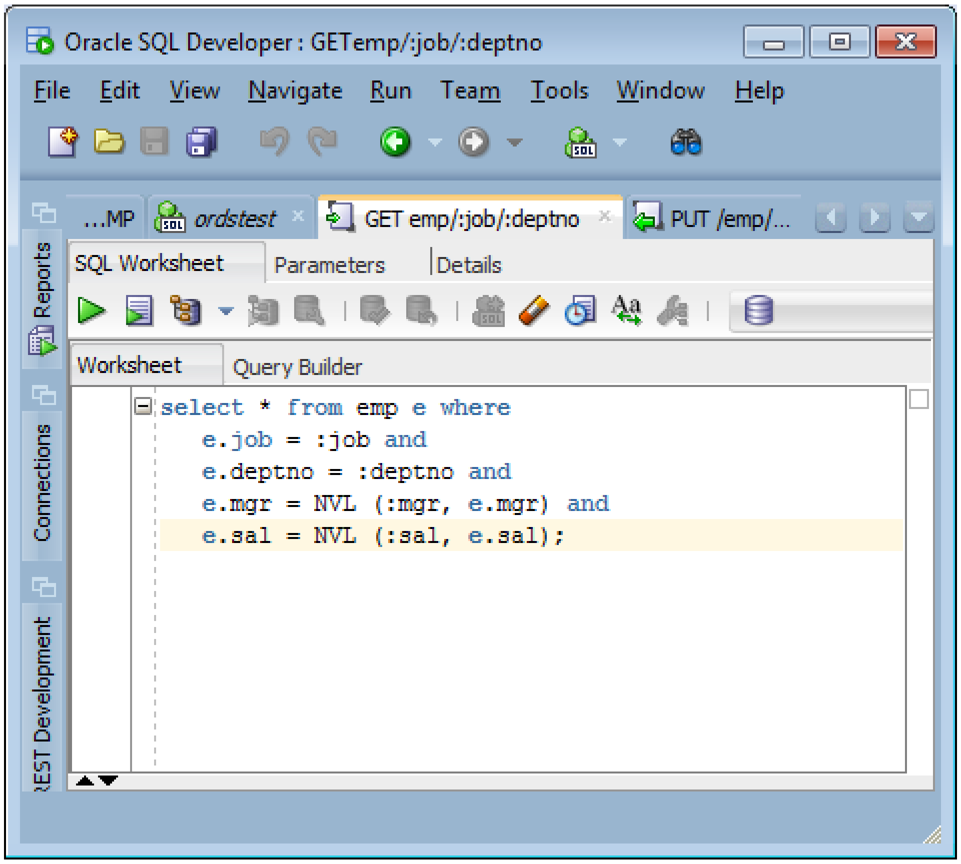
Priority: LOW MEDIUM HIGH

ETag: Secure Hash

Generate the version id using secure hashing which uniquely identifies the resource version.

2. Click **Next** to go to **REST Data Services — Step 2 of 3**, and click **Next** to go to **REST Data Services — Step 3 of 3**, then click **Finish** to complete the template.
3. Right click on the `emp/:job/:deptno` template and select `Add Handler` for the `GET` method.
4. Right click on the `GET` method to open the handler.
5. Add the following query to the SQL Worksheet: `select * from emp e where e.job = :job and e.deptno = :deptno and e.mgr = NVL (:mgr, e.mgr) and e.sal = NVL (:sal, e.sal);` as also shown in the following figure.

Figure 3-8 Adding a SQL Query to the Handler



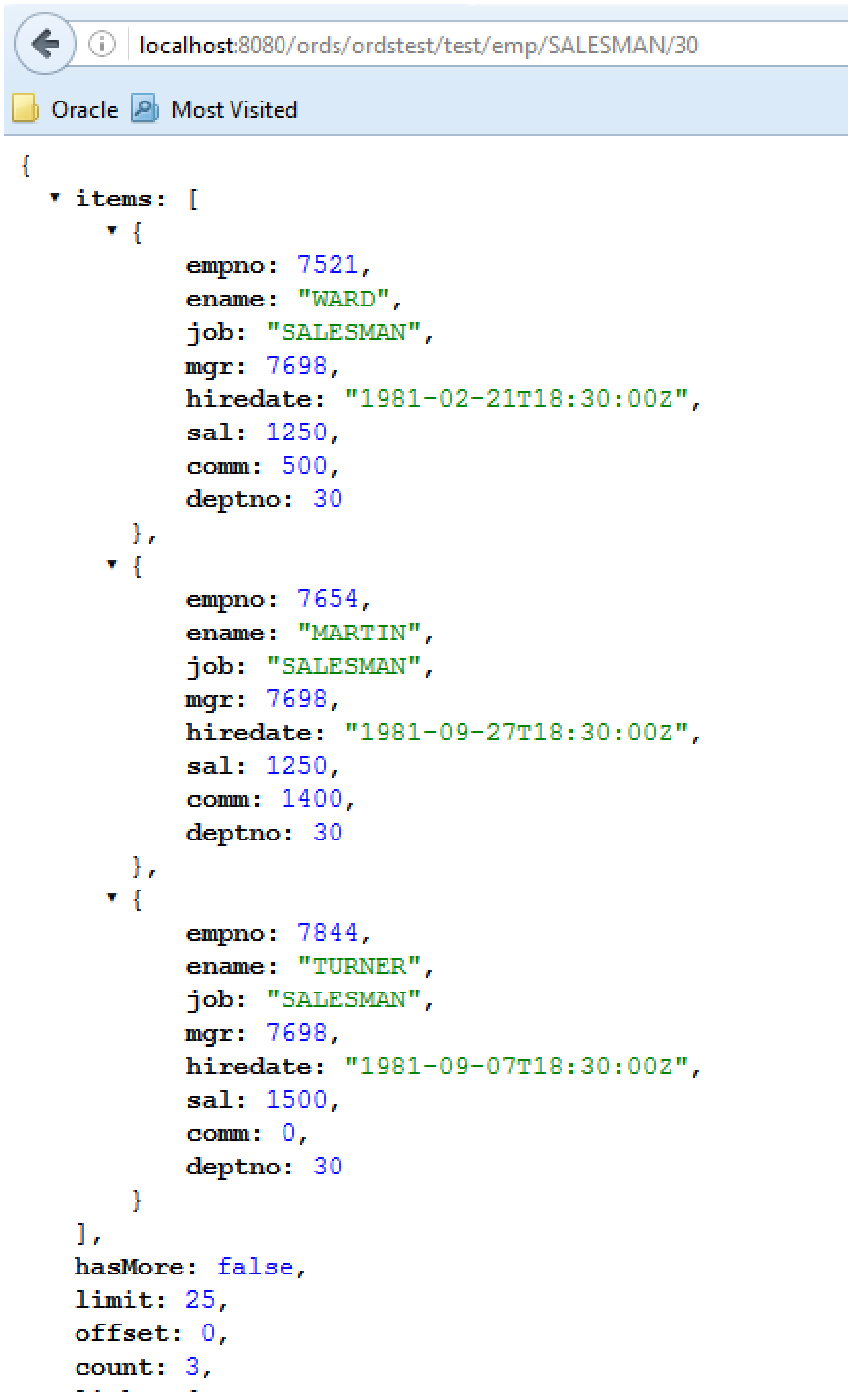
```
select * from emp e where
   e.job = :job and
   e.deptno = :deptno and
   e.mgr = NVL (:mgr, e.mgr) and
   e.sal = NVL (:sal, e.sal);
```

6. Click the **Details** tab to get the URL to call. Copy this URL to your clipboard.

7. Right click on the `test` module to upload the module. Do not forget this step.

8. Test the REST endpoint. In a web browser enter the URL:`http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30` as shown in the following figure.

Figure 3-9 Using Browser to Show the Results of Using a Route Pattern to Send a GET Method with Some Required Parameter Values



```
{
  ▾ items: [
      ▾ {
            empno: 7521,
            ename: "WARD",
            job: "SALESMAN",
            mgr: 7698,
            hiredate: "1981-02-21T18:30:00Z",
            sal: 1250,
            comm: 500,
            deptno: 30
        },
      ▾ {
            empno: 7654,
            ename: "MARTIN",
            job: "SALESMAN",
            mgr: 7698,
            hiredate: "1981-09-27T18:30:00Z",
            sal: 1250,
            comm: 1400,
            deptno: 30
        },
      ▾ {
            empno: 7844,
            ename: "TURNER",
            job: "SALESMAN",
            mgr: 7698,
            hiredate: "1981-09-07T18:30:00Z",
            sal: 1500,
            comm: 0,
            deptno: 30
        }
    ],
    hasMore: false,
    limit: 25,
    offset: 0,
    count: 3,
```

The query returns 3 records for the salesmen named Ward, Martin, and Turner.

See Also:

To learn more about Route Patterns see this document in the ORDS distribution at `docs/javadoc/plugin-api/route-patterns.html` and this document **Oracle REST Data Services Route Patterns**

3.2.6.1.3 Using Query Strings for Optional Parameters

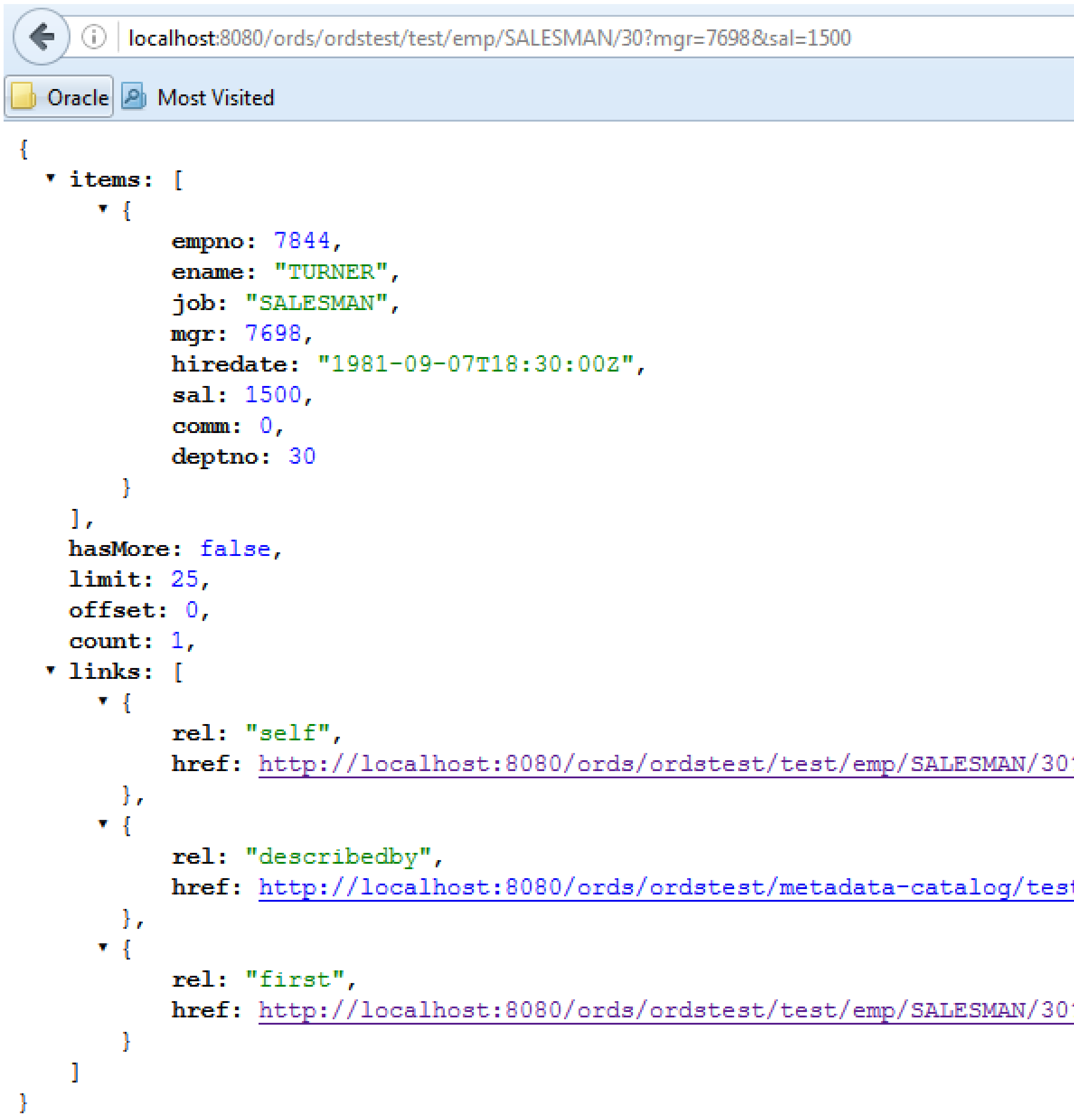
This section describes how to use query strings in the URI to specify parameters for REST requests like the GET method, which does not have a body. You can use query strings for any of the other optional bind variables in the query as you choose.

The syntax for using query strings is: `?parm1=value1&parm2=value2 … &parmN=valueN`.

For example, to further filter the query: `http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30`, to use a query string to send a GET method with some parameter name/value pairs, select employees whose `mgr` (manager) is `7698` and whose `sal` (salary) is `1500` by appending the query string `?mgr=7698&sal=1500` to the URL as follows: `http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30?mgr=7698&sal=1500`.

To test the endpoint, in a web browser enter the following URL: http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30?mgr=7698&sal=1500 as shown in the following figure:

Figure 3-10 Using Browser to Show the Results of Using a Query String to Send a GET Method with Some Parameter Name/Value Pairs


localhost:8080/ords/ordstest/test/emp/SALESMAN/30?mgr=7698&sal=1500
Oracle
Most Visited

```
{
  ▾ items: [
      ▾ {
            empno: 7844,
            ename: "TURNER",
            job: "SALESMAN",
            mgr: 7698,
            hiredate: "1981-09-07T18:30:00Z",
            sal: 1500,
            comm: 0,
            deptno: 30
        }
    ],
    hasMore: false,
    limit: 25,
    offset: 0,
    count: 1,
  ▾ links: [
      ▾ {
            rel: "self",
            href: http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30
        },
      ▾ {
            rel: "describedby",
            href: http://localhost:8080/ords/ordstest/metadata-catalog/test
        },
      ▾ {
            rel: "first",
            href: http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30
        }
    ]
}
```

The query returns one record for the salesman named Turner in department 30 who has a salary of 1500 and whose manager is 7698.

Note the following points:

- It is a good idea to URL encode your parameter values. This may not always be required; however, it is the safe thing to do. This prevents the Internet from transforming something, for example, such as a special character in to some other character that may cause a failure. Your REST client may provide this capability or you can search the Internet for the phrase `url encoder` to find tools that can do this for you.
- Never put a backslash at the end of your parameter list in the URI; otherwise, you may get a `404 Not Found` error.

See Also:

To gain more experience using JSON to pass parameter values, see **Lab 4 of the ORDS Oracle By Example (OBE)** and **Database Application Development Virtual Image**.

3.2.6.2 Using SQL/JSON Database Functions with ORDS

This section describes how to use the SQL/JSON database functions available in Oracle Database 12c Release 2 (12.2) to map the nested JSON objects to and from the hierarchical relational tables.

This section includes the following topics:

- Inserting Nested JSON Objects into Relational Tables (page 3-42)
- Generating Nested JSON Objects from Hierachical Relational Data (page 3-47)

3.2.6.2.1 Inserting Nested JSON Objects into Relational Tables

This section explains how to insert JSON objects with nested arrays into multiple, hierarchical relational tables.

The two key technologies used to implement this functionality are as follows:

- The `:body` bind variable that ORDS provides to deliver JSON and other content in the body of POST and other REST calls into PL/SQL REST handlers
- JSON_TABLE and other SQL/JSON operators provided in Oracle Database 12c Release 2 (12.2)

Some of the advantages of using these technologies for inserting data into relational tables are as follows:

- Requirements for implementing this functionality are very minimal. For example, installation of JSON parser software is not required
- You can use simple, declarative code that is easy to write and understand when the JSON to relational mapping is simple
- Powerful and sophisticated capabilities to handle more complex mappings. This includes:
  - Mechanisms for mapping NULLS and boolean values
  - Sophisticated mechanisms for handling JSON. JSON evolves over time. Hence, the mapping code must be able to handle both the older and newer versions of the JSON documents.

    For example, simple scalar values may evolve to become JSON objects containing multiple scalars or nested arrays of scalar values or objects. SQL/JSON operators that return the scalar value can continue to work even when the simple scalar is embedded within these more elaborate structures. A special mechanism, called the **Ordinality Column**, can be used to determine the structure from where the value was derived.

See Also:

The following pages for more information on JSON_TABLE and other SQL/JSON operators and on Ordinality Column mechanism:

- https://blogs.oracle.com/jsondb/
- https://blogs.oracle.com/jsondb/entry/the_new_sql_json_query3

3.2.6.2.1.1 Usage of the :body Bind Variable

This section provides some useful tips for using the `:body` bind variable.

Some of the useful tips for using the `:body` bind variable are as follows:

- The `:body` bind variable can be accessed, or de-referenced, only once. Subsequent accesses return a NULL value. So, you must first assign the `:body` bind variable to the local `L_PO` variable before using it in the two JSON_Table operations.
- The `:body` bind variable is a BLOB datatype and you can assign it only to a BLOB variable.

Note:

Since `L_PO` is a BLOB variable, you must use the `FORMAT JSON` phrase after the expression in the JSON_TABLE function. section for more information.

The `:body` bind variable can be used with other types of data such as image data.

See Also:

- Development Tutorial: Creating an Image Gallery (page F-1) for a working example of using `:body` bind variable with image data .
- Database SQL Language Reference

3.2.6.2.1.2 Example of JSON Purchase Order with Nested LineItems

This section shows an example that takes the JSON Purchase Order with Nested LineItems and inserts it into a row of the PurchaseOrder table and rows of the LineItem table.

Example 3-5 Nested JSON Purchase Order with Nested LineItems

```
{"PONumber"          : 1608,
  "Requestor"        : "Alexis Bull",
  "CostCenter"       : "A50",
  "Address"          : {"street"  : "200 Sporting Green",
                        "city"     : "South San Francisco",
                        "state"    : "CA",
                        "zipCode"  : 99236,
                                     "country" : "United States of America"},
     "LineItems"       : [ {"ItemNumber" : 1,
                               "Part"       : {"Description" : "One Magic Christmas",
                                               "UnitPrice"   : 19.95,
                                               "UPCCode"     : 1313109289},
                               "Quantity"   : 9.0},
                             {"ItemNumber" : 2,
                              "Part"       : {"Description" : "Lethal Weapon",
                                              "UnitPrice"   : 19.95,
                                              "UPCCode"     : 8539162892},
                              "Quantity"   : 5.0}]}'
```

3.2.6.2.1.3 Table Definitions for PurchaseOrder and LineItems Tables

This section provides definitions for the **PurchaseOrder** and **LineItem** tables.

The definitions for the **PurchaseOrder** and the **LineItems** tables are as follows:

```
CREATE TABLE PurchaseOrder (
     PONo NUMBER (5),
     Requestor VARCHAR2 (50),
     CostCenter VARCHAR2 (5),
     AddressStreet VARCHAR2 (50),
     AddressCity VARCHAR2 (50),
     AddressState VARCHAR2 (2),
     AddressZip VARCHAR2 (10),
     AddressCountry VARCHAR2 (50),
     PRIMARY KEY (PONo));

CREATE TABLE LineItem (
     PONo NUMBER (5),
     ItemNumber NUMBER (10),
     PartDescription VARCHAR2 (50),
     PartUnitPrice NUMBER (10),
     PartUPCCODE NUMBER (10),
     Quantity NUMBER (10),
     PRIMARY KEY (PONo,ItemNumber));
```

3.2.6.2.1.4 PL/SQL Handler Code for a POST Request

This section gives an example PL/SQL handler code for a POST request. The handler code is used to insert a purchase order into a row of the PurchaseOrder table and rows of the LineItem table.

Example 3-6   PL/SQL Handler Code Used for a POST Request

```
Declare
  L_PO     BLOB;

Begin
  L_PO := :body;

INSERT INTO PurchaseOrder
      SELECT * FROM json_table(L_PO  FORMAT JSON, '$'
         COLUMNS (
           PONo            Number    PATH '$.PONumber',
           Requestor       VARCHAR2  PATH '$.Requestor',
           CostCenter      VARCHAR2  PATH '$.CostCenter',
           AddressStreet   VARCHAR2  PATH '$.Address.street',
           AddressCity     VARCHAR2  PATH '$.Address.city',
           AddressState    VARCHAR2  PATH '$.Address.state',
           AddressZip      VARCHAR2  PATH '$.Address.zipCode',
           AddressCountry  VARCHAR2  PATH '$.Address.country'));

INSERT INTO LineItem
SELECT * FROM json_table(L_PO  FORMAT JSON, '$'
         COLUMNS (
           PONo  Number PATH '$.PONumber',
           NESTED             PATH '$.LineItems[*]'
             COLUMNS (
               ItemNumber        Number   PATH '$.ItemNumber',
               PartDescription   VARCHAR2   PATH '$.Part.Description',
               PartUnitPrice     Number   PATH '$.Part.UnitPrice',
               PartUPCCode       Number   PATH '$.Part.UPCCode',
               Quantity          Number   PATH '$.Quantity')));
commit;
end;
```

3.2.6.2.1.5 Creating the REST API Service to Invoke the Handler

This section explains how to create the REST API service to invoke the handler, using the Oracle REST Data Services.

To setup the REST API service, a URI is defined to identify the resource the REST calls will be operating on. The URI is also used by Oracle REST Data Services to route the REST HTTP calls to specific handlers. The general format for the URI is as follows:

```
<server>:<port>/ords/<schema>/<module>/<template>/<parameters>
```

Here, `<server>:<port>` is where the Oracle REST Data Service is installed. For testing purposes, you can use **demo** and **test** in place of **module** and **template** respectively in the URI. Modules are used to group together related templates that define the resources the REST API will be operating upon.

To create the REST API service, use one of the following methods:

- Use the ORDS PL/SQL API to define the REST service and a handler for the POST insert. Then connect to the `jsontable` schema on the database server that contains the PurchaseOrder and LineItem tables.

> **Note:**
>
> JSON_TABLE and other SQL/JSON operators use single quote so these must be escaped. For example, every single quote (') must be replaced with double quotes (").

- Use the ORDS REST Development pane in SQL Developer to define the REST service.

3.2.6.2.1.6 Defining the REST Service and Handler using ORDS PL/SQL API

This section shows how to define the REST Service and Handler for the POST insert using the Oracle REST Data Services (ORDS) PL/SQL API.

You can alternatively use the ORDS REST development pane in SQL Developer to create the modules, templates and handlers.

```
BEGIN
  ORDS.ENABLE_SCHEMA(
      p_enabled             => TRUE,
      p_schema              => 'ORDSTEST',
      p_url_mapping_type    => 'BASE_PATH',
      p_url_mapping_pattern => 'ordstest',
      p_auto_rest_auth      => FALSE);

  ORDS.DEFINE_MODULE(
      p_module_name    => 'demo',
      p_base_path      => '/demo/',
      p_items_per_page =>  25,
      p_status         => 'PUBLISHED',
      p_comments       => NULL);
  ORDS.DEFINE_TEMPLATE(
      p_module_name    => 'demo',
      p_pattern        => 'test',
      p_priority       => 0,
      p_etag_type      => 'HASH',
      p_etag_query     => NULL,
      p_comments       => NULL);
  ORDS.DEFINE_HANDLER(
      p_module_name    => 'demo',
      p_pattern        => 'test',
      p_method         => 'POST',
      p_source_type    => 'plsql/block',
      p_items_per_page =>  0,
      p_mimes_allowed  => '',
      p_comments       => NULL,
      p_source         => '
declare
    L_PO BLOB := :body;
begin

INSERT INTO PurchaseOrder
      SELECT * FROM json_table(L_PO  FORMAT JSON, ''$''
         COLUMNS (
           PONo                  Number           PATH ''$.PONumber'',
           Requestor            VARCHAR2  PATH ''$.Requestor'',
           CostCenter          VARCHAR2   PATH ''$.CostCenter'',
           AddressStreet      VARCHAR2  PATH ''$.Address.street'',
           AddressCity         VARCHAR2  PATH ''$.Address.city'',
           AddressState        VARCHAR2  PATH ''$.Address.state'',
           AddressZip           VARCHAR2  PATH ''$.Address.zipCode'',
           AddressCountry    VARCHAR2  PATH ''$.Address.country''));

INSERT INTO LineItem
SELECT * FROM json_table(L_PO  FORMAT JSON, ''$''
         COLUMNS (
           PONo  Number PATH ''$.PONumber'',
           NESTED                     PATH ''$.LineItems[*]''
             COLUMNS (
               ItemNumber       Number      PATH ''$.ItemNumber'',
               PartDescription  VARCHAR2    PATH ''$.Part.Description'',
               PartUnitPrice      Number     PATH ''$.Part.UnitPrice'',
               PartUPCCode     Number     PATH ''$.Part.UPCCode'',
               Quantity              Number    PATH ''$.Quantity'')));

commit;
end;'
      );
  COMMIT;
END;
```

Related Topics:

- Using the Oracle REST Data Services PL/SQL API (page 3-81)
- About Oracle REST Data Services Mechanisms for Passing Parameters (page 3-31)
- ORDS PL/SQL Package Reference (page 5-1)

3.2.6.2.2 Generating Nested JSON Objects from Hierachical Relational Data

This section explains how to query the relational tables in hierarchical (parent/child) relationships and return the data in a nested JSON format using the Oracle REST Data Services.

The two key technologies used to implement this functionality are as follows:

- The new SQL/JSON functions available with Oracle Database 12c Release 2 (12.2). You can use `json_objects` for generating JSON objects from the relational tables, and `json_arrayagg`, for generating nested JSON arrays from nested (child) relational tables.
- The ORDS media source type used for enabling the REST service handler to execute a SQL query that in turn returns the following types of data:
  - The HTTP Content-Type of the data, which in this case is **application/json**
  - The JSON data returned by the `json_object`

Some of the advantages of using this approach are as follows:

- Requirements for implementing this functionality is very minimal. For example, installation of JSON parser software is not required.
- Simple, declarative coding which is easy to write and understand which makes the JSON objects to relational tables mapping simple.
- Powerful and sophisticated capabilities to handle more complex mappings. This includes mechanisms for mapping NULLS and boolean values.

  For example, a NULL in the Oracle Database can be converted to either the absence of the JSON element or to a JSON NULL value. The Oracle Database does not store Boolean types but the SQL/JSON functions allow string or numeric values in the database to be mapped to Boolean TRUE or FALSE values.

3.2.6.2.2.1 Example to Generate Nested JSON Objects from the Hierachical Relational Tables

This section describes how to query or GET the data we inserted into the PurchaseOrder and LineItem relational tables in the form of nested JSON purchase order.

Example 3-7   GET Handler Code using Oracle REST Data Services Query on Relational Tables for Generating a Nested JSON object

```
SELECT 'application/json', json_object('PONumber' VALUE po.PONo,
       'Requestor' VALUE po.Requestor,
       'CostCenter' VALUE po.CostCenter,
       'Address' VALUE
           json_object('street' VALUE po.AddressStreet,
                 'city' VALUE po.AddressCity,
                 'state' VALUE po.AddressState,
                 'zipCode' VALUE po.AddressZip,
                 'country' VALUE po.AddressCountry),
        'LineItems' VALUE (select json_arrayagg(
            json_object('ItemNumber' VALUE li.ItemNumber,
                   'Part' VALUE
                     json_object('Description' VALUE li.PartDescription,
                                 'UnitPrice' VALUE li.PartUnitPrice,
                                 'UPCCode' VALUE li.PartUPCCODE),
                   'Quantity' VALUE li.Quantity))
                   FROM LineItem li WHERE po.PONo = li.PONo))
             FROM PurchaseOrder po
               WHERE po.PONo = :id
```

3.2.6.2.2.2 ORDS PL/SQL API Calls for Defining Template and GET Handler

This section provides an example of ORDS PL/SQL API call for creating a new template in the module created.

Example 3-8 ORDS PL/SQL API Call for Creating a New test/:id Template and GET Handler in the demo Module

```
Begin
ords.define_template(
 p_module_name => 'demo',
 p_pattern => 'test/:id');

ords.define_handler(
 p_module_name => 'demo',
 p_pattern => 'test/:id',
 p_method  => 'GET',
 p_source_type => ords.source_type_media,
 p_source => '

   SELECT ''application/json'', json_object(''PONumber'' VALUE po.PONo,
          ''Requestor'' VALUE po.Requestor,
          ''CostCenter'' VALUE po.CostCenter,
          ''Address'' VALUE
              json_object(''street'' VALUE po.AddressStreet,
                          ''city'' VALUE po.AddressCity,
                          ''state'' VALUE po.AddressState,
                          ''zipCode'' VALUE po.AddressZip,
                          ''country'' VALUE po.AddressCountry),
          ''LineItems'' VALUE (select json_arrayagg(
              json_object(''ItemNumber'' VALUE li.ItemNumber,
                     ''Part'' VALUE
                       json_object(''Description'' VALUE li.PartDescription,
                                   ''UnitPrice'' VALUE li.PartUnitPrice,
                                   ''UPCCode'' VALUE li.PartUPCCODE),
                      ''Quantity'' VALUE li.Quantity))
                      FROM LineItem li WHERE po.PONo = li.PONo))
               FROM PurchaseOrder po
                 WHERE po.PONo = :id '
   );

Commit;
End;
```

3.2.6.2.3 Testing the RESTful Services

This section shows how to test the **POST** and **GET** RESTful Services to access the Oracle database and get the results in a JSON format.

This section includes the following topics:

- Insertion of JSON Object into the Database (page 3-49)
- Generating JSON Object from the Database (page 3-49)

3.2.6.2.3.1 Insertion of JSON Object into the Database

This section shows how to test insertion of JSON purchase order into the database.

URI Pattern: `http://<HOST>:<PORT>/ords/<SchemaAlias>/<module>/<template>`

Example:

Method: POST

URI Pattern: `http://localhost:8080/ords/ordstest/demo/test/`

To test the RESTful service, create a file such as `po1.json` with the following data for PONumber 1608 :

```
{"PONumber"        : 1608,
 "Requestor"       : "Alexis Bull",
 "CostCenter"      : "A50",
 "Address"         : {"street"  : "200 Sporting Green",
                      "city"    : "South San Francisco",
                      "state"   : "CA",
                      "zipCode" : 99236,
                      "country" : "United States of America"},
      "LineItems"  : [ {"ItemNumber" : 1,
                        "Part"     : {"Description" : "One Magic Christmas",
                                       "UnitPrice"   : 19.95,
                                       "UPCCode"     : 1313109289},
                                       "Quantity"   : 9.0},
                                      {"ItemNumber" : 2,
                                        "Part"       : {"Description" : "Lethal
Weapon",
                                                        "UnitPrice"   : 19.95,
                                                        "UPCCode"     :
8539162892},
                                        "Quantity"   : 5.0}]}'
```

Then, execute the following cURL command in the command prompt:

```
curl -i -H "Content-Type: application/json" -X POST -d @po1.json "http://localhost:
8080/ords/ordstest/demo/test/"
```

The cURL command returns the following response:

```
HTTP/1.1 200 OK
Transfer-Encoding: chunked
```

3.2.6.2.3.2 Generating JSON Object from the Database

This section shows the results of a GET method to fetch the JSON object from the database..

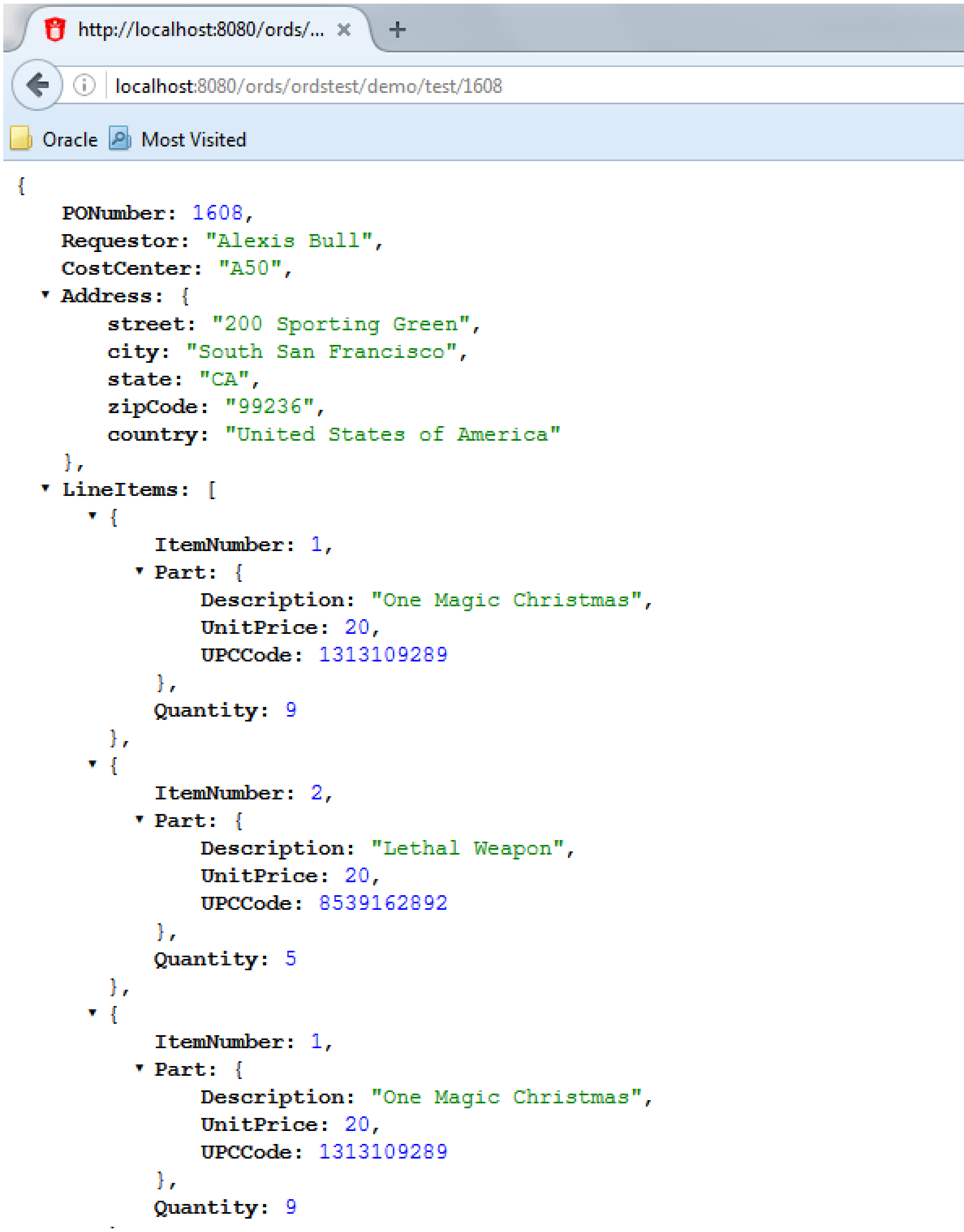
Method: `GET`

URI Pattern: `http://<HOST>:<PORT>/ords/<SchemaAlias>/<module>/<template>/<parameters>`

Example:

To test the RESTful service, in a web browser, enter the URL http://localhost:8080 / ords/ordstest/demo/test/1608 as shown in the following figure:

Figure 3-11   Generating Nested JSON Objects



http://localhost:8080/ords/...
localhost:8080/ords/ordstest/demo/test/1608
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```
{
    PONumber: 1608,
    Requestor: "Alexis Bull",
    CostCenter: "A50",
  ▾ Address: {
        street: "200 Sporting Green",
        city: "South San Francisco",
        state: "CA",
        zipCode: "99236",
        country: "United States of America"
    },
  ▾ LineItems: [
      ▾ {
            ItemNumber: 1,
          ▾ Part: {
                Description: "One Magic Christmas",
                UnitPrice: 20,
                UPCCode: 1313109289
            },
            Quantity: 9
        },
      ▾ {
            ItemNumber: 2,
          ▾ Part: {
                Description: "Lethal Weapon",
                UnitPrice: 20,
                UPCCode: 8539162892
            },
            Quantity: 5
        },
      ▾ {
            ItemNumber: 1,
          ▾ Part: {
                Description: "One Magic Christmas",
                UnitPrice: 20,
                UPCCode: 1313109289
            },
            Quantity: 9
```

3.2.7 About Working with Dates Using ORDS

ORDS enables developers to create REST interfaces to Oracle Database, Oracle Database 12c JSON Document Store, and Oracle NoSQL Database as quickly and easily as possible. When working with Oracle Database, developers can use the AutoREST feature for tables or write custom modules using SQL and PL/SQL routines for more complex operations.

ORDS uses the RFC3339 standard for encoding dates in strings. Typically, the date format used is dd-mmm-yyyy, for example, 15-Jan-2017. ORDS automatically converts JSON strings in the specified format to Oracle date data types when performing operations such as inserting or updating values in Oracle Database. When converting back to JSON strings, ORDS automatically converts Oracle date data types to the string format.

Note:

Oracle Database supports a date data type while JSON does not support a date data type.

This section includes the following topics:

- About Datetime Handling with Oracle REST Data Services (page 3-52)
- About Setting the Time Zone that ORDS Uses (page 3-53)

See Also:

The following page for more information, including details on how time and time zones are handled jsao_io_dates

3.2.7.1 About Datetime Handling with Oracle REST Data Services

As data arrives from a REST request, Oracle REST Data Services (ORDS) may parse ISO 8601 strings and convert them to the `TIMESTAMP` data type in Oracle Database. This occurs with AutoREST (`POST` and `PUT`) as well as with bind variables in custom modules. Remember that `TIMESTAMP` does not support time zone related components, so the `DATETIME` value is set to the time zone ORDS uses during the conversion process.

When constructing responses to REST requests, ORDS converts `DATETIME` values in Oracle Database to ISO 8601 strings in Zulu. This occurs with AutoREST (`GET`) and in custom modules that are mapped to SQL queries (GET). In the case of `DATE` and `TIMESTAMP` data types, which do not have time zone related components, the time zone is assumed to be that in which ORDS is running and the conversion to Zulu is made from there.

Here are some general recommendations when working with ORDS for REST (that is, not APEX):

- Ensure that ORDS uses the appropriate time zone as per the data in the database (for example, the time zone you want dates going into the database).
- Do not alter NLS settings (that is, the time_zone) mid-stream.

Note that while ISO 8601 strings are mentioned, ORDS actually supports strings. RFC3339 strings are a conformant subset of ISO 8601 strings. The default format returned by `JSON.stringify(date)` is supported.

WARNING:

It is important to keep the time zone that ORDS uses in sync with the session time zone to prevent issues with implicit data conversion to `TIMESTAMP WITH TIME ZONE` or `TIMESTAMP WITH LOCAL TIME ZONE`. ORDS does this automatically by default but developers can change the session time zone with an `ALTER SESSION` statement.

See Aslo:

rfc3339_date_time_format

3.2.7.2 About Setting the Time Zone that ORDS Uses

When Oracle REST Data Services (ORDS) is started, the JVM it runs in obtains and caches the time zone ORDS uses for various time zone conversions. By default, the time zone is obtained from the operating system (OS), so an easy way to change the time zone ORDS uses is to change the time zone of the OS and then restart ORDS or the application server on which it is running. Of course, the instructions for changing the time zone vary by the operating system.

If for any reason you do not want to use the same time zone as the OS, it is possible to override the default using the Java environment variable `Duser.timezone`. Exactly how that variable is set depends on whether you are running in standalone mode or in a Java application server. The following topics show some examples.

Standalone Mode

When running ORDS in standalone mode, it is possible to set Java environment variables by specifying them as command line options before the `-jar` option.

Example 3-9 Setting the Duser.timezone Java Environment Variable in Standalone Mode

The following code example shows how to set the timezone in standalone mode on the command line.

```
$ java -Duser.timezone=America/New_York -jar ords.war standalone
```

Java Application Server — Tomcat 8

In a Java application server, Tomcat 8, and possibly earlier and later versions too, it is possible to set the time zone using the environment variable `CATALINA_OPTS`. The recommended way to do this is not to modify the `CATALINA_BASE/bin/catalina.sh` directly, but instead to set environment variables by creating a script named `setenv.sh` in `CATALINA_BASE/bin`.

Example 3-10 Setting the Duser.timezone Java Environment Variable in a Java Application Server

The following code example shows the contents of the `setenv.sh` script for setting the timezone in a Java Application server — Tomcat 8.

```
CATALINA_TIMEZONE="-Duser.timezone=America/New_York"
CATALINA_OPTS="$CATALINA_OPTS $CATALINA_TIMEZONE
```

3.2.7.3 Exploring the Sample RESTful Services in Application Express (Tutorial)

Oracle highly recommends to develop ORDS application using SQL Developer because it supports the most recent ORDS releases, that is, 3.0.X. Application Express provides a tutorial that is useful for learning some basic concepts of REST and ORDS. However, the tutorial uses the earlier ORDS releases, that is, 2.0.X. Following are some of the useful tips discussed on how to use the tutorial:

If your Application Express instance is configured to automatically add the sample application and sample database objects to workspaces, then a sample resource module named: `oracle.example.hr` will be visible in the list of Resource Modules. If that resource module is not listed, then you can click the **Reset Sample Data** task on the right side of the RESTful Services Page to create the sample resource module.

1. Click on `oracle.example.hr` to view the Resource Templates and Resource Handlers defined within the module. Note how the module has a URI prefix with the value: `hr/`. This means that all URIs serviced by this module will start with the characters `hr/`.
2. Click on the resource template named `employees/{id}`. Note how the template has a URI Template with the value: `employees/{id}`. This means that all URIs starting with `hr/employees/` will be serviced by this Resource Template.

   The HTTP methods supported by a resource template are listed under the resource template. In this case, the only supported method is the `GET` method.
3. Click on the `GET` Resource Handler for `hr/employees/{id}` to view its configuration.

   The **Source Type** for this handler is `Query One Row`. This means that the resource is expected to be mapped to a single row in the query result set. The Source for this handler is:

   ```
   select * from emp
            where empno = :id
   ```

   Assuming that the `empno` column is unique, the query should only produce a single result (or no result at all if no match is found for `:id`). To try it out, press the **Test** button. The following error message should be displayed:

   400 - Bad Request - Request path contains unbound parameters: id

   If you look at the URI displayed in the browser, it will look something like this:

   ```
   https://server:port/ords/workspace/hr/employees/{id}
   ```

   where:

   - `server` is the DNS name of the server where Oracle Application Express is deployed
   - `port` is the port the server is listening on

- `workspace` is the name of the Oracle Application Express workspace you are logged into

Note the final part of the URI: `hr/employees/{id}`. The error message says that this is not a valid URI, the problem is that you did not substitute in a concrete value for the parameter named `{id}`. To fix that, press the browser **Back** button, then click **Set Bind Variables**.

4. For the bind variable named `:id`, enter the value `7369`, and press **Test**.

   A new browser window appears displaying the following JSON (JavaScript Object Notation):

```
{
 "empno":7369,
 "ename":"SMITH",
 "job":"CLERK",
 "mgr":7902,
 "hiredate":"1980-12-17T08:00:00Z",
 "sal":800,
 "deptno":20
}
```

   Note also the URI displayed in the browser for this resource:

```
https://server:port/ords/workspace/hr/employees/7369
```

   The `{id}` URI Template parameter is bound to the SQL `:id` bind variable, and in this case it has been given the concrete value of `7369`, so the query executed by the RESTful Service becomes:

```
select * from emp
          where empno = 7369
```

   The results of this query are then rendered as JSON as shown above.

Tip:

Reading JSON can be difficult. To make it easier to read, install a browser extension that *pretty prints* the JSON. For example, Mozilla Firefox and Google Chrome both have extensions:

- jsonview_firefox
- json_formatter_chrome

   Now see what happens when you enter the URI of a resource that does not exist.

5. On the Set Bind Variables page, change the value of `:id` from `7369` to `1111`, and press **Test**.

   As before, a new window pops up, but instead of displaying a JSON resource, it displays an error message reading:

```
404 - Not Found
```

   This is the expected behavior of this handler: when a value is bound to `:id` that does not exist in the `emp` table, the query produces no results and consequently the standard HTTP Status Code of `404 - Not Found` is returned.

So, you have a service that will provide information about individual employees, if you know the ID of an employee, but how do you discover the set of valid employee ids?

6. Press **Cancel** to return to the previous page displaying the contents of the Resource Module.
7. Click on the template named `employees/`.

   The following steps look at the resource it generates, and later text will help you understand its logic.
8. Click on the GET handler beneath `employees/`, and click **Test**.

   A resource similar to the following is displayed (If you haven't already done so, now would be a good time to install a JSON viewer extension in your browser to make it easier to view the output):

```
{
 "next":
  {"$ref":
    "https://server:port/ords/workspace/hr/employees/?page=1"},
 "items": [
  {
   "uri":
    {"$ref":
      "https://server:port/ords/workspace/hr/employees/7369"},
   "empno": 7369,
   "ename": "SMITH"
  },
  {
   "uri":
    {"$ref":
      "https://server:port/ords/workspace/hr/employees/7499"},
   "empno": 7499,
   "ename": "ALLEN"
  },
  ...
  {
   "uri":
    {"$ref":
      "https://server:port/ords/workspace/hr/employees/7782"},
   "empno": 7782,
   "ename": "CLARK"
  }
 ]
}
```

   This JSON document contains a number of things worth noting:

   - The first element in the document is named `next` and is a URI pointing to the next page of results. (An explanation of how paginated results are supported appears in later steps)
   - The second element is named `items` and contains a number of child elements. Each child element corresponds to a row in the result set generated by the query.
   - The first element of each child element is named `uri` and contains a URI pointing to the service that provides details of each employee. Note how the latter part of the URI matches the URI Template: `employees/{id}`. In other

words, if a client accesses any of these URIs, the request will be serviced by the `employees/{id}` RESTful service previously discussed.

So, this service addresses the problem of identifying valid employee IDs by generating a resource that lists all valid employee resources. The key thing to realize here is that it does not do this by just listing the ID value by itself and expecting the client to be able to take the ID and combine it with prior knowledge of the `employees/{id}` service to produce an employee URI; instead, it lists the URIs of each employee.

Because the list of valid employees may be large, the service also breaks the list into smaller pages, and again uses a URI to tell the client where to find the next page in the results.

To see at how this service is implemented, continue with the next steps.

9. Press the **Back** button in your browser to return to the `GET` handler definition.

Note the Source Type is `Query`, this is the default Source Type, and indicates that the resource can contain zero or more results. The Pagination Size is `7`, which means that there will be seven items on each page of the results. Finally, the Source for the handler looks like this:

```
select empno "$uri", empno, ename from (
 select emp.*,
        row_number() over (order by empno) rn
        from emp
 ) tmp
 where
  rn between :row_offset and :row_count
```

In this query:

- The first line states that you want to return three columns. The first column is the employee id: `empno`, but aliased to a column name of `$uri` (to be explained later), the second column is again the employee ID, and the third column is the employee name, `ename`.
- Columns in result sets whose first character is `$` (dollar sign) are given special treatment. They are assumed to denote columns that must be transformed into URIs, and these are called Hyperlink Columns. Thus, naming columns with a leading `$` is a way to generate hyperlinks in resources.

  When a Hyperlink Column is encountered, its value is prepended with the URI of the resource in which the column is being rendered, to produce a new URI. For example, recall that the URI of this service is `https://server:port/ords/workspace/hr/employees/`. If the value of `empno` in the first row produced by the service's query is `7369`, then the value of `$uri` becomes: `https://server:port/ords/workspace/hr/employees/7369`.
- JSON does not have a URI data type, so a convention is needed to make it clear to clients that a particular value represents a URI. Oracle REST Data Services uses the JSON Reference proposal, which states that any JSON object containing a member named `$ref`, and whose value is a string, is a URI. Thus, the column: `$uri` and its value: `https://server:port/ords/workspace/hr/employees/7369` is transformed to the following JSON object:

  ```
  {"uri":
       {"$ref":
        "https://server:port/ords/workspace/hr/employees/7369"
  ```

```
        }
      }
```

- The inner query uses the `row_number()` analytical function to count the number of rows in the result set, and the outer WHERE clause constrains the result set to only return rows falling within the desired page of results. Oracle REST Data Services defines two implicit bind parameters, `:row_offset` and `:row_count`, that always contain the indicies of the first and last rows that should be returned in a given page's results.

  For example, if the current page is the first page and the pagination size is `7`, then the value of `:row_offset` will be `1` and the value of `:row_count` will be `7`.

To see a simpler way to do both hyperlinks and paged results, continue with the following steps.

10. Click on the `GET` handler of the `employeesfeed/` resource template.

    Note that the Source Type of this handler is `Feed` and Pagination Size is `25`.

11. Change the pagination size to `7`, and click **Apply Changes**.

    The Source of the handler is just the following:

```
select empno, ename from emp
                   order by deptno, ename
```

As you can see, the query is much simpler than the previous example; however, if you click **Test**, you will see a result that is very similar to the result produced by the previous example.

- The `Feed` Source Type is an enhanced version of the `Query` Source Type that automatically assumes the first column in a result set should be turned into a hyperlink, eliminating the need to alias columns with a name starting with `$`. In this example, the `empno` column is automatically transformed into a hyperlink by the `Feed` Source Type.
- This example demonstrates the ability of Oracle REST Data Services to automatically paginate result sets if a Pagination Size of greater than zero is defined, and the query does *not* explicitly dereference the `:row_offset` or `:row_count` bind parameters. Because both these conditions hold true for this example, Oracle REST Data Services enhances the query, wrapping it in clauses to count and constrain the number and offset of rows returned. Note that this ability to automatically paginate results also applies to the `Query` Source Type.

See Also:

json_ref

3.3 Configuring Secure Access to RESTful Services

This section describes how to configure secure access to RESTful Services

RESTful APIs consist of resources, each resource having a unique URI. A set of resources can be protected by a privilege. A privilege defines the set of roles, at least one of which an authenticated user must possess to access a resource protected by a privilege.

Configuring a resource to be protected by a particular privilege requires creating a privilege mapping. A privilege mapping defines a set of patterns that identifies the resources that a privilege protects.

Topics:

3.3.1 Authentication

Users can be authenticated through first party cookie-based authentication or third party OAuth 2.0-based authentication

Topics:

3.3.1.1 First Party Cookie-Based Authentication

A first party is the author of a RESTful API. A first party application is a web application deployed on the same web origin as the RESTful API. A first party application is able to authenticate and authorize itself to the RESTful API using the same cookie session that the web application is using. The first party application has full access to the RESTful API.

3.3.1.2 Third Party OAuth 2.0-Based Authentication

A third party is any party other than the author of a RESTful API. A third party application cannot be trusted in the same way as a first party application; therefore, there must be a mediated means to selectively grant the third party application limited access to the RESTful API.

The OAuth 2.0 protocol defines flows to provide conditional and limited access to a RESTful API. In short, the third party application must first be registered with the first party, and then the first party (or an end user of the first party RESTful service) approves the third party application for limited access to the RESTful API, by issuing the third party application a short-lived access token.

See Also:

`https://tools.ietf.org/html/rfc6749`

3.3.1.2.1 Two-Legged and Three-Legged OAuth Flows

Some flows in OAuth are defined as two-legged and others as three-legged.

Two-legged OAuth flows involve two parties: the party calling the RESTful API (the third party application), and the party providing the RESTful API. Two-legged flows are used in server to server interactions where an end user does not need to approve access to the RESTful API. In OAuth 2.0 this flow is called the client credentials flow. It is most typically used in business to business scenarios.

Three-legged OAuth flows involve three parties: the party calling the RESTful API, the party providing the RESTful API, and an end user party that owns or manages the data to which the RESTful API provides access. Three-legged flows are used in client to server interactions where an end user must approve access to the RESTful API. In OAuth 2.0 the authorization code flow and the implicit flow are three-legged flows. These flows are typically used in business to consumer scenarios.

For resources protected by three-legged flows, when an OAuth client is registering with a RESTful API, it can safely indicate the protected resources that it requires access to, and the end user has the final approval decision about whether to grant the client access. However for resources protected by two-legged flows, the owner of the RESTful API must approve which resources each client is authorized to access.

3.3.2 About Privileges for Accessing Resources

A privilege for accessing resources consists of the following data:

- Name: The unique identifier for the Privilege. This value is required.
- Label: The name of the privilege presented to an end user when the user is being asked to approve access to a privilege when using OAuth. This value is required if the privilege is used with a three-legged OAuth flow.
- Description: A description of the purpose of the privilege. It is also presented to the end user when the user is being asked to approve access to a privilege. This value is required if the privilege is used with a three-legged OAuth flow.
- Roles: A set of role names associated with the privilege. An authenticated party must have at least one of the specified roles in order to be authorised to access resources protected by the privilege. A value is required, although it may be an empty set, which indicates that a user must be authenticated but that no specific role is required to access the privilege.

For two-legged OAuth flows, the third party application (called a *client* in OAuth terminology) must possess at least one of the required roles.

For three-legged OAuth flows, the end user that approves the access request from the third party application must possess at least one of the required roles.

Related Topics:

- Two-Legged and Three-Legged OAuth Flows (page 3-59)

3.3.3 About Users and Roles for Accessing Resources

A privilege enumerates a set of roles, and users can possess roles. but where are these Roles defined? What about the users that possess these roles? Where are they defined?

A privilege enumerates a set of roles, and users can possess roles. Oracle REST Data Services delegates the task of user management to the application server on which Oracle REST Data Services is deployed. Oracle REST Data Services is able to authenticate users defined and managed by the application server and to identify the roles and groups to which the authenticated user belongs. It is the responsibility of the party deploying Oracle REST Data Services on an application server to also configure the user repository on the application server.

Because an application server can be configured in many ways to define a user repository or integrate with an existing user repository, this document cannot describe how to configure a user repository in an application server. See the application server documentation for detailed information.

3.3.4 About the File-Based User Repository

Oracle REST Data Services provides a a simple file-based user repository mechanism. However, this user repository is only intended for the purposes of demonstration and testing, and is not supported for production use.

See the command-line help for the user command for more information on how to create a user in this repository:

```
java -jar ords.war help user
```

Format:

```
java -jar ords.war user <user> <roles>
```

Arguments:

- `<user>` is the user ID of the user.
- `<roles>` is the list of roles (zero or more) that the user has.

Related Topics:

- Tutorial: Protecting and Accessing Resources (page 3-61)

3.3.5 Tutorial: Protecting and Accessing Resources

This tutorial demonstrates creating a privilege to protect a set of resources, and accessing the protected resource with the following OAuth features:

- Client credentials
- Authorization code
- Implicit flow

It also demonstrates access the resource using first-party cookie-based authentication.

Topics:

- OAuth Flows and When to Use Each (page 3-61)
- Assumptions for This Tutorial (page 3-62)
- Steps for This Tutorial (page 3-62)

3.3.5.1 OAuth Flows and When to Use Each

This topic explains when to use various OAuth flow features.

Use *first party cookie-based authentication* when accessing a RESTful API from a web application hosted on the same origin as the RESTful API.

Use the *authorization code* flow when you need to permit third party web applications to access a RESTful API and the third party application has its own web server where it can keep its client credentials secure. This is the typical situation for most web applications, and it provides the most security and best user experience, because the third party application can use refresh tokens to extend the life of a user session without having to prompt the user to reauthorize the application.

Use the *implicit flow* when the third party application does not have a web server where it can keep its credentials secure. This flow is useful for third party single-page-based applications. Because refresh tokens cannot be issued in the Implicit flow, the user will be prompted more frequently to authorize the application.

Native mobile or desktop applications should use the authorization code or implicit flows. They will need to display the sign in and authorization prompts in a web browser view, and capture the access token from the web browser view at the end of the authorization process.

Use the *client credentials* flow when you need to give a third party application direct access to a RESTful API without requiring a user to approve access to the data managed by the RESTful API. The third party application must be a server-based application that can keep its credentials secret. The client credentials flow *must not* be used with a native application, because the client credentials can *always* be discovered in the native executable.

3.3.5.2 Assumptions for This Tutorial

This tutorial assumes the following:

- Oracle REST Data Services is deployed at the following URL: `https://example.com/ords/`
- A database schema named ORDSTEST has been enabled for use with Oracle REST Data Services, and its RESTful APIs are exposed under: `https://example.com/ords/ordstest/`
- The ORDSTEST schema contains a database table named EMP, which was created as follows:

```
create table emp (
  empno    number(4,0),
  ename    varchar2(10 byte),
  job      varchar2(9 byte),
  mgr      number(4,0),
  hiredate date,
  sal      number(7,2),
  comm     number(7,2),
  deptno   number(2,0),
  constraint pk_emp primary key (empno)
  );
```

- The resources to be protected are located under: `https://example.com/ords/ordstest/examples/employees/`

3.3.5.3 Steps for This Tutorial

Follow these steps to protect and access a set of resources.

1. **Enable the schema**. Connect to the ORDSTEST schema and execute the following PL/SQL statements;

```
begin
  ords.enable_schema;
  commit;
end;
```

2. **Create a resource.** Connect to the ORDSTEST schema and execute the following PL/SQL statements:

```
begin
ords.create_service(
      p_module_name => 'examples.employees' ,
      p_base_path  => '/examples/employees/',
      p_pattern =>  '.' ,
      p_items_per_page => 7,
      p_source  =>  'select * from emp order by empno desc');
commit;
end;
```

   The preceding code creates the `/examples/employees/` resource, which you will protect with a privilege in a later step.

   You can verify the resource by executing following cURL command:

```
curl -i https://example.com/ords/ordstest/examples/employees/
```

   The result should be similar to the following (edited for readability):

```
Content-Type: application/json
Transfer-Encoding: chunked

{
 "items":
   [
    {"empno":7934,"ename":"MILLER","job":"CLERK","mgr":
7782,"hiredate":"1982-01-23T00:00:00Z","sal":1300,"comm":null,"deptno":10},
    ...
   ],
 "hasMore":true,
 "limit":7,
 "offset":0,
 "count":7,
 "links":
   [
    {"rel":"self","href":"https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"describedby","href":"https://example.com/ords/ordstest/metadata-
catalog/examples/employees/"},
    {"rel":"first","href":"https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"next","href":"https://example.com/ords/ordstest/examples/employees/?
offset=7"}
   ]
}
```

3. **Create a privilege.** While connected to the ORDSTEST schema, execute the following PL/SQL statements:

```
begin
  ords.create_role('HR Administrator');

  ords.create_privilege(
      p_name => 'example.employees',
      p_role_name => 'HR Administrator',
      p_label => 'Employee Data',
      p_description => 'Provide access to employee HR data');
  commit;
end;
```

The preceding code creates a role and a privilege, which belong to the ORDSTEST schema.

- The role name must be unique and must contain printable characters only.
- The privilege name must be unique and must conform to the syntax specified by the OAuth 2.0 specification, section 3.3 for scope names.
- Because you will want to use this privilege with the three-legged authorization code and implicit flows, you must provide a label and a description for the privilege. The label and description are presented to the end user during the approval phase of three-legged flows.
- The values should be plain text identifying the name and purpose of the privilege.

You can verify that the privilege was created correctly by querying the USER_ORDS_PRIVILEGES view.

```
select id,name from user_ords_privileges where name = 'example.employees';
```

The result should be similar to the following:

```
ID
NAME



----- -----------------
10260 example.employees
```

The ID value will vary from database to database, but the NAME value should be as shown.

4. **Associate the privilege with resources.** While connected to the ORDSTEST schema, execute the following PL/SQL statements:

```
begin
 ords.create_privilege_mapping(
      p_privilege_name => 'example.employees',
      p_pattern => '/examples/employees/*');
  commit;
end;
```

The preceding code associates the `example.employees` privilege with the resource pattern `/examples/employees/`.

You can verify that the privilege was created correctly by querying the USER_ORDS_PRIVILEGE_MAPPINGS view.

```
select privilege_id, name, pattern from user_ords_privilege_mappings;
```

The result should be similar to the following:

```
PRIVILEGE_ID NAME                 PATTERN
------------ -------------------- ---------------------
10260        example.employees    /examples/employees/*
```

The PRIVILEGE_ID value will vary from database to database, but the NAME and PATTERN values should be as shown.

You can confirm that the `/examples/employees/` resource is now protected by the `example.employees` privilege by executing the following cURL command:

```
curl -i https://example.com/ords/ordstest/examples/employees/
```

The result should be similar to the following (reformatted for readability):

```
HTTP/1.1 401 Unauthorized
Content-Type: text/html
Transfer-Encoding: chunked

<!DOCTYPE html>
<html>
...
</html>
```

You can confirm that the protected resource can be accessed through first party authentication, as follows.

a. **Create an end user.** Create a test user with the HR Administrator role, required to access the `examples.employees` privilege using the file-based user repository. Execute the following command at a command prompt

   ```
   java -jar ords.war user "hr_admin" "HR Administrator"
   ```

   When prompted for the password, enter and confirm it.

b. **Sign in as the end user.** Enter the following URL in a web browser:

   ```
   https://example.com/ords/ordstest/examples/employees/
   ```

   On the page indicating that access is denied, click the link to sign in.

   Enter the credentials registered for the HR_ADMIN user, and click Sign In.

   Confirm that the page redirects to `https://example.com/ords/ordstest/examples/employees/` and that the JSON document is displayed.

5. **Register the OAuth client.** While connected to the ORDSTEST schema, execute the following PL/SQL statements:

```
begin
 oauth.create_client(
      p_name => 'Client Credentials Example',
      p_grant_type => 'client_credentials',
      p_privilege_names => 'example.employees',
      p_support_email => 'support@example.com');
 commit;
end;
```

The preceding code registers a client named `Client Credentials Example`, to access the `examples.employees` privilege using the client credentials OAuth flow.

You can verify that the client was registered and has requested access to the `examples.employees` privilege by executing the following SQL statement:

```
select client_id,client_secret from user_ords_clients where name = 'Client
Credentials Example';
```

The result should be similar to the following:

```
CLIENT_ID                        CLIENT_SECRET
-------------------------------- ------------------------
o_CZBVkEMN23tTB-IddQsQ..         4BJXceufbmTki-vruYNLIg..
```

The CLIENT_ID and CLIENT_SECRET values represent the secret credentials for the OAuth client. These values must be noted and kept secure. You can think of them as the userid and password for the client application.

6. **Grant the OAuth client a required role.** While connected to the ORDSTEST schema, execute the following PL/SQL statements:

   ```
   begin
    oauth.grant_client_role(
        'Client Credentials Example',
        'HR Administrator');
    commit;
   end;
   ```

   The preceding code registers a client named `Client Credentials Example`, to access the `examples.employees` privilege using the client credentials OAuth flow.

   You can verify that the client was granted the role by executing the following SQL statement:

   ```
   select * from user_ords_client_roles where client_name = 'Client Credentials
   Example';
   ```

   The result should be similar to the following:

   ```
    CLIENT_ID CLIENT_NAME                 ROLE_ID   ROLE_NAME
   ---------- --------------------------- --------  ----------------------
        10286 Client Credentials Example    10222   HR Administrator
   ```

7. **Obtain an OAuth access token using client credentials.**

   The OAuth protocol specifies the HTTP request that must be used to create an access token using the client credentials flow[rfc6749-4.4.].

   The request must be made to a well known URL, called the token endpoint. For Oracle REST Data Services the path of the token endpoint is always oauth/token, relative to the root path of the schema being accessed. The token endpoint for this example is:

   ```
   https://example.com/ords/ordstest/oauth/token
   ```

   Execute the following cURL command:

   ```
   curl -i --user clientId:clientSecret --data "grant_type=client_credentials"
   https://example.com/ords/ordstest/oauth/token
   ```

   In the preceding command, replace `clientId` with the CLIENT_ID value in USER_ORDS_CLIENTS for `Client Credentials Example`, and replace `clientSecret` with the CLIENT_SECRET value shown in USER_ORDS_CLIENTS for `Client Credentials Example`. The output should be similar to the following:

   ```
   HTTP/1.1 200 OK
   Content-Type: application/json

   {
    "access_token": "2YotnFZFEjr1zCsicMWpAA",
    "token_type":   "bearer",
    "expires_in":3600
   }
   ```

In the preceding output, the access token is of type `bearer`, and the value is specified by the `access_token` field. This value will be different for every request. The `expires_in` value indicates the number of seconds until the access token expires; in this case the token will expire in one hour (3600 seconds).

8. **Access a protected resource using the access token.** Execute the following cURL command:

```
curl -i -H"Authorization: Bearer accessToken" https://example.com/ords/ordstest/
examples/employees/
```

In the preceding command, replace `accessToken` with the value of the `access_token` field shown in the preceding step. The output should be similar to the following:

```
Content-Type: application/json
Transfer-Encoding: chunked

{
 "items":
   [
    {"empno":7934,"ename":"MILLER","job":"CLERK","mgr":
7782,"hiredate":"1982-01-23T00:00:00Z","sal":1300,"comm":null,"deptno":10},
    ...
   ],
 "hasMore":true,
 "limit":7,
 "offset":0,
 "count":7,
 "links":
   [
    {"rel":"self","href":"https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"describedby","href":"https://example.com/ords/ordstest/metadata-
catalog/examples/employees/"},
    {"rel":"first","href":"https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"next","href":"https://example.com/ords/ordstest/examples/employees/?
offset=7"}
   ]
}
```

9. **Register the client for authorization code.** While connected to the ORDSTEST schema, execute the following PL/SQL statements:

```
begin
 oauth.create_client(
    p_name => 'Authorization Code Example',
    p_grant_type => 'authorization_code',
    p_owner => 'Example Inc.',
    p_description => 'Sample for demonstrating Authorization Code Flow',
    p_redirect_uri => 'http://example.org/auth/code/example/',
    p_support_email => 'support@example.org',
    p_support_uri => 'http://example.org/support',
    p_privilege_names => 'example.employees'
    );
 commit;
end;
```

The preceding code registers a client named `Authorization Code Example`, to access the `examples.employees` privilege using the authorization code OAuth flow. For an actual application, a URI must be provided to redirect back to with the authorization code, and a valid support email address must be supplied; however, this example uses fictitious data and the sample `example.org` web service.

You can verify that the client is now registered and has requested access to the `examples.employees` privilege by executing the following SQL statement:

```
select id, client_id, client_secret from user_ords_clients where name =
'Authorization Code Example';
```

The result should be similar to the following:

```
        ID CLIENT_ID                        CLIENT_SECRET
---------- -------------------------------- --------------------------------
     10060 IGHso4BRgrBC3Jwg0Vx_YQ.. GefAsWv8FJdMSB30Eg6lKw..
```

To grant access to the privilege, an end user must approve access. The CLIENT_ID and CLIENT_SECRET values represent the secret credentials for the OAuth client. These values must be noted and kept secure. You can think of them as the userid and password for the client application.

10. **Obtain an OAuth access token using an authorization code.** This major step involves several substeps. (You must have already created the HR_ADMIN end user in a previous step.)

    a. **Obtain an OAuth authorization code.**

       The end user must be prompted (via a web page) to sign in and approve access to the third party application. The third party application initiates this process by directing the user to the OAuth Authorization Endpoint. For Oracle REST Data Services, the path of the authorization endpoint is always `oauth/auth`, relative to the root path of the schema being accessed. The token endpoint for this example is:

       ```
       https://example.com/ords/ordstest/oauth/auth
       ```

       The OAuth 2.0 protocol specifies that the Authorization request URI must include certain parameters in the query string:

       The `response_type` parameter must have a value of `code`.

       The `client_id` parameter must contain the value of the applications client identifier. This is the `client_id` value determined in a previous step.

       The `state` parameter must contain a unique unguessable value. This value serves two purposes: it provides a way for the client application to uniquely identify each authorization request (and therefore associate any application specific state with the value; think of the value as the application's own session identifier); and it provides a means for the client application to protect against Cross Site Request Forgery (CSRF) attacks. The `state` value will be returned in the redirect URI at the end of the authorization process. The client must confirm that the value belongs to an authorization request initiated by the application. If the client cannot validate the state value, then it should assume that the authorization request was initiated by an attacker and ignore the redirect.

       To initiate the Authorization request enter the following URL in a web browser:

       ```
       https://example.com/ords/ordstest/oauth/auth?
       response_type=code&client_id=cliendId&state=uniqueRandomValue
       ```

       In the preceding URI, replace `clientId` with the value of the CLIENT_ID column that was noted previously, and replace `uniqueRandromValue` with a unique unguessable value. The client application must remember this value and verify it against the `state` parameter returned as part of the redirect at the end of the authorization flow.

If the `client_id` is recognized, then a sign in prompt is displayed. Enter the credentials of the HR_ADMIN end user, and click Sign In; and on the next page click Approve to cause a redirect to redirect URI specified when the client was registered. The redirect URI will include the authorization code in the query string portion of the URI. It will also include the same `state` parameter value that the client provided at the start of the flow. The redirect URI will look like the following:

```
http://example.org/auth/code/example/?
code=D5doeTSIDgbxWiWkPl9UpA..&state=uniqueRandomValue
```

The client application must verify the value of the `state` parameter and then note the value of the `code` parameter, which will be used in to obtain an access token.

b. Obtain an OAuth access token.

After the third party application has an authorization code, it must exchange it for an access token. The third party application's server must make a HTTPS request to the Token Endpoint. You can mimic the server making this request by using a cURL command as in the following example:

```
curl --user clientId:clientSecret --data
"grant_type=authorization_code&code=authorizationCode" https://example.com/
ords/ordstest/oauth/token
```

In the preceding command, replace `clientId` with the value of the CLIENT_ID shown in USER_ORDS_CLIENTS for `Authorization Code Example`, replace `clientSecret` with the value of the CLIENT_SECRET shown in USER_ORDS_CLIENTS for `Authorization Code Example`, and replace `authorizationCode` with the value of the authorization code noted in a previous step (the value of the `code` parameter).

The result should be similar to the following:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
 "access_token": "psIGSSEXSBQyib0hozNEdw..",
 "token_type":   "bearer",
 "expires_in":3600,
 "refresh_token": "aRMg7AdWPuDvnieHucfV3g.."
}
```

In the preceding result, the access token is specified by the `access_token` field, and a refresh token is specified by the `refresh_token` field. This refresh token value can be used to extend the user session without requiring the user to reauthorize the third party application.

c. Access a protected resource using the access token.

After the third party application has obtained an OAuth access token, it can use that access token to access the protected `/examples/employees/` resource:

```
curl -i -H"Authorization: Bearer accessToken" https://example.com/ords/
ordstest/examples/employees/
```

In the preceding command, `accessToken` with the value of the `access_token` field shown in a previous step.

The result should be similar to the following:

```
Content-Type: application/json
Transfer-Encoding: chunked

{
 "items":
   [
    {"empno":7934,"ename":"MILLER","job":"CLERK","mgr":
7782,"hiredate":"1982-01-23T00:00:00Z","sal":1300,"comm":null,"deptno":10},
    ...
   ],
 "hasMore":true,
 "limit":7,
 "offset":0,
 "count":7,
 "links":
   [
    {"rel":"self","href":"https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"describedby","href":"https://example.com/ords/ordstest/metadata-
catalog/examples/employees/"},
    {"rel":"first","href":"https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"next","href":"https://example.com/ords/ordstest/examples/
employees/?offset=7"}
   ]
}
```

d. **Extend the session using a refresh token.**

At any time, the third party application can use the refresh token value to generate a new access token with a new lifetime. This enables the third party application to extend the user session at will. To do this, the third party application's server must make an HTTPS request to the Token Endpoint. You can mimic the server making this request by using a cURL command as in the following example:

```
curl --user clientId:clientSecret --data
“grant_type=refresh_token&refresh_token=refreshToken" https://example.com/
ords/ordstest/oauth/token
```

In the preceding command, replace `clientId` with the value of the CLIENT_ID shown in USER_ORDS_CLIENTS for `Client Credentials Client`, replace `clientSecret` with the value of the CLIENT_SECRET shown in USER_ORDS_CLIENTS for `Client Credentials Client`, and replace `refreshToken` with the value of `refresh_token` obtained in a previous step.

The result should be similar to the following:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
 "access_token":  "psIGSSEXSBQyib0hozNEdw..",
 "token_type":    "bearer",
 "refresh_token": "aRMg7AdWPuDvnieHucfV3g..",
 "expires_in":    3600
}
```

In the preceding result, the access token is specified by the `access_token` field, a new refresh token is specified by the `refresh_token` field. This refresh token value can be used to extend the user session without requiring the user to reauthorize the third party application. (Note that the previous access token and refresh token are now invalid; the new values must be used instead.)

11. **Register the client for implicit flow.** While connected to the ORDSTEST schema, execute the following PL/SQL statements:

```
begin
 oauth.create_client(
    p_name => 'Implicit Example',
    p_grant_type => 'implicit',
    p_owner => 'Example Inc.',
    p_description => 'Sample for demonstrating Implicit Flow',
    p_redirect_uri => 'http://example.org/implicit/example/',
    p_support_email => 'support@example.org',
    p_support_uri => 'http://example.org/support',
    p_privilege_names => 'example.employees'
    );
 commit;
end;
```

The preceding code registers a client named `Implicit Example` to access the `examples.employees` privilege using the implicit OAuth flow. For an actual application, a URI must be provided to redirect back to with the authorization code, and a valid support email address must be supplied; however, this example uses fictitious data and the sample `example.org` web service.

You can verify that the client is now registered and has requested access to the `examples.employees` privilege by executing the following SQL statement:

```
select id, client_id, client_secret from user_ords_clients where name =
'Implicit Example';
```

The result should be similar to the following:

```
        ID CLIENT_ID CLIENT_SECRET
---------- -------------------------------- --------------------------------
     10062 7Qz--bNJpFpv8qsfNQpS1A..
```

To grant access to the privilege, an end user must approve access.

12. **Obtain an OAuth access token using implicit flow.** (You must have already created the HR_ADMIN end user in a previous step.)

The end user must be prompted (via a web page) to sign in and approve access to the third party application. The third party application initiates this process by directing the user to the OAuth Authorization Endpoint. For Oracle REST Data Services, the path of the authorization endpoint is always `oauth/auth`, relative to the root path of the schema being accessed. The token endpoint for this example is:

```
https://example.com/ords/ordstest/oauth/auth
```

The OAuth 2.0 protocol specifies that the Authorization request URI must include certain parameters in the query string:

The `response_type` parameter must have a value of `token`.

The `client_id` parameter must contain the value of the applications client identifier. This is the `client_id` value determined in a previous step.

The `state` parameter must contain a unique unguessable value. This value serves two purposes: it provides a way for the client application to uniquely identify each authorization request (and therefore associate any application specific state with the value; think of the value as the application's own session identifier); and it provides a means for the client application to protect against Cross Site Request Forgery (CSRF) attacks. The `state` value will be returned in the redirect URI at the end of the authorization process. The client must confirm that the value belongs to an authorization request initiated by the application. If the client cannot validate the state value, then it should assume that the authorization request was initiated by an attacker and ignore the redirect.

To initiate the Authorization request enter the following URL in a web browser:

```
https://example.com/ords/ordstest/oauth/auth?
response_type=token&client_id=cliendId&state=uniqueRandomValue
```

In the preceding URI, replace `clientId` with the value of the CLIENT_ID column that was noted previously, and replace `uniqueRandromValue` with a unique unguessable value. The client application must remember this value and verify it against the `state` parameter returned as part of the redirect at the end of the authorization flow.

If the `client_id` is recognized, then a sign in prompt is displayed. Enter the credentials of the HR_ADMIN end user, and click Sign In; and on the next page click Approve to cause a redirect to redirect URI specified when the client was registered. The redirect URI will include the access token in the query string portion of the URI. It will also include the same `state` parameter value that the client provided at the start of the flow. The redirect URI will look like the following:

```
http://example.org/auth/code/example/
#access_token=D5doeTSIDgbxWiWkPl9UpA..&type=bearer&expires_in=3600&state=uniqueRa
ndomValue
```

The client application must verify the value of the `state` parameter and then note the value of the access token.

13. **Access a protected resource using an access token.** Execute the following cURL command:

```
curl -i -H "Authorization: Bearer accessToken" https://example.com/ords/ordstest/
examples/employees/
```

In the preceding command, replace `accessToken` with the value of the `access_token` field shown in the preceding step. The output should be similar to the following:

```
Content-Type: application/json
Transfer-Encoding: chunked

{
 "items":
   [
    {"empno":7934,"ename":"MILLER","job":"CLERK","mgr":
7782,"hiredate":"1982-01-23T00:00:00Z","sal":1300,"comm":null,"deptno":10},
    ...
   ],
 "hasMore":true,
 "limit":7,
 "offset":0,
 "count":7,
 "links":
   [
    {"rel":"self","href":"https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"describedby","href":"https://example.com/ords/ordstest/metadata-
catalog/examples/employees/"},
    {"rel":"first","href":"https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"next","href":"https://example.com/ords/ordstest/examples/employees/?
offset=7"}
   ]
}
```

Related Topics:

- Using the Oracle REST Data Services PL/SQL API (page 3-81)

3.4 About Oracle REST Data Services User Roles

Oracle REST Data Services defines a small number of predefined user roles:

- `RESTful Services` - This is the default role associated with a protected RESTful service.
- `OAuth2 Client Developer` - Users who want to register OAuth 2.0 applications must have this role.
- `SQL Developer` - Users who want to use Oracle SQL Developer to develop RESTful services must have this role.
- `SODA Developer` - This is the default role that is required to access the SODA REST API. For more information about this role, see *Oracle REST Data Services SODA for REST Developer's Guide*.
- `Listener Administrator` - Users who want to administrate an Oracle REST Data Services instance through Oracle SQL Developer must have this role. Typically, only users created through the `java -jar ords.war user` command will have this role.

  Because the `Listener Administrator` role enables a user to configure an Oracle REST Data Services instance, and therefore has the capability to affect all Application Express workspaces served through that instance, Application Express users are not permitted to acquire the `Listener Administrator` role.

Topics:

- About Oracle Application Express Users and Oracle REST Data Services Roles (page 3-73)
- Controlling RESTful Service Access with Roles (page 3-75)

3.4.1 About Oracle Application Express Users and Oracle REST Data Services Roles

By default, Oracle Application Express users do not have any of the Oracle REST Data Services predefined user roles. This means that, by default, Application Express users cannot:

- Invoke protected RESTful Services
- Register OAuth 2.0 applications

- Use Oracle SQL Developer to develop RESTful services.

This applies to all Application Express users, including Application Express developers and administrators. It is therefore important to remember to follow the steps below to add Application Express users to the appropriate user groups, so that they can successfully perform the above actions.

Topics:

- Granting Application Express Users Oracle REST Data Services Roles (page 3-74)
- Automatically Granting Application Express Users Oracle REST Data Services Roles (page 3-74)

3.4.1.1 Granting Application Express Users Oracle REST Data Services Roles

To give an Application Express User any of the roles above, the user must be added to the equivalent Application Express user group. For example, to give the `RESTEASY_ADMIN` user the `RESTful Services` role, follow these steps:

1. Log in to the `RESTEASY` workspace as a `RESTEASY_ADMIN`.
2. Navigate to **Administration** and then **Manage Users and Groups**.
3. Click the Edit icon to the left of the `RESTEASY_ADMIN` user.
4. For **User Groups**, select `RESTful Services`.
5. Click **Apply Changes**.

3.4.1.2 Automatically Granting Application Express Users Oracle REST Data Services Roles

Adding Application Express users to the appropriate user groups can be an easily overlooked step, or can become a repetitive task if there are many users to be managed.

To address these issues, you can configure Oracle REST Data Services to automatically grant Application Express users a predefined set of RESTful Service roles by modifying the `defaults.xml` configuration file.

In that file, Oracle REST Data Services defines three property settings to configure roles:

- `apex.security.user.roles` - A comma separated list of roles to grant ordinary users, that is, users who are not developers or administrators.
- `apex.security.developer.roles` - A comma separated list of roles to grant users who have the `Developer` account privilege. `Developers` also inherit any roles defined by the `apex.security.user.roles` setting.
- `apex.security.administrator.roles` - A comma separated list of roles to grant users who have the `Administrator` account privilege. `Administrators` also inherit any roles defined by the `apex.security.user.roles` and `apex.security.developer.roles` settings.

For example, to automatically give all users the `RESTful Services` privilege and all developers and administrators the `OAuth2 Client Developer` and `SQL Developer` roles, add the following to the `defaults.xml` configuration file:

```
<!-- Grant all Application Express Users the ability
        to invoke protected RESTful Services -->
<entry key="apex.security.user.roles">RESTful Services</entry>
<!-- Grant Application Express Developers and Administrators the ability
        to register OAuth 2.0 applications and use Oracle SQL Developer
        to define RESTful Services -->
<entry key="apex.security.developer.roles">
   OAuth2 Client Developer, SQL Developer</entry>
```

Oracle REST Data Services must be restarted after you make any changes to the `defaults.xml` configuration file.

3.4.2 Controlling RESTful Service Access with Roles

The built-in `RESTful Service` role is a useful default for identifying users permitted to access protected RESTful services.

However, it will often also be necessary to define finer-grained roles to limit the set of users who may access a specific RESTful service.

Topics:

- About Defining RESTful Service Roles (page 3-75)
- Associating Roles with RESTful Privileges (page 3-75)

3.4.2.1 About Defining RESTful Service Roles

A RESTful Service **role** is an Application Express user group. To create a user group to control access to the Gallery RESTful Service, follow these steps. (

1. Log in to the `RESTEASY` workspace as a workspace administrator.
2. Navigate to **Administration** and then **Manage Users and Groups**.
3. Click the **Groups** tab.
4. Click **Create User Group**.
5. For **Name**, enter `Gallery Users`.
6. Click **Create Group**.

3.4.2.2 Associating Roles with RESTful Privileges

After a user group has been created, it can be associated with a RESTful privilege. To associate the Gallery Users role with the `example.gallery` privilege, follow these steps.

1. Navigate to **SQL Workshop** and then **RESTful Services**.
2. In the Tasks section, click **RESTful Service Privileges**.
3. Click **Gallery Access**.
4. For **Assigned Groups**, select `Gallery Users`.
5. Click **Apply Changes**.

With these changes, users must have the Gallery Users role to be able to access the Gallery RESTful service.

See Also:

The steps here use the image gallery application in Development Tutorial: Creating an Image Gallery (page F-1) as an example.

3.5 Authenticating Against WebLogic Server and GlassFish User Repositories

Oracle REST Data Services can use APIs provided by WebLogic Server and GlassFish to verify credentials (username and password) and to retrieve the set of groups and roles that the user is a member of.

This section walks through creating a user in the built-in user repositories provided by WebLogic Server and GlassFish, and verifying the ability to authenticate against that user.

This document does not describe how to integrate WebLogic Server and GlassFish with the many popular user repository systems such as LDAP repositories, but Oracle REST Data Services can authenticate against such repositories after WebLogic Server or GlassFish has been correctly configured. See your application server documentation for more information on what user repositories are supported by the application server and how to configure access to these repositories.

Topics:

- Authenticating Against WebLogic Server (page 3-76)
- Authenticating Against GlassFish (page 3-78)

3.5.1 Authenticating Against WebLogic Server

Authenticating a user against WebLogic Server involves the following major steps:

1. Creating a WebLogic Server User (page 3-76)
2. Verifying the WebLogic Server User (page 3-77)

3.5.1.1 Creating a WebLogic Server User

To create a sample WebLogic Server user, follow these steps:

1. Start WebLogic Server if it is not already running
2. Access the WebLogic Server Administration Console (typically `http://server:7001/console`), enter your credentials.
3. In the navigation tree on the left, click the **Security Realms** node
4. If a security realm already exists, go to the next step. If a security realm does not exist, create one as follows:
   a. Click **New**.
   b. For **Name**, enter `Test-Realm`, then click **OK**.
   c. Click **Test-Realm**.

   d. Click the **Providers** tab.
   e. Click **New**, and enter the following information:

      Name: `test-authenticator`

      Type: `DefaultAuthenticator`
   f. Restart WebLogic Server if you are warned that a restart is necessary.
   g. Click **Test-Realm**.
5. Click the **Users and Groups** tab.
6. Click **New**, and enter the following information:
   - **Name**: `3rdparty_dev2`
   - **Password**: Enter and confirm the desired password for this user.
7. Click **OK**.
8. Click the **Groups** tab.
9. Click **New.**, and enter the following information:
   - **Name**: OAuth2 Client Developer (case sensitive)
10. Click **OK**.
11. Click the **Users** tab.
12. Click the **3rdparty_dev2** user.
13. Click the **Groups** tab.
14. In the **Chosen** list, add `OAuth2 Client Developer` .
15. Click **Save**.

You have created a user named `3rdparty_dev2` and made it a member of a group named `OAuth2 Client Developer`. This means the user will acquire the `OAuth2 Client Developer` role, and therefore will be authorized to register OAuth 2.0 applications.

Now verify that the user can be successfully authenticated.

3.5.1.2 Verifying the WebLogic Server User

To verify that the WebLogic Server user created can be successfully authenticated, follow these steps:

1. In your browser, go to a URI in the following format:

   ```
   https://server:port/ords/resteasy/ui/oauth2/clients/
   ```
2. Enter the credentials of the `3rdparty_dev2` user, and click **Sign In**.

The OAuth 2.0 Client Registration page should be displayed, with no applications listed. If this page is displayed, you have verified that authentication against the WebLogic Server user repository is working.

However, if the sign-on prompt is displayed again with the message `User is not authorized to access resource`, then you made mistake (probably misspelling the Group List value).

3.5.2 Authenticating Against GlassFish

Authenticating a user against GlassFish involves the following major steps:

1. Creating a GlassFish User (page 3-78)
2. Verifying the GlassFish User (page 3-78)

3.5.2.1 Creating a GlassFish User

To create a sample GlassFish user, follow these steps:

1. Start GlassFish if it is not already running
2. Access the GlassFish Administration Console (typically `http://server:4848`); and if you have configured a password, enter your credentials.
3. Navigate to the **Security Configuration** pages:
4. In the navigation tree on the left, expand the **Configurations** node, and then expand the following nodes: **server-config**, **Security**, **Realms**, **file**.
5. Click **Manage Users**.
6. Click **New**, and enter the following information:
   - **Name**: `3rdparty_dev2`
   - **Group List**: OAuth2 Client Developer (case sensitive)
   - **Password**: Enter and confirm the desired password for this user.
7. Click **OK**.

You have created a user named `3rdparty_dev2` and made it a member of a group named `OAuth2 Client Developer`. This means the user will acquire the `OAuth2 Client Developer` role, and therefore will be authorized to register OAuth 2.0 applications.

Now verify that the user can be successfully authenticated.

3.5.2.2 Verifying the GlassFish User

To verify that the WebLogic Server user created in Creating a GlassFish User (page 3-78) can be successfully authenticated, follow these steps:

1. In your browser, go to a URI in the following format:

   ```
   https://server:port/ords/resteasy/ui/oauth2/clients/
   ```
2. Enter the credentials of the `3rdparty_dev2` user, and click **Sign In**.

The OAuth 2.0 Client Registration page should be displayed, with no applications listed. If this page is displayed, you have verified that authentication against the WebLogic Server user repository is working.

However, if the sign-on prompt is displayed again with the message `User is not authorized to access resource`, then you made mistake (probably misspelling the Group List value).

3.6 Integrating with Existing Group/Role Models

The examples in other sections demonstrate configuring the built-in user repositories of WebLogic Server and GlassFish. In these situations you have full control over how user groups are named. If a user is a member of a group with the exact same (case sensitive) name as a role, then the user is considered to have that role.

However, when integrating with existing user repositories, RESTful service developers will often not have any control over the naming and organization of user groups in the user repository. In these situations a mechanism is needed to map from existing "physical" user groups defined in the user repository to the "logical" roles defined by Oracle REST Data Services and/or RESTful Services.

In Oracle REST Data Services, this group to role mapping is performed by configuring a configuration file named `role-mapping.xml`.

Topics:

- About `role-mapping.xml` (page 3-79)

3.6.1 About `role-mapping.xml`

`role-mapping.xml` is a Java XML Properties file where each property key defines a pattern that matches against a set of user groups, and each property value identifies the roles that the matched user group should be mapped to. It must be located in the same folder as the `defaults.xml` configuration file. The file must be manually created and edited.

Consider this example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
<properties>
 <entry key="webdevs">RESTful Services</entry>
</properties>
```

This role mapping is straightforward, stating that any user who is a member of a group named: `webdevs` is given the role `RESTful Services`, meaning that all members of the `webdevs` group can invoke `RESTful Services`.

A mapping can apply more than one role to a group. For example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
<properties>
 <entry key="webdevs">RESTful Services, SQL Developer</entry>
</properties>
```

This rule gives members of the `webdevs` group both the `RESTful Services` and `SQL Developer` roles.

Topics:

- Parameterizing Mapping Rules (page 3-80)
- Dereferencing Parameters (page 3-80)
- Indirect Mappings (page 3-80)

3.6.1.1 Parameterizing Mapping Rules

Having to explicitly map from each group to each role may not be scalable if the number of groups or roles is large. To address this concern, you can parameterize rules. Consider this example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
<properties>
 <entry key="{prefix}.webdevs">RESTful Services</entry>
</properties>
```

This example says that any group name that ends with `.webdevs` will be mapped to the `RESTful Services` role. For example, a group named: `HQ.webdevs` would match this rule, as would a group named: `EAST.webdevs`.

The syntax for specifying parameters in rules is the same as that used for URI Templates; the parameter name is delimited by curly braces (`{}`).

3.6.1.2 Dereferencing Parameters

Any parameter defined in the group rule can also be dereferenced in the role rule. Consider this example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
<properties>
 <entry key="cn={userid},ou={group},dc=MyDomain,dc=com">{group}</entry>
</properties>
```

This example maps the organizational unit component of an LDAP distinguished name to a role. It says that the organizational unit name maps directly to a role with same name. Note that it refers to a `{userid}` parameter but never actually uses it; in effect, it uses `{userid}` as a wildcard flag.

For example, the distinguished name `cn=jsmith,ou=Developers,dc=MyDomain,dc=com` will be mapped to the logical role named `Developers`.

3.6.1.3 Indirect Mappings

To accomplish the desired role mapping, it may sometimes be necessary to apply multiple intermediate rules. Consider this example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
<properties>
 <entry key="cn={userid},ou={group},dc=example,dc=com">{group}</entry>
 <entry key="{prefix},ou={group},dc=acquired,dc=com">{group}</entry>
 <entry key="Developers">RESTful Services, SQL Developer</entry>
</properties>
```

This example maps the organizational unit component of an LDAP distinguished name to some roles. Complicating matters is the fact that users can come from two different organizations, resulting in differing distinguishing name patterns.

- Users from `example.com` always have a single common name (CN) identifying their user id, followed by the organizational unit (OU) and the domain name (DC). For example: `cn=jsmith,ou=Developers,dc=example,dc=com`.
- Users from `acquired.com` have varying numbers of common name (CN) prefixes, but the organizational unit is the field you are interested in. For example: `cn=ProductDev,cn=abell,ou=Engineering,dc=acquired,dc=com`.
- Both organizations identify software engineers with `ou=Developers`.

You want to map engineers in both organizations to the `RESTful Services` and `SQL Developer` roles.

- The first rule maps engineers in the `example.com` organization to the intermediate `Developers` role.
- The second rule maps engineers in the `acquired.com` organization to the intermediate `Developers` role.
- The final rule maps from the intermediate `Developers` role to the `RESTful Services` and `SQL Developer` roles.

3.7 Using the Oracle REST Data Services PL/SQL API

Oracle REST Data Services has a PL/SQL API (application programming interface) that you can use as an alternative to the SQL Developer graphical interface for many operations. The available subprograms are included in the following PL/SQL packages:

- ORDS, documented in ORDS PL/SQL Package Reference (page 5-1)
- OAUTH, documented in OAUTH PL/SQL Package Reference (page 6-1)

To use the Oracle REST Data Services PL/SQL API, you must first:

- Install Oracle REST Data Services in the database that you will use to develop RESTful services.
- Enable one or more database schemas for REST access.

Topics:

- Creating a RESTful Service Using the PL/SQL API (page 3-81)
- Testing the RESTful Service (page 3-82)

Related Topics:

- Automatic Enabling of Schema Objects for REST Access (AutoREST) (page 3-6)

3.7.1 Creating a RESTful Service Using the PL/SQL API

You can create a RESTful service by connecting to a REST-enabled schema and using the ORDS.CREATE_SERVICE procedure.

The following example creates a simple "Hello-World"-type service:

```
begin
 ords.create_service(
      p_module_name => 'examples.routes' ,
      p_base_path   => '/examples/routes/',
      p_pattern     => 'greeting/:name',
      p_source => 'select ''Hello '' || :name || '' from '' ||
nvl(:whom,sys_context(''USERENV'',''CURRENT_USER'')) "greeting" from dual');
 commit;
end;
/
```

The preceding example does the following:

- Creates a resource module named examples.routes.
- Sets the base path (also known as the URI prefix) of the module to `/examples/routes/`.
- Creates a resource template in the module, with the route pattern `greeting/:name`.
- Creates a GET handler and sets its source as a SQL query that forms a short greeting:
  - `GET` is the default value for the `p_method` parameter, and it is used here because that parameter was omitted in this example.
  - `COLLECTION_FEED` is the default value for the `p_method` parameter, and it is used here because that parameter was omitted in this example
- An optional parameter named `whom` is specified.

Related Topics:

- ORDS.CREATE_SERVICE (page 5-1)

3.7.2 Testing the RESTful Service

To test the RESTful service that you created, start Oracle REST Data Services if it is not already started:

```
java -jar ords.war
```

Enter the URI of the service in a browser. The following example displays a "Hello" greeting to `Joe`, by default from the current user because no `whom` parameter is specified.:

```
http://localhost:8080/ords/ordstest/examples/routes/greeting/Joe
```

In this example:

- Oracle REST Data Services is running on localhost and listening on port 8080.
- Oracle REST Data Services is deployed at the context-path `/ords`.
- The RESTful service was created by a database schema named `ordstest`.
- Because the URL does not include the optional whom parameter, the :whom bind parameter is bound to the null value, which causes the query to use the value of the current database user (`sys_context(''USERENV'',''CURRENT_USER'')`) instead.

If you have a JSON viewing extension installed in your browser, you will see a result like the following:

```
{
 "items": [
  {
   "greeting": "Hello Joe from ORDSTEST"
  }
 ],
 "hasMore": false,
 "limit": 25,
 "offset": 0,
 "count": 1,
 "links": [
  {
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/examples/routes/greeting/"
  },
  {
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/examples/routes/
greeting/"
  },
  {
   "rel": "first",
   "href": "http://localhost:8080/ords/ordstest/examples/routes/greeting/Joe"
  }
 ]
}
```

The next example is like the preceding one, except the optional parameter `whom` is specified to indicate that the greeting is from `Jane`.

`http://localhost:8080/ords/ordstest/examples/routes/`**`greeting/Joe?whom=Jane`**

This time, the result will look like the following:

```
{
 "items": [
  {
   "greeting": "Hello Joe from Jane"
  }
 ],
 "hasMore": false,
 "limit": 25,
 "offset": 0,
 "count": 1,
 "links": [
  {
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/examples/routes/greeting/"
  },
  {
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/examples/routes/
greeting/"
  },
  {
   "rel": "first",
   "href": "http://localhost:8080/ords/ordstest/examples/routes/greeting/Joe"
  }
 ]
}
```

Notice that in this result, what follows "from" is `Jane` and not `ORDSTEST`, because the `:whom` bind parameter was bound to the `Jane` value.

3.8 About REST Enabled SQL Service

The REST Enabled SQL service is a HTTPS web service that provides access to the Oracle Database SQL Engine. You can POST SQL statements to the service. The service then runs the SQL statements against Oracle database and returns the result to the client in a JSON format.

Statically defined RESTful services use predefined SQL statements that are useful when you need a fixed and repeatable service. The REST Enabled SQL service enables you to define SQL statements dynamically and run them against the database without predefined SQL statements. This makes your data more accessible over REST.

A Typical Use Case: If your Oracle Database is in the Cloud and you wish to make it available through a REST API over HTTP(S).

Predefined REST APIs provide common operations such as returning the results of reports and providing an API for updating common tables in your database. There is a need for client developers to run their own queries or queries that can only be written at run time. In such cases, REST Enabled SQL service is useful.

Note:

If you have Oracle REST Data Services installed and if you do not have SQL*Net (JDBC, OCI) to establish Net connection to the Oracle Database, then REST Enabled SQL service provides an easy mechanism to query and run SQL, SQL*Plus, and SQLcl statements against the REST Enabled Oracle Database schema and makes your application available through REST.

Topics:

- REST Enabled SQL Service Terminology (page 3-84)
- Configuring REST Enabled SQL Service (page 3-85)
- About cURL and Testing REST Enabled SQL Service (page 3-85)
- Getting Started with REST Enabled SQL Service (page 3-87)

Related Topics:

- Supported SQL, SQL*Plus and SQLcl Statements (page D-1)

3.8.1 REST Enabled SQL Service Terminology

This section introduces some common terms that are used throughout this document.

- **REST Enabled SQL service**: A HTTPS web service that provides SQL access to the database. SQL statements can be posted to the service and the results are returned in a JSON format to the client.
- **HTTPS**: Hyper Text Transfer Protocol Secure (HTTPS) is the secure version of **HTTP**, the protocol over which data is sent between your browser and the website to which you are connected. The **'S'** at the end of HTTPS stands for **Secure**. It means all communications between your browser and ORDS are encrypted.
- **cURL**: cURL is a command line tool used to transfer data. It is free and open source software that can be downloaded from the following location: curl_haxx.

- **SQL*Net (or Net8)**: SQL*Net is the networking software of Oracle that enables remote data access between programs and the Oracle Database.

3.8.2 Configuring REST Enabled SQL Service

By default, the REST Enabled SQL service is turned off. To configure REST Enabled SQL service settings, see Configuring REST Enabled SQL Service Settings (page 2-5).

3.8.3 About cURL and Testing REST Enabled SQL Service

This section explains how to use cURL commands to test the REST Enabled SQL service.

The REST Enabled SQL service is accessible by using the HTTPS POST method. To test the REST Enabled SQL service, you can use the command-line tool named cURL. This powerful tool is available for most platforms, and enables you to test and control the data that is being sent to and received from a REST Enabled SQL service.

Example 3-11 Example cURL Command

Request: `curl -i -X POST --user ORDSTEST:ordstest --data-binary "select sysdate from dual" -H "Content-Type: application/sql" -k https://localhost:8088/ords/ordstest/_/sql`

Where:

- `-i` option displays the HTTP headers returned by the server.
- `-k` option allows cURL to proceed and operate even for server connections that are otherwise considered to be insecure.

Response:

```
HTTP/1.1 200 OK

Content-Type: application/json

X-Frame-Options: SAMEORIGIN

Transfer-Encoding: chunked



{

    "env":{

        "defaultTimeZone":"Europe/London"

    },

    "items":[

        {

            "statementId":1,

            "statementType":"query",
            "statementPos":{
                "startLine":1,
                "endLine":2
            },
            "statementText":"select sysdate from dual",
            "response":[

            ],
            "result":0,
            "resultSet":{
                "metadata":[
                    {
                        "columnName":"SYSDATE",
                        "jsonColumnName":"sysdate",
                        "columnTypeName":"DATE",
                        "precision":0,
                        "scale":0,
                        "isNullable":1
                    }
                ],
                "items":[
                    {
                        "sysdate":"2017-07-21T08:06:44Z"
                    }
                ],
                "hasMore":false,
                "limit":1500,
                "offset":0,
                "count":1
            }
        }
```

```
            ]
        }
```

3.8.4 Getting Started with REST Enabled SQL Service

The REST Enabled SQL service is provided only through HTTPS POST operation.

Topics:

- REST Enabling Oracle Database Schema (page 3-87)
- The HTTPS POST Authentication (page 3-87)
- HTTPS Post Request URL (page 3-88)

3.8.4.1 REST Enabling Oracle Database Schema

You must REST enable the Oracle database schema on which you want to use the REST Enabled SQL service. To REST enable the Oracle database schema, you can use SQL Developer or PL/SQL API.

The Following code snippet shows how to REST enable the Oracle database schema `ORDSTEST`:

```
SQL> CONNECT ORDSTEST/*****;
Connected
SQL> exec ords.enable_schema;
anonymous block completed
SQL> commit;
Commit complete.
SQL>
```

Related Topics:

- REST-Enable a Database Table (page H-1)
- Auto-Enabling Using the ORDS PL/SQL API (page 3-26)
  You can enable a PL/SQL object using the ORDS PL/SQL API.

3.8.4.2 The HTTPS POST Authentication

This section explains how to authenticate the schema on which you want to use the REST Enabled SQL service.

Before using the REST Enabled SQL service, you must authenticate against the Oracle Database schema on which you want to run the SQL statements.

Following are the different types of authentications available:

- **First Party Authentication (Basic Authentication)** : For this authentication, create a user in Oracle REST Data Services (ORDS) with the **SQL Developer** role. This ORDS user will be able to run SQL for any Oracle database schema that is REST enabled.
- **Schema Authentication**: For this authentication, use the Oracle database schema name in uppercase and the Oracle database schema password (for

example, HR and HRPassword). Such user will be able to run SQL for the specified schema.

3.8.4.3 HTTPS Post Request URL

This section shows the format or pattern used to access the REST Enabled SQL service.

If Oracle REST Data Services (ORDS) is running in a Java EE Application Server, then the REST Enabled SQL service is only accessible through HTTPS. If Oracle REST Data Services (ORDS) is running in standalone mode, then ORDS can be configured to use HTTPS. The examples in this document use this configuration.

The following example URL locates the REST Enabled SQL service for the specified schema alias:

Pattern: `https://<HOST>/ords/<SchemaAlias>/_/sql`

Example: `https://host/ords/ordstest/_/sql`

Where: Default port is 443

Content Type and Payload Data Type Supported

The HTTPS POST request comprises of the following:

- The Header Content-Type
  - `application/sql`: for SQL statements
  - `application/json`: for JSON documents
- Payload Data Type
  - **SQL**: SQL, PL/SQL, SQL*Plus, SQLcl statements
  - **JSON Document**: A JSON document with SQL statements and other options such as bind variables

Related Topics:

- HTTPS POST Request Examples for REST Enabled SQL Service (page C-1)
- Supported SQL, SQL*Plus and SQLcl Statements (page D-1)

4 NoSQL and Oracle REST Data Services

This chapter explains how to use Oracle REST Data Services to provide HTTP-based REST access to Oracle NoSQL Database (also referred to here as NoSQL) data and metadata.
See also some NoSQL example files included in the Oracle REST Data Services installation. For a short document about how to get started accessing NoSQL stores, double-click the file `examples/getting-started-nosql/index.html` under the location where you installed Oracle REST Data Services.

Topics:

- About NoSQL and Oracle REST Data Services (page 4-1)
- NoSQL Store Installation and Registration (page 4-4)
- Adding and Removing a NoSQL Store for Use with Oracle REST Data Services (page 4-5)
- NoSQL REST Services (page 4-6)

4.1 About NoSQL and Oracle REST Data Services

Oracle REST Data Services can provide HTTP-based REST service access to Oracle NoSQL Database, through operations on the NoSQL data and metadata.Data access consists of CRUD (create, read, update, delete) operations on NoSQL tables:

- Create: HTTP POST and PUT to provide services to create row data.
- Read: HTTP GET to provide key, partial key, and field range queries on row data, with directives for consistency and order.
- Update: HTTP PUT to provide services to update row data.
- Delete: HTTP DELETE to provide services to delete row data.

Metadata access consists of HTTP GET to provide services to read NoSQL metadata.

Topics:

- Technology Environment (page 4-1)
- Typical Oracle REST Data Services Input and Output (page 4-3)

4.1.1 Technology Environment

The key pieces in the technology environment for using Oracle REST Data Services with NoSQL are:

- REST services

  Direct web service calls to Oracle NoSQL Database, and marshall data returned into JSON format.

  Can be deployed using Oracle WebLogic Server, GlassFish, or Apache Tomcat.

- Oracle NoSQL Database (Release 3.2.5 or later)

  Provides full CRUD (create, read, update, delete) operations across single and master/replicated nodes.

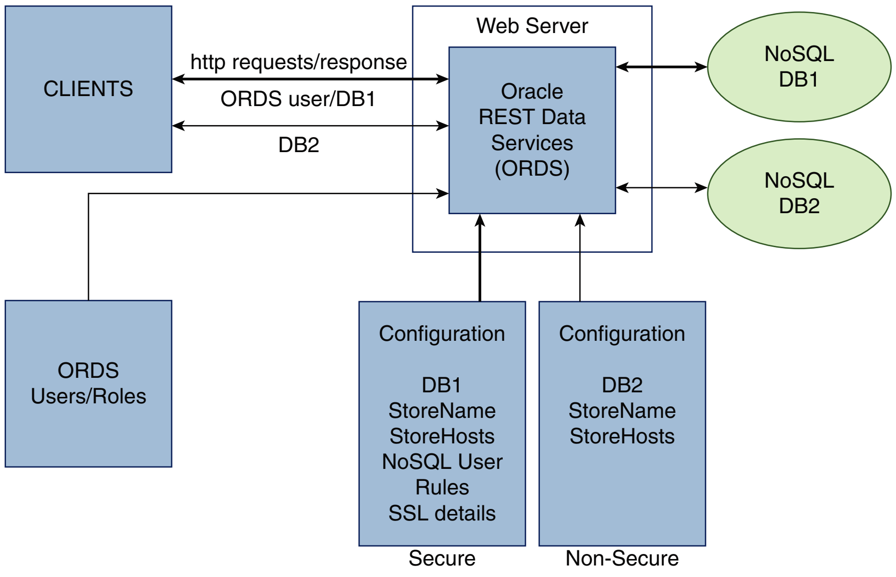
  Provides access through the Oracle NoSQL Database driver (.jar file).

The essential components of this environment are:

- A client, such as Java, JavaScript, or C++
- A web application server, such as standalone (Jetty), Oracle WebLogic Server, GlassFish, Apache Tomcat
- Oracle REST Data Services: the HTTP-based REST service provider
- NoSQL servlets: Oracle REST Data Services components to provide CRUD operations on the NoSQL database
- Oracle NoSQL Database: distributed master/replica NoSQL database that is the target of the NoSQL servlets

Figure 4-1 (page 4-2) provides an overview of a typical environment for Oracle REST Data Services with NoSQL.

Figure 4-1 Overview of Typical Environment



In Figure 4-1 (page 4-2):

- Oracle REST Data Services is deployed in the web server.
- Clients submit HTTP requests to Oracle REST Data Services inside the web server, and receive responses. In this case the HTTP requests are targeting NoSQL stores DB1 and DB2.
- Oracle REST Data Services users and roles are used by Oracle REST Data Services.
- Two NoSQL stores (named DB1 and DB2) communicate with Oracle REST Data Services inside the web server.
- Configuration information for the two NoSQL stores is used by Oracle REST Data Services. The DB1 store is secure (includes the NoSQL user, roles, and SSL

details), and the DB2 store is non-secure. The configuration information was specified the stores were registered with Oracle REST Data Services.

4.1.2 Typical Oracle REST Data Services Input and Output

Example 4-1 (page 4-3) is a REST service request (input) to get metadata about tables from a NoSQL database.

Example 4-1 Getting Metadata from a NoSQL Database

```
http://localhost:8080/ords/sales/metadata-catalog/
```

In Example 4-1 (page 4-3):

- `http://localhost:8080/ords` is the URL for accessing the Oracle REST Data Services web application from the web server running on `localhost` with port 8080.
- `/sales` is the NoSQL database identifier. This identifier will map to a NoSQL configuration.
- `metadata-catalog/` is the component that services the metadata request.

Example 4-1 (page 4-3) might product output similar to the following in response:

```
{
 "items": [
     {
         "name": "complexUsers",
         "links": [
                {
                    "rel": "canonical",
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/complexUsers/",
                    "mediaType": "application/json"
                },
                {
                    "rel": "describes",
                    "href": "http://localhost:8080/ords/sales/tables/complexUsers/"
                }
         ]
     },
     {
         "name": "evolveUsers",
         "links": [

                {

                    "rel": "canonical",

                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/evolveUsers/",
                    "mediaType": "application/json"
                },
                {
                    "rel": "describes",
                    "href": "http://localhost:8080/ords/sales/tables/evolveUsers/"
   .
   .
   .
```

4.2 NoSQL Store Installation and Registration

To install and register a NoSQL store involves regarding the Oracle REST Data Services installation host as a NoSQL Client. Therefore, if the NoSQL store is secure, then the security properties file (`client.security`) and the SSL information file (`client.trust`) must be copied to the Oracle REST Data Services host's network. These files are generated when the NoSQL store is first established, as explained in the NoSQL documentation.

If the NoSQL store is secure, it must be accessed by a NoSQL user. NoSQL provide a Wallet (for Enterprise Editions) and a password file (for Community editions) to hold password information. The password file is not secure because it is plain text, so Oracle REST Data Services provides an alternative storage of passwords. Creating the Wallet is also described in the NoSQL documentation; and if the Wallet is used, it too must be copied into the Oracle REST Data Services host's network.

Each Oracle REST Data Services installation has a configuration directory, which includes a `nosql` directory for NoSQL store configurations. The nosql directory will have one directory for each NoSQL store, and each store-specific directory includes the following files:

```
client.security  (for Secure noSQL stores)
client.trust (for Secure NoSQL stores)
Wallet directory (Optional for NoSQL secure stores)
nosql.properties
```

The `nosql.properties` file includes the following:

```
oracle.dbtools.kv.store.name=<storename>
oracle.dbtools.kv.store.hosts=<comma separated set of HOSTS:PORTS>
[And optionally the following:]
oracle.dbtools.kv.store.pagelimit=<maximum number of items per page>
oracle.dbtools.kv.store.security.properties=client.security  (the name of the NoSQL
client.security file)
oracle.dbtools.kv.store.requiredRoles=<list of comma separated roles>
```

If `oracle.dbtools.kv.store.requiredRoles property` is not included in the `nosql.properties` file, then the REST service is authorized for anonymous users; otherwise access is granted to any user that has any of these roles.

The `client.security` file contains the SSL properties, and it also contains the following:

```
oracle.kv.auth.username=<NoSQL user used for ORDS to access the store>
```

The `client.security` file may also need to include the following:

- `oracle.kv.auth.wallet.dir=<wallet directory>` to specify the wallet directory, if a wallet is used
- `oracle.dbtools.kv.store.auth.pwd=<encrypted pwd>` to specify the password for the NoSQL user, if a password option is used

Note all path names in the `client.security` file must be specified with the full path.

The following examples show:

- A store accessed by Oracle REST Data Services anonymous users on the `localhost` port 5000 with name `kvstore` (a typical KVLite store).

```
ords/nosql/sales
     nosql.properties
          oracle.dbtools.kv.store.name=kvstore
          oracle.dbtools.kv.store.hosts=localhost:5000
```

- A store accessed by Oracle REST Data Services users with the role SALES on the `localhost` port 5000 with name `kvstore` (a typical KVLite store).

```
ords/nosql/sales
     nosql.properties
          oracle.dbtools.kv.store.name=kvstore
          oracle.dbtools.kv.store.hosts=localhost:5000
          oracle.dbtools.kv.store.requiredRoles=SALES
```

- A secure store on `xyz6160769` port 5000 accessed with user NOSQL_PUBLIC_USER and whose password is stored in a wallet. It can be accessed by anonymous Oracle REST Data Services users.

```
ords/nosql/sales
   nosql.properties
      oracle.dbtools.kv.store.name=mystore
      oracle.dbtools.kv.store.hosts=xyz6160769.example.com:5000
      oracle.dbtools.kv.store.security.properties=client.security
   client.security
      oracle.kv.ssl.trustStore=d:/nosqlconfs/ords/nosql/salesecure/client.trust
      oracle.kv.transport=ssl
      oracle.kv.ssl.protocols=TLSv1.2,TLSv1.1,TLSv1
      oracle.kv.ssl.hostnameVerifier=dnmatch(CN\=NoSQL)
      oracle.kv.auth.username=NOSQL_PUBLIC_USER
      oracle.kv.auth.wallet.dir=d:/nosqlconfs/ords/nosql/salesecure/wallet
   client.trust
   wallet (directory)
```

- A secure store on `xyz6160769` port 5000 accessed with user NOSQL_PUBLIC_USER and whose password is stored in the properties file (encoded) It can be accessed by anonymous Oracle REST Data Services users.

```
ords/nosql/sales
   nosql.properties
      oracle.dbtools.kv.store.name=mystore
      oracle.dbtools.kv.store.hosts=xyz6160769.example.com:5000
      oracle.dbtools.kv.store.security.properties=client.security
   client.security
      oracle.kv.ssl.trustStore=d:/nosqlconfs/ords/nosql/salesecure/client.trust
      oracle.kv.transport=ssl
      oracle.kv.ssl.protocols=TLSv1.2,TLSv1.1,TLSv1
      oracle.kv.ssl.hostnameVerifier=dnmatch(CN\=NoSQL)
      oracle.kv.auth.username=NOSQL_PUBLIC_USER
      oracle.dbtools.kv.store.auth.pwd=0571B5B831C9945D167D2510B5E6BB021B
   client.trust
```

Related Topics:

- Oracle NoSQL Database Administrator's Guide
- Installing Oracle REST Data Services (page 1-1)

4.3 Adding and Removing a NoSQL Store for Use with Oracle REST Data Services

To add a NoSQL store, use the `java` command with the `nosqladd` keyword.

Usage:

```
java -jar ords.war nosqladd [--secure] [--clientTrustFile] [--clientSecurityFile] [--
walletDir] [--password] [--user] [--pagelimit] <storeAlias> <storeName> <hostPorts>
<roles>
```

Options:

- `[--secure]` Flag indicating that the store is secure.
- `[--clientTrustFile]` Location of the client.trust file, which will be copied from this location into the NoSQL configuration area).
- `[--clientSecurityFile]` Location of the client.security file, which will be copied from this location, with potential updates, to the NoSQL configuration area.
- `[--walletDir]` Location of the wallet directory (folder), which will be copied from this location to the NoSQL configuration area.
- `[--password]` Password for the connection.
- `[--user]` User name for the connection.
- `[-- pagelimit]` Maximum number of items per page for this store.

Arguments:

- `<storeAlias>` Store alias.
- `<storeName>` Store name.
- `<hostPorts>` Host:Port values (comma-separated list).
- `<roles>` Roles (comma-separated list).

To remove (delete) a NoSQL store, use the `java` command with the `nosqldel` keyword.

Usage:

```
java -jar ords.war nosqldel <storeAlias>
```

Arguments:

- `<storeAlias>` Store alias.

4.4 NoSQL REST Services

A NoSQL request has the following format:

```
host:port/ords/<nosqlalias>/<nosqlservice>
```

Where:

- `<nosqlalias>` is the alias for the NoSQL store.
- `<nosqlservice>` is an appropriate string for the metadata, data, or DDL service being invoked.

Topics:

- Metadata Services (page 4-7)
- Data Services (page 4-10)
- DDL Services (page 4-15)

- Common Parameters (page 4-17)

4.4.1 Metadata Services

GET (Read Metadata) is the only NoSQL service available.

Topics:

- Read Metadata (GET) (page 4-7)

4.4.1.1 Read Metadata (GET)

The GET (Read Metadata) service has different `<nosqlservice>` formats and output, depending on whether the request is for metadata for all tables or a specified table.

- For all tables: `<nosqlservice>` = `metadata-catalog/`

  The JSON output is of the following format, which has links to each table's metadata and the first page of data. For example:

```
{

    "items": [
        {
            "name": "complexUsers",
            "links": [
                {
                    "rel": "canonical",
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/
complexUsers/",
                    "mediaType": "application/json"
                },
                {
                    "rel": "describes",
                    "href": "http://localhost:8080/ords/sales/tables/complexUsers/"
                }
            ]
        },
        {
            "name": "shardUsers",
            "links": [
                {
                              "rel": "canonical",
                              "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/
shardUsers/",
                    "mediaType": "application/json"
                },
                {
                             "rel": "describes",
                              "href": "http://localhost:8080/ords/sales/tables/shardUsers/"
                }
            ]
        },
        {
            "name": "simpleUsers",
            "links": [
                {
                              "rel": "canonical",
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/
simpleUsers/",
                    "mediaType": "application/json"
                },
                {
                    "rel": "describes",
                    "href": "http://localhost:8080/ords/sales/tables/simpleUsers/"
                }
            ]
        }
    ],
    "hasMore": false,
    "count": 3,
    "limit": 25,
    "offset": 0,
    "links": [
        {
            "href": "http://localhost:8080/ords/sales/metadata-catalog/",
            "rel": "self"
        }
    ]

}
```

- For a specified table: `<nosqlservice>` = `metadata-catalog/tables/<name>/` where `<name>` is the name of the table

  The JSON output is of the following format, with properties, keys, column details, child tables, and links. For example:

```
{
     "type": "TABLE",
     "name": "simpleUsers",
     "fullname": "simpleUsers",
     "description": null,
     "primarykey": [
     "userID"
          ],
     "shardkey": [
          "userID"
     ],
     "members": [
          {
               "name": "firstName",
               "type": "STRING",
               "description": null
          },
          {
               "name": "lastName",
               "type": "STRING",
               "description": null
          },
          {
               "name": "userID",
               "type": "INTEGER",
               "description": null
          }
          ],
          "indexes": [
               {
                    "name": "compoundIndex",
                    "description": null,
                    "indexfields": [
                         "lastName",
                         "firstName"
                    ]
               },
               {
                    "name": "simpleIndex",
                    "description": null,
                    "indexfields": [
                         "firstName"
                    ]
               }
          ],
          "childtables": [ ],
          "links": [
              {               "rel": "collection",               "href": "http://localhost:8080/
ords/sales/metadata-catalog/"              },
               {
                   "rel": "canonical",
                   "href":        "http://localhost:8080/ords/sales/metadata-catalog/tables/
simpleUsers/",
                   "mediaType": "application/json"
               },
               {
                   "rel": "describes",
                   "href": "http://localhost:8080/ords/sales/tables/simpleUsers/"
               }
          ]
}
```

- For a specified table's items: `<nosqlservice> = metadata-catalog/tables/<name>/item` where `<name>` is the name of the table

  The JSON output is of the following format, with properties, keys, column details, child tables, and links. For example:

```
{
     "name": "simpleUsers",
     "fullname": "simpleUsers",
     "description": null,
     "primarykey": [
     "userID"
          ],
     "members": [
          {
               "name": "firstName",
               "type": "STRING",
               "description": null
          },
          {
               "name": "lastName",
               "type": "STRING",
               "description": null
          },
          {
               "name": "userID",
               "type": "INTEGER",
               "description": null
          }
          ],
          "links": [
               {
                 "rel": "collection",
                 "href": "http://localhost:8080/ords/sales/metadata-catalog/"
```

```
                },
                {
                    "rel": "canonical",
                    "href":        "http://localhost:8080/ords/sales/metadata-catalog/tables/
simpleUsers/item",
                    "mediaType": "application/json"
                }
            ]
}
```

4.4.2 Data Services

Services are available for reading, writing, and deleting NoSQL data.

Topics:

- Read Data (GET) (page 4-10)
- Idempotent Write (PUT) (page 4-14)
- Write (POST) (page 4-15)
- Delete (DELETE) (page 4-15)

4.4.2.1 Read Data (GET)

The GET (Read Data) service has different `<nosqlservice>` formats and output, depending on whether the request is for all data in a table or a subset of the data in a table.

- For all data in a table: `<nosqlservice> = tables/<name>/`

  The JSON output is of the following format. The data is returned in an unordered sequence, and it includes property pair values and links from the collection to show where it belongs and that it is editable. For example:

```
{
    "items": [
        {
            "$version": "rO0ABXcsAAQC5a2Fp3hHLajIZEw7k4elAAAAAAAAAQABAwAAAAEAAAABAAAAAAAEwTE.",
            "firstName": "Bob",
            "lastName": "Johnson",
            "userID": 109,
            "links": [
                {
                    "href": "http://localhost:8080/ords/sales/tables/simpleUsers/109",
                    "rel": "self"
                },
                {
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/simpleUsers/
item",
                    "rel": "describedby"
                }
            ]
        },
        {
            "$version": "rO0ABXcsAAQC5a2Fp3hHLajIZEw7k4elAAAAAAAAAKYBAwAAAAEAAAABAAAAAAAEZNg.",
            "firstName": "Alex",
            "lastName": "Robertson",
            "userID": 1,
            "links": [
                {
                    "href": "http://localhost:8080/ords/sales/tables/simpleUsers/1",
                    "rel": "self"
                },
                {
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/simpleUsers/
item",
                    "rel": "describedby"
                }
            ]
        },……..
   "accepts": [
        "application/json"
    ],
    "hasMore": false,
    "count": 6,
    "limit": 25,
    "offset": 0,
    "links": [
        {
            "href": "http://localhost:8080/ords/sales/tables/simpleUsers/",
            "rel": "edit",
            "targetSchema": "application/json"
        },
        {
            "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/simpleUsers/",
            "rel": "describedby"
        },
        {
            "href": "http://localhost:8080/ords/sales/tables/simpleUsers/",
            "rel": "self"
        }
    ] }
```

- For data in a table where keys are specified: `<nosqlservice> = tables/<name>/<keys>`

  `<name>` is the name of the table, and `<keys>` is a set of comma-separated index key values. The key values must be in the order of key definition. If not all key parts are specified, retrieval is based on partial keys. If the full key is specified, the output is a single item.

  The JSON output includes property pair values and links from the collection to show where it belongs. The following example shows JSON output when a *full key* is specified (`tables/shardUsers/Robertson,Alex`).

```
{
    "$version": "rO0ABXcsAAQC5a2Fp3hHLajIZEw7k4elAAAAAAAAAKYBAwAAAAEAAAABAAAAAAAEZNg.",
    "firstName": "Alex",
    "lastName": "Robertson",
    "userID": 1,
    "accepts": [
        "application/json"
    ],
    "links": [
        {
            "href": "http://localhost:8080/ords/sales/tables/simpleUsers/1",
            "rel": "self"
        },
        {
            "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/simpleUsers/item",
            "rel": "describedby"
        },
        {
            "href": "http://localhost:8080/ords/sales/tables/simpleUsers/1",
            "rel": "edit",
            "targetSchema": "application/json"
        },
        {
            "href": "http://localhost:8080/ords/sales/tables/simpleUsers/",
            "rel": "collection"
        }
    ] }
```

The following example shows JSON output where a *partial key* is specified (`tables/shardUsers/Robertson`).

```
{
    "items": [
        {
            "$version": "rO0ABXcsAAQC5a2Fp3hHLajIZEw7k4elAAAAAAAAAMIBAwAAAAEAAAABAAAAAAAEbLw.",
            "firstName": "Alex",
            "lastName": "Robertson",
            "email": "alero@email.com",
            "links": [
                {
                    "href": "http://localhost:8080/ords/sales/tables/shardUsers/Robertson,Alex",
                    "rel": "self"
                },
                {
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/shardUsers/
item",
                    "rel": "describedby"
                }
            ]
        },
        {
            "$version": "rO0ABXcsAAQC5a2Fp3hHLajIZEw7k4elAAAAAAAAAMQBAwAAAAEAAAABAAAAAAAEbSE.",
            "firstName": "Beatrix",
            "lastName": "Robertson",
            "email": "bero@email.com",
            "links": [
                {
                    "href": "http://localhost:8080/ords/sales/tables/shardUsers/
Robertson,Beatrix",
                    "rel": "self"
                },
                {
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/shardUsers/
item",
                    "rel": "describedby"
                }
            ]
        }
    ],
    "accepts": [
        "application/json"
    ],
    "hasMore": false,
    "count": 2,
    "limit": 25,
    "offset": 0,
    "links": [
        {
            "href": "http://localhost:8080/ords/sales/tables/shardUsers/",
            "rel": "edit",
            "targetSchema": "application/json"
        },
        {
            "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/shardUsers/",
            "rel": "describedby"
        },
        {
            "href": "http://localhost:8080/ords/sales/tables/shardUsers/",
            "rel": "up"
        },
        {
            "href": "http://localhost:8080/ords/sales/tables/shardUsers/Robertson",
            "rel": "self"
        }
    ] }
```

- For data in a table where an index and keys are specified: `<nosqlservice> = tables/<name>/index/<indexname>/<keys>`

  `<name>` is the name of the table, `<indexname>` is the name of the index, and `<keys>` is a set of comma-separated index key values. The key values must be in the order of key definition. If not all key parts are specified, retrieval is based on partial keys. If the full key is specified, the output is a single item.

  The JSON output includes property pair values and links from the collection to show where it belongs and that it is editable. For example:

```
{
    "items": [
        {
            "$version": "rO0ABXcsAAQC5a2Fp3hHLajIZEw7k4elAAAAAAAALIBAwAAAAEAAAABAAAAAAAEaIk.",
            "firstName": "Joel",
            "lastName": "Robertson",
            "userID": 3,
            "links": [
                {
                    "href": "http://localhost:8080/ords/sales/tables/simpleUsers/3",
                    "rel": "self"
                },
                {
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/simpleUsers/
item",
                    "rel": "describedby"
                }
            ]
        },
        {
            "$version": "rO0ABXcsAAQC5a2Fp3hHLajIZEw7k4elAAAAAAAAL4BAwAAAAEAAAABAAAAAAAEa4k.",
            "firstName": "Joel",
            "lastName": "Jones",
            "userID": 6,
            "links": [
                {
                    "href": "http://localhost:8080/ords/sales/tables/simpleUsers/6",
                    "rel": "self"
                },
                {
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/simpleUsers/
item",
                    "rel": "describedby"
                }
            ]
        }
    ],
    "hasMore": false,
    "count": 2,
    "limit": 25,
    "offset": 0,
    "links": [
        {
            "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/simpleUsers/",
            "rel": "describedby"
        },
        {
            "href": "http://localhost:8080/ords/sales/tables/simpleUsers/index/simpleIndex/Joel",
            "rel": "self"
        },
        {
            "href": "http://localhost:8080/ords/sales/tables/simpleUsers/",
            "rel": "collection"
        }
    ] }
```

4.4.2.2 Idempotent Write (PUT)

The PUT (Idempotent Write) service has different `<nosqlservice>` formats and output, depending on whether the operation is upsert, put if present, or put if version. ("Put if version" means that the PUT operation will succeed only if the latest version in the NoSQL database is the stated version. This prevents a client from overwriting a newer value with an older value.)

- For Upsert (update it present, create if not): `<nosqlservice> = tables/<name>/`

  The body of the request is JSON format of the form returned by the Read Data (GET) (page 4-10) operations, but without links. For example:

```
{ "userID": 108, "firstName": "Bob", "lastName": "Johnson"}
```

- For Put if Present: `<nosqlservice> = tables/<name>/<key>`

  `<name>` is the name of the table, and `<key>` is the primary key value of the new object.

  The body of the request is JSON format of the form returned by the Read Data (GET) (page 4-10) operations, but without links. For example:

```
{ "userID": 108, "firstName": "Bob", "lastName": "Johnson"}
```

  If the row is not present, the status 404 (NOT_FOUND) is returned.

- For Put if Present for a specified version: `<nosqlservice> = tables/<name>/<key>`

  `<name>` is the name of the table, `<key>` is the primary key value of the new object, and the header parameter `If-Match` specifies the value of the `$version` property on an item. If the version matches the one specified, then it is updated.

  The body of the request is JSON format of the form returned by the Read Data (GET) (page 4-10) operations, but without links. For example:

```
{ "userID": 108, "firstName": "Bob", "lastName": "Johnson"}
If-Match= rO0ABXcsAAQC5a2Fp3hHLajIZEw7k4elAAAAAAAAAL4BAwAAAAEAAAABAAAAAAAEa4k
```

If the row is not present, the status 404 (NOT_FOUND) is returned. If the row does not match the specified version, the status 412 (PRECONDITION_FAILED) is returned.

Related Topics:

- Read Data (GET) (page 4-10)

4.4.2.3 Write (POST)

The POST (Put if Absent) service has the following `<nosqlservice>` format:
`<nosqlservice> = tables/<name>/`

`<name>` is the name of the table.

The body of the request is JSON format of the form returned by the Read Data (GET) (page 4-10) operations, but without links. For example:

```
{ "userID": 108, "firstName": "Bob", "lastName": "Johnson"}
```

If the row is present, the status 400 ((BAD_REQUEST) This row already exists) is returned. If the row is absent, the status 201 (CREATED) is returned.

Related Topics:

- Read Data (GET) (page 4-10)

4.4.2.4 Delete (DELETE)

The DELETE (Delete) service can have an optional version identifier specified.

- For Delete with no version specified: `<nosqlservice> = tables/<name>/<keys>`

  `<name>` is the name of the table, and `<keys>` is the primary key value or set of comma--separated primary key values of the rows to be deleted. If not all key parts are specified, deletion is based on partial keys.

  If a specified row is present, the status 204 (NO_CONTENT) is returned. If a specified row is absent, the status 404 (NOT_FOUND) is returned.

- For Delete if the version and keys must result in only one object being returned (that is, the object is fully specified): `<nosqlservice> = tables/<name>/<keys>`

  `<name>` is the name of the table, `<keys>` is the primary key value or set of comma--separated primary key values of the rows to be deleted, and the header parameter `If-Match` specifies the value of the `$version` property on an item. If the version matches the one specified, then it is deleted. For example:

  ```
  If-Match= rO0ABXcsAAQC5a2Fp3hHLajIZEw7k4elAAAAAAAAAL4BAwAAAAEAAAABAAAAAAAEa4k
  ```

  If a specified row-version combination is present, the status 204 (NO_CONTENT) is returned. If a specified row is present but not for the specified version, the status 412 (PRECONDITION_FAILED) is returned. If a specified row is absent, the status 404(NOT_FOUND) is returned.

4.4.3 DDL Services

Services are available for manipulating NoSQL tables and indexes.

For table requests, the body of the request is a text format corresponding to that specified in *Getting Started with Oracle NoSQL Database Tables*, Appendix A ("Table Data Definition Language Overview").

Topics:

- Create/Update (POST) (page 4-16)
- Drop (POST) (page 4-16)
- Poll (GET) (page 4-17)

Related Topics:

- Getting Started with Oracle NoSQL Database Tables

4.4.3.1 Create/Update (POST)

For DDL create and update operations, the service has the following `<nosqlservice>` format: `<nosqlservice> = ddl/`

Example:

```
http://localhost:8080/ords/sales/ddl/
```

The body of the request contains the DDL to be executed on the NoSQL store. Examples of the body of the request:

```
CREATE TABLE IF NOT EXISTS myUsers (firstName STRING,lastName STRING,userID
INTEGER,PRIMARY KEY (userID))

CREATE INDEX IF NOT EXISTS myUser_index ON myUsers(lastName, firstName)

ALTER TABLE myUsers(ADD newcolumn STRING)
```

If the operation succeeds, a status of OK is returned, along with a `Location` header variable giving the location of the new resource. For example (creating an index):

```
Status: 200: OK
Headers:
Location: http://localhost:8080/ords/sales/metadata-catalog/tables/myUsers/index/
myUser_index
```

If the operation fails, an error code is returned.

If the operation does not complete within 1 second, a status of ACCEPTED is returned, along with a task ID so that you can send requests to see if it has finished. For example (creating an index):

```
Status: 202: Accepted
Headers:
Location: http://localhost:8080/ords/sales/ddl/tasks/16
```

4.4.3.2 Drop (POST)

For DDL drop operations, the service has the following `<nosqlservice>` format: `<nosqlservice> = ddl/`

Example:

```
http://localhost:8080/ords/sales/ddl/
```

The body of the request contains the DDL to be executed on the NoSQL store. Examples of the body of the request:

```
DROP INDEX IF EXISTS myUser_index ON myUsers
```

```
DROP TABLE IF EXISTS myUsers
```

If the operation succeeds, a status of NO_CONTENT is returned.

If the operation fails, an error code is returned.

If the operation does not complete within 1 second, a status of ACCEPTED is returned, along with a task ID so that you can send requests to see if it has finished. For example (dropping a table):

```
Status: 202: Accepted
Headers:
Location: http://localhost:8080/ords/sales/ddl/tasks/17
```

4.4.3.3 Poll (GET)

The Poll service has the following `<nosqlservice>` format: `<nosqlservice> = ddl/tasks/<id>`

Example:

```
http://localhost:8080/ords/sales/ddl/tasks/17
```

If the operation succeeds, a status of OK is returned, and the `Location` header can provide additional information.

If the `Location` header is the same as the URL request (for example, `http://localhost:8080/ords/sales/ddl/tasks/17`), then the task is still ongoing.

If the `Location` header is blank or null, then the task has finished and this task was a drop operation, so there is no new location.

If the `Location` header is not blank and is not the same as the URL request, then it is the location of the new or updated resource.

4.4.4 Common Parameters

Several groups of parameters can be used for with multiple operations and for specific desired results.

Topics:

4.4.4.1 Parameters to Skip Results and Limit the Number of Results

In GET operations, you can specify a limit and an offset by using `?limit={limit}&offset={offset}`. For example:

```
<nosqlservice> = metadata-catalog/?limit=2&offset=1
```

The preceding example returns two objects per page, starting with the second object (that is, skipping the first one). The JSON output might be as follows:

```
{
   "items": [
      {
         "name": "evolveUsers",
           "links": [
                {
                    "rel": "canonical",
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/evolveUsers/",
                    "mediaType": "application/json"
                },
                {
                    "rel": "describes",
                    "href": "http://localhost:8080/ords/sales/tables/evolveUsers/"
                }
            ]
            },
            {
               "name": "shardUsers",
           "links": [
                {
                    "rel": "canonical",
                    "href": "http://localhost:8080/ords/sales/metadata-catalog/tables/shardUsers/",
                    "mediaType": "application/json"
                },
                {
                    "rel": "describes",
                    "href": "http://localhost:8080/ords/sales/tables/shardUsers/"
                }
            ]
            }
      ],
      "hasMore": false,
      "count": 2,
      "limit": 2,
      "offset": 1,
   "links": [
      {
         "href": "http://localhost:8080/ords/sales/metadata-catalog/",
         "rel": "self"
      },
      {
         "href": "http://localhost:8080/ords/sales/metadata-catalog/?limit=2",
         "rel": "prev"
      },
      {
         "href": "http://localhost:8080/ords/sales/metadata-catalog/?limit=2",
         "rel": "first"
      }
   ]
```

4.4.4.2 Parameters to Specify Query Conditions

You can limit rows retrieved by using field ranges, and you can specify the order of retrieval. The query structure for this is a simple list of ANDed pairs. For example:

```
?q={"firstName":{"$between":["A","C"]},"$direction":"reverse"}
```

Special characters must be escaped using URL encoding. For example:

```
http://localhost:8080/ords/sales/tables/simpleUsers/index/simpleIndex/?
q={"firstName":{"$between":%5B"A","C"%5D}}
```

4.4.4.3 Parameters to Specify Direction (Order), and Consistency and Durability Guarantees

You can specify values for the direction (order), consistency guarantees, and durability guarantees, overriding any related default values in the store.

- For direction (order), specify the `$direction` property with one of the values as follows:

  ```
  $direction = "forward" | "reverse" | "unordered"
  ```

  For direction (order), the default is `"forward"`.

  For *primary key* retrieval using a *partial or empty key*, only `"unordered"` is allowed, and any other value is ignored.

- For consistency guarantees, specify the `$consistency` property with appropriate values as follows (note that `<LONG>` means a long number):

  ```
  $consistency = <Absolute> | <None> | <Replica> | <Time> | <Version>
  <Absolute> = "absolute"
  <None> = "none"
  <Replica>  =  "replica"
  <Time> = <Lag> "," <Timeout>
  <Lag> = <LONG> "," <Units>
  <Timeout> = <LONG> "," <Units>
  <Units> = "nanoseconds" | "microseconds" | "milliseconds" | "seconds" |
  "minutes" | "hours" | "days"
  <version> = <version_id> "," <LONG> "," <Units>
  <version_id> = <version id of item as returned in GET>
  ```

  For example:

  ```
  http://localhost:8080/ords/sales/tables/shardUsers/Robertson,Beatrix?
  q={"$consistency":"time(3,seconds,2,minutes)"}
  ```

- For durability guarantees, specify a header called `NoSQL-Write-Option` with a value in the following format (note that `<LONG>` means a long number):

  ```
  <WriteOption> =  (<DurabilityPolicy> | <DurabilityGuarantees>)  ";"
  <WriteTimeOut>
  <DurabilityPolicy> = "Durability" "=" <DurabilityValue>
  <DurabilityValue> =  "COMMIT_NO_SYNC" | "COMMIT_SYNC" | "COMMIT_WRITE_NO_SYNC"
  <DurabilityGuarantees> =  <MasterSyncPolicy> ";"  <ReplcaSyncPolicy> ";"
  <ReplicaAckPolicy>
  <MasterSyncPolicy> = "MasterSync" "=" "NO_SYNC" | "SYNC" | "WRITE_NO_SYNC"
  <ReplicaSyncPolicy> = "ReplicaSync" "=" "NO_SYNC" | "SYNC" | "WRITE_NO_SYNC"
  <ReplicaAckPolicy> = "ReplicaAck" "=" "ALL" | "NONE" | "SIMPLE_MAJORITY"
  <WriteTimeOut> = "TimeOut" "=" <LONG> [ ;  "Units" "=" <Units>]
  ```

  For example, create a header `NoSQL-Write-Option` with the value:

  ```
  Durability = COMMIT_NO_SYNC; TimeOut = 3; Units = seconds
  ```

5
ORDS PL/SQL Package Reference

The ORDS PL/SQL package contains subprograms (procedures and functions) for developing RESTful services using Oracle REST Data Services.

Related Topics:

- Using the Oracle REST Data Services PL/SQL API (page 3-81)

5.1 ORDS.CREATE_ROLE

Format

```
ORDS.CREATE_ROLE(
   p_role_name IN sec_roles.name%type);
```

Description

CREATE_ROLE creates an Oracle REST Data Services role with the specified name.

Parameters

p_role_name
Name of the role.

Usage Notes

After the role is created, it can be associated with any Oracle REST Data Services privilege.

Examples

The following example creates a role.

```
EXECUTE ORDS.CREATE_ROLE(p_role_name=>'Tickets User');
```

5.2 ORDS.CREATE_SERVICE

Note:

ORDS.CREATE_SERVICE is deprecated. Use ORDS.DEFINE_SERVICE (page 5-11) instead.

Format

```
ORDS.CREATE_SERVICE(
   p_module_name        IN ords_modules.name%type,
   p_base_path          IN ords_modules.uri_prefix%type,
   p_pattern           IN ords_templates.uri_template%type,
   p_method            IN ords_handlers.method%type DEFAULT 'GET',
   p_source_type       IN ords_handlers.source_type%type
                              DEFAULT ords.source_type_collection_feed,
   p_source            IN ords_handlers.source%type,
   p_items_per_page    IN ords_modules.items_per_page%type DEFAULT 25,
   p_status            IN ords_modules.status%type DEFAULT 'PUBLISHED',
   p_etag_type         IN ords_templates.etag_type%type DEFAULT 'HASH',
   p_etag_query        IN ords_templates.etag_query%type DEFAULT NULL,
   p_mimes_allowed     IN ords_handlers.mimes_allowed%type DEFAULT NULL,
   p_module_comments   IN ords_modules.comments%type DEFAULT NULL,
   p_template_comments IN ords_modules.comments%type DEFAULT NULL,
   p_handler_comments  IN ords_modules.comments%type DEFAULT NULL);
```

Description

Creates a new RESTful service.

Parameters

p_module_name
The name of the RESTful service module. Case sensitive. Must be unique.

p_base_path
The base of the URI that is used to access this RESTful service. Example: `hr/` means that all URIs starting with `hr/` will be serviced by this resource module.

p_pattern
A matching pattern for the resource template. For example, a pattern of `/objects/:object/:id?` will match `/objects/emp/101` (matches a request for the item in the `emp` resource with `id` of 101) and will also match `/objects/emp/` (matches a request for the `emp` resource, because the `:id` parameter is annotated with the `?` or question mark modifier, which indicates that the `id` parameter is optional).

p_method
The HTTP method to which this handler will respond. Valid values: `GET` (retrieves a representation of a resource), `POST` (creates a new resource or adds a resource to a collection), `PUT` (updates an existing resource), `DELETE` (deletes an existing resource).

p_source_type
The HTTP request method for this handler. Valid values:

- `source_type_collection_feed`. Executes a SQL query and transforms the result set into an ORDS Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- `source_type_collection_item`. Executes a SQL query returning one row of data into a ORDS Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- `source_type_media`. Executes a SQL query conforming to a specific format and turns the result set into a binary representation with an accompanying HTTP Content-Type header identifying the Internet media type of the representation. Result Format: Binary
- `source_type_plsql`. Executes an anonymous PL/SQL block and transforms any OUT or IN/OUT parameters into a JSON representation. Available only when the HTTP method is DELETE, PUT, or POST. Result Format: JSON

- `source_type_query || source_type_csv_query`. Executes a SQL query and transforms the result set into either an ORDS legacy JavaScript Object Notation (JSON) or CSV representation, depending on the format selected. Available when the HTTP method is GET. Result Format: JSON or CSV
- `source_type_query_one_row`. Executes a SQL query returning one row of data into an ORDS legacy JSON representation. Available when the HTTP method is GET. Result Format: JSON
- `source_type_feed`. Executes a SQL query and transforms the results into a JSON Feed representation. Each item in the feed contains a summary of a resource and a hyperlink to a full representation of the resource. The first column in each row in the result set must be a unique identifier for the row and is used to form a hyperlink of the form: `path/to/feed/{id}`, with the value of the first column being used as the value for `{id}`. The other columns in the row are assumed to summarize the resource and are included in the feed. A separate resource template for the full representation of the resource should also be defined. Result Format: JSON

p_source
The source implementation for the selected HTTP method.

p_items_per_page
The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database query. Default: NULL (defers to the resource module setting).

p_status
The publication status. Valid values: 'PUBLISHED' (default) or 'NOT_PUBLISHED'.

p_etag_type
A type of entity tag to be used by the resource template. An entity tag is an HTTP Header that acts as a version identifier for a resource. Use entity tag headers to avoid retrieving previously retrieved resources and to perform optimistic locking when updating resources. Valid values: 'HASH' or 'QUERY' or 'NONE'.

- HASH - Known as Secure HASH: The contents of the returned resource representation are hashed using a secure digest function to provide a unique fingerprint for a given resource version.
- QUERY - Manually define a query that uniquely identifies a resource version. A manually defined query can often generate an entity tag more efficiently than hashing the entire resource representation.
- NONE - Do not generate an entity tag.

p_etag_query
A query that is used to generate the entity tag.

p_mimes_allowed
A comma-separated list of MIME types that the handler will accept. Applies to PUT and POST only.

p_module_comments
Comment text.

p_template_comments
Comment text.

p_handler_comments
Comment text.

Usage Notes

Creates a resource module, template, and handler in one call.

This procedure is deprecated. Use ORDS.DEFINE_SERVICE (page 5-11) instead.

Examples

The following example creates a simple service.

```
BEGIN
  ORDS.CREATE_SERVICE(
    p_module_name => 'my.tickets',
    p_base_path => '/my/tickets/',
    p_pattern => '.',
    p_source => 'select t.id "$.id", t.id, t.title from tickets t' ||
                ' where t.owner = :current_user order by t.updated_on desc'
  );
END;
/
```

5.3 ORDS.DEFINE_HANDLER

Format

```
ORDS.DEFINE_HANDLER(
   p_module_name   IN ords_modules.name%type,
   p_pattern       IN ords_templates.uri_template%type,
   p_priority      IN ords_templates.priority%type DEFAULT 0,
   p_etag_type     IN ords_templates.etag_type%type DEFAULT 'HASH',
   p_etag_query    IN ords_templates.etag_query%type DEFAULT NULL,
   p_comments      IN ords_templates.comments%type DEFAULT NULL);
```

Description

DEFINE_HANDLER defines a module handler. If the handler already exists, then the handler and any existing handlers will be replaced by this definition; otherwise, a new handler is created.

Parameters

p_module_name
Name of the owning RESTful service module. Case sensitive.

p_pattern
Matching pattern for the owning resource template.

p_method
The HTTP method to which this handler will respond. Valid values: `GET` (retrieves a representation of a resource), `POST` (creates a new resource or adds a resource to a collection), `PUT` (updates an existing resource), `DELETE` (deletes an existing resource).

p_source_type
The HTTP request method for this handler. Valid values:

- `source_type_collection_feed`. Executes a SQL query and transforms the result set into an ORDS Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- `source_type_collection_item`. Executes a SQL query returning one row of data into a ORDS Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- `source_type_media`. Executes a SQL query conforming to a specific format and turns the result set into a binary representation with an accompanying HTTP Content-Type header identifying the Internet media type of the representation. Result Format: Binary
- `source_type_plsql`. Executes an anonymous PL/SQL block and transforms any OUT or IN/OUT parameters into a JSON representation. Available only when the HTTP method is DELETE, PUT, or POST. Result Format: JSON
- `source_type_query || source_type_csv_query`. Executes a SQL query and transforms the result set into either an ORDS legacy JavaScript Object Notation (JSON) or CSV representation, depending on the format selected. Available when the HTTP method is GET. Result Format: JSON or CSV
- `source_type_query_one_row`. Executes a SQL query returning one row of data into an ORDS legacy JSON representation. Available when the HTTP method is GET. Result Format: JSON
- `source_type_feed`. Executes a SQL query and transforms the results into a JSON Feed representation. Each item in the feed contains a summary of a resource and a hyperlink to a full representation of the resource. The first column in each row in the result set must be a unique identifier for the row and is used to form a hyperlink of the form: `path/to/feed/{id}`, with the value of the first column being used as the value for `{id}`. The other columns in the row are assumed to summarize the resource and are included in the feed. A separate resource template for the full representation of the resource should also be defined. Result Format: JSON

p_source
The source implementation for the selected HTTP method.

p_items_per_page
The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database query. Default: NULL (defers to the resource module setting).

p_mimes_allowed
Comma-separated list of MIME types that the handler will accept. Applies to PUT and POST only.

p_comments
Comment text.

Usage Notes

Only one handler for each HTTP method (source type) is permitted.

Examples

The following example defines a POST handler to the `/my/tickets/` resource to accept new tickets.

```
BEGIN
  ORDS.DEFINE_HANDLER(
    p_module_name => 'my.tickets',
    p_pattern => '.',
    p_method  => 'POST',
    p_mimes_allowed => 'application/json',
    p_source_type => ords.source_type_plsql,
    p_source => '
      declare
        l_owner varchar2(255);
        l_payload blob;
        l_id number;
      begin
        l_payload := :body;
        l_owner := :owner;
        if ( l_owner is null ) then
          l_owner := :current_user;
        end if;
        l_id := ticket_api.create_ticket(
          p_json_entity => l_payload,
          p_author => l_owner
        );
        :location := ''./'' || l_id;
        :status := 201;
      end;
      '
  );
END;
/
```

5.4 ORDS.DEFINE_MODULE

Format

```
ORDS.DEFINE_MODULE(
   p_module_name      IN ords_modules.name%type,
   p_base_path        IN ords_modules.uri_prefix%type,
   p_items_per_page   IN ords_modules.items_per_page%type DEFAULT 25,
   p_status           IN ords_modules.status%type DEFAULT 'PUBLISHED',
   p_comments         IN ords_modules.comments%type DEFAULT NULL);
```

Description

DEFINE_MODULE defines a resource module. If the module already exists, then the module and any existing templates will be replaced by this definition; otherwise, a new module is created.

Parameters

p_module_name
Name of the owning RESTful service module. Case sensitive.

p_base_path
The base of the URI that is used to access this RESTful service. Example: `hr/` means that all URIs starting with `hr/` will be serviced by this resource module.

p_items_per_page
The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database query. Default: 25.

p_status
Publication status. Valid values: `PUBLISHED` (default) or `NOT_PUBLISHED`.

p_comments
Comment text.

Usage Notes

(None.)

Examples

The following example creates a simple module.

```
BEGIN
  ORDS.DEFINE_MODULE(
    p_module_name => 'my.tickets',
    p_base_path => '/my/tickets/'
  );
END;
/
```

5.5 ORDS.DEFINE_PARAMETER

Format

```
ORDS.DEFINE_PARAMETER(
   p_module_name        IN ords_modules.name%type,
   p_pattern            IN ords_templates.uri_template%type,
   p_method             IN ords_handlers.method%type,
   p_name               IN ords_parameters.name%type ,
   p_bind_variable_name IN ords_parameters.bind_variable_name%type
                              DEFAULT NULL,
   p_source_type        IN ords_parameters.source_type%type DEFAULT 'HEADER',
   p_param_type         IN ords_parameters.param_type%type DEFAULT 'STRING',
   p_access_method      IN ords_parameters.access_method%type DEFAULT 'IN',
   p_comments           IN ords_parameters.comments%type DEFAULT NULL);
```

Description

DEFINE_PARAMETER defines a module handler parameter. If the parameter already exists, then the parameter will be replaced by this definition; otherwise, a new parameter is created.

Parameters

p_module_name
Name of the owning RESTful service module. Case sensitive.

p_pattern
Matching pattern for the owning resource template.

p_method
The owning handler HTTP Method. Valid values: `GET` (retrieves a representation of a resource), `POST` (creates a new resource or adds a resource to a collection), `PUT` (updates an existing resource), `DELETE` (deletes an existing resource).

p_name
The name of the parameter, as it is named in the URI Template or HTTP Header. Used to map names that are not valid SQL parameter names.

p_bind_variable_name
The name of the parameter, as it will be referred to in the SQL. If NULL is specified, then the parameter is unbound.

p_source_type
The type that is identified if the parameter originates in the URI Template or a HTTP Header. Valid values: `HEADER`, `RESPONSE`, `URI`.

p_param_type
The native type of the parameter. Valid values: `STRING`, `INT`, `DOUBLE`, `BOOLEAN`, `LONG`, `TIMESTAMP`.

p_access_method
The parameter access method. Indicates if the parameter is an input value, output value, or both. Valid values: `IN`, `OUT`, `INOUT`.

p_comments
Comment text.

Usage Notes

All parameters must have unique names and variable names for the same handler.

Examples

The following example defines an outbound parameter on the POST handler to store the location of the created ticket.

```
BEGIN
  ORDS.DEFINE_PARAMETER(
    p_module_name => 'my.tickets',
    p_pattern => '.',
    p_method => 'POST',
    p_name => 'X-APEX-FORWARD',
    p_bind_variable_name => 'location',
    p_source_type => 'HEADER',
    p_access_method => 'OUT'
  );
END;
/
```

The following example defines an outbound parameter on the POST handler to store the HTTP status of the operation.

```
BEGIN
  ORDS.DEFINE_PARAMETER(
    p_module_name => 'my.tickets',
    p_pattern => '.',
    p_method => 'POST',
    p_name => 'X-APEX-STATUS-CODE',
    p_bind_variable_name => 'status',
    p_source_type => 'HEADER',
    p_access_method => 'OUT'
  );
END;
/
```

5.6 ORDS.DEFINE_PRIVILEGE

Format

```
ORDS.DEFINE_PRIVILEGE(
   p_privilege_name    IN sec_privileges.name%type,
   p_roles             IN owa.vc_arr,
   p_patterns          IN owa.vc_arr,
   p_modules           IN owa.vc_arr,
   p_label             IN sec_privileges.label%type DEFAULT NULL,
   p_description       IN sec_privileges.description%type DEFAULT NULL,
   p_comments          IN sec_privileges.comments%type DEFAULT NULL);
or
ORDS.DEFINE_PRIVILEGE(
   p_privilege_name    IN sec_privileges.name%type,
   p_roles             IN owa.vc_arr,
   p_patterns          IN owa.vc_arr,
   p_label             IN sec_privileges.label%type DEFAULT NULL,
   p_description       IN sec_privileges.description%type DEFAULT NULL,
   p_comments          IN sec_privileges.comments%type DEFAULT NULL);
or
ORDS.DEFINE_PRIVILEGE(
   p_privilege_name    IN sec_privileges.name%type,
   p_roles             IN owa.vc_arr,
   p_label             IN sec_privileges.label%type DEFAULT NULL,
   p_description       IN sec_privileges.description%type DEFAULT NULL,
   p_comments          IN sec_privileges.comments%type DEFAULT NULL);
```

Description

DEFINE_PRIVILEGE defines an Oracle REST Data Services privilege. If the privilege already exists, then the privilege and any existing patterns and any associations with modules and roles will be replaced by this definition; otherwise, a new privilege is created.

Parameters

p_privilege_name
Name of the privilege. No spaces allowed.

p_roles
The names of the roles, at least one of which the privilege requires. May be empty, in which case the user must be authenticated but does not require any specific role; however, must not be null. Unauthenticated users will be denied access.

p_patterns
A list of patterns.

p_modules
A list of module names referencing modules created for the current schema.

p_label
Name of this security constraint as displayed to an end user. May be null.

p_description
A brief description of the purpose of the resources protected by this constraint.

p_comments
Comment text.

Usage Notes

`p_roles`, `p_patterns`, and `p_modules` do not accept null values. If no value is to be passed, then either choose the appropriate procedure specification or pass an empty `owa.vc_arr` value.

Examples

The following example creates a privilege connected to roles, patterns, and modules:

```
DECLARE
  l_priv_roles owa.vc_arr;
  l_priv_patterns owa.vc_arr;
  l_priv_modules owa.vc_arr;
BEGIN
  l_priv_roles(1) := 'Tickets User';
  l_priv_patterns(1) := '/my/*';
  l_priv_patterns(2) := '/comments/*';
  l_priv_patterns(3) := '/tickets_feed/*';
  l_priv_patterns(4) := '/tickets/*';
  l_priv_patterns(5) := '/categories/*';
  l_priv_patterns(6) := '/stats/*';

  l_priv_modules(1) := 'my.tickets';

  ords.create_role('Tickets User');

  ords.define_privilege(
    p_privilege_name     => 'tickets.privilege',
    p_roles              => l_priv_roles,
    p_patterns           => l_priv_patterns,
    P_modules            => l_priv_modules,
    p_label              => 'Task Ticketing Access',
    p_description        => 'Provides the ability to create, ' ||
                            'update and delete tickets ' ||
                            'and post comments on tickets'
  );
END;
/
```

The following example creates a privilege connected to roles and patterns:

```
DECLARE
  l_priv_roles owa.vc_arr;
  l_priv_patterns owa.vc_arr;
BEGIN
  l_priv_roles(1) := 'Tickets User';
  l_priv_patterns(1) := '/my/*';
  l_priv_patterns(2) := '/comments/*';
  l_priv_patterns(3) := '/tickets_feed/*';
  l_priv_patterns(4) := '/tickets/*';
  l_priv_patterns(5) := '/categories/*';
  l_priv_patterns(6) := '/stats/*';

  ords.create_role('Tickets User');

  ords.define_privilege(
    p_privilege_name     => 'tickets.privilege',
    p_roles              => l_priv_roles,
    p_patterns           => l_priv_patterns,
    p_label              => 'Task Ticketing Access',
    p_description        => 'Provides the ability to create, ' ||
                            'update and delete tickets ' ||
                            'and post comments on tickets'
  );
END;
/
```

The following example creates a privilege connected to roles:

```
DECLARE
  l_priv_roles owa.vc_arr;
BEGIN
  l_priv_roles(1) := 'Tickets User';

  ords.create_role('Tickets User');

  ords.define_privilege(
    p_privilege_name     => 'tickets.privilege',
    p_roles              => l_priv_roles,
    p_label              => 'Task Ticketing Access',
    p_description        => 'Provides the ability to create, ' ||
                            'update and delete tickets ' ||
                            'and post comments on tickets'
  );
END;
/
```

5.7 ORDS.DEFINE_SERVICE

Format

```
ORDS.DEFINE_SERVICE(
   p_module_name        IN ords_modules.name%type,
   p_base_path          IN ords_modules.uri_prefix%type,
   p_pattern            IN ords_templates.uri_template%type,
   p_method             IN ords_handlers.method%type DEFAULT 'GET',
   p_source_type        IN ords_handlers.source_type%type
                             DEFAULT ords.source_type_collection_feed,
   p_source             IN ords_handlers.source%type,
   p_items_per_page     IN ords_modules.items_per_page%type DEFAULT 25,
   p_status             IN ords_modules.status%type DEFAULT 'PUBLISHED',
   p_etag_type          IN ords_templates.etag_type%type DEFAULT 'HASH',
   p_etag_query         IN ords_templates.etag_query%type DEFAULT NULL,
   p_mimes_allowed      IN ords_handlers.mimes_allowed%type DEFAULT NULL,
   p_module_comments    IN ords_modules.comments%type DEFAULT NULL,
   p_template_comments  IN ords_modules.comments%type DEFAULT NULL,
   p_handler_comments   IN ords_modules.comments%type DEFAULT NULL);
```

Description

DEFINE_SERVICE defines a resource module, template, and handler in one call. If the module already exists, then the module and any existing templates will be replaced by this definition; otherwise, a new module is created.

Parameters

p_module_name
Name of the RESTful service module. Case sensitive. Must be unique.

p_base_path
The base of the URI that is used to access this RESTful service. Example: `hr/` means that all URIs starting with `hr/` will be serviced by this resource module.

p_pattern
A matching pattern for the resource template. For example, a pattern of `/objects/:object/:id?` will match `/objects/emp/101` (matches a request for the item in the `emp` resource with `id` of 101) and will also match `/objects/emp/`. (Matches a request for the `emp` resource, because the `:id` parameter is annotated with the `?` modifier, which indicates that the `id` parameter is optional.)

p_method
The HTTP Method to which this handler will respond. Valid values: `GET` (retrieves a representation of a resource), `POST` (creates a new resource or adds a resource to a collection), `PUT` (updates an existing resource), `DELETE` (deletes an existing resource).

p_source_type
The HTTP request method for this handler. Valid values:

- `source_type_collection_feed`. Executes a SQL query and transforms the result set into an ORDS Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- `source_type_collection_item`. Executes a SQL query returning one row of data into a ORDS Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- `source_type_media`. Executes a SQL query conforming to a specific format and turns the result set into a binary representation with an accompanying HTTP Content-Type header identifying the Internet media type of the representation. Result Format: Binary
- `source_type_plsql`. Executes an anonymous PL/SQL block and transforms any OUT or IN/OUT parameters into a JSON representation. Available only when the HTTP method is DELETE, PUT, or POST. Result Format: JSON
- `source_type_query || source_type_csv_query`. Executes a SQL query and transforms the result set into either an ORDS legacy JavaScript Object Notation (JSON) or CSV representation, depending on the format selected. Available when the HTTP method is GET. Result Format: JSON or CSV
- `source_type_query_one_row`. Executes a SQL query returning one row of data into an ORDS legacy JSON representation. Available when the HTTP method is GET. Result Format: JSON

- source_type_feed. Executes a SQL query and transforms the results into a JSON Feed representation. Each item in the feed contains a summary of a resource and a hyperlink to a full representation of the resource. The first column in each row in the result set must be a unique identifier for the row and is used to form a hyperlink of the form: path/to/feed/{id}, with the value of the first column being used as the value for {id}. The other columns in the row are assumed to summarize the resource and are included in the feed. A separate resource template for the full representation of the resource should also be defined. Result Format: JSON

p_source
The source implementation for the selected HTTP method.

p_items_per_page
The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database query. Default: NULL (defers to the resource module setting).

p_status
Publication status. Valid values: PUBLISHED (default) or NOT_PUBLISHED.

p_etag_type
A type of entity tag to be used by the resource template. An entity tag is an HTTP Header that acts as a version identifier for a resource. Use entity tag headers to avoid retrieving previously retrieved resources and to perform optimistic locking when updating resources. Valid values are HASH, QUERY, NONE:

- HASH (known as Secure HASH): The contents of the returned resource representation are hashed using a secure digest function to provide a unique fingerprint for a given resource version.
- QUERY: Manually define a query that uniquely identifies a resource version. A manually defined query can often generate an entity tag more efficiently than hashing the entire resource representation.
- NONE: Do not generate an entity tag.

p_etag_query
Query that is used to generate the entity tag.

p_mimes_allowed
Comma-separated list of MIME types that the handler will accept. Applies to PUT and POST only.

p_module_comments
Comment text.

p_template_comments
Comment text.

p_handler_comments
Comment text.

Usage Notes

Creates a resource module, template, and handler in one call.

Use this procedure instead of the deprecated ORDS.CREATE_SERVICE procedure.

Examples

The following example defines a REST service that retrieves the current user's tickets.

```
BEGIN
  ORDS.DEFINE_SERVICE(
    p_module_name => 'my.tickets',
    p_base_path => '/my/tickets/',
    p_pattern => '.',
    p_source => 'select t.id "$.id", t.id, t.title from tickets t' ||
                ' where t.owner = :current_user order by t.updated_on desc'
  );
END;
/
```

The following example defines a REST service that retrieves tickets filtered by category.

```
BEGIN
  ORDS.DEFINE_SERVICE(
    p_module_name => 'by.category',
    p_base_path => '/by/category/',
    p_pattern => ':category_id',
    p_source => 'select ''../../my/tickets/'' ||
                  t.id "$.id", t.id, t.title' ||
                ' from tickets t, categories c, ticket_categories tc' ||
                ' where c.id = :category_id and c.id = tc.category_id and' ||
                ' tc.ticket_id = t.id order by t.updated_on desc'
  );
END;
/
```

5.8 ORDS.DEFINE_TEMPLATE

Format

```
ORDS.DEFINE_TEMPLATE(
   p_module_name  IN ords_modules.name%type,
   p_pattern      IN ords_templates.uri_template%type,
   p_priority     IN ords_templates.priority%type DEFAULT 0,
   p_etag_type    IN ords_templates.etag_type%type DEFAULT 'HASH',
   p_etag_query   IN ords_templates.etag_query%type DEFAULT NULL,
   p_comments     IN ords_templates.comments%type DEFAULT NULL);
```

Description

DEFINE_TEMPLATE defines a resource template. If the template already exists, then the template and any existing handlers will be replaced by this definition; otherwise, a new template is created.

Parameters

p_module_name
Name of the owning RESTful service module. Case sensitive.

p_pattern
A matching pattern for the resource template. For example, a pattern of `/objects/:object/:id?` will match `/objects/emp/101` (matches a request for the item in the `emp` resource with `id` of 101) and will also match `/objects/emp/`. (Matches a request for the `emp` resource, because the `:id` parameter is annotated with the `?` modifier, which indicates that the `id` parameter is optional.)

p_priority
The priority for the order of how the resource template should be evaluated: 0 (low priority. the default) through 9 (high priority).

p_etag_type
A type of entity tag to be used by the resource template. An entity tag is an HTTP Header that acts as a version identifier for a resource. Use entity tag headers to avoid retrieving previously retrieved resources and to perform optimistic locking when updating resources. Valid values are `HASH`, `QUERY`, `NONE`:

- `HASH` (known as Secure HASH): The contents of the returned resource representation are hashed using a secure digest function to provide a unique fingerprint for a given resource version.
- `QUERY`: Manually define a query that uniquely identifies a resource version. A manually defined query can often generate an entity tag more efficiently than hashing the entire resource representation.
- `NONE`: Do not generate an entity tag.

p_etag_query
Query that is used to generate the entity tag.

p_comments
Comment text.

Usage Notes

he resource template pattern must be unique with a resource module.

Examples

The following example defines a resource for displaying ticket items.

```
BEGIN
  ORDS.DEFINE_TEMPLATE(
    p_module_name => 'my.tickets',
    p_pattern => '/:id'
  );
END;
/
```

5.9 ORDS.DELETE_MODULE

Format

```
ORDS.DELETE_MODULE(
   p_module_name  IN ords_modules.name%type);
```

Description

DELETE_MODULE deletes a resource module.

Parameters

p_module_name
Name of the owning RESTful service module. Case sensitive.

Usage Notes

If the module does not already exist or is accessible to the current user, then no exception is raised.

Examples

The following example deletes a resource module.

```
EXECUTE ORDS.DELETE_MODULE(p_module_name=>'my.tickets');
```

5.10 ORDS.DELETE_PRIVILEGE

Format

```
ORDS.DELETE_PRIVILEGE(
   p_name   IN sec_privileges.name%type);
```

Description

DELETE_PRIVILEGE deletes a provilege.

Parameters

p_name
Name of the privilege.

Usage Notes

If the privilege does not already exist or is not accessible to the current user, then no exception is raised.

Examples

The following example deletes a privilege.

```
EXECUTE ORDS.DELETE_PRIVILEGE(p_name=>'tickets.privilege');
```

5.11 ORDS.DELETE_ROLE

Format

```
ORDS.DELETE_ROLE(
   p_role_name IN sec_roles.name%type);
```

Description

DELETE_ROLE deletes the named role.

Parameters

p_name
Name of the role.

Usage Notes

This will also delete any association between the role and any privileges that reference the role.

No exception is produced if the role does not already exist.

Examples

The following example deletes a role.

```
EXECUTE ORDS.DELETE_ROLE(p_role_name=>'Tickets User');
```

5.12 ORDS.DROP_REST_FOR_SCHEMA

Format

```
ORDS.DROP_REST_FOR_SCHEMA(
   p_schema ords_schemas.parsing_schema%type DEFAULT NULL);
```

Description

DROP_REST_FOR_SCHEMA deletes all auto-REST Oracle REST Data Services metadata for the associated schema.

Parameters

p_schema
Name of the schema.

Usage Notes

This procedure effectively "undoes" the actions performed by the `ORDS.Enable_Schema` procedure.

Examples

The following example deletes all auto-REST Oracle REST Data Services metadata for the TICKETS schema.

```
EXECUTE ORDS.DROP_REST_FOR_SCHEMA('tickets');
```

Related Topics:

- ORDS.ENABLE_SCHEMA (page 5-18)

5.13 ORDS.ENABLE_OBJECT

Format

```
ORDS.ENABLE_OBJECT(
   p_enabled         IN boolean DEFAULT TRUE,
   p_schema          IN ords_schemas.parsing_schema%type DEFAULT NULL,
   p_object          IN ords_objects.parsing_object%type,
   p_object_type     IN ords_objects.type%type DEFAULT 'TABLE',
   p_object_alias    IN ords_objects.object_alias%type DEFAULT NULL,
   p_auto_rest_auth  IN boolean DEFAULT NULL);
```

Description

ENABLE_OBJECT enables Oracle REST Data Services access to a specified table or view in a schema.

Parameters

p_enabled
`TRUE` to enable access; `FALSE` to disable access.

p_schema
Name of the schema for the table or view.

p_object
Name of the table or view.

p_object_type
Type of the object: `TABLE` (default) or `VIEW`.

p_object_alias
Alias of the object.

p_auto_rest_auth
Controls whether Oracle REST Data Services should require user authorization before allowing access to the Oracle REST Data Services metadata for this object.

Usage Notes

Only database users with the DBA role can enable/access to objects that they do now own.

Examples

The following example enables a table named CATEGORIES.

```
EXECUTE ORDS.ENABLE_OBJECT(p_object=>'CATEGORIES');
```

The following example enables a view named TICKETS_FEED.

```
BEGIN
  ORDS.ENABLE_OBJECT(
    p_object => 'TICKETS_FEED',
    p_object_type => 'VIEW'
  );
END;
/
```

5.14 ORDS.ENABLE_SCHEMA

Format

```
ORDS.ENABLE_SCHEMA
   p_enabled             IN boolean DEFAULT TRUE,
   p_schema              IN ords_schemas.parsing_schema%type DEFAULT NULL,
   p_url_mapping_type    IN ords_url_mappings.type%type DEFAULT 'BASE_PATH',
   p_url_mapping_pattern IN ords_url_mappings.pattern%type DEFAULT NULL,
   p_auto_rest_auth      IN boolean DEFAULT NULL);
```

Description

ENABLE_SCHEMA enables Oracle REST Data Services to access the named schema.

Parameters

p_enabled
`TRUE` to enable Oracle REST Data Services access; `FALSE` to disable Oracle REST Data Services access.

p_schema
Name of the schema. If the `p_schema` parameter is omitted, then the current schema is enabled.

p_url_mapping_type
URL Mapping type: `BASE_PATH` or `BASE_URL`.

p_url_mapping_pattern
URL mapping pattern.

p_auto_rest_auth
For a schema, controls whether Oracle REST Data Services should require user authorization before allowing access to the Oracle REST Data Services metadata catalog of this schema.

Usage Notes

Only database users with the DBA role can enable or disable a schema other than their own.

Examples

The following example enables the current schema.

```
EXECUTE ORDS.ENABLE_SCHEMA;
```

5.15 ORDS.PUBLISH_MODULE

Format

```
ORDS.PUBLISH_MODULE(
   p_module_name  IN ords_modules.name%type,
   p_status       IN ords_modules.status%type DEFAULT 'PUBLISHED');
```

Description

PUBLISH_MODULE changes the publication status of an Oracle REST Data Services resource module.

Parameters

p_module_name
Current name of the RESTful service module. Case sensitive.

p_status
Publication status. Valid values: `PUBLISHED` (default) or `NOT_PUBLISHED`.

Usage Notes

(None.)

Examples

The following example publishes a previously defined module named `my.tickets`.

```
EXECUTE ORDS.PUBLISH_MODULE(p_module_name=>'my.tickets');
```

5.16 ORDS.RENAME_MODULE

Format

```
ORDS.RENAME_MODULE(
   p_module_name    IN ords_modules.name%type,
   p_new_name       IN ords_modules.name%type DEFAULT NULL,
   p_new_base_path  IN ords_modules.uri_prefix%type DEFAULT NULL);
```

Description

RENAME_MODULE lets you change the name or the base path, or both, of an Oracle REST Data Services resource module.

Parameters

p_module_name
Current name of the RESTful service module. Case sensitive.

p_new_name
New name to be assigned to the RESTful service module. Case sensitive. If this parameter is null, the name is not changed.

p_new_base_path
The base of the URI to be used to access this RESTful service. Example: hr/ means that all URIs starting with hr/ will be serviced by this resource module. If this parameter is null, the base path is not changed.

Usage Notes

Both the new resource module name and the base path must be unique within the enabled schema.

Examples

The following example renames resource module `my.tickets` to `old.tickets`.

```
BEGIN
  ORDS.RENAME_MODULE(
    p_module_name =>'my.tickets',
    p_new_name=>'old.tickets',
    p_new_base_path=>'/old/tickets/');
END;
/
```

5.17 ORDS.RENAME_PRIVILEGE

Format

```
ORDS.RENAME_PRIVILEGE(
   p_name      IN sec_privileges.name%type,
   p_new_name  IN sec_privileges.name%type);
```

Description

RENAME_PRIVILEGE renames a privilege.

Parameters

p_name
Current name of the privilege.

p_new_name
New name to be assigned to the privilege.

Usage Notes

(None.)

Examples

The following example renames the privilege `tickets.privilege` to `old.tickets.privilege`.

```
BEGIN
  ORDS.RENAME_PRIVILEGE(
    p_name =>'tickets.privilege',
    p_new_name=>'old.tickets.privilege');
END;
/
```

5.18 ORDS.RENAME_ROLE

Format

```
ORDS.RENAME_ROLE(
   p_role_name  IN sec_roles.name%type,
   p_new_name   IN sec_roles.name%type);
```

Description

RENAME_ROLE renames a role.

Parameters

p_role_name
Current name of the role.

p_new_name
New name to be assigned to the role.

Usage Notes

`p_role_name` must exist.

Examples

The following example renames an existing role.

```
BEGIN
  ORDS.RENAME_ROLE(
    p_role_name=>'Tickets User',
    p_new_name=>'Legacy Tickets User');
END;
/
```

5.19 ORDS.SET_MODULE_ORIGINS_ALLOWED

Format

```
ORDS.SET_MODULE_ORIGINS_ALLOWED
   p_module_name     IN ords_modules.name%type,
   p_origins_allowed IN sec_origins_allowed_modules.origins_allowed%type);
```

Description

SET_MODULE_ORIGINS_ALLOWED configures the allowed origins for a resource module. Any existing allowed origins will be replaced.

Parameters

p_module_name
Name of the resource module.

p_origins_allowed
A comma-separated list of URL prefixes. If the list is empty, any existing origins are removed.

Usage Notes

To indicate no allowed origins for a resource module (and remove any existing allowed origins), specify an empty `p_origins_allowed` value.

Examples

The following restricts the resource module `my.tickets` to two specified origins.

```
BEGIN
  ORDS.SET_MODULE_ORIGINS_ALLOWED(
    p_module_name     => 'my.tickets',
    p_origins_allowed => 'http://example.com,https://example.com');
```

```
END;
/
```

5.20 ORDS.SET_URL_MAPPING

Format

```
ORDS.SET_URL_MAPPING
   p_schema              IN ords_schemas.parsing_schema%type DEFAULT NULL,
   p_url_mapping_type    IN ords_url_mappings.type%type,
   p_url_mapping_pattern IN ords_url_mappings.pattern%type);
```

Description

SET_URL_MAPPING configures how the specified schema is mapped to request URLs.

Parameters

p_schema
Name of the schema to map. The default is the schema of the current user.

p_url_mapping_type
URL Mapping type: `BASE_PATH` or `BASE_URL`.

p_url_mapping_pattern
URL mapping pattern.

Usage Notes

Only DBA users can update the mapping of a schema other than their own.

Examples

The following example creates a `BASE_PATH` mapping for the current user.

```
BEGIN
  ORDS.SET_URL_MAPPING(
    p_url_mapping_type    => 'BASE_PATH',
    p_url_mapping_pattern => 'https://example.com/ords/ticketing'
  );
END;
/
```

6

OAUTH PL/SQL Package Reference

The OAUTH PL/SQL package contains procedures for implementing OAuth authentication using Oracle REST Data Services.

Related Topics:

- Using the Oracle REST Data Services PL/SQL API (page 3-81)

6.1 OAUTH.CREATE_CLIENT

Format

```
OAUTH.CREATE_CLIENT(
   p_name            VARCHAR2 IN,
   p_grant_type      VARCHAR2 IN,
   p_owner           VARCHAR2 IN DEFAULT NULL,
   p_description     VARCHAR2 IN DEFAULT NULL,
   p_allowed_origins VARCHAR2 IN DEFAULT NULL,
   p_redirect_uri    VARCHAR2 IN DEFAULT NULL,
   p_support_email   VARCHAR2 IN DEFAULT NULL,
   p_support_uri     VARCHAR2 IN DEFAULT NULL,
   p_privilege_names VARCHAR2 IN)
```

Description

Creates an OAuth client registration.

Parameters

p_name
Name for the client, displayed to the end user during the approval phase of three-legged OAuth. Must be unique.

p_grant_type
Must be one of `authorization_code`, `implicit`, or `client_credentials`.

p_owner
Name of the party that owns the client application.

p_description
Description of the purpose of the client, displayed to the end user during the approval phase of three-legged OAuth. May be null if `p_grant_type` is `client_credentials`; otherwise, must not be null.

p_allowed_origins
A comma-separated list of URL prefixes. If the list is empty, any existing origins are removed.

p_redirect_uri
Client-controlled URI to which redirect containing an OAuth access token or error will be sent. May be null if `p_grant_type` is `client_credentials`; otherwise, must not be null.

p_support_email
The email where end users can contact the client for support.

p_support_uri
The URI where end users can contact the client for support. Example: `http://www.myclientdomain.com/support/`

p_privilege_names
List of comma-separated privileges that the client wants to access.

Usage Notes

To have the operation take effect, use the COMMIT statement after calling this procedure.

Examples

The following example creates an OAuth client registration.

```
BEGIN
  OAUTH.create_client(
    'CLIENT_TEST',
    'authorization_code',
    'test_user',
    'This is a test description.',
    '',
    'https://example.org/my_redirect/#/',
    'test@example.org',
    'https://example.org/help/#/',
     'MyPrivilege'
    );
    COMMIT;
END;
/
```

6.2 OAUTH.DELETE_CLIENT

Format

```
OAUTH.DELETE_CLIENT(
   p_name VARCHAR2 IN);
```

Description

Deletes an OAuth client registration.

Parameters

p_name
Name of the client registration to be deleted.

Usage Notes

To have the operation take effect, use the COMMIT statement after calling this procedure.

Examples

The following example deletes an OAuth client registration.

```
BEGIN
  OAUTH.delete_client(
    'CLIENT_TEST'
    );
  COMMIT;
END;
/
```

6.3 OAUTH.GRANT_CLIENT_ROLE

Format

```
OAUTH.GRANT_CLIENT_ROLE(
   p_client_name VARCHAR2 IN,
   p_role_name   VARCHAR2 IN);
```

Description

Grant an OAuth client the specified role, enabling clients performing two-legged OAuth to access privileges requiring the role.

Parameters

p_client_name
Name of the OAuth client.

p_role_name
Name of the role to be granted.

Usage Notes

To have the operation take effect, use the COMMIT statement after calling this procedure.

Examples

The following example creates a role and grants that role to an OAuth client.

```
BEGIN
  ORDS.create_role(p_role_name => 'CLIENT_TEST_ROLE');

  OAUTH.grant_client_role(
    'CLIENT_TEST',
    'CLIENT_TEST_ROLE'
    );
  COMMIT;
END;
/
```

6.4 OAUTH.RENAME_CLIENT

Format

```
OAUTH.RENAME_CLIENT(
   p_name     VARCHAR2 IN,
   p_new_name VARCHAR2 IN);
```

Description

Renames a client.

Parameters

p_name
Current name for the client.

p_new_name
New name for the client.

Usage Notes

The client name is displayed to the end user during the approval phase of three-legged OAuth.

To have the operation take effect, use the COMMIT statement after calling this procedure.

Examples

The following example renames a client.

```
BEGIN
  OAUTH.rename_client(
    'CLIENT_TEST',
    'CLIENT_TEST_RENAMED'
    );
  COMMIT;
END;
/
```

6.5 OAUTH.REVOKE_CLIENT_ROLE

Format

```
OAUTH.REVOKE_CLIENT_ROLE(
   p_client_name  VARCHAR2 IN,
   p_role_name    VARCHAR2 IN);
```

Description

Revokes the specified role from an OAuth client, preventing the client from accessing privileges requiring the role through two-legged OAuth.

Parameters

p_client_name
Name of the OAuth client.

p_role_name
Name of the role to be revoked

Usage Notes

To have the operation take effect, use the COMMIT statement after calling this procedure.

Examples

The following example revokes a specified role from an OAuth client.

```
BEGIN
  OAUTH.revoke_client_role(
    'CLIENT_TEST_RENAMED',
    'CLIENT_TEST_ROLE'
    );
  COMMIT;
END;
/
```

6.6 OAUTH.UPDATE_CLIENT

Format

```
OAUTH.UPDATE_CLIENT(
  p_name              VARCHAR2 IN,
  p_description       VARCHAR2 IN,
  p_origins_allowed   VARCHAR2 IN,
  p_redirect_uri      VARCHAR2 IN,
  p_support_email     VARCHAR2 IN,
  p_suppor_uri        VARCHAR2 IN,
  p_privilege_names   t_ords_vchar_tab IN);
```

Description

Updates the client information (except name). Any null values will not alter the existing client property.

Parameters

p_name
Name of the client that requires the owner, description, origins allowed, support e-mail, support URI, and/or privilege modification.

p_description
Description of the purpose of the client, displayed to the end user during the approval phase of three-legged OAuth.

p_redirect_uri
Client-controlled URI to which a redirect containing the OAuth access token/error will be sent. If this parameter is null, the existing `p_redirect_uri` value (if any) is not changed.

p_support_email
The email address where end users can contact the client for support.

p_support_uri
The URI where end users can contact the client for support. Example: `http://www.myclientdomain.com/support/`

p_privilege_names
List of names of the privileges that the client wishes to access.

Usage Notes

To have the operation take effect, use the COMMIT statement after calling this procedure.

If you want to rename the client, use the `OAUTH.RENAME_CLIENT` procedure.

Example to Updates the Description of the Specified Client

The following example updates the description of the client with the name matching the value for `p_name`.

```
BEGIN
  ORDS_METADATA.OAUTH.update_client(
    p_name => 'CLIENT_TEST_RENAMED',
    p_description => 'The description was altered',
    p_origins_allowed => null,
    p_redirect_uri => null,
    p_support_email => null,
    p_support_uri => null,
    p_privilege_names => null);
  COMMIT;
END;
/
```

Example 6-1 Example to Add Multiple Privileges

The following example adds a second privilege:

```
declare
 my_privs t_ords_vchar_tab  := t_ords_vchar_tab ();
begin
 my_privs.EXTEND (3);
 my_privs(1):='tst.privilege1';
 my_privs(2):='tst.privilege2';
.
 oauth.update_client(
    p_name => 'Test_Client',
    p_owner => 'scott',
    p_description => 'Description',
    p_grant_type => 'client_credentials',
    p_redirect_uri => '/abc/efg/',
    p_privilege_names => my_privs);
commit;
end;
```

Related Topics:

- OAUTH.RENAME_CLIENT (page 6-4)

A ORDS Database Type Mappings

This appendix describes the ORDS database type mappings along with the structural database types.

A.1 Oracle Built-in Types

This section describes the database type mappings.

Data Type	JSON Data Type	REST Version	Value Example	Description
NUMBER	number	v1	`"big" : 1234567890` `"bigger" : 1.2345678901e10`	Represented with all significant digits. An exponent is used when the number exceeds 10 digits.
RAW	string	Custom	`"code" : "SEVMTE8gV09STEQh"`	Base64 bit encoding is used
DATE	string	v1.2	`"start" : "1995-06-02T04:29:11Z"`	Represented using ISO 8601 format in UTC time zone
TIMESTAMP	string	v1.2	`when : "1995-06-02T04:29:11.002Z"`	Represented using ISO 8601 format in UTC time zone
TIMESTAMP WITH LOCAL TIME ZONE	string	v1.2	"at" : "1995-06-02T04:29:11.002Z"	Represented using ISO 8601 format. The local time zone is converted to UTC time zone as the local time zone specification does not apply for a transfer encoding.
CHAR	string	v1	`"message" : "Hello World! "`	Represented with trailing spaces. This may be required as padding for PUT or POST methods. For example, "`abc `".
ROWID	string	Custom	`"id" : "AAAGq9AAEAAAA0bAAA"`	Output as the native Oracle textual representation. For example, equivalent to the following conversion: `SELECT ROWIDTOCHAR(id) id FROM DUAL`.
UROWID	string	Custom	`"uid" : "AAAGq9AAEAAAA0bAAA"`	Output as the native Oracle textual representation. For example, equivalent to the following conversion: `SELECT CAST(uid as VARCHAR(4000)) id FROM DUAL`.
FLOAT	number	v1	`*as NUMBER`	

Data Type	JSON Data Type	REST Version	Value Example	Description
NCHAR	string	v1	`"message" : "Hello World! "`	Represented using unicode character where the character is not supported by the body character set.
NVARCHAR2	string	v1	`"message" : "Hello World!"`	Represented using unicode character where the character is not supported by the body character set.
VARCHAR2	string	v1	`"message" : "Hello World!"`	
BINARY_FLOAT	number	v1	`*as NUMBER`	
BINARY_DOUBLE	number	v1	`*as NUMBER`	
TIMESTAMP WITH TIME ZONE	object	v1.2	`"event" : "1995-06-02T04:29:11.002Z"` `"when" : "1995-06-02T04:29:11.002Z"`	Represented using ISO 8601 format in UTC time zone. The value represents the same point in time but the original time zone is lost.
INTERVAL YEAR TO MONTH	object	Custom	`"until" : "P-123Y3M"` `"until" : "P3M"`	Represented using ISO 8601 "Duration" format. Zero duration components are considered optional.
INTERVAL DAY TO SECOND	object	Custom	`"until" : "P-5DT3H55M"` `"until" : "PT3H55M"`	Represented using ISO 8601 "Duration" format. Zero duration components are considered optional
LONG	string	v1	`*as VARCHAR`	
LONG RAW	string	Custom	`"long_code" : { "SEVMTE8gV09STEQh"`	
BLOB	string	Custom	`"bin" : { "base64_value" : "bGVhc3VyZS4=" }`	
CLOB	string	Custom	`"text" : { "value" : "Hello World! " }`	

Data Type	JSON Data Type	REST Version	Value Example	Description
BFILE	Object	Custom	`"file" : { "locator" : "TARGET_DIR", "filename" : "myfile" }`	
BOOLEAN	true| false	v1	`"right" : true" wrong" : false`	

A.2 Handling Structural Database Types

This section explains how structural database types are handled.

Object Types

An exception to this is where ORDS has adopted an accepted encoding for an Industry Standard type such as GeoJSON.

Following is a sample code snippet:

```
"address" : {

"number" : 42,

"street" : "Wallaby Way",

"city" : "Sydney"

}
```

Inheritance

Object type inheritance is not supported. For marshalling purposes, all object types are treated as if they are left concrete types.

PL/SQL Records

PL/SQL Records are not supported.

VARRAYS

VARRAYS are mapped directly to the JSON array type.

Following is a sample code snippet:

```
"addresses" : [

{

"__db_type" : "MY_SCHEMA.AUS_ADDRESS",

"number" : 42,
"street" : "Wallaby Way",

"city" : "Sydney"

},

{

"__db_type" : "MY_SCHEMA.UK_ADDRESS"

"number : 1,

"street" : "Oracle Parkway"

"city" : "Reading"

"postcode" : "RG6 1RA"

}

]
```

Element Inheritance

If the type of a VARRAY element instance is a sub-type of the defined type, then it becomes mandatory to add the `__db_type` named value, as explained in the object types section.

Associative Arrays

Associative arrays (formally known as PL/SQL table or index-by table) fall into following two categories:

- **Indexed by an integer value**: A sparsely populated indexed array. This type of array may not yield a value for a given index. When this type of array is converted to and from JSON, the index is ignored, removing the indexable value gaps. This will have the side-effect that a sparsely populated indexed array that is passed as an IN/OUT parameter through a PL/SQL procedure without any changes, could still appear to have been changed, as the indexable value gaps would have been removed.

  Following is a sample code snippet:

  ```
  "avg_values" : [

  34,

  57,

  86,

  3235

  ]

  :
  ```

- **Not indexed by an integer value**: For example, VARCHAR. This category is rarely used and not supported by the Oracle JDBC API.

A.3 Oracle Geospacial Encoding

Oracle Geospacial types comprises of more than the predefined Oracle Object types. However, recognized JSON encoding call, GeoJSON is used to encode the instance data.

Related Topics:

- GeoJSON standard documentation

A.4 Enabling Database Mapping Support

This section shows how to enable the extended database mapping support.

To enable the extended database mapping support, the following code snippet must be added to the ORDS `defaults.xml` file, which is located in the ORDS configuration `ords` directory:

```
<entry key="misc.datatypes.enable">true</entry>
```

B

About the Oracle REST Data Services Configuration Files

The section describes the Oracle REST Data Services configuration files.

Topics:

B.1 Locating Configuration Files

Use the `configdir` command to display the current location of the configuration files:

```
java -jar ords.war configdir
```

If the configuration folder has not yet been configured, the message: `The config.dir setting is not set`, is displayed. If it has been configured, the current value of the setting is displayed.

B.2 Setting the Location of the Configuration Files

To change the location of the configuration folder use the `configdir` command:

```
java -jar ords.war configdir </path/to/config>
```

Where:

- `</path/to/config>` is the location where the configuration files are stored.

B.3 Understanding the Configuration Folder Structure

The configuration folder has the following structure:

```
./
|
+-defaults.xml
+-apex.properties*
+-url-mapping.xml
|
+conf/
  |
  +-apex.xml
  +-apex_al.xml
```

```
+-apex_rt.xml
+-apex_pu.xml
|
...
+-(db-name).xml
+-(db-name)_al.xml
+-(db-name)_rt.xml
+-(db-name)_pu.xml
```

Global settings that apply to all database connections are stored in `defaults.xml`.

Settings specific to a particular database connection (for example, the default `apex` connection) are stored in `conf/<db-name>.xml`, where `<db-name>` is the name of the database connection.

If the database connection uses Oracle Application Express RESTful Services, the files with names including `_al.xml`, `_rt.xml`, and `_pu.xml` store the configuration for the `APEX_LISTENER`, `APEX_REST_PUBLIC_USER`, and `ORDS_PUBLIC_USER` database users, respectively.

If the database connection uses Oracle REST Data Services RESTful Services, the file `<db-name>_pu.xml` stores the configuration for the `ORDS_PUBLIC_USER` database user.

B.4 Understanding the Configuration File Format

Configuration files use the standard Java XML properties file format, where each configuration setting contains a key and a corresponding value. The following is an example of a `defaults.xml` file:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
<properties>

<entry key="db.connectionType">basic</entry>
<entry key="db.hostname">localhost</entry>
<entry key="db.port">1521</entry>
<entry key="db.sid">orcl</entry>

<entry key="jdbc.DriverType">thin</entry>
<entry key="jdbc.InitialLimit">3</entry>
<entry key="jdbc.MinLimit">1</entry>
<entry key="jdbc.MaxLimit">10</entry>
<entry key="jdbc.MaxStatementsLimit">10</entry>
<entry key="jdbc.InactivityTimeout">1800</entry>
<entry key="jdbc.statementTimeout">900</entry>
<entry key="jdbc.MaxConnectionReuseCount">1000</entry>

</properties>
```

B.4.1 Understanding the url-mapping.xml File Format

The `url-mapping.xml` file stores the rules that route requests to the appropriate database when more than one database is configured. The following is an example of a `url-mapping.xml` file:

```
<pool-config xmlns="http://xmlns.oracle.com/apex/pool-config">
 <pool name="sales_db"
   base-path="/sales"
   workspace-id="sales_rest"/>
</pool-config>
```

B.5 Understanding Configurable Parameters

Table B-1 (page B-3) lists editable parameters for the `defaults.xml` and `(db-name).xml` configuration files.

Tip:

Oracle recommends users to use the Oracle REST Data Services command-line interface and Oracle SQL Developer Oracle REST Data Services Administration to edit the configuration files.

Table B-1 Oracle REST Data Services Configuration Files Parameters

Key	Type	Description	Example
`apex.docTable`	string	Name of the document table used by Application Express. Defaults to `FLOWS_FILES.WWV_FLOW_FILE_OBJECTS$`.	`MYDOCTABLE`
`apex.excel2collection`	boolean	Indicate whether to place your Excel files into an Oracle Application Express collection. Supported values: • true • false (default) If value is true, then either `apex.excel2collection.onecollection` or `apex.excel2collection.useSheetName` should be set to true.	`false`
`apex.excel2collection.name`	string	The name of the apex collection. The name is required if `apex.excel2collection.onecollection` is true.	`mycollection`
`apex.excel2collection.onecollection`	boolean	Indicate whether to put all Excel worksheets into a single collection. Supported values: • true • false (default)	`false`
`apex.excel2collection.useSheetName`	boolean	Indicate whether to create a collection for each Excel worksheet, and uses each worksheet name for the corresponding collection name. Supported values: • true • false (default)	`false`

Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Type	Description	Example
`cache.caching`	boolean	Supported values: • true • false (default) For caching to be enabled, this must be set to true and the procedureNameList must have a procedure.	`true`
`cache.directory`	string	The directory location for the cache files.	`C:\data \cachefiles`
`cache.duration`	string	Supported values: • days (default) • minutes • hours Required for expire cache type.	`days`
`cache.expiration`	numeric	Required for expire cache type. Defaults to 7.	`7`
`cache.maxEntries`	numeric	Required for lru cache type. Defaults to 500.	`500`
`cache.monitorInterval`	numeric	Interval time is specified in minutes. If the cache type is expire, Oracle REST Data Services, checks the cache every *`NN`* minutes for files that have expired. For example, if the `monitorInterval` is 60, then it checks the cache every 60 minutes. Defaults to 60.	`60`
`cache.procedureNameList`	string	Specify the procedure names to allow for caching of their files. Procedure names can contain the wildcard characters asterisk (*) or question mark (?). Use an asterisk (*) to substitute zero or more characters and a question mark (?) to substitute for any one character. Each procedure name must be separated by a comma.	`p, download_file`
`cache.type`	string	Supported values: • expire • lru (default)	`lru`
`db.connectionType`	string	The type of connection. Supported values: • basic • tns • customurl	`basic`

Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Type	Description	Example
`db.customURL`	string	The JDBC URL connection to connect to the database.	`jdbc:oracle:thin:@(DESCRIPTION=(ADDRESS=(PROTOCOL=TCP) (HOST=myhost)(PORT=1521))(CONNECT_DATA=(SERVICE_NAME=ora111.example.com)))`
`db.hostname`	string	The host system for the Oracle database.	`myhostname`
`db.password`	string	The password of the specified database user. Include an exclamation at the beginning of the password so that it can be stored encrypted.	`!password4user`
`db.port`	numeric	The database listener port.	`1521`
`db.servicename`	string	The network service name of the database.	`ora111.example.com`
`db.serviceNameSuffix`	string	Indicates that the pool points to a CDB, and that the PDBs connected to that CDB should be made addressable by Oracle REST Data Services (see Making All PDBs Addressable by Oracle REST Data Services (Pluggable Mapping) (page G-3)).	`apex_pu`
`db.sid`	string	The name of the database.	`ora111`
`db.tnsAliasName`	string	The TNS alias name that matches the name in the tnsnames.ora file.	`MY_TNSALIAS`
`db.tnsDirectory`	string	The directory location of your `tnsnames.ora` file.	`C:\ORACLE\NETWORK\ADMIN`
`db.username`	string	The name of the database user for the connection.	`APEX_PUBLIC_USER`
`debug.debugger`	boolean	Indicate whether to display debugging messages on the application server console. Supported values: • true • false (default)	`false`
`debug.printDebugToScreen`	boolean	Indicate whether to display error messages on the browser. Supported values: • true • false (default)	`false`
`error.keepErrorMessages`	boolean	Indicate whether to retain the error messages. Supported values: • true • false (default)	`true`

Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Type	Description	Example
`error.maxEntries`	numeric	Specify the total number of error messages to retain. Defaults to 50.	`50`
`icap.port`	numeric	Specify the Internet Content Adaptation Protocol (ICAP) Port to virus scan files. The `icap.port` is required to have a value.	`5555`
`icap.server`	string	Specify the Internet Content Adaptation Protocol (ICAP) Server name to virus scan files. The `icap.server` is required to have a value.	`servername`
`jdbc.DriverType`	string	The JDBC driver type. Supported values: • thin • oci8	`thin`
`jdbc.InactivityTimeout`	numeric	Specify how long an available connection can remain idle before it is closed. The inactivity connection timeout is in seconds. Defaults to 1800.	`1800`
`jdbc.InitialLimit`	numeric	Specify the initial size for the number of connections that will be created. Defaults to 3. (The default is low, and should probably be set higher in most production environments.)	`10`
`jdbc.MaxConnectionReuseCount`	numeric	Specify the maximum number of times to reuse a connection before it is discarded and replaced with a new connection. Defaults to 1000.	`1000`
`jdbc.MaxLimit`	numeric	Specify the maximum number of connections. Defaults to 10. (Might be too low for some production environments.)	`20`
`jdbc.maxRows`	numeric	Specify the maximum number of rows that will be returned from a query when processing a RESTful service and that will be returned from a nested cursor in a result set. Affects all RESTful services generated through a SQL query, regardless of whether the resource is paginated. Defaults to 500.	`300`
`jdbc.MaxStatementsLimit`	numeric	Specify the maximum number of statements to cache for each connection. Defaults to 10.	`10`

Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Type	Description	Example
`jdbc.MinLimit`	numeric	Specify the minimum number of connections. Defaults to 1.	`1`
`jdbc.statementTimeout`	numeric	Specify how long a borrowed (in use) connection can remain unused before it is considered as abandoned and reclaimed. The abandoned connection timeout is in seconds. Defaults to 900.	`900`
`log.logging`	boolean	Indicate whether to retain the log messages. Supported values: • true • false (default)	`true`
`log.maxEntries`	numeric	Specify the total number of log messages to retain. Defaults to 50.	`50`
`log.procedure`	boolean	Indicate whether procedures are to be logged. Supported values: • true • false (default)	`false`
`misc.defaultPage`	string	The default page to display. The Oracle REST Data Services home page, **apex**, is commonly used.	`apex`
`procedure.postProcess`	string	Specify the procedure name(s) to execute after executing the procedure specified on the URL. Multiple procedure names must be separated by commas.	`SCHEMA1.SUBMIT.REQUEST,FINISHTASK`
`procedure.preProcess`	string	Specify the procedure name(s) to execute prior to executing the procedure specified on the URL. Multiple procedure names must be separated by commas.	`SCOTT.PREPROC1, INITIALIZE, PKG1.PROC`
`security.disableDefaultExclusionList`	boolean	Supported values: • true • false (default)	`false`

Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Type	Description	Example
`security.exclusionList`	string	Specify a pattern for procedures, packages, or schema names which are forbidden to be directly executed from a browser. Procedure names can contain the wildcard characters asterisk (*) or question mark (?). Use an asterisk (*) to substitute zero or more characters and a question mark (?) to substitute for any one character. **Note**: Separate multiple patterns using commas.	`customer_account, bank*, employe?`
`security.inclusionList`	string	Specify a pattern for procedures, packages, or schema names which are allowed to be directly executed from a browser. Procedure names can contain the wildcard characters asterisk (*) or question mark (?). Use an asterisk (*) to substitute zero or more characters and a question mark (?) to substitute for any one character. **Note**: Separate multiple patterns using commas.	`apex, p, v, f, wwv_*, y*, c*`
`security.maxEntries`	numeric	Specify the maximum cache size. Defaults to 2000.	`2000`
`security.requestValidationFunction`	string	Specify a validation function to determine if the requested procedure in the URL should be allowed or disallowed for processing. The function should return true if the procedure is allowed; otherwise, return false.	`CHECK_VALID_PROCEDURE`
`security.verifySSL`	boolean	Indicate whether HTTPS is available in your environment. Supported values: • true (default) • false If you change the value to false, see Using OAuth2 in Non-HTTPS Environments (page 1-11).	`true`
`soda.defaultLimit`	string	When using the SODA REST API, specifies the default number of documents returned for a GET request on a collection when a limit is not specified in the URL. Must be a positive integer, or "unlimited" for no limit. Defaults to 100.	`75`

Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Type	Description	Example
`soda.maxLimit`	string	When using the SODA REST API, specifies the maximum number of documents that will be returned for a GET request on a collection URL, regardless of any limit specified in the URL. Must be a positive integer, or "unlimited" for no limit. Defaults to 1000.	`700`

See Also:

For more information, see Configuring and Installing Oracle REST Data Services (page 1-3) and "Oracle REST Data Services Administration" in *Oracle SQL Developer User's Guide*.

C

HTTPS POST Request Examples for REST Enabled SQL Service

This appendix provides different HTTPS POST Request examples that use ORDS standalone setup with secure HTTPS access.

The payload data of the HTTPS POST request message can be in one of the following formats:

- POST Requests Using `application/sql` `Content-Type` (page C-1)
- POST Requests Using `application/json` `Content-Type` (page C-6)

C.1 POST Requests Using `application/sql` `Content-Type`

For POST requests with `Content-Type` as `application/sql` , the payload is specified using SQL, SQL*Plus and SQLcl statements. The payload can be single line, multiple line statements, or a file comprising of multi-line statements as shown in the following examples:

- Using a Single SQL Statement (page C-1)
- Using Multiple SQL Statements (page C-3)
- Using a File with cURL (page C-2)

C.1.1 Using a Single SQL Statement

The following example uses Schema Authentication to run a single SQL statement against the `demo` Oracle database schema:

Request:

```
curl -i -X POST --user DEMO:demo --data-binary "select sysdate from dual" -H
"Content-Type: application/sql" -k https://localhost:8088/ords/demo/_/sql
```

Response:

```
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked

{
    "env":{
        "defaultTimeZone":"Europe/London"
    },
    "items":[
        {
            "statementId":1,
            "statementType":"query",
            "statementPos":{
                "startLine":1,
                "endLine":2
            },
            "statementText":"select sysdate from dual",
            "response":[

            ],
            "result":0,
            "resultSet":{
                "metadata":[
                    {
                        "columnName":"SYSDATE",
                        "jsonColumnName":"sysdate",
                        "columnTypeName":"DATE",
                        "precision":0,
                        "scale":0,
                        "isNullable":1
                    }
                ],
                "items":[
                    {
                        "sysdate":"2017-07-21T08:06:44Z"
                    }
                ],
                "hasMore":false,
                "limit":1500,
                "offset":0,
                "count":1
            }
        }
    ]
}
```

Where:

- `DEMO` is the Oracle Database schema name.
- `demo` is the Oracle Database schema password.
- `select sysdate from dual` is the SQL statement will run in the DEMO Oracle database schema.
- `Content-Type: application/sql` is the content type. Only `application/sql` and `application/json` are supported.
- `https://localhost:8088/ords/demo/_/sql` is the location of the REST Enabled SQL service for the `demo` Oracle Database schema.

C.1.2 Using a File with cURL

For multi line SQL statements, using a file as payload data in requests is useful.

File: `simple_query.sql`

```
SELECT 10
FROM dual;
```

Request:

```
curl -i -X POST --user DEMO:demo --data-binary "@simple_query.sql" -H "Content-
Type: application/sql" -k https://localhost:8088/ords/demo/_/sql
```

Response:

```
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked

{
    "env":{
        "defaultTimeZone":"Europe/London"
    },
    "items":[
        {
            "statementId":1,
            "statementType":"query",
            "statementPos":{
                "startLine":1,
                "endLine":1
            },
            "statementText":"SELECT 10 FROM dual",
            "response":[

            ],
            "result":0,
            "resultSet":{
                "metadata":[
                    {
                        "columnName":"10",
                        "jsonColumnName":"10",
                        "columnTypeName":"NUMBER",
                        "precision":0,
                        "scale":-127,
                        "isNullable":1
                    }
                ],
                "items":[
                    {
                        "10":10
                    }
                ],
                "hasMore":false,
                "limit":1500,
                "offset":0,
                "count":1
            }
        }
    ]
}
```

C.1.3 Using Multiple SQL Statements

You can run one or more statements in each POST request. Statements are separated similar to Oracle database SQL*Plus script syntax, such as, end of line for SQL*Plus statements, a semi colon for SQL statements and forward slash for PL/SQL statements.

File: **`script.sql`**:

```
CREATE TABLE T1 (col1 INT);

DESC T1
```

```
INSERT INTO T1 VALUES(1);

SELECT * FROM T1;

BEGIN

INSERT INTO T1 VALUES(2);

END;

/

SELECT * FROM T1;
```

Request:`curl -i -X POST --user DEMO:demo --data-binary "@script.sql" -H "Content-Type: application/sql" -k https://localhost:8088/ords/demo/_/sql`

Response:

```
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked

{
    "env":{
        "defaultTimeZone":"Europe/London"
    },
    "items":[
        {
            "statementId":1,
            "statementType":"ddl",
            "statementPos":{
                "startLine":1,
                "endLine":1
            },
            "statementText":"CREATE TABLE T_EXAMPLE1 (col1 INT)",
            "response":[
                "\nTable T_EXAMPLE1 created.\n\n"
            ],
            "result":0
        },
        {
            "statementId":2,
            "statementType":"sqlplus",
            "statementPos":{
                "startLine":2,
                "endLine":2
            },
            "statementText":"DESC T_EXAMPLE1",
            "response":[
                "Name Null\n Type \n---- ----- ---------- \nCOL1 NUMBER(38) \n"
            ],
            "result":0
        },
        {
            "statementId":3,
            "statementType":"dml",
            "statementPos":{
                "startLine":3,
                "endLine":3
            },
            "statementText":"INSERT INTO T_EXAMPLE1 VALUES(1)",
            "response":[
                "\n1 row inserted.\n\n"
            ],
            "result":1
        },
        {
            "statementId":4,
            "statementType":"query",
            "statementPos":{
                "startLine":4,
                "endLine":4
            },
            "statementText":"SELECT * FROM T_EXAMPLE1",
            "response":[

            ],
            "result":1,
            "resultSet":{
                "metadata":[
                    {
                        "columnName":"COL1",
                        "jsonColumnName":"col1",
                        "columnTypeName":"NUMBER",
                        "precision":38,
                        "scale":0,
                        "isNullable":1
                    }
                ],
                "items":[
                    {
                        "col1":1
                    }
                ],
                "hasMore":false,
                "limit":1500,
                "offset":0,
                " count":1
            }
        },
        {
            "statementId":5,
            "statementType":"plsql",
            "statementPos":{
                "startLine":5,
                "endLine":8
            },
            "statementText":"BEGIN\n INSERT INTO T_EXAMPLE1 VALUES(2);\nEND;",
            "response":[
                "\nPL\/SQL procedure successfully completed.\n\n"
            ],
            "result":1
        },
        {
            "statementId":6,
            "statementType":"query",
            "statementPos":{
                "startLine":9,
                "endLine":9
            },
            "statementText":"SELECT * FROM T_EXAMPLE1",
            "response":[

            ],
            "result":1,
            "resultSet":{
                "metadata":[
                    {
                        "columnName":"COL1",
                        "jsonColumnName":"col1",
                        "columnTypeName":"NUMBER",
                        "precision":38,
                        "scale":0,
                        "isNullable":1
                    }
                ],
                "items":[
                    {
                        "col1":1
                    },
                    {
                        "col1":2
                    }
                ],
                "hasMore":false,
                "limit":1500,
                "offset":0,
                "count":2
            }
        },
        {
            "statementId":7,
            "statementType":"ddl",
            "statementPos":{
                "startLine":10,
                "endLine":10
            },
            "statementText":"DROP TABLE T_EXAMPLE1",
            "response":[
                "\nTable T_EXAMPLE1 dropped.\n\n"
            ],
            "result":1
        }
    ]
}
```

C.2 POST Requests Using `application/json Content-Type`

Using a JSON document as the payload, enables you to define more complex requests as shown in the following examples:

- Using a File with cURL (page C-7)
- Specifying Limit Value in a POST Request for Pagination (page C-8)
- Specifying Offset Value in a POST Request for Pagination (page C-11)
- Defining Binds in a POST Request (page C-14)

C.2.1 Using a File with cURL

The following example POSTs a JSON document (within the `simple_query.json` file) to the REST Enabled SQL service.

File: `simple_query.json`

```
{ "statementText":"SELECT TO_DATE('01-01-1976','dd-mm-yyyy') FROM dual;"}
```

Request: `curl -i -X POST --user DEMO:demo --data-binary "@simple_query.json" -H "Content-Type: application/json" -k https://localhost:8088/ords/demo/_sql`

Where:

- `statementText` holds the SQL statement(s)
- `Content-Type` is `application/json`

Response:

```
HTTP/1.1 200 OK

Content-Type: application/json

X-Frame-Options: SAMEORIGIN

Transfer-Encoding: chunked


{

    "env":{

        "defaultTimeZone":"Europe/London"

    },

    "items":[

        {

            "statementId":1,

            "statementType":"query",

            "statementPos":{

                "startLine":1,

                "endLine":1

            },

            "statementText":"SELECT TO_DATE('01-01-1976','dd-mm-yyyy') FROM dual",

            "response":[


            ],
            "result":0,
            "resultSet":{
                "metadata":[
                    {
                        "columnName":"TO_DATE('01-01-1976','DD-MM-YYYY')",
                        "jsonColumnName":"to_date('01-01-1976','dd-mm-yyyy')",
                        "columnTypeName":"DATE",
                        "precision":0,
                        "scale":0,
                        "isNullable":1
                    }
                ],
                "items":[
                    {
                        "to_date('01-01-1976','dd-mm-yyyy')":"1976-01-01T00:00:00Z"
                    }
                ],
                "hasMore":false,
                "limit":1500,
                "offset":0,
                "count":1
            }
        }
    ]
}
```

C.2.2 Specifying Limit Value in a POST Request for Pagination

You can specify `limit` value in a POST JSON request for pagination of a large result set returned from a query.

File: `limit.json`

```
{
 "statementText": "
 WITH data(r) AS (

 SELECT 1 r FROM dual

 UNION ALL

 SELECT r+1 FROM data WHERE r < 100

 )

 SELECT r FROM data;",

 "limit": 5

}
```

Request: `curl -i -X POST --user DEMO:demo --data-binary "@offset_limit.json" -H "Content-Type: application/json" -k https://localhost:8088/ords/demo/_sql`

Where: `limit` is the maximum number of rows returned from a query.

> **Note:**
>
> The maximum number of rows returned from a query is based on the `jdbc.maxRows` value set in `default.xml` file.

Response:

```
HTTP/1.1 200 OK

Content-Type: application/json

X-Frame-Options: SAMEORIGIN

Transfer-Encoding: chunked


 {

    "env":{

        "defaultTimeZone":"Europe/London"

    },

    "items":[

        {

            "statementId":1,

            "statementType":"query",

            "statementPos":{

                "startLine":1,
                "endLine":1

            },

            "statementText":" WITH data(r) AS ( SELECT 1 r FROM dual UNION ALL
SELECT r+1 FROM data WHERE r < 100 ) SELECT r FROM data",

            "response":[



            ],

            "result":0,

            "resultSet":{

                "metadata":[

                    {

                        "columnName":"R",

                        "jsonColumnName":"r",

                        "columnTypeName":"NUMBER",

                        "precision":0,

                        "scale":-127,

                        "isNullable":1

                    }

                ],

                "items":[

                    {

                        "r":1

                    },

                    {

                        "r":2

                    },

                    {

                        "r":3

                    },

                    {

                        "r":4
                    },

                    {

                        "r":5

                    }

                ],

                "hasMore":true,

                "limit":5,

                "offset":0,

                "count":5

            }

        }

    ]

}
```

Related Topics:

- Configuring Maximum Number of Rows Returned from a Query (page 2-6)
  This section explains how to configure the maximum number of rows returned from a query.

C.2.3 Specifying Offset Value in a POST Request for Pagination

You can specify `offset` value in a POST JSON request. This value specifies the first row that need to be returned and is used for pagination of the result set returned from a query.

File: `offset_limit.json`

```
{
 "statementText": "
 WITH data(r) AS (
 SELECT 1 r FROM dual
 UNION ALL
 SELECT r+1 FROM data WHERE r < 100
 )
 SELECT r FROM data;",
 "offset": 25,
 "limit": 5
}
```

Request: `curl -i -X POST --user DEMO:demo --data-binary "@offset_limit.json" -H "Content-Type: application/json" -k https://localhost:8088/ords/demo/_sql`

Where: `offset` is the first row to be returned in the result set. Typically, this is used to provide pagination for a large result set that returns the **next** page of rows in the result set.

> **Note:**
>
> Each request made to the REST Enabled SQL service is performed in its own transaction. So, you cannot ensure that the rows returned will match with the previous request. To avoid such risks, queries that need pagination should use the ORDER BY clause on a Primary Key.

Response:

```
HTTP/1.1 200 OK

Content-Type: application/json

X-Frame-Options: SAMEORIGIN

Transfer-Encoding: chunked


 {

    "env":{

        "defaultTimeZone":"Europe/London"

    },

    "items":[

        {

            "statementId":1,

            "statementType":"query",

            "statementPos":{

                "startLine":1,

                "endLine":1

            },

            "statementText":" WITH data(r) AS ( SELECT 1 r FROM dual UNION ALL
SELECT r+1 FROM data WHERE r < 100 ) SELECT r FROM data",

            "response":[


            ],

            "result":0,

            "resultSet":{

                "metadata":[

                    {
```

```
            "columnName":"R",
            "jsonColumnName":"r",
            "columnTypeName":"NUMBER",
            "precision":0,
            "scale":-127,
            "isNullable":1
        }
    ],
    "items":[
        {
            "r":26
        },
        {
            "r":27
        },
        {
            "r":28
        },
        {
            "r":29
        },
        {
            "r":30
        }
    ],
    "hasMore":true,
    "limit":5,
    "offset":25,
    "count":5
}
```

```
        }
    ]
}
```

C.2.4 Defining Binds in a POST Request

You can define binds in JSON format. This functionality is useful when calling procedures and functions that use binds as the parameters.

File: `binds.json`

```
{
 "statementText": "CREATE PROCEDURE TEST_OUT_PARAMETER (V_PARAM_IN INT IN,
V_PARAM_OUT INT OUT) AS BEGIN V_PARAM_OUT := V_PARAM_IN + 10; END;
/
EXEC TEST_OUT_PARAMETER(:var1, :var2)",
 "binds":[
 {"name":"var1","data_type":"NUMBER","value":10},
 {"name":"var2","data_type":"NUMBER","mode":"out"}
 ]
}
```

Request: `curl -i -X POST --user DEMO:demo --data-binary "@binds.json" -H "Content-Type: application/json" -k https://localhost:8088/ords/demo/_sql`

Response:

```
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked


 {
    "env":{
        "defaultTimeZone":"Europe/London"
    },
    "items":[
        {
            "statementId":1,
            "statementType":"plsql",
            "statementPos":{
                "startLine":1,
                "endLine":2
            },
            "statementText":"CREATE PROCEDURE TEST_OUT_PARAMETER (V_PARAM_IN IN INT,
V_PARAM_OUT OUT INT) AS BEGIN V_PARAM_OUT := V_PARAM_IN + 10; END;",
            "response":[
                "\nProcedure TEST_OUT_PARAMETER compiled\n\n"
            ],
            "result":0,
            "binds":[
                {
                    "name":"var1",
                    "data_type":"NUMBER",
                    "value":10
                },
                {
                    "name":"var2",
                    "data_type":"NUMBER",
                    "mode":"out",
                    "result":null
                }
            ]
        },
        {
            "statementId":2,
            "statementType":"sqlplus",
            "statementPos":{
                "startLine":3,
                "endLine":3
            },

            "statementText":"EXEC TEST_OUT_PARAMETER(:var1, :var2)",

            "response":[

                "\nPL\/SQL procedure successfully completed.\n\n"

            ],

            "result":0,

            "binds":[

                {

                    "name":"var1",

                    "data_type":"NUMBER",

                    "value":10

                },

                {

                    "name":"var2",

                    "data_type":"NUMBER",

                    "mode":"out",

                    "result":20

                }

            ]

        }

    ]

}
```

C.3 Example POST Request with DATE and TIMESTAMP Format

Example C-1 Example Where ORDS time zone is set as Europe/London

Oracle Database DATE and TIMESTAMP data types do not have a time zone associated with them. The DATE and TIMESTAMP values are associated with the time zone of the application. Oracle REST Data Services (ORDS) and REST Enabled SQL service return values in a JSON format. The standard for JSON is to return date and timestamp values using the UTC Zulu format. ORDS and REST Enabled SQL service return Oracle Database DATE and TIMESTAMP values in the Zulu format using the time zone in which ORDS is running. So the zoneless values stored in the Oracle Database can be interpreted and generated.

Oracle recommends to run ORDS using the UTC time zone to make this process easier.

File: `date.json`

```
{
    "statementText":"SELECT TO_DATE('2016-01-01 10:00:03','yyyy-mm-dd hh24:mi:ss' )
winter, TO_DATE('2016-07-01 10:00:03','yyyy-mm-dd hh24:mi:ss' ) summer FROM dual;"
}
```

Request: `curl -i -X POST --user DEMO:demo --data-binary "@date.json" -H "Content-Type: application/json" -k https://localhost:8088/ords/demo/_/sql`

Response:

Note:

In this example both DATE values are specified as 10 a.m. The `"summer"` value is returned as 9 a.m. Zulu time. This is due to British Summer Time.

```
HTTP/1.1 200 OK

Date: Wed, 26 Jul 2017 14:59:27 GMT

Content-Type: application/json

X-Frame-Options: SAMEORIGIN

Transfer-Encoding: chunked

Server: Jetty(9.2.21.v20170120)


 {

 "env":{

 "defaultTimeZone":"Europe/London"

 },

 "items":[

 {

 "statementId":1,

 "statementType":"query",

 "statementPos":{

 "startLine":1,

 "endLine":1

 },
 "statementText":"SELECT TO_DATE('2016-01-01 10:00:03','yyyy-mm-dd hh24:mi:ss' )
winter, TO_DATE('2016-07-01 10:00:03','yyyy-mm-dd hh24:mi:ss' ) summer FROM dual",

 "response":[

],

 "result":0,

 "resultSet":{

 "metadata":[

 {

 "columnName":"WINTER",

 "jsonColumnName":"winter",

 "columnTypeName":"DATE",

 "precision":0,

 "scale":0,

 "isNullable":1

 },

 {

 "columnName":"SUMMER",

 "jsonColumnName":"summer",

 "columnTypeName":"DATE",

 "precision":0,

 "scale":0,

 "isNullable":1

 }

 ],

 "items":[

 {

 "winter":"2016-01-01T10:00:03Z",

 "summer":"2016-07-01T09:00:03Z"

 }

 ],

 "hasMore":false,
 "limit":1500,

 "offset":0,

 "count":1

 }

 }

 ]

}
```

C.4 Data Types and the Formats Supported

Following code snippet shows the different data types and the formats supported:

```
{

"statementText":"SELECT ?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?,?
,?,?,?,?,?,?,?,?,?,?,?,?,?,? FROM dual",

    "binds":[

        {

            "index":1,

            "data_type":"NUMBER",

            "value":1233

        },

        {

            "index":2,

            "data_type":"NUMERIC",

            "value":123

        },

        {

            "index":3,

            "data_type":"DECIMAL",

            "value":123

        },

        {

            "index":4,
            "data_type":"DEC",
            "value":123
        },
        {
            "index":5,
            "data_type":"NUMBER",
            "value":123
        },
        {
            "index":6,
            "data_type":"INTEGER",
            "value":123
        },
        {
            "index":7,
            "data_type":"INT",
            "value":123
        },
        {
            "index":8,
            "data_type":"SMALLINT",
            "value":123
        },
        {
            "index":9,
            "data_type":"FLOAT",
            "value":123
        },
        {
            "index":10,
            "data_type":"DOUBLE PRECISION",
            "value":123
        },
        {
            "index":11,
            "data_type":"REAL",
            "value":123
        },
        {
            "index":12,
            "data_type":"BINARY_FLOAT",
            "value":123
        },
        {
            "index":13,
            "data_type":"BINARY_DOUBLE",
            "value":123
        },
        {
            "index":14,
            "data_type":"CHAR",
            "value":"abc"
        },
        {
            "index":15,
            "data_type":"CHARACTER",
            "value":"abc"
        },
        {
            "index":16,
            "data_type":"VARCHAR",
            "value":"abc"
        },
        {
            "index":17,
            "data_type":"VARCHAR2",
            "value":"abc"
        },
        {
            "index":18,
            "data_type":"CHAR VARYING",
            "value":"abc"
        },
        {
            "index":19,
            "data_type":"CHARACTER VARYING",
            "value":"abc"
        },
        {
            "index":20,
            "data_type":"NCHAR",
            "value":"abc"
        },
        {
            "index":21,
            "data_type":"NATIONAL CHAR",
            "value":"abc"
        },
        {
            "index":22,
            "data_type":"NATIONAL CHARACTER",
            "value":"abc"

        },

        {

            "index":23,

            "data_type":"NVARCHAR",

            "value":"abc"

        },

        {

            "index":24,

            "data_type":"NVARCHAR2",

            "value":"abc"

        },

        {

            "index":25,

            "data_type":"NCHAR VARYING",

            "value":"abc"

        },

        {

            "index":26,

            "data_type":"NATIONAL CHAR VARYING",

            "value":"abc"

        },

        {

            "index":27,

            "data_type":"NATIONAL CHARACTER VARYING",

            "value":"abc"

        },

        {

            "index":28,

            "data_type":"DATE",

            "value":"01-Jan-2016"
```

```
},
{
    "index":29,
    "data_type":"TIMESTAMP",
    "value":"1976-02-01T00:00:00Z"
},
{
    "index":30,
    "data_type":"TIMESTAMP",
    "value":"1976-02-01T00:00:00Z"
},
{
    "index":31,
    "data_type":"TIMESTAMP WITH LOCAL TIME ZONE",
    "value":"1976-02-01T00:00:00Z"
},
{
    "index":32,
    "data_type":"TIMESTAMP WITH TIME ZONE",
    "value":"1976-02-01T00:00:00Z"
},
{
    "index":33,
    "data_type":"INTERVALYM",
    "value":"P10Y10M"
},
{
    "index":34,
    "data_type":"INTERVAL YEAR TO MONTH",
    "value":"P10Y10M"
```

```
},
{
    "index":35,
    "data_type":"INTERVAL YEAR(2) TO MONTH",
    "value":"P10Y10M"
},
{
    "index":36,
    "data_type":"INTERVALDS",
    "value":"P11DT10H10M10S"
},
{
    "index":37,
    "data_type":"INTERVAL DAY TO SECOND",
    "value":"P11DT10H10M10S"
},
{
    "index":38,
    "data_type":"INTERVAL DAY(2) TO SECOND(6)",
    "value":"P11DT10H10M10S"
},
{
    "index":39,
    "data_type":"ROWID",
    "value":1
},
{
    "index":40,
    "data_type":"RAW",
    "value":"AB"
},
            {
                "index":41,
                "data_type":"LONG RAW",
                "value":"AB"
            },
            {
                "index":42,
                "data_type":"CLOB",
                "value":"clobvalue"
            },
            {
                "index":43,
                "data_type":"NCLOB",
                "value":"clobvalue"
            },
            {
                "index":45,
                "data_type":"LONG",
                "value":"A"
            }
        ]
    }
```

D

Supported SQL, SQL*Plus and SQLcl Statements

This appendix lists all the supported SQL, SQL*Plus and SQLcl statements for REST Enabled SQL service.

Topics

D.1 Supported SQL Statements

This section describes the SQL statements that the REST Enabled SQL service supports.

REST Enabled SQL service supports all SQL commands. If the specified Oracle database schema has the appropriate privileges, then you can run them. ORDS makes all queries into in-line views before execution to provide pagination support. Queries are made in-line irrespective of the format in which you provide the query. All the other nonquery SQL statements are executed as they are.

In-line views have the following limitations:

- All column names in a query must be unique as the views and in-line views cannot have ambiguous column names
- Cursor expressions are not displayed in view or in-line views

Related Topics:

- http://docs.oracle.com/database/122/SQLQR/SQL-Statements.htm#SQLQR109

D.2 Supported PL/SQL Statements

The REST Enabled SQL service supports PL/SQL statements and blocks.

Example D-1 PL/SQL Statement

```
DECLARE v_message VARCHAR2(100) := 'Hello World';

BEGIN

  FOR i IN 1..3 LOOP

    DBMS_OUTPUT.PUT_LINE (v_message);
  END LOOP;

END;

/
```

Related Topics:

- http://docs.oracle.com/database/122/LNPLS/block.htm#LNPLS01303

D.3 Supported SQL*Plus Statements

This section lists all the SQL*Plus statements that the REST Enabled SQL service supports.

REST Enabled SQL service supports most of the SQL*Plus statements except those statements that are related to formatting. The specific Oracle database schema must have the appropriate privileges to run the SQL*Plus statemments.

Following is a list of supported SQL*Plus statements:

- `SET system_variable value`

> **Note:**
>
> `system_variable` and `value` represent one of the clauses described in Set System Variables (page D-3) section.

- `/ (slash)`
- `COPY {FROM database | TO database | FROM database TO database} {APPEND | CREATE | INSERT | REPLACE} destination_table[(column, column, column, ...)] USING query`
- `DEF[INE] [variable] | [variable = text]`
- `DESC[RIBE] {[schema.]object[@connect_identifier]}`
- `EXEC[UTE] statement`
- `HELP | ? [topic]`
- `PASSW[ORD] [username]`
- `PRINT [variable ...]`
- `PRO[MPT] [text]`
- `REM[ARK]`
- `SHO[W] [option]`
- `TIMI[NG] [START text | SHOW | STOP]`
- `UNDEF[INE] variable ...`
- `VAR[IABLE] [variable [type][=value]]`
- `WHENEVER OSERROR {EXIT [SUCCESS | FAILURE | n | variable | :BindVariable] [COMMIT | ROLLBACK] | CONTINUE[COMMIT | ROLLBACK | NONE]}`

- `WHENEVER SQLERROR {EXIT [SUCCESS | FAILURE | WARNING | n | variable | :BindVariable] [COMMIT | ROLLBACK] | CONTINUE [COMMIT | ROLLBACK | NONE]}`
- `XQUERY xquery_statement`

Related Topics:

- https://docs.oracle.com/database/122/SQPUG/SQL-Plus-command-summary.htm#SQPUG02345

D.3.1 Set System Variables

Following is a list of possible values for `system_variable` and `value`:

- `SET APPI[NFO]{ON | OFF | text}`
- `SET AUTOP[RINT] {ON | OFF}`
- `SET AUTOT[RACE] {ON | OFF | TRACE[ONLY]} [EXP[LAIN]] [STAT[ISTICS]]`
- `SET BLO[CKTERMINATOR] {. | c | ON | OFF}`
- `SET CMDS[EP] {; | c | ON | OFF}`
- `SET COLINVI[SIBLE] [ON | OFF]`
- `SET CON[CAT] {. | c | ON | OFF}`
- `SET COPYC[OMMIT] {0 | n}`
- `SET DEF[INE] {& | c | ON | OFF}`
- `SET DESCRIBE [DEPTH {1 | n | ALL}] [LINENUM {ON | OFF}] [INDENT {ON | OFF}]`
- `SET ECHO {ON | OFF}`
- `SET ERRORL[OGGING] {ON | OFF} [TABLE [schema.]tablename] [TRUNCATE] [IDENTIFIER identifier]`
- `SET ESC[APE] {\ | c | ON | OFF}`
- `SET FEED[BACK] {6 | n | ON | OFF | ONLY}]`
- `SET SERVEROUT[PUT] {ON | OFF} [SIZE {n | UNL[IMITED]}] [FOR[MAT] {WRA[PPED] | WOR[D_WRAPPED] | TRU[NCATED]}]`
- `SET SHOW[MODE] {ON | OFF}`
- `SET SQLBL[ANKLINES] {ON | OFF}`
- `SET SQLP[ROMPT] {SQL> | text}`
- `SET TI[ME] {ON | OFF}`
- `SET TIMI[NG] {ON | OFF}`
- `SET VER[IFY] {ON | OFF}`
- `SET XQUERY BASEURI {text}`
- `SET XQUERY ORDERING {UNORDERED | ORDERED | DEFAULT}`
- `SET XQUERY NODE {BYVALUE | BYREFERENCE | DEFAULT}`
- `SET XQUERY CONTEXT {text}`

Related Topics:

- https://docs.oracle.com/database/122/SQPUG/SET-system-variable-summary.htm#SQPUG060

D.3.2 Show System Variables

This section lists the possible values for `option` which is either a term or a clause used in `SHO[W] option` command.

Following is a list of possible values for `option` variable:

- `SHOW system_variable`
- `SHOW EDITION`
- `SHOW ERR[ORS] [ { ANALYTIC VIEW | ATTRIBUTE DIMENSION | HIERARCHY | FUNCTION | PROCEDURE | PACKAGE | PACKAGE BODY | TRIGGER | VIEW | TYPE | TYPE BODY | DIMENSION | JAVA CLASS } [schema.]name]`
- `SHOW PDBS`
- `SHOW SGA`
- `SHOW SQLCODE`
- `SHOW COLINVI[SIBLE]`
- `SHOW APPIN[FO]`
- `SHOW AUTOT[RACE]`
- `SHOW BINDS`
- `SHOW BLO[CK TERMINATOR]`
- `SHOW CMDSEP`
- `SHOW COPYTYPECHECK`
- `SHOW COPYCOMMIT`
- `SHOW DEFINE`
- `SHOW DEFINES`
- `SHOW DESCR[IBE]`
- `SHOW ECHO`
- `SHOW EDITION`
- `SHOW ERRORL[OGGING]`
- `SHOW ESC[APE]`
- `SHOW FEEDBACK`
- `SHOW CONCAT`
- `SHOW SHOW[MODE]`
- `SHOW RECYC[LEBIN]`
- `SHOW RELEASE`
- `SHOW SQLBL[ANKLINES]`
- `SHOW SCAN`

- `SHOW SERVEROUT[PUT]`
- `SHOW SPACE`
- `SHOW TABLES`
- `SHOW TIMI[NG]`
- `SHOW USER`
- `SHOW VER[IFY]`
- `SHOW XQUERY`

Related Topics:

- https://docs.oracle.com/database/122/SQPUG/SHOW.htm#SQPUG124

D.4 Supported SQLcl Statements

This section lists the SQLcl statements that the REST Enabled SQL service supports.

REST Enabled SQL service supports some of the SQLcl statements. The specific Oracle database schema must have the appropriate privileges to run the SQLcl statements.

Following is a list of supported SQLcl statements:

- `CTAS`
- `DDL`
- `SET DDL`

E

Troubleshooting Oracle REST Data Services

This appendix contains information on troubleshooting Oracle REST Data Services.

Topics:

E.1 Enabling Debug Tracing

To enable debug tracing, add the following setting to the Oracle REST Data Services configuration file named: `defaults.xml`:

```
<entry key="debug.debugger">true</entry>
```

When this setting is present in `defaults.xml`, detailed logging information that may help with problem diagnosis is appended to the Oracle REST Data Services log output. This setting should not be enabled on production systems due to the performance impact of outputting large amounts of data to the log.

E.2 Enabling Detailed Request Error Messages

To enable detailed request error messages, add the following setting to the Oracle REST Data Services configuration file named: `defaults.xml`:

```
<entry key="debug.printDebugToScreen">true</entry>
```

When this setting is present in `defaults.xml`, any request that produces an error response includes a detailed message, including a stack trace. This setting must not be enabled on productions systems due to the risk of sensitive information being revealed to an attacker.

E.3 Configuring Application Express Static Resources with Oracle REST Data Services

When using Oracle REST Data Services, a blank page might be displayed when attempting to access an Oracle Application Express page, for example, when attempting to display `https://example/ords/`. This problem is caused by an improper configuration of Application Express static resources, which causes the JavaScript and CSS resources required by Application Express not to be found and the Application Express page not to render correctly.

The specific cause can be any of the following:

- Forgetting to ensure that the Application Express static images are located on the same server as the Oracle REST Data Services instance
- Forgetting to deploy `i.war` on WebLogic Server or GlassFish
- Specifying an incorrect path when using the `java -jar ords.war static` command to generate `i.war`
- Configuring Application Express to use a nondefault context path for static resources (`/i`) and not specifying the same context path (using the `--context-path` option) when using `java -jar ords.war static`
- Moving, renaming, or deleting the folder pointed to by `i.war` after deploying `i.war`
- When running in Standalone mode, entering an incorrect path (or not specifying a path) when prompted on the first run of Standalone mode
- When running in Standalone mode, entering an incorrect path with the `--static-images` option
- Upgrading to a new version of Application Express and forgetting to reconfigure and redeploy `i.war` to point to the static resources for the new Application Express version, or in Standalone mode forgetting to update the location by using the `--apex-images` option

To help in diagnosing the problem, you can try to access the `apex_version.txt` file. For example, if your Application Express deployment is located at `https://example.com/ords/` and your static resources have been deployed at `https://example.com/i/`, use a browser to access the following URL:

```
https://example.com/i/apex_version.txt
```

If you get a `404 Not Found` error, then check the preceding list of possible specific causes, including `i.war` not being deployed or not pointing to a folder containing Application Express static resources.

If a plain text file is displayed, it should contain text like the following:

```
Application Express Version:  4.2.1
```

Check that the version number matches the version of Application Express that is deployed on the database. If the numbers do not match, check if you have made an error mentioned in the last item in the preceding list of possible specific causes, because Oracle REST Data Services is not configured to use the correct version of the Application Express static resources to match the Application Express version in the database.

If you need help in solving the problem, check the information in this book about creating and deploying `i.war` for your environment, such as WebLogic Server or Glassfish.

You can also get detailed help on the static listener command by entering the following at a command prompt:

```
java -jar ords.war help static
```

F

Development Tutorial: Creating an Image Gallery

This appendix explains an extended example that builds an image gallery service for storing and retrieving images. This tutorial uses Oracle Application Express.

Topics:

See Also:

To do this tutorial, you must be familiar with the concepts and techniques covered in Developing Oracle REST Data Services Applications (page 3-1).

F.1 Before You Begin

This section describes some common conventions used in this example as well as best practices regarding API entry points.

Topics:

F.1.1 About URIs

Throughout this example, URIs and URI Templates are referenced using an abbreviated form that omits the host name, context root and workspace path prefix. Consider the following example:

```
gallery/images/
```

To access this URI in your Web browser, you would use a URI in the following format:

```
https://<host>:<port>/ords/<workspace>/gallery/images/
```

where

- `<host>` is the host on which Oracle REST Data Services is running.
- `<port>` is the port on which Oracle REST Data Services is listening.
- `/ords` is the context root where Oracle REST Data Services is deployed.
- `/<workspace>/` is the workspace path prefix of the Oracle Application Express workspace where the RESTful Service is defined.

F.1.2 About Browser Support

This example uses many modern features defined in HTML5 and related specifications. It has only been tested in Mozilla Firefox and Google Chrome. It has not been tested in Microsoft Internet Explorer or on smart-phone/tablet web browsers. Please use recent versions of either Mozilla Firefox or Google Chrome for this example.

F.1.3 Creating an Application Express Workspace

To follow the instructions for creation the Gallery example application and related objects, first, create a new Oracle Application Express Workspace (in Full Development mode). See the Oracle Application Express Documentation for details on how to do this.

Call the workspace `resteasy` and call the administrator user of the workspace `resteasy_admin`. Ensure the `resteasy_admin` user is a a member of the `RESTful Services` user group.

F.2 Creating the Gallery Database Table

To create the Gallery database table, follow these steps:

1. Log into the `resteasy` workspace.
2. Navigate to **SQL Workshop** and then **SQL Commands**.
3. Enter or copy and paste in the following SQL:

```
CREATE SEQUENCE GALLERY_SEQ
/
CREATE TABLE GALLERY (
  ID NUMBER NOT NULL ENABLE,
  TITLE VARCHAR2(1000) NOT NULL ENABLE,
  CONTENT_TYPE VARCHAR2(1000) NOT NULL ENABLE,
  IMAGE BLOB NOT NULL ENABLE,
  CONSTRAINT GALLERY_PK PRIMARY KEY (ID) ENABLE
)
/
CREATE OR REPLACE TRIGGER BI_GALLERY
 before insert on GALLERY for each row
 begin
  if :NEW.ID is null then
   select GALLERY_SEQ.nextval into :NEW.ID from sys.dual;
  end if;
```

```
end;
/
ALTER TRIGGER BI_GALLERY ENABLE
/
```

F.3 Creating the Gallery RESTful Service Module

To create the Gallery RESTful services module, follow these steps:

1. Navigate to **SQL Workshop** and then **RESTful Services**.
2. Click **Create** on the right side, and enter the following information:
   - **Name**: `gallery.example`
   - **URI Prefix**: `gallery/`
   - **URI Template**: `images/`
   - **Method**: `POST`
   - **Source**: Enter or copy and paste in the following:

   ```
   declare
    image_id integer;
   begin
    insert into gallery (title,content_type,image)
                values  (:title,:content_type,:body)
                returning id into image_id;
    :status := 201;
    :location := image_id;
   end;
   ```
3. Click **Create Module**.
4. Click the `POST` handler under `images/`
5. For **Requires Secure Access**, select `No`.
6. Click **Create Parameter**, and enter the following:
   - **Name**: `Slug`
   - **Bind Variable Name**: `title`
7. Click **Create**.
8. Click **Create Parameter** on the bottom right, and enter the following information:
   - **Name**: `X-APEX-FORWARD`
   - **Bind Variable Name**: `location`
   - **Access Method**: `OUT`
9. Click **Create**.
10. Click **Create Parameter** on the bottom right, and enter the following information:
    - **Name**: `X-APEX-STATUS-CODE`
    - **Bind Variable Name**: `status`
    - **Access Method**: `OUT`
    - **Parameter Type**: `Integer`
11. Click **Create**.

At this point you have created the module with a single service that can store new images. Next, add a service to display the list of stored images:

1. Navigate to **SQL Workshop** and then **RESTful Services**.
2. Click the module named `gallery.example`.
3. Click **Create Handler** under `images/`, and enter the following information:
   - **Method**: `GET`
   - **Source Type**: `Feed`
   - **Requires Secure Access**: `No`
   - **Source**: Enter or copy and paste in the following:

     ```
     select id,title,content_type from gallery order by id desc
     ```
4. Click **Create**.

At this point you have created the service to store and list images. Next, add a service to display individual images:

1. Navigate to **SQL Workshop** and then **RESTful Services**.
2. Click the module named `gallery.example`.
3. Click **Create Template** under gallery.example, and enter the following information:
   - **URI Template**: `images/{id}`
4. Click **Create**.
5. Click **Create Handler** under images/{id}, and enter the following information:
   - **Method**: `GET`
   - **Source Type**: `Media Resource`
   - **Requires Secure Access**: `No`
   - **Source**: Enter or copy and paste in the following:

     ```
     select content_type, image from gallery where id = :id
     ```
6. Click **Create**.

F.4 Trying Out the Gallery RESTful Service

To try out the Gallery RESTful Service, follow these steps:

1. Navigate to **SQL Workshop** and then **RESTful Services**.
2. Click the module named `gallery.example`.
3. Click the `GET` handler located under `images/`.
4. Click **Test**.

   The following URI should be displayed in the browser:

   ```
   https://<host>:<port>/ords/resteasy/gallery/images/
   ```

   Content similar to the following should be displayed:

   ```
   {"next":
    {"$ref":
     "http://localhost:8080/ords/resteasy/gallery/images/?page=1"
   ```

```
 },
 "items":[]
}
```

- The content is a JSON document that lists the location of each image in the gallery, but since you have not yet added any images, the list (the `items[]` element) is empty.
- The JSON has no extra white space to minimize its size, this can make it difficult to decipher, it is recommended to add a JSON viewing plugin to your browser to make viewing the JSON easier.

To create an Oracle Application Express application to enable users to add and view images in the gallery, see Creating the Gallery Application (page F-5).

F.5 Creating the Gallery Application

To create an Oracle Application Express application that uses the gallery RESTful Services, follow these steps:

1. Navigate to **Application Builder**.
2. Click **Create**.
3. Choose `Database`, then click **Next**.
4. Enter `Image Gallery` in the **Name** field, then click **Next**.
5. Click **Create Application**, and then **Create Application** again to confirm creation of the application.
6. Click `page 1, Home`.
7. Under **Regions** click the + (plus sign) icon to create a new region.
8. For **Region Type**, choose `HTML` and click **Next**, then click **Next** on the next page.
9. For **Region Template**, choose `No Template`.
10. For **Title**, enter `Tasks`, and click **Next**.
11. For **Enter HTML Text Region Source**, specify:

    ```
    <a class="button" id="upload-btn">Upload Image</a>
    ```
12. Click **Create Region**.
13. Under **Regions**, click the + (plus sign) icon to create a new region.
14. For **Region Type**, choose `HTML`, and click Next, then Next again.
15. For **Region Template**, choose `DIV Region with ID`.
16. For **Title**, enter `Images`.
17. Click **Create Region**.
18. Click the `Images` region and click the **Attributes** tab.
19. For **Static ID**, enter `images`, and click **Apply Changes**.
20. Under **Page**, click the Edit icon, then click the **JavaScript** tab.
21. For **Function and Global Variable Declaration**, enter or copy and paste in the following:

```
var workspace_path_prefix = 'resteasy';
 var gallery_url = './' + workspace_path_prefix + '/gallery/images/';
 function uploadFiles(url, fileOrBlob, onload) {
  var name = 'unspecified';
  if ( fileOrBlob['name'] ) {
   name = fileOrBlob.name;
  }
  var xhr = new XMLHttpRequest();
  xhr.open('POST', url, true);
  xhr.setRequestHeader('Slug',name);
  xhr.onload = onload;
  xhr.send(fileOrBlob);
 }

 function createUploader() {
  var $upload = $('<div id="uploader" title="Image Upload"\
   style="display:none">\
   <form>\
    <fieldset>\
     <label for="file">File</label>\
     <input type="file" name="file" id="file"\
      class="text ui-widget-content ui-corner-all"/>\
    </fieldset>\
   </form>\
  </div>');
  $(document.body).append($upload);
  $upload.dialog({
   autoOpen:false,
   modal: true,
   buttons: {
    "Upload": function() {
     var file = document.querySelector('input[type="file"]');
     uploadFiles(gallery_url,file.files[0],function() {
      $('#uploader').dialog("close");
      getImages();
     });
    },
    "Cancel": function() {
     $('#uploader').dialog("close");
    }
   }
  });
  $('#upload-btn').click(function() {
   $('#uploader').dialog("open");
  });
 }

 function getImages() {
  var xhr = new XMLHttpRequest();
  xhr.open('GET', gallery_url);
  xhr.onload = function(e) {
   var data = JSON.parse(this.response);
   $('#image-list').remove();
   var $images = $('<ol id="image-list"></ol>');
   for ( i in data.items ) {
    var item = data.items[i];
    var uri = item.uri['$ref'];
    var $image = $('<li></li>')
                  .append('<a href="' + uri + '" + title="' +
                          item.title + '"><img src="graphics/'+ uri +
                          '"></a>');
    $images.append($image);
   }
   $('#images').append($images);
  }
  xhr.send();
 }
```

22. For Execute when Page Loads, enter or copy and paste in the following:

```
createUploader();
getImages();
```

23. Click **Apply Changes**.
24. Under **Page**, click the Edit icon, then click the **CSS** tab.
25. For **Inline**, enter or copy and paste in the following:

```
a img { border:none; }
#images ol { margin: 1em auto; width: 100%; }
#images li { display: inline; }
#images a { background: #fff; display: inline; float: left;
            margin: 0 0 27px 30px; width: auto; padding: 10px 10px 15px;
            textalign: center; text-decoration: none; color: #333;
            font-size: 18px; -webkit-box-shadow: 0 3px 6px rgba(0,0,0,.25);
            -moz-boxshadow: 0 3px 6px rgba(0,0,0,.25); }
#images img { display: block; width: 190px; margin-bottom: 12px; }
label {font-weight: bold; text-align: right;float: left;
       width: 120px; margin-right: 0.625em; }
label :after {content(":")}
input, textarea { width: 250px; margin-bottom: 5px;textalign: left}
textarea {height: 150px;}
br { clear: left; }
#images a:after { content: attr(title); }
.button {
  border-top: 1px solid #96d1f8;
  background: #65a9d7;
  background:
   -webkit-gradient(linear,left top,left bottom,
                    from(#3e779d),to(#65a9d7));
  background:
   -webkit-linear-gradient(top, #3e779d, #65a9d7);
  background:
   -moz-linear-gradient(top, #3e779d, #65a9d7);
  background: -ms-linear-gradient(top, #3e779d, #65a9d7);
  background: -o-linear-gradient(top, #3e779d, #65a9d7);
  padding: 5px 10px;
  -webkit-border-radius: 8px;
  -moz-border-radius: 8px;
  border-radius: 8px;
  -webkit-box-shadow: rgba(0,0,0,1) 0 1px 0;
  -moz-box-shadow: rgba(0,0,0,1) 0 1px 0;
  box-shadow: rgba(0,0,0,1) 0 1px 0;
  text-shadow: rgba(0,0,0,.4) 0 1px 0;
  color: white;
  font-size: 14px;
  text-decoration: none;
  vertical-align: middle;
  }

 .button:hover {
  border-top-color: #28597a;
  background: #28597a;
  color: #ccc;
  cursor: pointer;
 }

 .button:active {
  border-top-color: #1b435e;
  background: #1b435e;
 }
```

26. Click **Apply Changes**.

F.6 Trying Out the Gallery Application

To try out the Gallery application, follow these steps:

1. Navigate to Application Builder.
2. Click Run beside the Image Gallery application.
3. Log in as the `resteasy_admin` user.
4. Click Upload Image.
5. Choose an image file (a `JPEG` or `PNG` file) and click Upload.

   The application displays the uploaded image.

F.7 Securing the Gallery RESTful Services

It is not wise to allow public access to the image uploading service, and it is probably not ideal to allow public access to the images in the gallery either. Therefore, you should protect access to the RESTful services.

RESTful Services support two kinds of authentication:

- First Party Authentication. This is authentication intended to be used by the party who created the RESTful service, enabling an Application Express application to easily consume a protected RESTful service. The application must be located with the RESTful service, that is, it must be located in the same Oracle Application Express workspace. The application must use the standard Oracle Application Express authentication.
- Third Party Authentication. This is authentication intended to be used by third party applications not related to the party who created the RESTful service. Third party authentication relies on the OAuth 2.0 protocol.

Topics:

- Protecting the RESTful Services (page F-8)
- Modifying the Application to Use First Party Authentication (page F-9)

F.7.1 Protecting the RESTful Services

To protect the RESTful services, follow these steps:

1. Navigate to **SQL Workshop** and then **RESTful Services**.

2. Click **RESTful Service Privileges** in the section labeled **Tasks**.
3. Click **Create**, and enter the following:
   - **Name**: `example.gallery`
   - **Label**: `Gallery Access`
   - **Assigned Groups**: `RESTful Services`
   - **Description**: `View and Post images in the Gallery`
   - **Protected Modules**: `gallery.example`
4. Click **Create**.

To check that access to the RESTful Service is now restricted, follow these steps:

1. Navigate to **SQL Workshop** and then **RESTful Services**.
2. Click the module named `gallery.example`.
3. Click the `GET` handler located under `images/`.
4. Click **Test**.

   The URI in the following format should be displayed in the browser:

   ```
   https://<host>:<port>/ords/resteasy/gallery/images
   ```

   An error page should be displayed with the error message:

   ```
   401 Unauthorized.
   ```

See Also:

This is the expected result, because a protected RESTful Service cannot be accessed unless proper credentials are provided. To add the required credentials to the request, see Modifying the Application to Use First Party Authentication (page F-9)

F.7.2 Modifying the Application to Use First Party Authentication

First Party Authentication relies on the cookie and user session established by the Application Express application, but Oracle REST Data Services needs additional information to enable it to verify the cookie. It needs to know the application ID and the current session ID. This information is always known to the Application Express application, and must be included with the request made to the RESTful service by adding the custom `Apex-Session` HTTP header to each request sent to a RESTful Service. The application ID and session ID are sent as the value of the header, separated from each other by a comma delimiter. For example:

```
GET /ords/resteasy/gallery/images/
Host: server.example.com
Apex-Session: 102,6028968452563
```

Sometimes it is not possible to include a custom header in the HTTP request. For example, when displaying an image in an HTML page using the `<img>` tag, an alternative mechanism is used for these scenarios. The application ID and session ID are included in a query parameter named `_apex_session`, which is added to the

Request URI, which contains the application ID and session ID separated by a comma. For example:

```
<img src="graphics/101?_apex_session=102,6028968452563">
```

Note that this approach must only be used when it is not possible to use a custom header. Otherwise, this approach is discouraged because of the increased risk of the session ID being inadvertently stored or disclosed due to its inclusion in the URI.

To modify the application to add the first party authentication information to each request, follow these steps:

1. Navigate to **Application Builder**.
2. Click the Edit button beside the Image Gallery application.
3. Click the first page, named `Home`.
4. Under **Page** click the Edit icon, and click the **JavaScript** tab.
5. Add the following at the start of the **Function and Global Variable Declaration** field:

   ```
   function setApexSession(pathOrXhr) {
    var appId = $v('pFlowId');
    var sessionId = $v('pInstance');
    var apexSession = appId + ',' + sessionId;
    if ( typeof pathOrXhr === 'string' ) {
     var path = pathOrXhr;
     if ( path.indexOf('?') == -1 ) {
      path = path + '?_apex_session=' + apexSession;
     } else {
      path = path + '&_apex_session=' + apexSession;
     }
     return path;
    } else {
     var xhr = pathOrXhr;
     xhr.setRequestHeader('Apex-Session',apexSession);
     return xhr;
    }
   }
   ```

6. This defines a JavaScript function named `setApexSession()` which will add the first party authentication information to an `XMLHttpRequest` object or a string containing a path.

   Now you must modify the existing JavaScript code to add call this function when appropriate.
7. After the line reading `xhr.open('POST',url,true);`, add the following line:

   ```
   setApexSession(xhr);
   ```

8. After the line reading `xhr.open('GET', gallery_url);`, add the following line:

   ```
   setApexSession(xhr);
   ```

9. Change the line reading `var uri = item.uri['$ref'];` to:

   ```
   var uri = setApexSession(item.uri['$ref']);
   ```

10. Click **Apply Changes**.
11. Try running the application as before. It should work, because it is now providing the RESTful Services with the required authentication information.

F.8 Accessing the RESTful Services from a Third Party Application

If third parties want to consume and use the Gallery RESTful services, they must register the third party application in order to gain OAuth 2.0 credentials, which can then be used to initiate an interactive process by which users can authorize the third party application to access the RESTful Services on their behalf.

Once an application is registered, it can then acquire an access token. The access token must be provided with each request to a protected RESTful Service. Oracle REST Data Services verifies the access token before allowing access to the RESTful service.

OAuth 2.0 defines a number of different protocol flows that can be used by applications to acquire an access token. Oracle REST Data Services supports two of these protocol flows:

- **Authorization Code**. This flow is used when the third party application is able to keep its client credentials secure, for example, a third party website that is properly secured.
- **Implicit Grant**. This flow is used when the third party application cannot assure that its credentials would remain secret, for example, a JavaScript-based browser application or a native smartphone application.

The first step is to register the third party application. To demonstrate this, you will create a user representing the third party developer, and then use that user to register an application.

The steps in the related topics create a user in the `RESTEASY` workspace user repository and perform related actions.

Note:

In addition to authenticating users defined in workspace user repositories, Oracle REST Data Services can also authenticate against any user repository accessible from WebLogic Server or GlassFish. For information, see Authenticating Against WebLogic Server and GlassFish User Repositories (page 3-76).

Topics:

- Creating the Third Party Developer User (page F-12)
- Registering the Third Party Application (page F-12)
- Acquiring an Access Token (page F-12)
- Using an Access Token (page F-14)
- About Browser Origins (page F-15)
- Configuring a RESTful Service for Cross Origin Resource Sharing (page F-15)
- Acquiring a Token Using the Authorization Code Protocol Flow (page F-15)

- About Securing the Access Token (page F-19)

F.8.1 Creating the Third Party Developer User

To create the third party developer user (the user account for the third party developer who wants to register an application to access the RESTful services), follow these steps:

1. Navigate to **Administration**.
2. Click **Manage Users and Groups**.
3. Click **Create User**, and enter the following information:
   - **Username**: `3rdparty_dev`
   - **Email Address**: Email address for this developer user
   - **Password**: Password for this user
   - **User Groups**: `OAuth 2.0 Client Developer`
4. Click **Create User**.

F.8.2 Registering the Third Party Application

To register the third party application to use the `Implicit Grant` OAuth 2.0 protocol flow, follow these steps:

1. Go to the following URI in your browser:

   https://*server*:*port*/ords/resteasy/ui/oauth2/clients/
2. Enter the credentials of the `3rdparty_dev` user created above, and click Sign In.
3. Click `Register Client`, and enter the following information:
   - **Name**: `3rd Party Gallery`
   - **Description**: `Demonstrates consuming the Gallery RESTful Service`
   - **Response Type**: `Token`
   - **Redirect URI**: https://*server*:*port*/i/oauthdemo/gallery.html
   - **Support Email**: Desired email address
   - **Required Scopes**: `Gallery Access`
4. Click **Register**.
5. Click **3rd Party Gallery** in the list that appears on the next page.
6. Note the values of the Client Identifier and the Authorization URI fields.

F.8.3 Acquiring an Access Token

To acquire an access token, a user must be prompted to approve access. To initiate the approval process, direct the user to the approval page using the following URI:

```
https://server:port/ords/resteasy/oauth2/auth?response_type=token&\
                                              client_id=CLIENT_IDENTIFIER&\
                                              state=STATE
```

where:

- `CLIENT_IDENTIFIER` is the Client Identifier assigned to the application when it was registered.
- `STATE` is a unique value generated by the application used to prevent Cross Site Request Forgery (CSRF) attacks.

Note the following about the Oracle REST Data Services OAuth 2.0 implementation:

- The OAuth 2.0 specification allows two optional parameters to be supplied in the above request:
  - `redirect_uri`: Identifies the location where the authorization server will redirect back to after the user has approved/denied access.
  - `scope`: Identifies the RESTful Service Privileges that the client wishes to access.

  Oracle REST Data Services does not support either of these parameters: both of these values are specified when the client is registered, so it would be redundant to repeat them here. Any values supplied for these parameters will be ignored.
- The OAuth 2.0 specification *recommends* the use of the `state` parameter, but Oracle REST Data Services ***requires*** the use of the parameter because of its importance in helping to prevent CSRF attacks.
- The response type is also specified when the application is registered, and thus the `response_type` parameter is also redundant; however, the OAuth 2.0 specification states the parameter is always required, so it must be included. It is an error if the `response_type` value differs from the registered response type.

When the preceding URI is accessed in a browser, the user is prompted to sign on, and then prompted to review the application's request for access and choose whether to approve or deny access.

If the user approves the request, then the browser will be redirected back to the registered redirect URI, and the access token will be encoded in the fragment portion of the URI:

```
https://server:port/i/oauthdemo/gallery.html#token_type=bearer&\
                                              access_token=ACCESS_TOKEN&\
                                              expires_in=TOKEN_LIFETIME&\
                                              state=STATE
```

where:

- `ACCESS_TOKEN` is the unique, unguessable access token assigned to the current user session, and which must be provided with subsequent requests to the RESTful service.
- `TOKEN_LIFETIME` is the number of seconds for which the access token is valid.
- `STATE` is the unique value supplied by the application at the start of the authorization flow. If the returned `state` value does not match the initial `state` value, then there is an error condition, and the access token must not be used, because it is possible an attacker is attempting to subvert the authorization process through a CSRF attack.

Note:

You can modify the default OAuth access token duration (or lifetime) for all the generated access tokens. To achieve this, add the `security.oauth.tokenLifetime` entry to the `defaults.xml` configuration file in the following way, with the OAuth access token duration specified in seconds: `<entry key="security.oauth.tokenLifetime”>600</entry>`

If the user denies the request, or the user is not authorized to access the RESTful Service, the browser will be redirected back to the registered redirect URI, and an error message will be encoded in the fragment portion of the URI:

```
https://server:port/i/oauthdemo/gallery.html#error=access_denied&state=STATE
```

where:

- `error=access_denied` informs the client that the user is not authorized to access the RESTful Service, or chose not to approve access to the application.
- `STATE` is the unique value supplied by the application at the start of the authorization flow. If the returned `state` value does not match the initial `state` value, then there is an error condition, the client should ignore this response. It is possible an attacker is attempting to subvert the authorization process via a CSRF attack.

F.8.4 Using an Access Token

After the application has acquired an access token, the access token must be included with each request made to the protected RESTful service. To do this, an `Authorization` header is added to the HTTP request, with the following syntax:

```
Authorization: Bearer ACCESS_TOKEN
```

where:

- `ACCESS_TOKEN` is the access token value.

For example, a JavaScript-based browser application might invoke the Gallery service as follows:

```
var accessToken = ... /* initialize with the value of the access token */
var xhr = new XMLHttpRequest();
xhr.open('GET', 'https://server:port/ords/resteasy/gallery/images/',true);
/* Add the Access Token to the request */
xhr.setRequestHeader('Authorization', 'Bearer ' + accessToken);
xhr.onload = function(e) {
 /* logic to process the returned JSON document */
 ...
};
xhr.send();
```

The preceding example uses the `XMLHttpRequest.setRequestHeader(name,value)` function to add the `Authorization` header to the HTTP request. If the access token is valid, then the server will respond with a JSON document listing the images in the gallery.

F.8.5 About Browser Origins

One of the key security concepts of web browsers is the **Same Origin Policy**, which permits scripts running on pages originating from the same web site (an Origin) to access each other's data with no restrictions, but prevents access to data originating from other web sites.

An origin is defined by the protocol, host name and port of a web-site. For example `https://example.com` is one origin and `https://another.example.com` is a different origin, because the host name differs. Similarly, `http://example.com` is a different origin than `https://example.com` because the protocol differs. Finally, `http://example.com` is a different origin from `http://example.com:8080` because the port differs.

For example, if a third party client of the Gallery RESTful service is located at:

```
https://thirdparty.com/gallery.html
```

and the Gallery RESTful service is located at:

```
https://example.com/ords/resteasy/gallery/images/
```

then the Same Origin Policy will prevent `gallery.html` making an `XMLHttpRequest` to `https://example.com/ords/resteasy/gallery/images/`, because scripts in the `https://thirdparty.com` origin can only access data from that same origin, and `https://example.com` is clearly a different origin.

This is proper if the authors of `https://example.com` do not trust the authors of `https://thirdparty.com`. However, if the authors do have reason to trust each other, then the Same Origin Policy is too restrictive. Fortunately, a protocol called **Cross Origin Resource Sharing (CORS)**, provides a means for `https://example.com` to inform the web browser that it trusts `https://thirdparty.com` and thus to instruct the browser to permit `gallery.html` to make an `XMLHttpRequest` to `https://example.com/ords/resteasy/gallery/images/`.

F.8.6 Configuring a RESTful Service for Cross Origin Resource Sharing

To configure a RESTful service for Cross Origin Resource Sharing, follow these steps:

1. Navigate to **SQL Workshop** and then **RESTful Services**.
2. Click the module named `gallery.example`.
3. For **Origins Allowed**, enter the origins that are permitted to access the RESTful service (origins are separated by a comma).
4. Press **Apply Changes**

F.8.7 Acquiring a Token Using the Authorization Code Protocol Flow

Other sections have explained acquiring an access token using the OAuth 2.0 Implicit protocol flow. This section explains how to do the same using the Authorization Code protocol flow. The process is slightly more involved than for the Implicit protocol flow, because it requires exchanging an authorization code for an access token.

This section will mimic this exchange process using cURL.

Topics:

F.8.7.1 Registering the Client Application

[To register the client, follow these steps:

1. Go to the following URI in your browser:

   `https://`*`server:port`*`/ords/resteasy/ui/oauth2/clients/`
2. Enter the credentials of the `3rdparty_dev` user, and click **Sign In**.
3. Click **Register Client**, and enter the following information:
   - **Name**: `Another Gallery`
   - **Description**: `Demonstrates using the Authorization Code OAuth 2.0 Protocol Flow`
   - **Response Type**: `Code`
   - **Redirect URI** : `https://gallery.example.demo`
   - **Support EMail**: any desired email address
   - **Required Scopes**: `Gallery Access`
4. Click **Register**.
5. Click **3rd Party Gallery** in the list that appears on the next page.
6. Note the values of the Client Identifier, Client Secret, and the Authorization URI fields.

F.8.7.2 Acquiring an Authorization Code

The first step in the Authorization Code protocol flow is to acquire an authorization code. An authorization code is a short lived token that when presented along with the application's client identifier and secret can be exchanged for an access token.

To acquire an access token, the user must be prompted to approve access. To initiate the approval process, direct the user to the approval page using a URI in the following format:

```
https://server:port/ords/resteasy/oauth2/auth?response_type=code&\
                                              client_id=CLIENT_IDENTIFIER&\
                                              state=STATE
```

where:

- `CLIENT_IDENTIFIER` is the Client Identifier assigned to the application when it was registered.
- `STATE` is a unique value generated by the application used to prevent Cross Site Request Forgery (CSRF) attacks.

If the user approves the request, then the browser will be redirected back to the registered redirect URI, and the access token will be encoded in the query string portion of the URI:

```
https://gallery.example.demo?code=AUTHORIZATION_CODE&state=STATE
```

where:

- `AUTHORIZATION_CODE` is the authorization code value.
- `STATE` is the unique value supplied by the application at the start of the authorization flow. If the returned `state` value does not match the initial `state` value, then there is an error condition, the authorization code must not be used. It is possible an attacker is attempting to subvert the authorization process via a CSRF attack.

  Because the registered `https://gallery.example.demo` redirect URI does not exist, the browser will report a server not found error, but for the purposes of this example, this does not matter, because you can still see the authorization code value encoded in the URI. Note the value of the `code` parameter, because it will be used while Exchanging an Authorization Code for an Access Token.

F.8.7.3 Exchanging an Authorization Code for an Access Token

In this section you will use cURL to exchange the authorization code for an access token. To exchange an authorization code the application must make an HTTP request to the Oracle REST Data Services OAuth 2.0 token endpoint, providing the authorization code and its client identifier and secret. If the credentials are correct, Oracle REST Data Services responds with a JSON document containing the access token. Note that the application makes the HTTP request from its server side (where the client identifier and secret are securely stored) directly to Oracle REST Data Services; the web-browser is not involved at all in this step of the protocol flow.

Use a cURL command in the following format to exchange the authorization code for an access token:

```
curl -i -d "grant_type=authorization_code&code=AUTHORIZATION_CODE" \
     --user CLIENT_IDENTIFER:CLIENT_SECRET \
     https://server:port/ords/resteasy/oauth2/token
```

where:

- `AUTHORIZATION_CODE` is the authorization code value (which was encoded in the `code` parameter of the query string in the redirect URI in the previous section).
- `CLIENT_IDENTIFER` is the client identifier value.
- `CLIENT_SECRET` is the client secret value.

cURL translates the above commands into an HTTP request like the following:

```
POST /ords/resteasy/oauth2/token HTTP/1.1
Authorization: Basic Q0xJRU5UX0lERU5USUZJRVI6Q0xJRU5UX1NFQ1JFVA==
Host: server:port
Accept: */*
Content-Length: 59
Content-Type: application/x-www-form-urlencoded

grant_type=authorization_code&code=AUTHORIZATION_CODE
```

where:

- The request is an HTTP `POST` to the `oauth2/token` OAuth 2.0 token endpoint.
- The `Authorization` header uses the HTTP `BASIC` authentication protocol to encode the client identifier and secret to assert the application's identity.
- The `Content-Type` of the request is form data (`application/x-www-form-urlencoded`) and the content of the request is the form data asserting the OAuth 2.0 token grant type and the OAuth 2.0 authorization code value.

The preceding HTTP request will produce a response like the following:

```
HTTP/1.1 200 OK
ETag: "..."
Content-Type: application/json

{
 "access_token":"04tss-gM35uOeQzR_2ve4Q..",
 "token_type":"bearer",
 "expires_in":3600,
 "refresh_token":"UX4FVHhPFJl6GokvTXYw0A.."
}
```

The response is a JSON document containing the access token along with a refresh token. After the application has acquired an access token, the access token must be included with each request made to the protected RESTful Service. To do this an `Authorization` header is added to the HTTP request, with the following syntax:

```
Authorization: Bearer ACCESS_TOKEN
```

Related Topics:

- Extending OAuth 2.0 Session Duration (page F-18)

F.8.7.4 Extending OAuth 2.0 Session Duration

To extend the lifetime of an OAuth 2.0 session, a refresh token can be exchanged for a new access token with a new expiration time. Note that refresh tokens are only issued for the Authorization Code protocol flow.

The application makes a similar request to that used to exchange an authorization code for an access token. Use a cURL command in the following format to exchange the refresh token for an access token:

```
curl -i -d "grant_type=refresh_token&refresh_token=REFRESH_TOKEN" \
     --user CLIENT_IDENTIFER:CLIENT_SECRET \
     https://server:port/ords/resteasy/oauth2/token
```

where:

- `REFRESH_TOKEN` is the refresh token value returned when the access token was initially issued.
- `CLIENT_IDENTIFER` is the client identifier value.
- `CLIENT_SECRET` is the client secret value.

cURL translates the above commands into an HTTP request like the following:

```
POST /ords/resteasy/oauth2/token HTTP/1.1
Authorization: Basic Q0xJRU5UX0lERU5USUZJRVI6Q0xJRU5UX1NFQ1JFVA==
Host: server:port
Accept: */*
```

```
Content-Length: 53
Content-Type: application/x-www-form-urlencoded

grant_type=refresh_token&refresh_token=REFRESH_TOKEN
```

where:

- The request is an HTTP `POST` to the `oauth2/token` OAuth 2.0 token endpoint.
- The `Authorization` header uses the HTTP `BASIC` authentication protocol to encode the client identifier and secret to assert the application's identity.
- The `Content-Type` of the request is form data (`application/x-www-form-urlencoded`) and the content of the request is the form data asserting the OAuth 2.0 token grant type and the refresh token value.

The preceding HTTP request will produce a response like the following:

```
HTTP/1.1 200 OK
ETag: "..."
Content-Type: application/json

{
 "access_token":"hECH_Fc7os2KtXT4pDfkzw..",
 "token_type":"bearer",
 "expires_in":3600,
 "refresh_token":"-7OBQKc_gUQG93ZHCi08Hg.."
}
```

The response is a JSON document containing the new access token along with a new refresh token. The existing access token and refresh token are invalidated, and any attempt to access a service using the old access token will fail.

F.8.8 About Securing the Access Token

In OAuth 2.0 the access token is the sole credential required to provide access to a protected service. It is, therefore, essential to keep the access token secure. Follow these guidelines to help keep the token secure:

- It is strongly recommended to use HTTPS for all protected RESTful Services. This prevents snooping attacks where an attacker may be able to steal access tokens by eavesdropping on insecure channels. It also prevents attackers from viewing the sensitive data that may be present in the payload of the requests.
- Ensure that the client application is not located in a browser origin with other applications or scripts that cannot be trusted. For example assume that user Alice has a client application hosted at the following location:

  ```
  https://sharedhosting.com/alice/application
  ```

  If another user (such as Fred) is also able to host his application in the same origin, for example, at:

  ```
  https://sharedhosting.com/fred/trouble
  ```

  then it will be easy for `/fred/trouble` to steal any access token acquired by `/alice/application`, because they share the same origin `https://sharedhost.com`, and thus the browser will not prevent either application from accessing the other's data.

  To protect against this scenario, Alice's application must be deployed in its own origin, for example:

```
https://alice.sharedhosting.com/application
```

or:

```
https://application.alice.sharedhosting.com
```

or:

```
https://aliceapp.com
```

G

Using the Multitenant Architecture with Oracle REST Data Services

This section outlines the installation choices and different scenarios associated with copying and moving pluggable databases introduced by the Oracle Database 12*c* multitenant architecture with respect to Oracle REST Data Services.

G.1 Understanding the Installation Choices

Oracle Database 12*c* Release 1 (12.1) introduces the multitenant architecture. This database architecture has a multitenant container database (CDB) that includes a root container, `CDB$ROOT`, a seed database, `PDB$SEED`, and multiple pluggable databases (PDBs). A PDB appears to users and applications as if it were a non-CDB. Each PDB is equivalent to a separate database instance in Oracle Database Release 11*g*.

The root container, `CDB$ROOT`, holds common objects that are accessible to every PDB utilizing metadata links or object links. The seed database, `PDB$SEED`, is used when creating a new PDB to seed the new pluggable database. The key benefit of the Oracle Database 12*c* multitenant architecture is that the database resources, such as CPU and memory, can be shared across all of the PDBs. This architecture also enables many databases to be treated as one for tasks such as upgrades or patches, and backups.

You can install Oracle REST Data Services into one or more pluggable databases PDBs in a multitenant database or into the container database (CDB). The installation choices are as follows:

- If you want the same version of Oracle REST Data Services available in all the PDBs, then install it into the CDB. The rest of the instructions in this topic refer to installing into the CDB.
- If you want only some PDBs to be able to use Oracle REST Data Services, or if you want different PDBs to use different versions of Oracle REST Data Services, then install into the desired PDBs. (Use the same procedure as for a non-CDB.)

When Oracle REST Data Services is installed into a CDB, it is installed in the root container, the seed container, and any existing PDBs. The root container (`CDB$ROOT`) includes the ORDS_METADATA schema to store the common database objects for Oracle REST Data Services packages, functions, procedures, and views. It also includes the Oracle REST Data Services public user (ORDS_PUBLIC_USER).

The seed container (PDB$SEED) includes the ORDS_METADATA schema and the ORDS public user. You can create a new PDB by copying PDB$SEED and creating metadata links back to the common database objects in the ORDS_METADATA schema within the CDB$ROOT. As a result, there are multiple copies of the Oracle REST Data Services tables and only single copies of the Oracle REST Data Services packages, functions, procedures, and views. Thus, each PDB has the ORDS_METADATA schema and its own copy of the Oracle REST Data Services tables, so that it can hold the metadata for the Oracle REST Data Services application within that PDB. Each PDB also has its own ORDS public user.

See also "Creating a PDB using the Seed" in *Oracle Database Administrator's Guide*.)

G.2 Installing Oracle REST Data Services into a CDB

If you want to have all PDBs in a multitenant environment to use the same Oracle REST Data Services release and patch set, install into the CDB. (This option will not allow you to have different releases of Oracle REST Data Services in different PDBs.)

Before installing into the a CDB:

- Ensure that the PDBs are open (not mounted/closed) in read/write mode (except for PDB$SEED, which remains in read-only mode). See "Modifying the Open Mode of PDBs" in Oracle Database Administrator's Guide.
- Ensure that the default and temporary tablespaces to be used by the ORDS_METADATA schema and the ORDS_PUBLIC_USER user exist and that you know the tablespace names. The installation procedure creates those users, but it does not create the tablespaces.

  Note that ORDS_METADATA and ORDS_PUBLIC_USER are also installed in the seed container, and that the default and temporary tables will have to exist in PDB$SEED. If these tablespace do not already exist there, then you will have to create the tablespaces in PDB$SEED; see "Running Oracle-Supplied SQL Scripts in a CDB" in *Oracle Database Administrator's Guide*.

To install Oracle REST Data Services into a CDB, follow these steps.

1. Go to the folder into which you unzipped the Oracle REST Data Services installation kit.
2. Enter the following command:

   ```
   java -jar ords.war install advanced
   ```

   > **Note:**
   >
   > To use the pluggable mapping feature, see Making All PDBs Addressable by Oracle REST Data Services (Pluggable Mapping) (page G-3).

3. When prompted, enter the database connection information for your CDB:

   ```
   Enter the name of the database server [localhost]:
   Enter the database listen port [1521]:
   Enter 1 to specify the database service name, or 2 to specify the database SID
   [1]:
   Enter the database service name: (for example, cdb.example.com)
   ```

4. Verify the Oracle REST Data Services installation:

```
Enter 1 if you want to verify/install Oracle REST Data Services schema or 2 to
skip this step [1]:
```

Accept or enter 1 (the default) to install Oracle REST Data Services into the CDB and all of its PDBs.

5. Enter and confirm the ORDS_PUBLIC_USER password:

```
Enter the database password for ORDS_PUBLIC_USER:
Confirm password:
```

6. When prompted, enter additional information as needed. (See Advanced Installation Using Command-Line Prompts (page 1-8).)

Related Topics:

- Advanced Installation Using Command-Line Prompts (page 1-8)

G.3 Upgrading Oracle REST Data Services in a CDB Environment

When you use a new release of Oracle REST Data Services, upgrading ORDS schema in the CDB and its pluggable databases (PDBs) will occur automatically when you perform a simple or advanced installation.

For example:

```
java -jar ords.war
```

If Oracle REST Data Services is already installed or upgraded, a message displays the Oracle REST Data Services schema version, and you will not be prompted for information.

If an error occurred, view the log files.

Related Topics:

- Simple Installation Using a Parameters File (page 1-6)
- Advanced Installation Using Command-Line Prompts (page 1-8)

G.4 Making All PDBs Addressable by Oracle REST Data Services (Pluggable Mapping)

Pluggable mapping refers to the ability to make all PDBs in a CDB addressable by Oracle REST Data Services. To use this feature, follow the instructions in this topic.

If the Oracle REST Data Services configuration file includes the `db.serviceNameSuffix` parameter, this indicates that the Oracle REST Data Services pool points to a CDB, and that the PDBs connected to that CDB should be made addressable by Oracle REST Data Services.

The value of the `db.serviceNameSuffix` parameter must match the value of the `DB_DOMAIN` database initialization parameter, and it must start with a period (.). To set the value of the `db.serviceNameSuffix` parameter:

1. In SQL*Plus, connect to the root as a user with SYSDBA privileges.

2. Check the value of the `DB_DOMAIN` database initialization parameter.

   ```
   SQL> show parameter DB_DOMAIN
   ```

3. Exit SQL*Plus.

   ```
   SQL> exit
   ```

4. If the `DB_DOMAIN` value was not empty, then on the command line enter the command to create the key and value for the db.`serviceNameSuffix` parameter and its `DB_DOMAIN`. This will be used to add this entry to the ORDS configuration file.

   ```
   echo db.serviceNameSuffix=.value-of-DB_DOMAIN > snsuffix.properties
   ```

   For example, if `DB_DOMAIN` is set to `example.com`, enter the following:

   ```
   echo db.serviceNameSuffix=.example.com > snsuffix.properties
   ```

5. If the `db.serviceNameSuffix` parameter value is not defined, enter a command in the following format to add an entry to the configuration file:

   ```
   java -jar ords.war set-properties --conf pool-name snsuffix.properties
   ```

   Where *pool-name* is one of the following:

   - `poolName` for a PL/SQL Gateway configuration
   - `poolName_pu` for an Oracle REST Data Services RESTful Services configuration
   - `poolName_rt` for an Application Express RESTful Services configuration

   Example 1: You want to make PDBs in a CDB addressable globally. Specify `defaults` by entering the following command:

   ```
   java -jar ords.war set-properties --conf defaults snsuffix.properties
   ```

   Note:

   The approach shown in Example 1 (setting the property for all pools through the `defaults.xml` file) is best for most use cases.

   Example 2: You want to make PDBs in a CDB addressable for your PL/SQL Gateway, and your pool name is `apex`. Enter the following command:

   ```
   java -jar ords.war set-properties --conf apex snsuffix.properties
   ```

   For example, if the database pointed to by apex has a `DB_DOMAIN` value of `example.com` and contains the two PDBs `pdb1.example.com` and `pdb2.example.com`, the first PDB will be mapped to URLs whose path starts with `/ords/pdb1/`, and the second PDB will be mapped to URLs whose path starts with `/ords/pdb2/`.

   Example 3: You want to make PDBs in a CDB addressable for your Oracle REST Data Services RESTful Services, and your pool name is `apex_pu`. Enter the following command:

   ```
   java -jar ords.war set-properties --conf apex_pu snsuffix.properties
   ```

   Example 4: You want to make PDBs in a CDB addressable for your Application Express RESTful Services and your pool name is `apex_rt`. Enter the following command:

```
java -jar ords.war set-properties --conf apex_rt snsuffix.properties
```

Related Topics:

- About the Oracle REST Data Services Configuration Files (page B-1)

G.5 Uninstalling Oracle REST Data Services in a CDB Environment

To uninstall Oracle REST Data Services from a CDB, use the `uninstall` command.

For example:

```
java -jar ords.war uninstall
```

Oracle REST Data Services will be removed from the CDB and its pluggable databases (PDBs).

Related Topics:

- If You Want to Reinstall or Uninstall (Remove) Oracle REST Data Services (page 1-10)

H Getting Started with RESTful Services

This tutorial is based on the following document that is included in the Oracle REST Data Services installation kit: `<install-directory>\examples\getting-started\index.html`. That document is among several resources supplied to help you become productive quickly.

Before you perform the actions in this tutorial, note the following prerequisites and recommendations:

- Ensure that you have installed Oracle REST Data Services and configured it to connect to an Oracle database.
- Ensure that you have installed Oracle SQL Developer 4.1 or later in order to be able to edit RESTful services.
- It is strongly recommended that you install a browser extension that enables you to view JSON in the web browser. Recommended extensions:
  - For Google Chrome: JSON Formatter (`webstore_json_formatter`)
  - For Mozilla Firefox: JSON View (`addons_mozilla_org`)

The examples in this tutorial assume the following:

- Oracle REST Data Services has been installed and configured, and is running in standalone mode on the following server, port, and context path: `localhost:8080/ords/`
- Oracle REST Data Services is configured to connect as its default connection to an Oracle database listening on `localhost:1521`, and the database has a service name of `orcl`.

This "getting started" tutorial has the following major steps:

1. REST-Enable a Database Table (page H-1)
2. Create a RESTful Service from a SQL Query (page H-5)
3. Protect Resources (page H-11)
4. Creating a RESTful Service through the Connections Navigator (page H-12)
5. Register an OAuth Client Application (page H-20)

H.1 REST-Enable a Database Table

To enable a table for REST access, follow these steps.

> **Tip:**
>
> It is recommended that you follow the steps as closely as possible, including using the specified names for schemas and database objects. After you have successfully completed the tutorial using this approach, feel free to try it again using other values if you wish.

1. Create a database schema named `ordstest` for use in trying out RESTful services. In SQL Developer, connect to the database as `sys` and enter the following in the SQL Worksheet:

```
CREATE USER ordstest IDENTIFIED BY <password>;
GRANT "CONNECT" TO ordstest;
GRANT "RESOURCE" TO ordstest;
GRANT UNLIMITED TABLESPACE TO ordstest
```

2. Connect to the `ordstest` schema. In SQL Developer create a connection to the `ordstest` schema, connect to it, and open a SQL worksheet.

3. Create a database table. For example, enter the following in the SQL Worksheet to create an example table named EMP:

```
CREATE TABLE EMP (
  EMPNO NUMBER(4,0),
  ENAME VARCHAR2(10 BYTE),
  JOB VARCHAR2(9 BYTE),
  MGR NUMBER(4,0),
  HIREDATE DATE,
  SAL NUMBER(7,2),
  COMM NUMBER(7,2),
  DEPTNO NUMBER(2,0),
  CONSTRAINT PK_EMP PRIMARY KEY (EMPNO)
  );
```

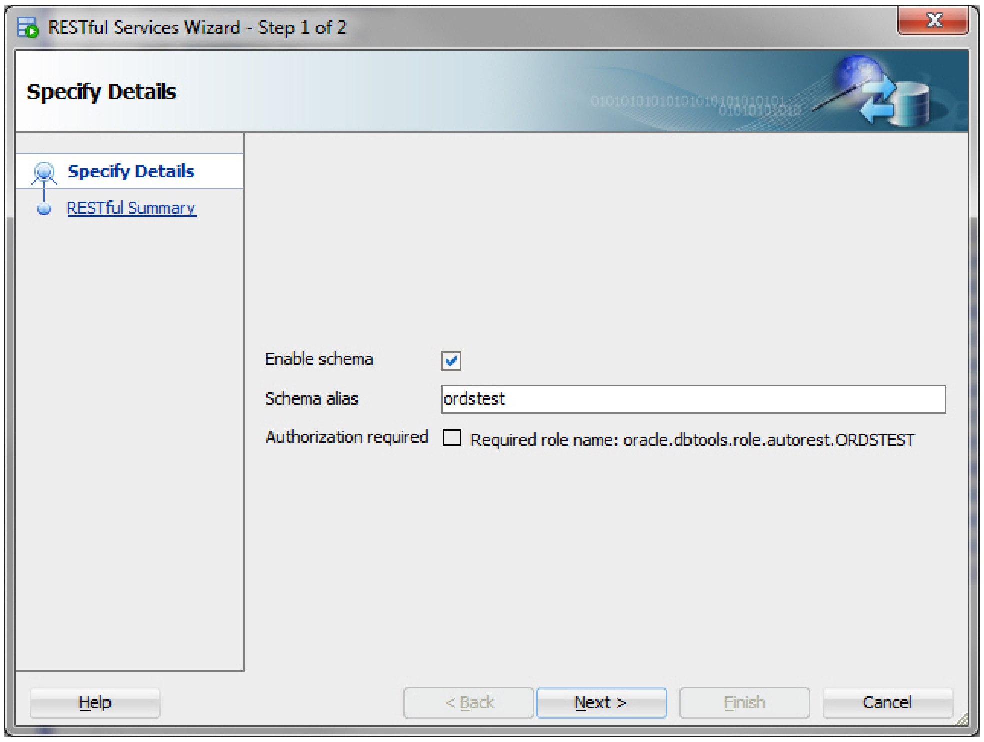
4. Insert some sample data into the table. For example:

```
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7369,'SMITH','CLERK',7902,to_date('17-DEC-80','DD-MON-RR'),800,null,20);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7499,'ALLEN','SALESMAN',7698,to_date('20-FEB-81','DD-MON-RR'),1600,300,30);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7521,'WARD','SALESMAN',7698,to_date('22-FEB-81','DD-MON-RR'),1250,500,30);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7566,'JONES','MANAGER',7839,to_date('02-APR-81','DD-MON-RR'),2975,null,20);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7654,'MARTIN','SALESMAN',7698,to_date('28-SEP-81','DD-MON-RR'),1250,1400,30);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7698,'BLAKE','MANAGER',7839,to_date('01-MAY-81','DD-MON-RR'),2850,null,30);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7782,'CLARK','MANAGER',7839,to_date('09-JUN-81','DD-MON-RR'),2450,null,10);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7788,'SCOTT','ANALYST',7566,to_date('19-APR-87','DD-MON-RR'),3000,null,20);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7839,'KING','PRESIDENT',null,to_date('17-NOV-81','DD-MON-RR'),5000,null,10);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7844,'TURNER','SALESMAN',7698,to_date('08-SEP-81','DD-MON-RR'),1500,0,30);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7876,'ADAMS','CLERK',7788,to_date('23-MAY-87','DD-MON-RR'),1100,null,20);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
```

```
(7900,'JAMES','CLERK',7698,to_date('03-DEC-81','DD-MON-RR'),950,null,30);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7902,'FORD','ANALYST',7566,to_date('03-DEC-81','DD-MON-RR'),3000,null,20);
Insert into EMP (EMPNO,ENAME,JOB,MGR,HIREDATE,SAL,COMM,DEPTNO) values
(7934,'MILLER','CLERK',7782,to_date('23-JAN-82','DD-MON-RR'),1300,null,10);
commit;
```

5. Enable the schema of the EMP table for REST. In SQL Developer, right-click the `ordstest` connection, and select **REST Services > Enable RESTful Services** to display the following wizard page:

Figure H-1 Enabling the Schema of the EMP Table for REST



Enable schema ☑
Schema alias: ordstest
Authorization required ☐ Required role name: oracle.dbtools.role.autorest.ORDSTEST

Enable schema: Enable this option.

Schema alias: Accept `ordstest` for the schema alias.

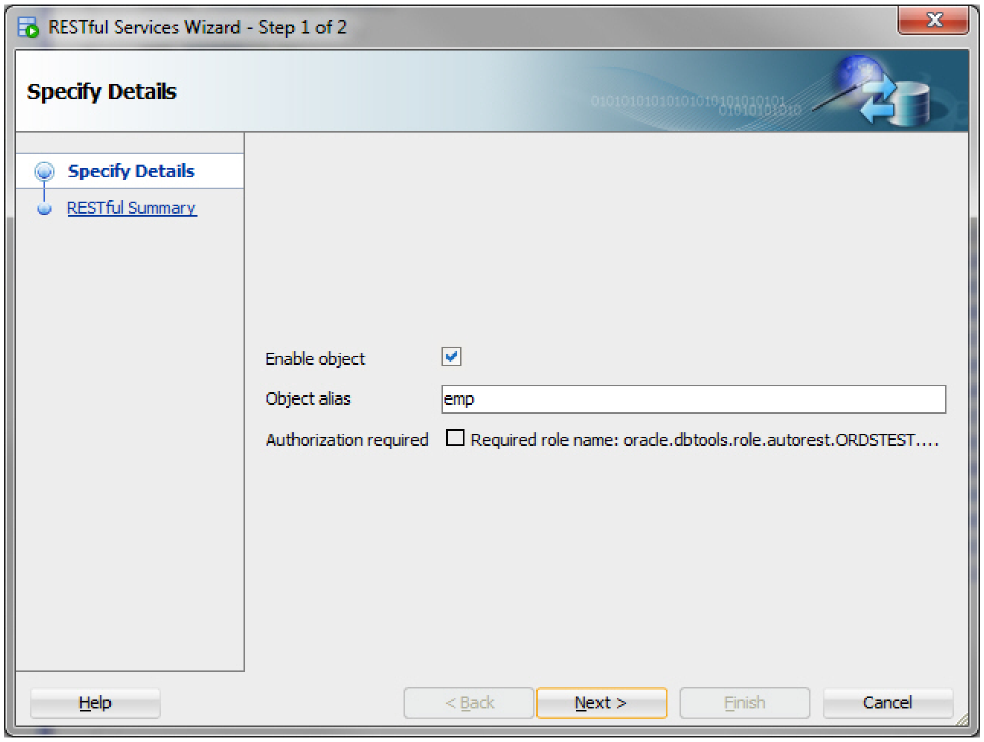
Authorization required: For simplicity, this tutorial does not require authorisation, so disable this option.

Click **Next**.

6. On the RESTful Summary page of the wizard, click **Finish**.

7. Enable the EMP table. In SQL Developer, right-click EMP table in the Connections navigator, and select **REST Services > Enable RESTful Services** to display the following wizard page:

Figure H-2 REST Enabling the EMP Table



Enable object [✓]

Object alias: emp

Authorization required [ ] Required role name: oracle.dbtools.role.autorest.ORDSTEST....

Enable object: Enable this option (that is, enable REST access for the EMP table).

Object alias: Accept `emp` for the object alias.

Authorization required: For simplicity, this tutorial does not require authorisation, so disable this option.

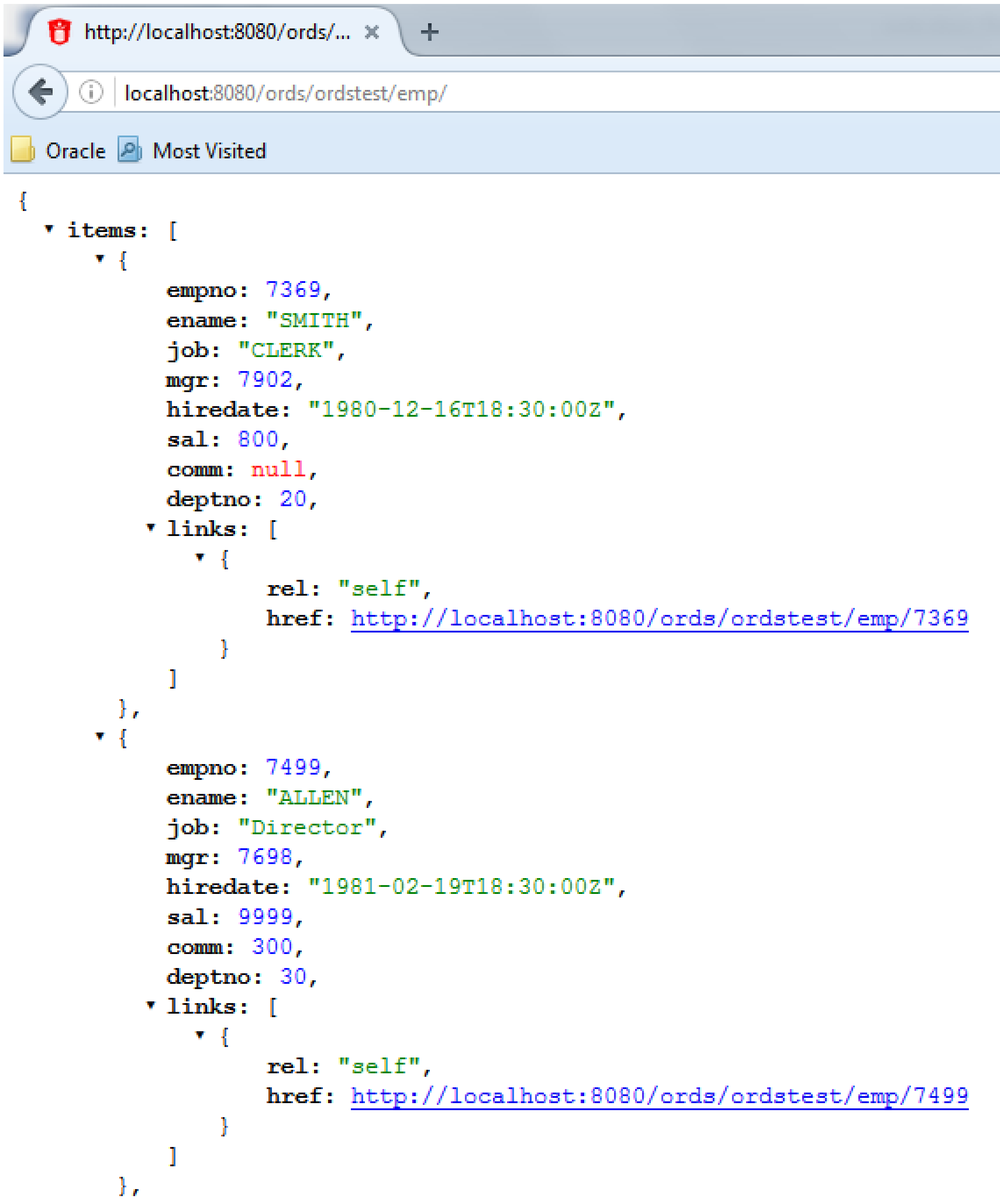
8. On the RESTful Summary page of the wizard, click **Finish**.

   The EMP table is now exposed as a REST HTTP endpoint.

9. Test the REST endpoint. In a web browser, enter the URL `http://localhost:8080/ords/ordstest/emp/` as shown in the following figure:

   - The ORDSTEST schema has been exposed at the `/ordstest/` path.
   - The EMP table has been exposed at the `/emp/` path.

Figure H-3 Testing the REST Enabled Table



http://localhost:8080/ords/...
localhost:8080/ords/ordstest/emp/
Oracle
Most Visited

```
{
  ▾ items: [
      ▾ {
            empno: 7369,
            ename: "SMITH",
            job: "CLERK",
            mgr: 7902,
            hiredate: "1980-12-16T18:30:00Z",
            sal: 800,
            comm: null,
            deptno: 20,
          ▾ links: [
              ▾ {
                    rel: "self",
                    href: http://localhost:8080/ords/ordstest/emp/7369
                }
            ]
        },
      ▾ {
            empno: 7499,
            ename: "ALLEN",
            job: "Director",
            mgr: 7698,
            hiredate: "1981-02-19T18:30:00Z",
            sal: 9999,
            comm: 300,
            deptno: 30,
          ▾ links: [
              ▾ {
                    rel: "self",
                    href: http://localhost:8080/ords/ordstest/emp/7499
                }
            ]
        },
```

H.2 Create a RESTful Service from a SQL Query

Oracle REST Data Services provides a REST API (called the Resource Modules API) that enables Oracle SQL Developer to create and edit RESTful service definitions. Access to the Resource Modules API is protected, a user with the correct role must be provisioned, and the created user's credentials must be used when accessing the API from SQL Developer.

To create a RESTful service from a SQL query, follow these steps.

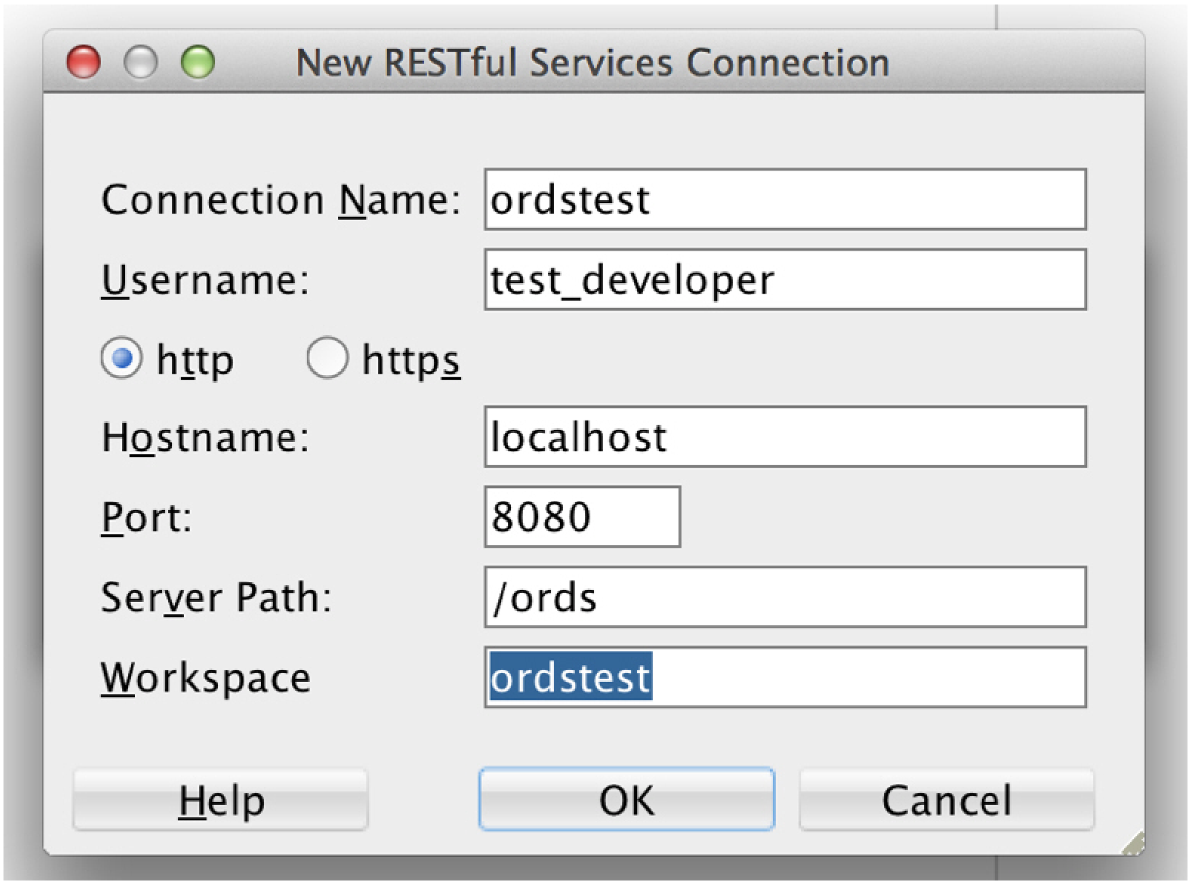
1. In the folder where Oracle REST Data Services was installed, enter the following command at a command prompt:

   ```
   java -jar ords.war user test_developer "SQL Developer"
   ```

   - You will be prompted to enter a password.
   - This command creates a user named `test_developer` and grants the user the role named `SQL Developer`. Only users with the `SQL Developer` role are permitted to access the resource module's API.
   - The user details are stored in a file named `credentials` in the ORDS configuration folder. However, it is not recommended to store user credentials in the credentials file in production deployments; instead, users should be provisioned in the host application server.

   The remaining steps create and test the RESTful service.
2. Create RESTful connection. In SQL Developer, select **View > REST Data Services > Development**.
3. In the REST Development pane, right-click **REST Data Services > Connect**.
4. In the RESTful Services Connection dialog box, click the **+** (plus sign) icon to add a connection to the list available for selection.
5. In the New RESTful Services Connection dialog box, enter the necessary information:

Figure H-4 Entering Information for New RESTful Services Connection


New RESTful Services Connection

Connection Name: ordstest
Username: test_developer
[● http] ○ https
Hostname: localhost
Port: 8080
Server Path: /ords
Workspace ordstest

Connection Name: Any desired name for the connection. Example: `ordstest`

Username: `test_developer`

http or **https**: Select `http` for simplicity in this tutorial.

Hostname: `localhost`

Port: `8080`

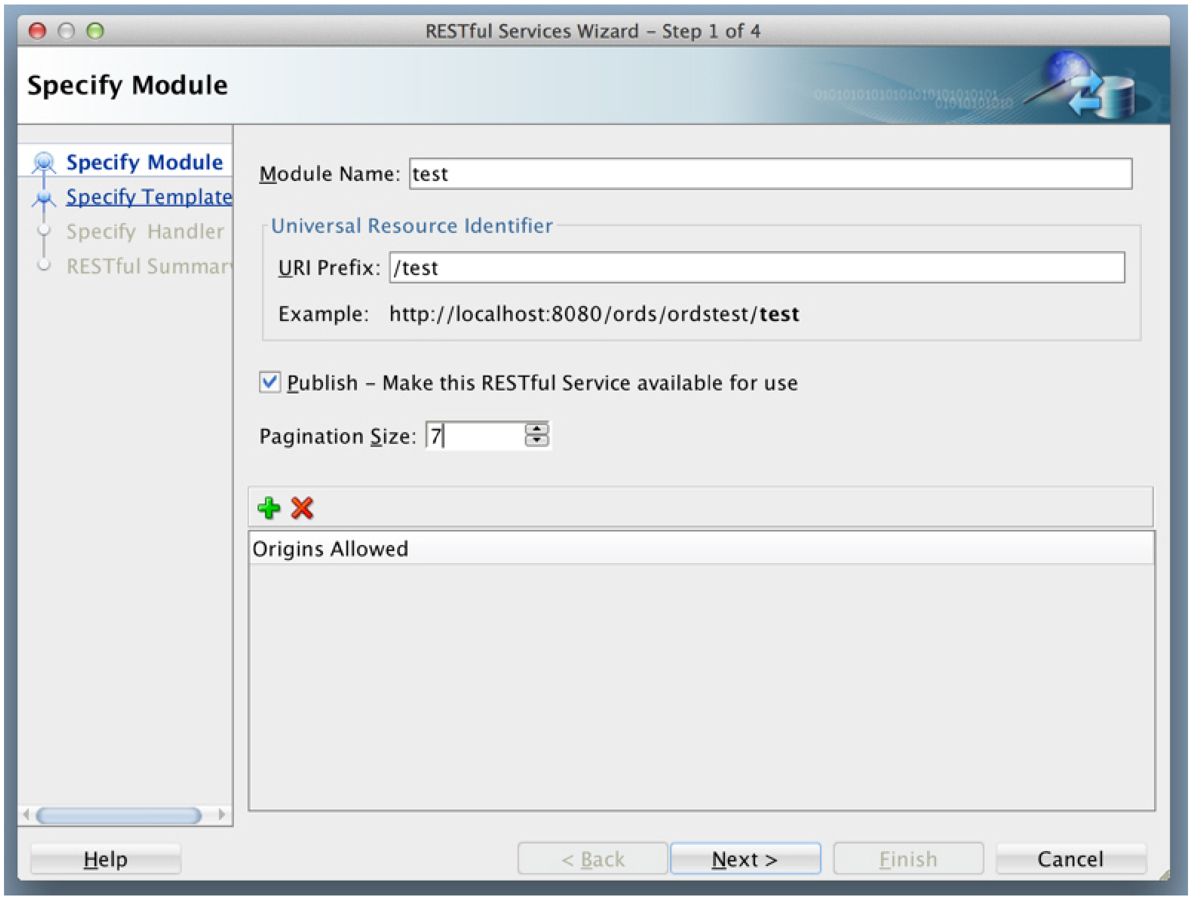
Server Path: `/ords`

Workspace: `ordstest`

Click **OK**, then enter the password for the `test_developer` user at the prompt.

6. Create the module. Right-click the `Modules` node in the REST Development view, click **New Module**, and enter information on the Specify Module page:

Figure H-5 Entering Information on the Specify Module Page



Module Name: test

Universal Resource Identifier

URI Prefix: /test

Example: http://localhost:8080/ords/ordstest/**test**

☑ Publish – Make this RESTful Service available for use

Pagination Size: 7

Origins Allowed

Module Name: Any desired name for the connection. Example: `test`

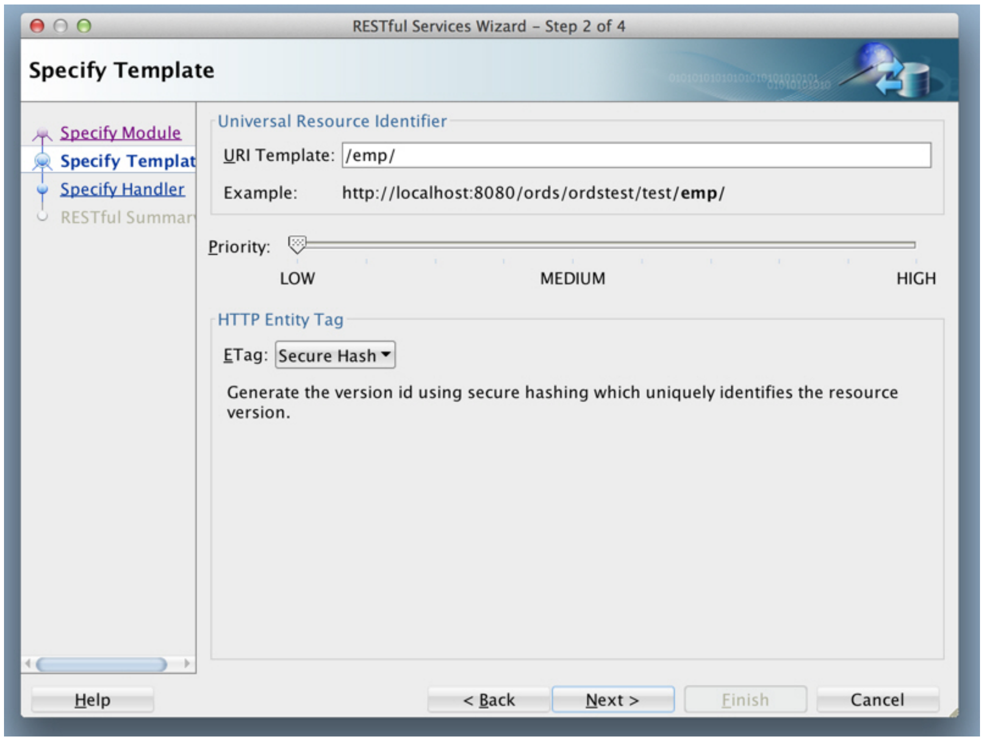
URI Prefix: `/test`

Publish - Make this RESTful Service available for use: Enable (check).

Pagination Size: `7`

7. Click **Next**, and enter information on the Specify Template page:

Figure H-6   Entering Information on the Specify Template Page



Universal Resource Identifier
URI Template: /emp/
Example: http://localhost:8080/ords/ordstest/test/**emp/**

Priority: LOW MEDIUM HIGH

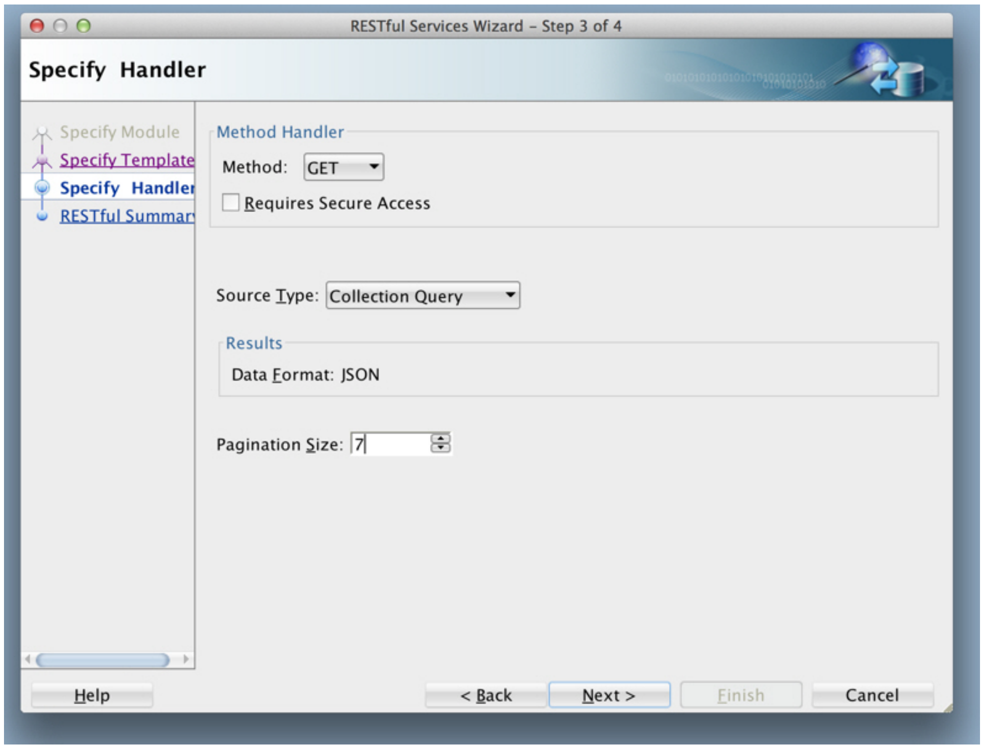
HTTP Entity Tag
ETag: Secure Hash
Generate the version id using secure hashing which uniquely identifies the resource version.

URI Template: `/emp/`

Accept the defaults for the remaining options.

8. Click **Next**, and enter information on the Specify Handler page:

Figure H-7   Entering Information on the Specify Handler Page:



Method Handler
Method: GET
Requires Secure Access

Source Type: Collection Query

Results
Data Format: JSON

Pagination Size: 7

Method: `GET`

Requires Secure Access: Disable (uncheck) for this tutorial.

Source Type: `Collection Query`

Pagination Size: `7`

9. Click Next to go to the RESTful Summary page of the wizard, then click **Finish**.

   The resource module is now created, the next step is to define the query for the GET resource handler.

10. Define the query for the GET resource handler.

    a. Expand the `test` node under the `Modules` node in the REST Development view.

    b. Expand the `/emp/` node, right-click the `GET` node, and select **Open**.

    c. In the SQL Worksheet that opens for `GET /emp/`, enter the following SQL query:

    ```
    select * from emp
    ```

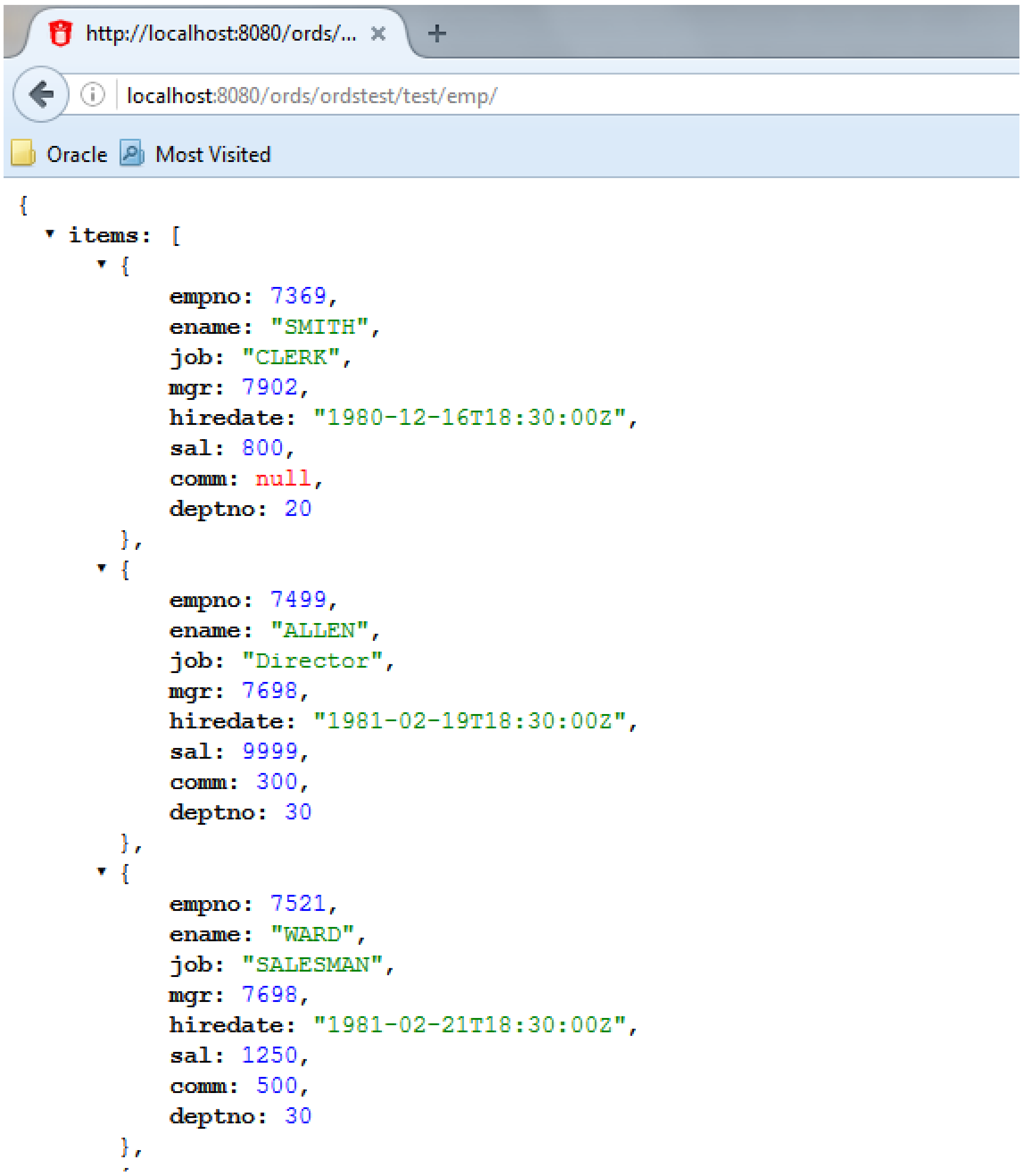
    d. Right-click on the test node under the 'Modules' node in the 'REST Development' view

    e. Click 'Upload...'. A confirmation dialog will appear confirming the module has been uploaded.

11. Test the RESTful service. In a web browser enter the URL `http://localhost:8080/ords/ordstest/test/emp/` as shown in the following figure:

    - The ORDSTEST schema has been exposed at the `/ordstest/` path.
    - The EMP table has been exposed at the `/test/emp/` path.

Figure H-8 Testing the RESTful Service Created from a SQL Query


http://localhost:8080/ords/...
localhost:8080/ords/ordstest/test/emp/
Oracle
Most Visited

```
{
  ▾ items: [
      ▾ {
            empno: 7369,
            ename: "SMITH",
            job: "CLERK",
            mgr: 7902,
            hiredate: "1980-12-16T18:30:00Z",
            sal: 800,
            comm: null,
            deptno: 20
        },
      ▾ {
            empno: 7499,
            ename: "ALLEN",
            job: "Director",
            mgr: 7698,
            hiredate: "1981-02-19T18:30:00Z",
            sal: 9999,
            comm: 300,
            deptno: 30
        },
      ▾ {
            empno: 7521,
            ename: "WARD",
            job: "SALESMAN",
            mgr: 7698,
            hiredate: "1981-02-21T18:30:00Z",
            sal: 1250,
            comm: 500,
            deptno: 30
        },
```

See Also:

Now the users can also create a RESTful service from the Connection Navigator. For more information refer to Creating a RESTful Service through the Connections Navigator (page H-12)

H.3 Protect Resources

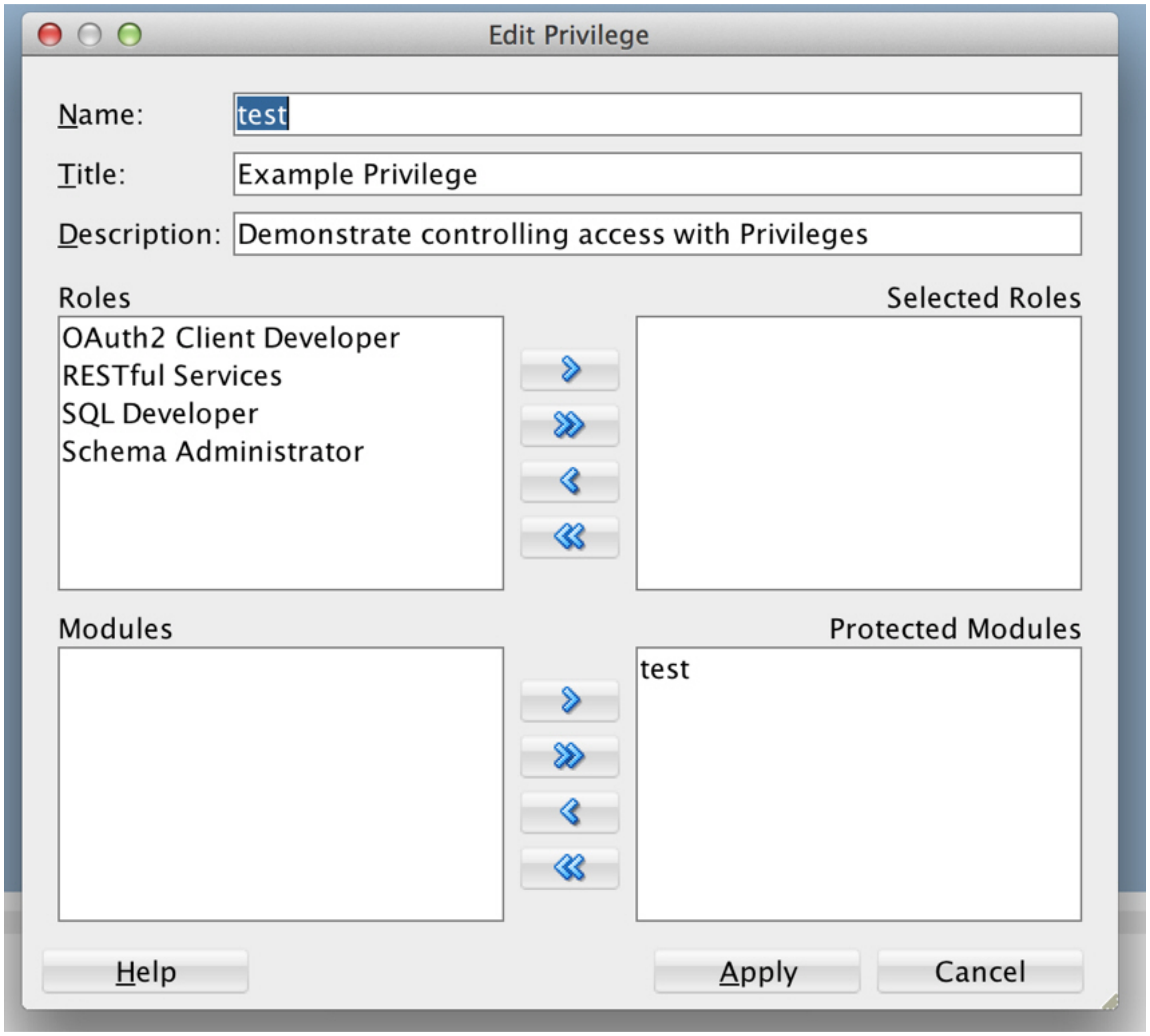
Up to this point the tutorial has deliberately disabled security on the RESTful endpoints you created, because it is easier to test them without security. In this topic you protect the `/test/emp/` service, requiring users to authenticate before accessing the service.

Controlling access to protected resources is done by defining privileges. **Privileges** restrict access to only users having at least one of a set of specified roles. A privilege is then associated with one or more resource modules: before those resource modules can be accessed, the user must be authenticated and then authorized to ensure that the user has one of the required roles.

To protect resources, follow these steps.

1. Create a privilege. In SQL Developer, right-click the `Privileges` node in the REST Development view and select **New Privileges** to display the Edit Privilege dialog box:

Figure H-9 Edit Privilege Dialog Box



Name: test
Title: Example Privilege
Description: Demonstrate controlling access with Privileges

Roles
OAuth2 Client Developer
RESTful Services
SQL Developer
Schema Administrator

Selected Roles

Modules

Protected Modules
test

Name: `test`

Title: `Example Privilege`

Description: `Demonstrate controlling access with privileges`

Protected Modules: Ensure that the list includes the `test` module. Use the arrow button to move it if necessary.

Click **Apply**.

2. Right click the `test` privilege and click **Upload**.

   A dialog box confirms that the privilege has been uploaded.

   You have now created a privilege that protects the test module. However, you have not restricted the privilege to any particular role; this will just require that the user be authenticated before accessing the test module (the next step).

3. Test the RESTful service. In a web browser enter the following URL:

   ```
   http://localhost:8080/ords/ordstest/test/emp/
   ```

4. Click the link to sign in, and enter the `test_developer` credentials.

   The contents of the JSON document are displayed.

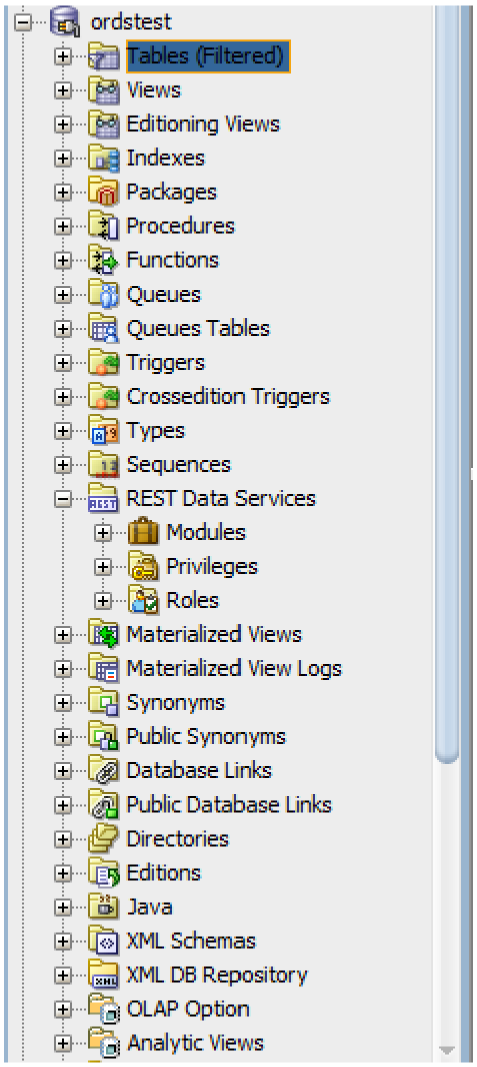
H.4 Creating a RESTful Service through the Connections Navigator

This section explains how to create a RESTful service by using REST Data Services node in the Connections navigator. Oracle REST Data Services provides an option through the Connections navigator that enables you to create and edit RESTful service definitions.

To create and test a RESTful service by using REST Data Services node in the Connections navigator, follow these steps:

1. Under **ordstest** schema, select **REST Data Services.**

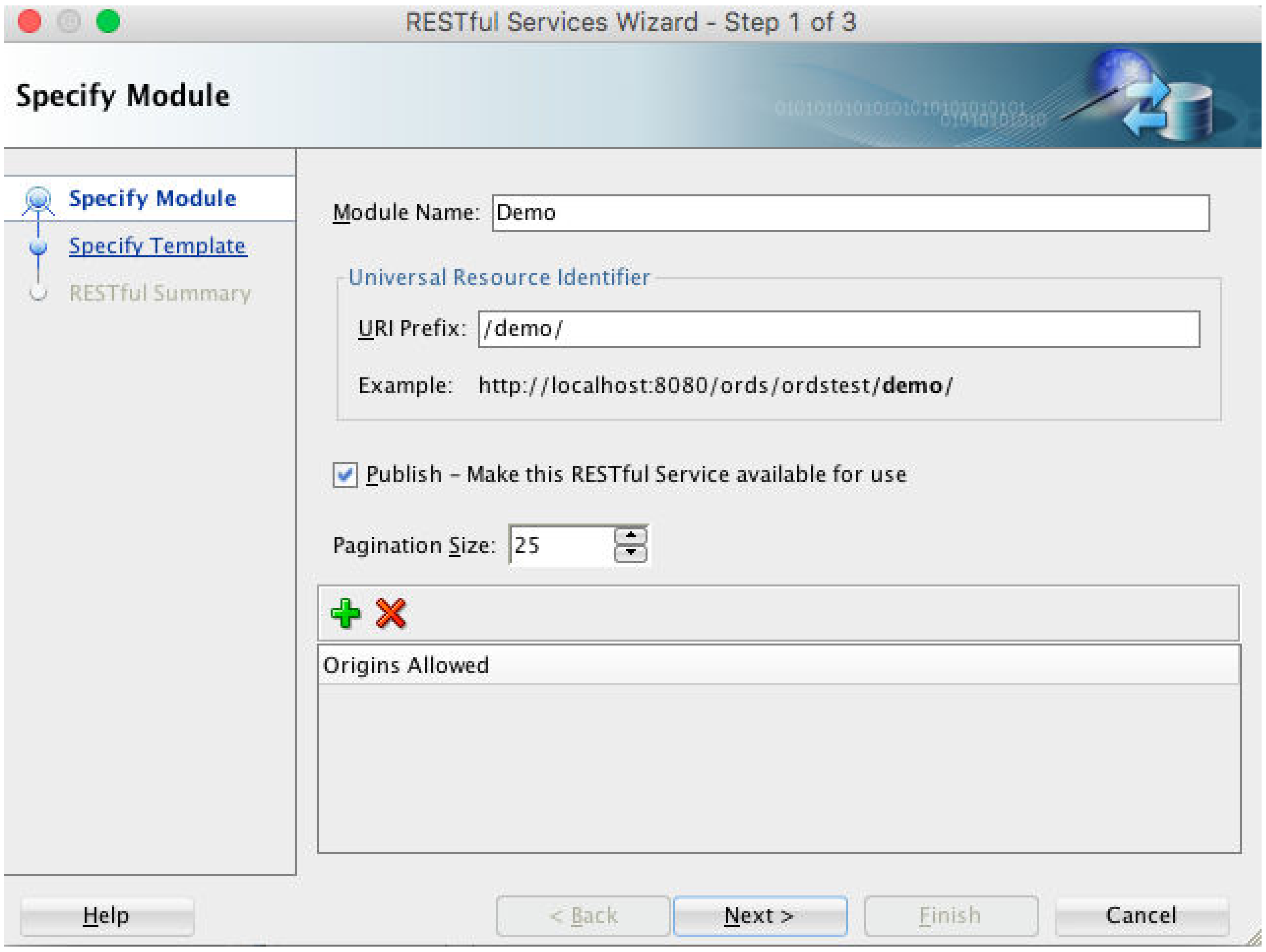
Figure H-10 REST Data Services option under Connections Navigator



The following steps create and test the RESTful service.

2. Under **REST Data Services** node, right-click the `Modules` node, click **New Module**, and enter information on the Specify Module page:

Figure H-11 Entering Information on the Specify Module Page


RESTful Services Wizard - Step 1 of 3

Specify Module

Module Name: Demo

Universal Resource Identifier

URI Prefix: /demo/

Example: http://localhost:8080/ords/ordstest/**demo/**

☑ Publish - Make this RESTful Service available for use

Pagination Size: 25

Origins Allowed

Module Name: Any desired name for the connection. For example, `demo`

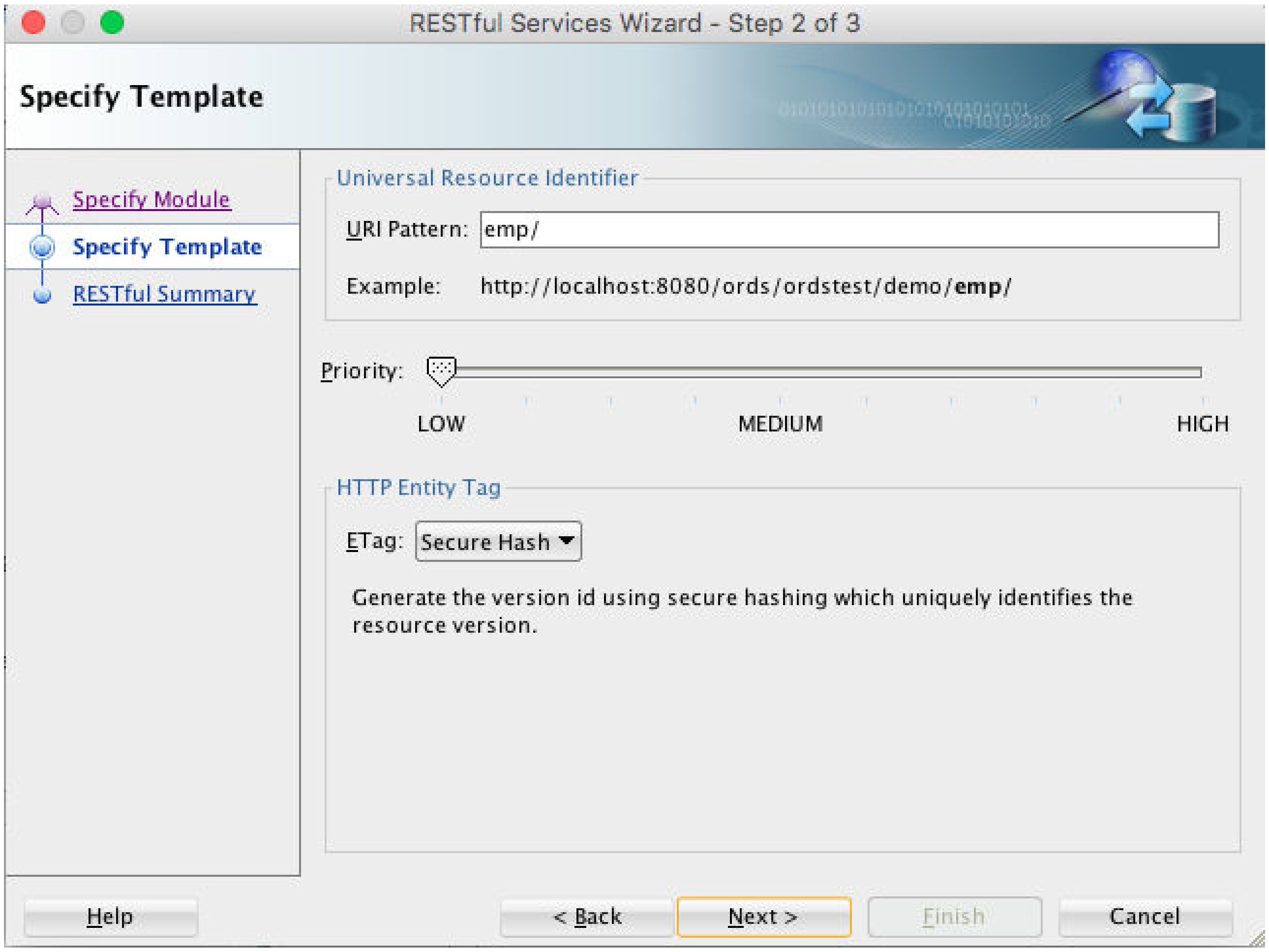
URI Prefix: `/demo/`

Publish - Make this RESTful Service available for use: Enable (check).

Pagination Size: `25`

3. Click **Next**, and enter information on the Specify Template page:

Figure H-12 Entering Information on the Specify Template Page

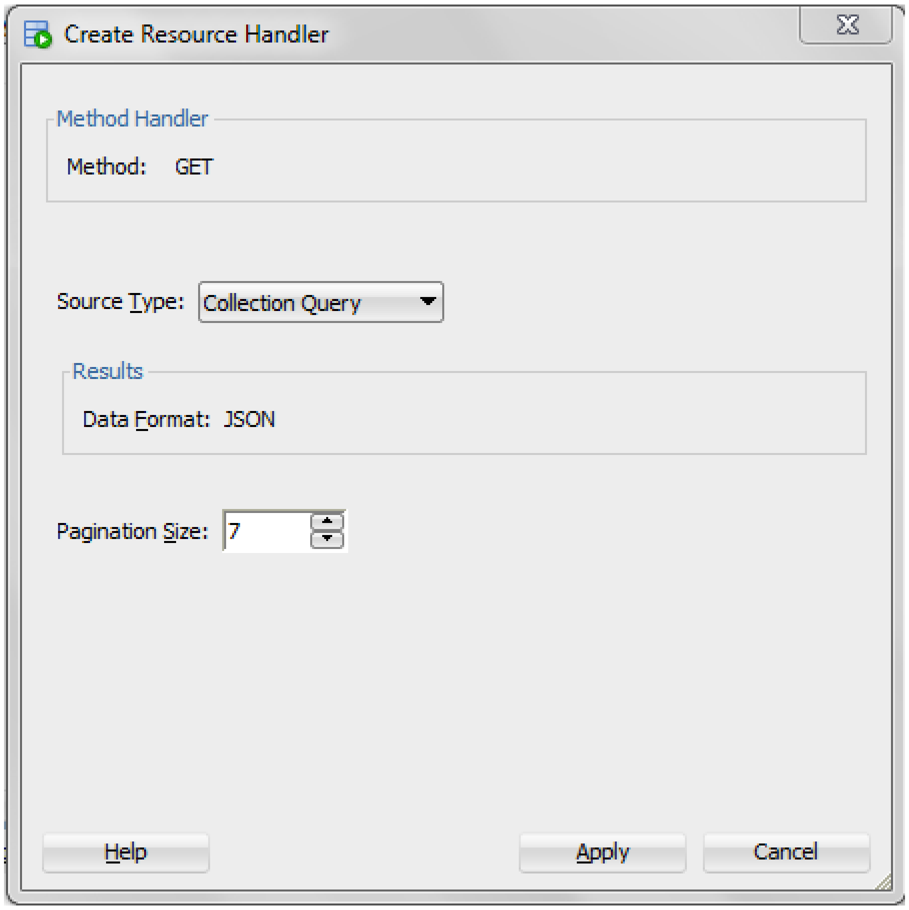

RESTful Services Wizard - Step 2 of 3
Specify Template
Specify Module
Specify Template
RESTful Summary
Universal Resource Identifier
URI Pattern: emp/
Example: http://localhost:8080/ords/ordstest/demo/emp/
Priority:
LOW
MEDIUM
HIGH
HTTP Entity Tag
ETag: Secure Hash
Generate the version id using secure hashing which uniquely identifies the resource version.
Help
< Back
Next >
Finish
Cancel

URI Pattern: `emp/`

Accept the defaults for the remaining options.

4. Click Next to go to the RESTful Summary page of the wizard, then click **Finish**. Expand the Modules node to display the resource module that you created.
5. Expand the module, Demo and right click on the `emp/`node, select **Add** handler and then select **GET** method.
6. Enter the information on the Create Resource Handler page.

Figure H-13 Entering Information on Create Resource Handler Page:



Source Type: `Collection Query`

Pagination Size: `7`

Click **Apply**.

Next step is to define the query for the GET resource handler.

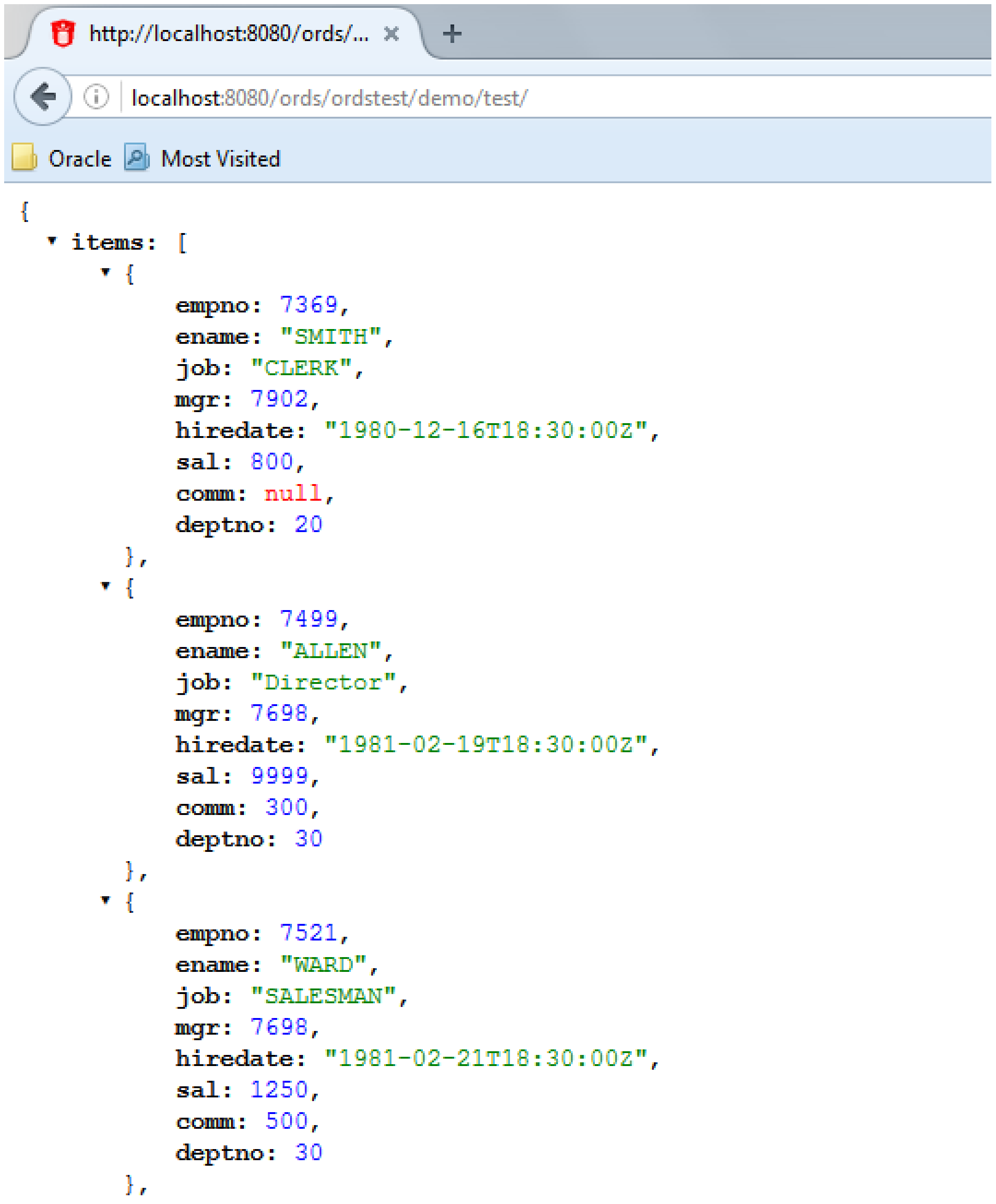
7. In the SQL Worksheet, enter the following query:

```
select * from emp
```

8. Click **Save REST Handler** icon. A confirmation message appears in the **Messages - Log** pane to confirm that the handler is saved to the database.

> **Note:**
>
> If you do not see the Messages - Log pane, go to the **View** menu and then select **Log**.

9. Test the RESTful service. In a web browser enter the URL http://localhost:8080/ords/ordstest/demo/emp/ as shown in the following figure:
   - The ORDSTEST schema has been exposed at the /ordstest/ path.
   - The EMP table has been exposed at the /test/emp/ path.


http://localhost:8080/ords/...
localhost:8080/ords/ordstest/demo/test/
Oracle
Most Visited

```
{
  ▾ items: [
      ▾ {
            empno: 7369,
            ename: "SMITH",
            job: "CLERK",
            mgr: 7902,
            hiredate: "1980-12-16T18:30:00Z",
            sal: 800,
            comm: null,
            deptno: 20
        },
      ▾ {
            empno: 7499,
            ename: "ALLEN",
            job: "Director",
            mgr: 7698,
            hiredate: "1981-02-19T18:30:00Z",
            sal: 9999,
            comm: 300,
            deptno: 30
        },
      ▾ {
            empno: 7521,
            ename: "WARD",
            job: "SALESMAN",
            mgr: 7698,
            hiredate: "1981-02-21T18:30:00Z",
            sal: 1250,
            comm: 500,
            deptno: 30
        },
```

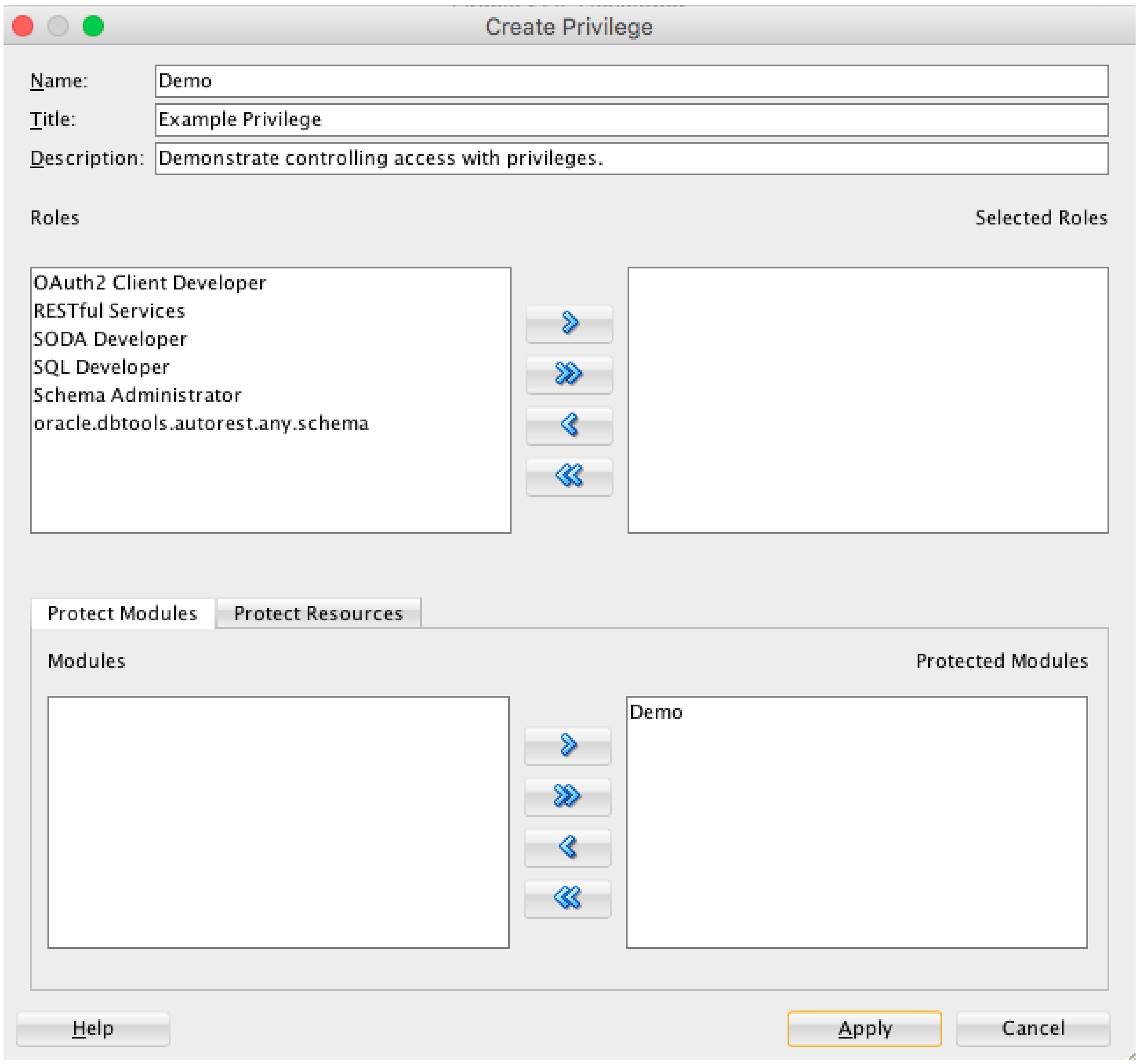
H.4.1 Creating a Privilege under REST Data Services

Controlling access to protected resources is done by defining privileges. **Privileges** restrict access to only users having at least one of a set of specified roles. A privilege is then associated with one or more resource modules: before those resource modules can be accessed, the user must be authenticated and then authorized to ensure that the user has one of the required roles.

To protect resources, follow these steps.

1. Create a privilege. In SQL Developer, right-click the `Privileges` node under REST Data Services and select **New Privileges** to display the Create Privilege dialog box:

Figure H-14 Create Privilege Dialog Box



Name: `Demo`

Title: `Example Privilege`

Description: `Demonstrate controlling access with privileges`

Protected Modules: Ensure that the list includes the `Demo` module. Use the arrow button to move it if necessary.

Click **Apply**.

You have now created a privilege that protects the test module. However, you have not restricted the privilege to any particular role; this will just require that the user be authenticated before accessing the test module (the next step).

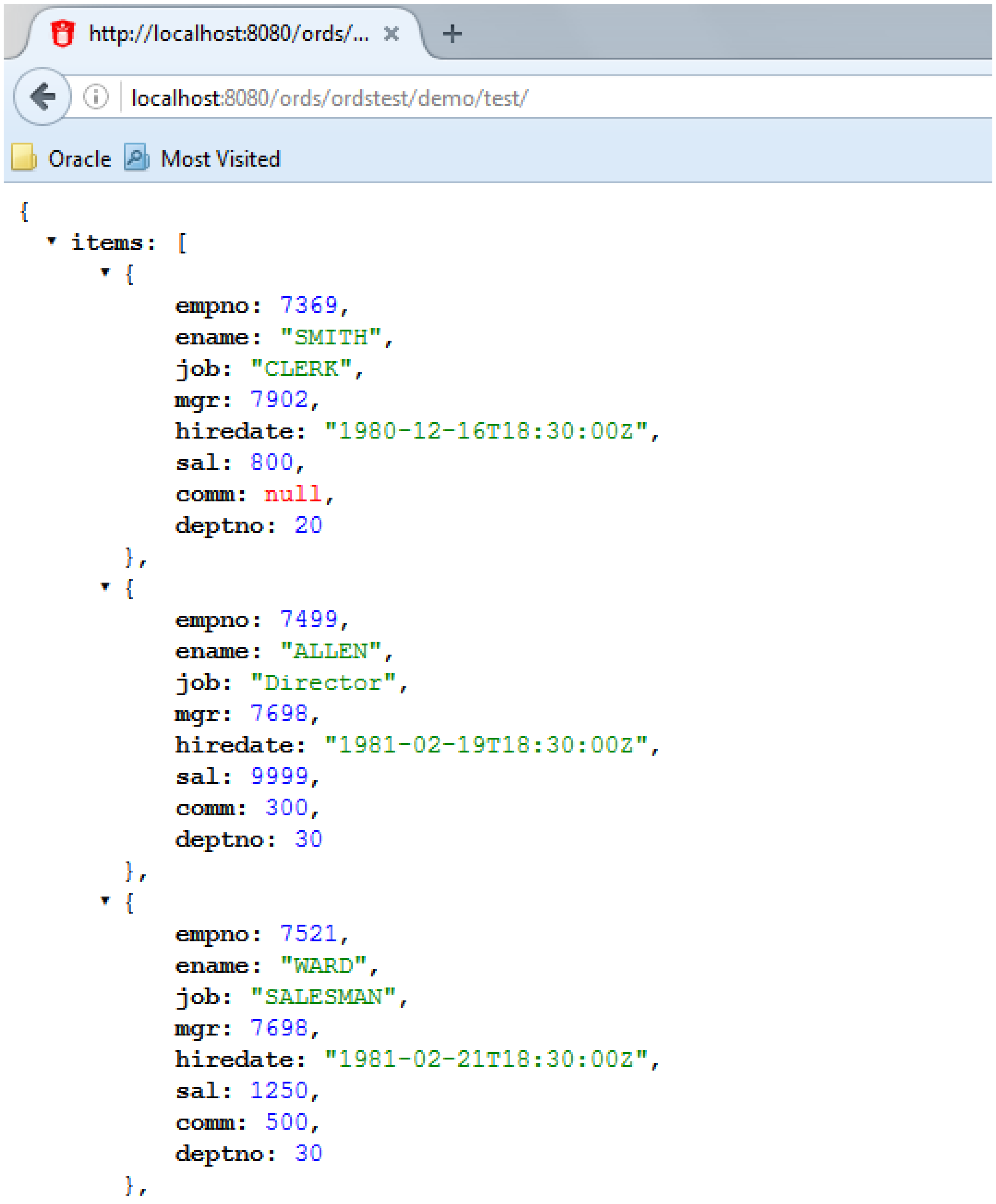
2. Test the RESTful service. In a web browser enter the following URL:

   http://localhost:port/ords/ordstest/demo/emp/

3. Click the link to sign in, and enter the `test_developer` credentials.

> **Note:**
>
> To create a test_developer user refer to **Create a RESTful Service from a SQL Query** section.

A JSON document similar to the following is displayed:


http://localhost:8080/ords/...
localhost:8080/ords/ordstest/demo/test/
Oracle
Most Visited

```
{
  ▾ items: [
      ▾ {
            empno: 7369,
            ename: "SMITH",
            job: "CLERK",
            mgr: 7902,
            hiredate: "1980-12-16T18:30:00Z",
            sal: 800,
            comm: null,
            deptno: 20
        },
      ▾ {
            empno: 7499,
            ename: "ALLEN",
            job: "Director",
            mgr: 7698,
            hiredate: "1981-02-19T18:30:00Z",
            sal: 9999,
            comm: 300,
            deptno: 30
        },
      ▾ {
            empno: 7521,
            ename: "WARD",
            job: "SALESMAN",
            mgr: 7698,
            hiredate: "1981-02-21T18:30:00Z",
            sal: 1250,
            comm: 500,
            deptno: 30
        },
```

Related Topics:

- Create a RESTful Service from a SQL Query (page H-5)

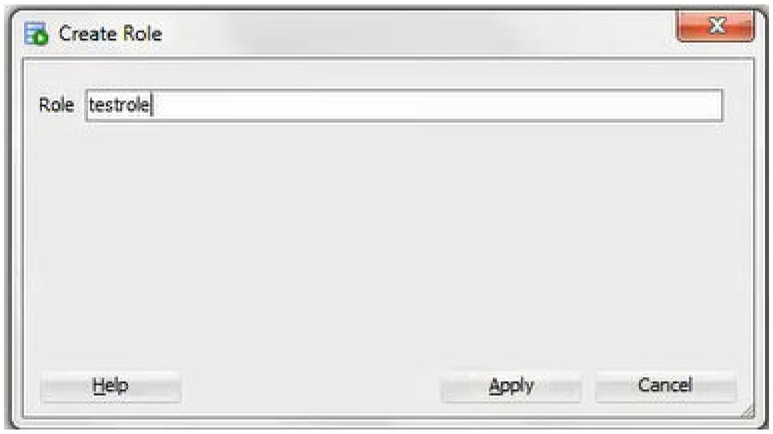
H.4.2 Creating a Role

This section explains how to create and delete a role.

To create a role, follow these steps:

1. Under **REST Data Services**, right click **Roles** and then click **New Role**.
2. In the **Create Role** dialog box, enter the name of the role you want to create.

   Figure H-15 Entering the New Role Name

   Role testrole

3. Click **Apply**, the new role is now created.

   To rename or delete a role, right click on the role name and choose one of the following options:

   - **Rename**: to change the role name.
   - **Delete**: to remove the role.

H.5 Register an OAuth Client Application

This topic explains how to register your applications (called "third-party" applications here) to access a REST API.

OAuth 2.0 is a standard Internet protocol that provides a means for HTTP servers providing REST APIs to give limited access to third party applications *on behalf of* an end user.

- The author of the third-party application must register the application to gain client credentials.
- Using the client credentials the third party application starts a web flow that prompts the end-user to approve access.

So, before a third party application can access a REST API, it must be registered and the user must approve access. And before the application can be registered, it must be assigned a user identity that enables the user to register applications. Users possessing the `SQL Developer` role (such as the `test_developer` user created in Create a RESTful Service from a SQL Query (page H-5)) are permitted to register OAuth clients.

> **Tip:**
>
> In a real application, you may want to provision specific users that can register OAuth clients; these users should be granted the `OAuth Client Developer` role.

This topic outlines how to complete these actions. It is not a full-featured demonstration of how to create and integrate a third party application; it just outlines the concepts involved.

1. Register the client application.

   a. In a web browser enter the following URL:

      ```
      http://localhost:8080/ords/ordstest/oauth/clients/
      ```

   b. At the prompt, click the link to sign in and enter the credentials for the `test_developer` user.

   c. Click **New Client** and enter the following information:

      Name: `Test Client`

      Description: `An example OAuth Client`

      Redirect URI: `http://example.org/redirect`

      Support e-mail: `info@example.org`

      Support URI: `http://example.org/support`

      Required Privileges: `Example Privilege`

   d. Click **Create**.

      The client registration is created, and the Authorization URI for the client is displayed. You have created a client that will use the Implicit Grant authorization flow (explained at `https://tools.ietf.org/html/rfc6749#section-4.2`).

      Note the Client Identifier assigned to the client and the Authorization URI value. These values are used to start the authorization flow (next major step).

2. Approve the client application.

   In a real third-party client application, the client will initiate the approval flow by directing a web browser to the Authorization URI. The end user will be prompted to sign in and approve access to the client application. The browser will be redirected back to the client's registered Redirect URI with a URI fragment containing the `access_token` for the approval. To simulate this process:

   a. In a web browser, enter the Authorization URI that you noted in the previous step. The URL should look like the following (though you should not copy and paste in this example value):

      ```
      http://localhost:8080/ords/ordstest/oauth/auth?
      response_type=token&client_id=5B77A34A266EFB0056BE3497ED7099.&state=d5b7944-
      d27d-8e2c-4d5c-fb80e1114490&_auth_=force
      ```

      The `client_id` value must be the value of the client identifier assigned to the application. Be sure you are using the correct `client_id` value. Do not use the value in the preceding example; replace it with the client identifier assigned to your application.

The `state` value should be a unique, unguessable value that the client remembers, and can use later to confirm that the redirect received from Oracle REST Data Services is in response to this authorisation request. This value is used to prevent Cross Site Request Forgery attacks; it is very important, cannot be omitted, and must not be guessable or discoverable by an attacker.

b. At the prompt, click the link to sign in and enter the credentials for the `test_developer` user.

c. Review the access being requested, and click **Approve**.

The browser is redirected to a URL similar to the following:

```
http://example.org/redirect#token_type=bearer&access_token=-
i_Ows8j7JYu0p07jOFMEA..&expires_in=3600
```

When registering the OAuth client, you specified `http://example.org/`redirect as the Redirect URI. On completion of the approval request, the browser is redirected to this registered redirect URI. Appended to the URI is the information about the access token that was generated for the approval.

In a real application, the third party application would respond to the redirect to the redirect URI by caching the access token, redirecting to another page to show the user that they are now authorized to access the REST API, and including the access token in every subsequent request to the REST API. However, in this tutorial you just make note of the access token value and manually create a HTTP request with the access token included, as explained in the next major step.

The value of the access token (which in the preceding example is `-i_Ows8j7JYu0p07jOFMEA..`) will change on every approval.

Note that the access token expires. In the preceding example it expires after 3600 seconds (`&expires_in=3600`), that is, one hour.

3. Issue an authorized request.

After an access token has been acquired, the client application must remember the access token and include it with every request to the protected resource. The access token must be included in the HTTP Authorization request header (explained at `http://tools.ietf.org/html/rfc2616#section-14.8`) as in the following example:

```
Host: localhost:8080
GET /ords/ordstest/test/emp/
Authorization: Bearer -i_Ows8j7JYu0p07jOFMEA..
```

To emulate creating a valid HTTP request, use the cURL command line tool (if necessary, install cURL). In a real application this request would be performed by the client making an HTTP request, such as an `XMLHttpRequest`. For example:

```
curl -i -H'Authorization: Bearer -i_Ows8j7JYu0p07jOFMEA..' http://localhost:8080/
ords/ordstest/test/emp/
```

However, in this example replace `-i_Ows8j7JYu0p07jOFMEA..` with the access token value that you previously noted.

Output similar to the following JSON document should be displayed:

```
HTTP/1.1 200 OK
Content-Type: application/json
Transfer-Encoding: chunked
```

```
{
 "items":[
  {"empno":7369,"ename":"SMITH","job":"CLERK","mgr":
7902,"hiredate":"1980-12-17T00:00:00Z","sal":800,"comm":null,"deptno":20},
  {"empno":7499,"ename":"ALLEN","job":"SALESMAN","mgr":
7698,"hiredate":"1981-02-20T00:00:00Z","sal":1600,"comm":300,"deptno":30},
  {"empno":7521,"ename":"WARD","job":"SALESMAN","mgr":
7698,"hiredate":"1981-02-22T00:00:00Z","sal":1250,"comm":500,"deptno":30},
  {"empno":7566,"ename":"JONES","job":"MANAGER","mgr":
7839,"hiredate":"1981-04-01T23:00:00Z","sal":2975,"comm":null,"deptno":20},
  {"empno":7654,"ename":"MARTIN","job":"SALESMAN","mgr":
7698,"hiredate":"1981-09-27T23:00:00Z","sal":1250,"comm":1400,"deptno":30},
  {"empno":7698,"ename":"BLAKE","job":"MANAGER","mgr":
7839,"hiredate":"1981-04-30T23:00:00Z","sal":2850,"comm":null,"deptno":30},
  {"empno":7782,"ename":"CLARK","job":"MANAGER","mgr":
7839,"hiredate":"1981-06-08T23:00:00Z","sal":2450,"comm":null,"deptno":10}
 ],
 "hasMore":true,
 "limit":7,
 "offset":0,
 "count":7,
 "links":[
  {"rel":"self","href":"http://localhost:8080/ords/ordstest/test/emp/"},
  {"rel":"describedby","href":"http://localhost:8080/metadata-catalog/test/
emp/"},
  {"rel":"first","href":"http://localhost:8080/ords/ordstest/test/emp/"},
  {"rel":"next","href":"http://localhost:8080/ords/ordstest/test/emp/?offset=7"}
 ]
}
```

However, if the `Authorization` header is omitted, then the status `401 Unauthorized` is returned instead.

See Also:

`curl_haxx`

Index