Oracle® REST Data Services Quick Start Guide



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ORACLE

Oracle REST Data Services Quick Start Guide, Release 24.3

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Preface

Oracle REST Data Services Quick start Guide is designed to let you get started quickly developing RESTful services using Oracle REST Data Services.

Topics:

- Audience
- Documentation Accessibility
- Related Documents
- Conventions
- Third-Party License Information

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.

Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc.

Access to Oracle Support

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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.

Third-Party License Information

Oracle REST Data Services contains third-party code. See the Oracle Database Licensing Information book for notices Oracle is required to provide.

Note, however, that the Oracle program license that accompanied this product determines your right to use the Oracle program, including the third-party software, and the terms contained in the following notices do not change those rights.



1 Getting Started with Oracle REST Data Services

This tutorial is designed to let you get started quickly developing RESTful services using Oracle REST Data Services.

1.1 Getting Started with RESTful Services

Prerequisites

The following are the prerequisites before you start performing the steps in this tutorial:

- Ensure that you have installed Oracle REST Data Services and configured with a currently supported version of Oracle database.
- Ensure that you have installed a currently supported version of client applications. This tutorial uses the following clients to create a RESTful service:
 - Oracle Database Actions
 - Oracle SQLcl

Note:

The latest version of SQLcl can be downloaded from one of the following:

- * SQLcl Downloads
- * Through Homebrew using the command: brew install --cask sqlcl. Additional SQLcl installation information can be found on SQLcl Homebrew.
- Oracle SQL Developer
- Oracle strongly recommends you to install a browser extension that enables you to view JSON in the web browser. Popular browser extensions include one of the following:
 - * JSON Formatter for Google Chrome
 - * JSONView Add-on for Mozilla Firefox

This tutorial assumes the following:

- Oracle REST Data Services has been installed and configured on the following server, port, and context path: localhost:8080/ords/
- Oracle REST Data Services is running in a standalone mode
- Oracle REST Data Services installation was performed using the Basic Connection type with the following attributes:
 - * Server: localhost



- * Port: 1521
- * Service name: ORCLPBD1

The examples in this tutorial assume that Oracle REST Data Services has been installed and configured in a single instance database or Pluggable Database (PDB). The examples and images in this tutorial refer to the PDB as ORCLPDB1.

Client Applications used in this tutorial for Creating the RESTful Services

The examples in this tutorial use the following client applications:

- Oracle Database Actions
- SQLcl

Web browser requirements

For a complete list of currently supported web browsers, refer to Oracle Software Web Browser Support Policy.

1.1.1 Creating a RESTful Service Using Oracle SQLcl

This section describes the steps for creating a RESTful service using Oracle SQLcl.

Note:

Oracle recommends that you perform the following steps in this tutorial using the specified names for schemas and database objects. After you have completed the tutorial, you can follow the same steps again using alternate schema and database object names.

Perform the following steps to create a RESTful service:

- 1. Creating a New Database User and REST-enabling Schema
- 2. REST-enabling a Schema
- 3. Accessing the Database Actions
- 4. Auto REST-enabling a Table
- 5. Testing the Auto REST-enabled Object

1.1.1.1 Creating a New Database User and REST-enabling Schema

To create a new user, perform the following steps:

1. Using SQLcl, connect to your database as an administrator or using an account with the DBA role.



– java • sql sys/oracle@localhost:1521/ORCLPDB1 as sysdba

Figure 1-1 Connecting to the Database as an Administrator or an User with DBA Role

Last login: Wed May 31 14:07:44 on ttys002 - % sql sys/oracle0localhost:1521/ORCLPD01 as sysdba SQLcl: Release 23.1 Production on Wed May 31 14:25:10 2023 Copyright (c) 1982, 2023, Oracle. All rights reserved. Oracle Database 21c Enterprise Edition Release 21.0.0.0.0 - Production Version 21.3.0.0.0

2. Run the following commands to create a new ORDSTEST user with the required privileges, roles, and tablespace:

```
CREATE USER ORDSTEST IDENTIFIED BY <password>;
GRANT "CONNECT" TO ORDSTEST;
GRANT "RESOURCE" TO ORDSTEST;
GRANT UNLIMITED TABLESPACE TO ORDSTEST;
```

Figure 1-2 ORDSTEST User with required Privileges, Roles, and Tablespace

```
~ — java 🖣
                               ~ — -zsh
Last login: Thu Jun 1 10:54:47 on ttys004
              ~ % sql sys/oracle@localhost:1521/ORCLPDB1 as sysdba
     0
SQLcl: Release 23.1 Production on Thu Jun 01 10:56:18 2023
Copyright (c) 1982, 2023, Oracle. All rights reserved.
Connected to:
Oracle Database 21c Enterprise Edition Release 21.0.0.0.0 - Production
Version 21.3.0.0.0
SQL> CREATE USER ORDSTEST IDENTIFIED BY oracle;
User ORDSTEST created.
[SQL> GRANT "CONNECT" TO ORDSTEST;
Grant succeeded.
SQL> GRANT "RESOURCE" TO ORDSTEST;
Grant succeeded.
SQL> GRANT UNLIMITED TABLESPACE TO ORDSTEST;
Grant succeeded.
SQL>
```

1.1.1.2 REST-enabling a Schema

To REST-enable a schema, connect to your database as the ORDSTEST user and then run the following PL/SQL procedure:

```
ORDS ADMIN.ENABLE SCHEMA
```



Figure 1-3 Executing the ORDS.ENABLE_SCHEMA PL/SQL Procedure

```
SQL> Execute ORDS.ENABLE_SCHEMA;
PL/SQL procedure successfully completed.
```

Figure 1-4 ORDS.ENABLE_SCHEMA PL/SQL Procedure

See Also: ORDS PL/SQL Package Reference

1.1.1.3 Accessing the Database Actions

To access the Database Actons, perform the following steps:

Now that ORDSTEST user schema is REST-enabled, you can now access Database Actions as the ORDSTEST user.

 Navigate to the URL: http://[server]:[port]/ords/sql-developer to display the Signin page.



Sign-in	\times localhost:8080/ords/ordstest/emp/ \times	+				
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		Username				
		ORDSTEST				
		Password				
		Fassword				
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		Sid	an in			

Figure 1-5 Accessing Database Actions as the ORDSTEST User

- 2. Sign-in as the ORDSTEST user with <username>: ORDSTEST and <password>: [Password].
- 3. Click on Sign in button.
- 4. Database Actions Launchpad home page appears. It comprises of six main categories: Development, Data Studio, Administration, Monitoring, Downloads, and Related Services. Each category consists of feature-based icons that you can click to navigate to the respective pages available to the ORDSTEST user.

	calhost:8080/ords/ordstest/_sdw/		☆ Search	ତ 👱 o o 💿
	npad	1// APC/ #101 #11112AMMAN 000055	Search	
Development		Administration		Getting Started
SoL Execute queries and scripts, browse and manage your X REST An IDE for your REST APIs that enables you to manage J JSON Create collections, upload documents, query and filter you G SCHEDULING An interface for	Image: Second	REST enable schemas, change passwords, assign storage quot.	1 DATA PUMP View Data Pump jobs and use our wizard to quickly create and run	Visual Explain Plans In the SQL workshet your query explain plans are now displayed with an easy-to-read, to-down diagrar The plans are automatically filterer show you the problematic steps, w plan cost, I/O, and cardinality prominently displayed. Data Pump Import Wizard Create and start import jobs easily Browse the contents of your Objec Store, choose your dhump file(s), create filters, and more. Scheduling Forecast upcoming DBMS_SCHEDULER jobs, find jobs with execution delays, quickly crea jobs, programs, schedules, chains, and more. Charts Create visualizations using area, b ple, and other popular charting
DBMS_SCHEDULER that enable Monitoring Reat TIME SQL MONITOR Monitor executed SQL queries in real time.				methods from your SQL query rest Need Help? Documentation SQL Developer Community Forum SQL Developer on Twitter

Figure 1-6 Database Actions Launchpad





1.1.1.4 Auto REST-enabling a Table

Perform the following steps to connect as a new user and auto REST-enable a table:

Note: The tasks listed in this section are completed with the user logged-in as an ORDSTEST user.

- 1. Creating a Database Table
- 2. Inserting the Sample Data
- 3. REST-enabling the EMP Table

1.1.1.4.1 Creating a Database Table

Perform the following steps to create an EMP table:

1. From the Database Actions launchpad, select **SQL**, under the **Development** category of the dashboard.

→ C ○ □ ≈	localhost:8080/ords/ordstest/_sdw/		☆	
DRACLE' Database Actions Launch	npad		Search	୍ 🖉 ୧ ordste
Development	SQL	ministration		Getting Started
Sol. Execute queries and scripts, browse and manage your Y REST An IDE for your REST APIs that enables you to manage () JSON Create collections, upload documents, query and filter you G SCHEDULING An interface for	Execute queries and scripts, browse and manage your database objects, load data, create charts, and optimize planes. The control optimize optimizes View ChangeLogs applied to your schema. fils CHARTS Use SQL queries to build rich charts and dashboards	DATABASE USERS REST enable schemas, change passwords, assign storage quot	1 DATA PUMP View Data Pump jobs and use our wizard to quickly create and run	Visual Explain Plans In the SQL worksheet your query explain plans are now displayed with an easy-to-read, top-down diagra The plans are automatically filters plan carl, I(0) and cardiniships, prominently displayed. Data Pump Import Wizard Create and start import jobs easily Browse the contents of your Objes Store, choose your dump file(s), create filters, and more. Scheduling Forecast upcoming DBMS_SCHEDULER Jobs, find job with execution delays, quickly cre- jobs, programs, schedules, chains and more. Charts Create visualizations using area, t pie, and other popular charting
DBMS_SCHEDULER that enable Monitoring Real Time SQL MONITOR Monitor executed SQL queries in real time. A o 68 o L 11/48/16 AM - DEST refurgeby				Methods from your SQL query resident of the second

Figure 1-7 Selecting SQL Worksheet

2. After the SQL Worksheet is loaded, enter the following SQL query to create the EMP table:

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)
);
```

1.1.1.4.2 Inserting the Sample Data

1. After the EMP table is successfully created, insert the following sample data:

```
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;
```

1.1.1.4.3 REST-enabling the EMP Table

Perform the following steps to auto REST-enable the table:

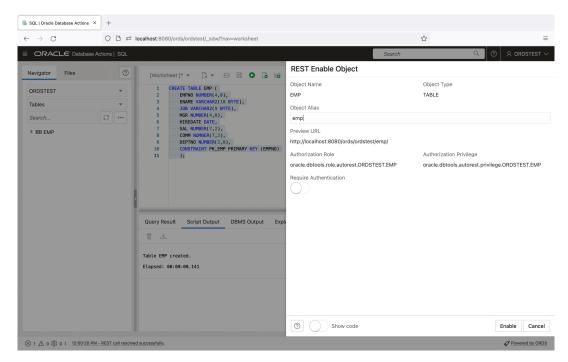
1. From the navigator panel, right mouse-click on the table name, navigate to **REST** and then click **Enable**.

	SQL Oracle Database Actions \times +			
Navigator Files (Worksheet)* * * * Image: Constraint of the constra	- → C O D =	localhost:8080/ords/ordstest/_sdw/?nav=worksheet	<u>ය</u>	1 =
ORDSTEST I CRATE TABLE EMP (I I CRATE TABLE EMP (I I<			Search Q 🖉	$^{\&}$ ordstest $^{\sim}$
	ORDSTEST ▼ Tables ▼ Search ② ···· > 囲 EMP © Open © Edit Add → © Use as Template REST → Ø Data Loading →	Query Result Script Output DBMS Output Explain Plan Autotrace SQL Hist Query Result Script Output DBMS Output Explain Plan Autotrace SQL Hist Table EMP created. State State State State SQL Hist		0

Figure 1-8 Auto REST-enabling the EMP table

2. A **REST Enable Object** screen appears. After reviewing the parameters that got automatically generated, click on **Enable** located at the bottom of the screen.

3. Figure 1-9 REST Enable Object Screen



4. A message slider appears confirming that the EMP table has been REST-enabled.



	Confirmation Object REST Enabled The table EMP has been successfully REST enabled
7369,' <mark>SMITH','CLERK'</mark> ,7902,to_date('17-DE ^C -80','DD-MON-RR'),800,null,20); nsert 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);	
<pre>7521; 'WARD', 'SALESMAN', 7698, to_date('22-FEB-81','DD-MON-RR'),1250, 500, 30); nsert into EMP (EMPNO, ENAME, J0B, MGR, HIREDATE, SAL, COMM, DEPTNO) values 7566, 'JONES', 'MANAGER', 7839, to_date('02-ARE.81', 'DD-MON-RR'),2575, null,20); nsert into EMP (EMPNO, ENAME, J0B, MGR, HIREDATE, SAL, COMM, DEPTNO) values 7654, 'MARTIN', 'SALESMAN', 7698, to_date('28-SEP-81','DD-MON-RR'),1250, 1400, 30); nsert into EMP (EMPNO, ENAME, J0B, MGR, HIREDATE, SAL, COMM, DEPTNO) values 7659, 'BLACK', 'MANAGER', 7839, to_date('01-MAY.81', 'DD-MON-RR'),2580, null,30); nsert into EMP (EMPNO, ENAME, J0B, MGR, HIREDATE, SAL, COMM, DEPTNO) values 7782, 'CLARK', 'MANAGER', 7839, to_date('01-MAY.81', 'DD-MON-RR'),2450, null,10); nsert into EMP (EMPNO, ENAME, J0B, MGR, HIREDATE, SAL, COMM, DEPTNO) values 7788, 'SCOTT', 'ANALYST', 7566, to_date('19-ARE.87', 'DD-MON-RR'),2450, null,20); nsert into EMP (EMPNO, ENAME, J0B, MGR, HIREDATE, SAL, COMM, DEPTNO) values 7788, 'SCOTT', 'ANALYST', 7566, to_date('19-ARE.87', 'DD-MON-RR'),3000, null,20); nsert into EMP (FMPNO, ENAME, J0B, MGR, HIREDATE, SAL, COMM, DEPTNO) values</pre>	

Figure 1-10 Table REST-enabled Confirmation

1.1.1.5 Testing the Auto REST-enabled Object

Note:

An icon next to the database objects indicates that the database objects have been auto-REST enabled.



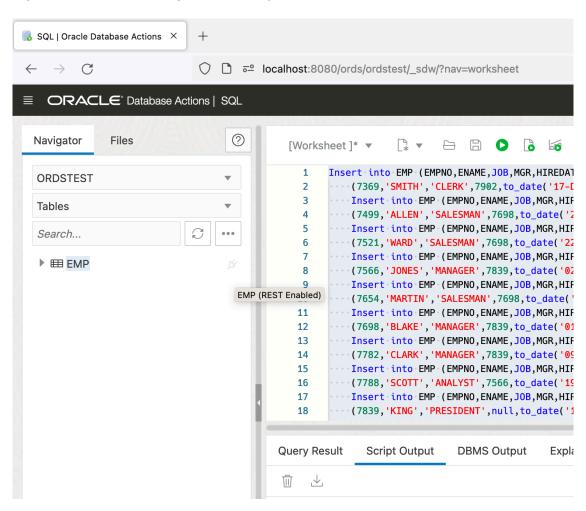


Figure 1-11 Icon showing Database Object is Auto REST-enabled

Note:

If you do not see the icon, then click **Refresh** in the Navigator Panel to display the icon.

To review and retrieve the REST endpoints for the EMP table, perform the following steps:

1. Right-click on the name of the object, click **REST** and then select **cURL command**:

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lavigator Files	(Worksheet]* ▼ ↓ ↓ ↓ ∴ ↓ ∴ ↓ ∴ ↓ ∴ ↓ <th>Data Load 🤞</th>	Data Load 🤞
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▶ Ⅲ EMP □ Open □ Edit	<pre>6 (7521, 'WABO': 'SALESMM', 7688; to date('22-FEB-81', 'DD-MOK-RY'), 1259, 569, 39); 7 Insert into PM (PMMOR, DAME, JOB, MCH, RIEDAT, SAL, MCM, DETNIO, Values 8 (7566, 'JOMES', 'MANAGER', 7638; to, date('22-APR-81', 'DD-MOK-RY'), 2075, null, 20); 9 Insert into PM (PMMOR, DAME, JOB, MCH, RIEDAT, SAL, MCM, DETNIO, Values 10 (7654, 'MARTIM', 'SALESMM', 7698; to, date('28-EF-81', 'DD-MOK-RY'), 1259, 1469, 39); 11 Insert into PM (PMMOR, DAME, JOB, MCH, RIEDAT, SAL, MCM, DETNIO, Values 10 (7654, 'MARTIM', 'SALESMM', 7698; to, date('28-EF-81', 'DD-MOK-RY'), 1259, 1469, 39);</pre>	
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	<pre>Solsable [//doi.scul1, Add(151./200(2)dd(1)sram(2), [Johnson / Johnson / Johnson (Johnson / Johnson /</pre>	
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	1 row inserted. Elapsed: 00:00:00.009	
	Commit complete.	
	Elapsed: 00:00:00.016	

Figure 1-12 Locating Curl Command to Test the Rest Endpoint

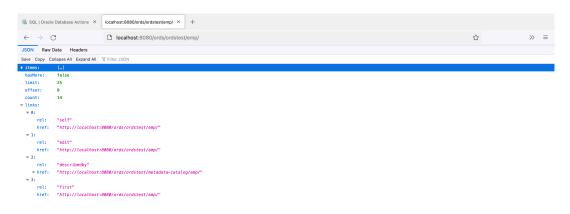
- 2. A slider **cURL for the table EMP** appears with the following HTTP methods available to an auto-REST enabled resource:
 - GET ALL
 - GET Single
 - POST
 - BATCH LOAD
 - PUT
 - DELETE
- 3. Copy the URL portion of the GET ALL cURL command.
- 4. Open a new browser and paste the URL in the address bar, and press **Enter** on your keyboard.



	localhost:8080/ords/ordstest/emp/	\$	>>
$\leftarrow \rightarrow G$	D localnost:8080/ords/ordstest/emp/	W	"
SON Raw Data	Headers		
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items:			
~ 0:			
empno:	7369		
ename:	"SMITH"		
job:	"CLERK"		
mgr:	7902		
hiredate:	"1980-12-17T00:00:002"		
sal:	800		
conn:	null		
deptno:	20		
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# 0:			
rel:	"self"		
href:	"http://localhost:8080/ords/ordstest/emp/7369"		
▼ 1:			
empno:	7499		
ename:	"ALLEN"		
job:	"SALESMAN"		
mgr:	7698		
hiredate:	"1981-02-20T00:00:00Z"		
sal:	1600		
conn:	300		
deptno:	30		
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₩ 0:	"self"		
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▼ 2:	nctp://tutatnost:s000/0105/0105tst/emp/7499		
empno:	7521		
ename:	"WARD"		
job:	"SALESMAN"		
mgr:	7698		
hiredate:	"1981-02-22T00:00:00Z"		
sal:	1259		
conn:	500		

Figure 1-13 Results Atfer Testing the Emp URL in the Browser

- 5. A list of the first 25 items in the EMP table are displayed.
- 6. If you collapse the preceding items list, it reveals the other helpful links that are automatically included with all the auto-REST enabled resources.



1.1.2 Creating a RESTful Service Through the REST Workshop

This section explains how to create a RESTful service using REST Workshop of Database Actions. The REST Workshop enables you to create and edit the RESTful service definitions.



Perform the following steps to create and test a RESTful service in the REST Workshop:

- 1. Navigate to the REST Workshop
- 2. Create a Module
- 3. Create Template
- 4. Create Handler
- 5. Test the RESTful Service

1.1.2.1 Navigate to the REST Workshop

Perform the following steps to navigate to the REST Workshop:

- 1. Log in as the ORDSTEST user and navigate to the Database Actions Launchpad.
- 2. Select **REST** under the **Development** section.

Actions Launchpad	untilises and a lateral way		In the second market was to be	Search	० 📀
Development	,	Administration			Getting Star
∏a squ	I DATA MODELER	𝔅 DATABASE USERS	Î↓ DATA PUMP		Visual Explain Plan In the SQL workshe explain plans are n
Execute queries and scripts, browse and manage your	Reverse-engineer schemas to elational diagrams and data	REST enable schemas, change passwords, assign storage quot	View Data Pump jobs and use our wizard to quickly create and run		an easy-to-read, The plans are aut show you the pro
X REST	🛠 REST				plan cost, I/O, and prominently displa
An IDE for your REST APIs that enables you to manage	An IDE for your REST APIs that enables you to manage templates, handlers and OAuth clients, generate API				Data Pump Impor Create and start Browse the conte Store, choose yo create filters, and
L	La CHARTS				Scheduling
Create collections, upload documents, query and filter you	Use SQL queries to build rich charts and dashboards				Forecast upcomi DBMS_SCHEDU with execution d jobs, programs, and more.
C SCHEDULING					Charts
An interface for DBMS_SCHEDULER that enable					Create visualiza pie, and other p methods from y
Monitoring					Need Help
E REAL TIME SQL MONITOR					SQL Developer (
Monitor executed SQL queries in real time.					SQL Developer

Figure 1-14 Navigating to the REST Workshop from the Launchpad

1.1.2.2 Create a Module

To create a module, perform the following steps:

1. After the REST workshop screen loads, click on Modules widget.



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	0,0013						
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		http://localhost:8080/ords/	ordstest/metadata-catalog/	0 0			
		Module Secur					
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	ecent Ob OBJ	Published Modules REST modules either fully jects	v or partially secured by a privilege NAME/URI		UPDAT		
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Figure 1-15 Modules Dashboard

- 2. Modules dashboard appears. Click on **Create Module** button located at the upper righthand corner of the dashboard.
- 3. A Create Module slider appears.

Figure 1-16	Entering Values in the Create Module Screen
-------------	---

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Sector Modelar, Elf Prefar, C Tare by * 1 Sorthy * Modelar Type Marka C Modelar Type Marka Paramodela Modelar Type Marka Paramodela Markar Marka Paramodela Markar Markar Paramodela <	REST > Modules	Create Module	
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	©1 ≜ 0 © 01 12:10 20 M- 8157 col normal successfuly,	The second secon	Creato Cancel

Enter he following values in the respective fields:



- Module Name: Any desired name for the connection. For example, demo.module.
- URI Prefix: /demo/
- Pagination Size: 25
- In the Protected by Privilege field, select Not Protected
- 4. Click on **Create**, the module settings are saved, and a confirmation message is displayed to confirm that the module is created.

1.1.2.3 Create Template

Perform the following steps to create a template:

 After creating a Module, you will be automatically taken to the Create Template screen. Click on Create Template button.

	Overview	Modules	AutoREST	Security \vee		Search
REST > Modules > demo.module						
	đ		demo.mo /demo/ No comments avai Page Size: 25 Tem	lable plates: 1 Handlers		I
		ht	ttp://localhost:808	Vords/ordstest/o	an-api-catalog/demo/	0.0
	Templa	ates				+ Create Template
	Search I	by URI Temp	plate Q	J ⁿ Sort by ▼	Page Size: 20 💌	
					Sort by U	IRI Template: ASC ×

2. A Create Template screen appears. In the URI Template field, enter emp/.





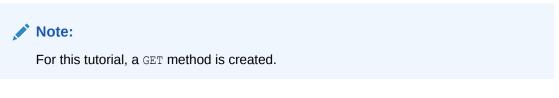
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REST > Modules > demo.module	Create Template
etam.ancodule // Array // Array etam.ancodule // Array // Array	Module Name demomodule Base Path demod UII Trendsta* emod Priority Priority 0 V T Priority 0 V T Priority 0 V T 0 V
	Show code Create Cancel
⊗ 2 △ 0 🖗 0 1 2:29:29 PM - REST call resolved successfully.	Powered by ORDS

Figure 1-17 Create Template Screen

3. You are automatically taken to the **Create Handler** page.

1.1.2.4 Create Handler

Perform the following steps to create the Get handler and review the SQL query results:



- 1. Click on Create Handler button to display the Create Handler screen. Verify the following settings:
 - Method: GET
 - Items Per Page: 7
 - Source Type: Collection Query



ORACLE: Database Actions REST Overview Modules AutoREST Security		Search Q Ø & ORDSTEST V
REST > Modules > demo.module > emp/	Create Handler	
emp/	Handler Definition	MIMEs Allowed
No comments available	Module Name	
Priority: 0 Handlers: 0	demo.module	
	Full URL	
http://localhost:8080/ords/ordstest/demo/emp/	http://localhost:8080/ords/ordstest/demo/emp/	
Handlers	Method *	Items Per Page
	GET v	7 🗸 🖍
	Source Type	
	Collection Query	v
	Source *	
(-	
No results found mat	2	
	Comments	
		li.
	Go to Handler after creation	
	Show code	Create Cancel
⊗ 2 🛆 0 🖏 0 2:33:41 PM - REST call resolved successfully.		Powered by ORDS

Figure 1-18 Create Handler

2. In the **Source** field, enter the following SQL query:

```
SELECT
INITCAP(ENAME) name,
lower(job) job,
TO_CHAR(sal,'9G999','NLS_NUMERIC_CHARACTERS=",."') salary,
hiredate
FROM
emp
```

Click on the **Create** button to automatically open the **Resource Handler** page with a confirmation message indicating that the handler is created.

3. You can then test the SQL query. To do so, click on the **Play** icon. The results of the query appears in the output window.



GET	emp/ Last Updated: 1 se No comments available Source Type: json/collectio				:
h	ttp://localhost:8080/ords	s/ordstest/demo/emp/			Ľ
Source					
1 SELECT	ENAME) name,			A Handler Parame	eters
3 ··lower(jot		RIC_CHARACTERS=",.") salary,	_ / Implicit Parame	ters
5 hiredate 6 FROM				body	
7 emp				:body_text	
	wnload + Execution t	ime: 0.031 seconds			
	wnload v Execution t	SALARY	HIREDATE		
			HIREDATE 12/17/1980, 12:00:00		
NAME	JOB	SALARY			
NAME 1 Smith	JOB clerk	SALARY 800	12/17/1980, 12:00:00		
NAME 1 Smith 2 Allen	JOB clerk salesman	SALARY 800 1,600	12/17/1980, 12:00:00 2/20/1981, 12:00:00 /		
NAME 1 Smith 2 Alten 3 Ward	JOB clerk salesman salesman	SALARY 800 1,600 1,250	12/17/1980, 12:00:00 2/20/1981, 12:00:00 / 2/22/1981, 12:00:00 /		

Figure 1-19 Resource handler SQL query results

1.1.2.5 Test the RESTful Service

Perform the following steps to test the RESTful service:

1. Click on the **Open in a new tab** icon.

> Modules > dem	no.module > emp/ > GET			
	GET emp/ Last Updated: 1 second ago No comments available Source type (pervicalments) Faga Star. 7			:
	http://iocalhost:8080/ords/ordstest/demo/emp/		C Open in n	6
	Source i SELECT i SELECT	_	A Handler Parameters	ĺ
	<pre>3 tower(glob)job, 4 TO_CHAR(sat)'96999','HL5_NUMERIC_CHARACTERS=',.'') salary, 5 hiredate 6 FROM 7 emp</pre>		Implicit Parameters :body	0
			:body_text	

Figure 1-20 New Tab for Testing the Endpoint

- 2. A new browser tab appears. Enter the Get URI in the browser tab.
- 3. A JSON response is returned in the browser window.



۲	🔒 н	andler Details Modules	RESTX	localhost:8080/o	rds/ordstest/demo/×	+
		Г				
\leftarrow	\rightarrow	C	٥	localhost:8080/d	ords/ordstest/demo	/emp/
JSON R	Raw Data	Headers				
Save Copy	y Collapse	All Expand All 🗑 Filter JSON				
r items:						
▼ 0:						
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job	ary:	" 800"				
		"1980-12-17T00:00:00Z"				
v 1:						
nam	ne:	"Allen"				
job		"salesman"				
	lary:	" 1,600"				
	redate:	"1981-02-20T00:00:00Z"				
₹ 2:		"Ward"				
nam job		"ward" "salesman"				
	iary:	" 1,250"				
	redate:	"1981-02-22T00:00:00Z"				
₹ 3:						
nam		"Jones"				
job		"manager"		-		
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• 4:	redate:	"1981-04-02T00:00:00Z"				
• 4: nam		"Martin"				
job		"salesman"				
	lary:	" 1,250"				
		"1981-09-28T00:00:00Z"				
÷ 5:						
nam		"Blake"				
job		"manager"				
	lary:	" 2,850" "1981-05-01T00:00:00Z"				
▼ 6:	redate:	.1981-02-01100:00:002				
v o: nam	ie:	"Clark"				
job		"manager"				
	lary:	" 2,450"				
		"1981-06-09T00:00:00Z"				
hasMore:		true				
limit:		7				
offset:		0				
count: links:		7				
▼ 0:						
rel		"self"				
hre		"http://localhost:8080/ords/o	rdstest/de	emo/emp/"		
v 1:						
rel	la 👘	"describedby"				
⇒ hre	ef:	"http://localhost:8080/ords/o	rdstest/m	tadata-catalog/demo/emp/"	• • • • • • • • • • • • • • • • • • •	
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+ are		neepsy/cocaciloscs0000/0105/0	- ustest/ d	moremp/1011301=7		

Figure 1-21 JSON Response from GET Method

1.1.3 Creating a Privilege Using Database Actions

This section describes how to create a privilege and control access to protected resources.

Privileges are defined to control access to protected resources. Privileges restrict access to those users who have access to at least one from a set of the specified roles. A privilege is then associated with one or more resource modules. Before accessing those resource modules, the user must be authenticated and then authorized to ensure that the user has one of the required roles.

1.1.3.1 Steps to Create a Privilege

This section describes the steps to control access to the protected resources.

Perform the following steps to create a privilege:

- 1. Navigate to the REST Workshop
- 2. Under the Security menu item, select Privileges.

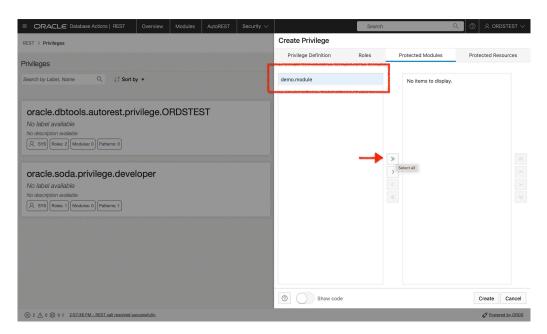


Figure 1-22 Selecting Privileges Menu Option

	and the second se
ORACLE Database Actions REST Overview Modules AutoREST	Security V Search Q Ø & ORDSTEST V
REST > Modules	Roles
Modules	Privileges Outh Clients
Search by Module, URI Prefix Q ⊽ Filter by v J. [*] , Sort by v Module Type Module X	Page Size: 20 + K < > C BB BB Sort by Module Name: ASC >
No re	esults found matching your search terms.

- 3. Click on **Create Privilege** to display the **Create Privilege** screen.
- 4. Enter the following values in the respective fields:
 - Label: Demo module privilege
 - Name: demo.module.privilege
 - **Description**: A Privilege created for demonstrating privileges for the demo.module Resource Module.
 - Navigate to the **Protected Modules** table. Move the demo.module Resource Module from the left column to the right column. This ensures that the demo.module Resource Module is associated with this Privilege.

Figure 1-23 Associating Resource Module with the Privilege



 Click on the Create button. A confirmation message appears indicating successful creation of a new privilege.



Note:

The newly created privilege can now be viewed in the **Privileges** dashboard.



	Overview	Modules	AutoREST	Security \checkmark	Search	O Confirmation X
REST > Privileges						Privilege created The privilege 'Demo module privilege' has been
						created
Privileges						Create Brivilege
Search by Label, Name Q 1 Sort by						Page Size: 20 V
	•					Sort by Name: ASC X
	994.9449.949.949.9499.999					
demo.module.privilege				:	oracle.dbtools.autorest.pi	rivilege.ORDSTEST
Demo module privilege					No label available	
A Privilege created for demonstrating privileges for	or the demo.mod	lule Resource	Module.		No description available	
Q ORDSTEST Roles: 0 Modules: 1 Patterns: 0					A SYS Roles: 2 Modules: 0 Patterns: 0	
L						
oracle.dbtools.sqldev					oracle.soda.privilege.deve	eloper
					No label available	siopei
RESTful Service Editing Provides access to edit RESTful Service definition	16				No label available No description available	
SYS Roles: 2 Modules: 0 Patterns: 0					Q SYS Roles: 1 Modules: 0 Patterns: 1	
						Page Size: 20 💌
	ccessfully.					Powered by ORDS

5. To test the Privilege created, navigate to the path of the demo.module.

Figure 1-25 Navigating to the demo module to Test the Privilege

_	lle, URI Prefix Q ⊽ Filter by	v ▼ ↓ ^q Sort by ▼			
	demo.module /demo/ No comments available	lers: 1	a a fan muss út ú finddrinf ar	:	
	http://localhost:8080/ords/ordstes	t/open-api-catalog/demo/		0 5	



6. Copy the emp/ URI.

Image: Security of the secure of the security of the security of the security of the security	
/demo/	
No comments available Page Size: 25 Templates: 1 Handlers: 1 http://localhost:8080/ords/ordstest/open-api-catalog/demo/	
Templates	
Search by URI Template Q 1° Sort by Template Page Size: 20	•
emp/ :	
No comments available	
Priority: 0 Handlers: 1	
http://localhost:8080/ords/ordstest/demo/emp/	
Copy to clipboard	

Figure 1-26 Copying the URI to Test the Privilege

- 7. Sign out of Database Actions. Open a new browser window. Paste the URI in the address bar and press Enter
- 8. A 401 unauthorized error message is displayed to indicate that the resource is protected. Notice that a sign-in prompt appears. Since this Privilege has not been associated with a specific role, any user who has been granted the Connect role can sign-in to view the response from this request.
- 9. Sign-in with your database credentials to view the resource.



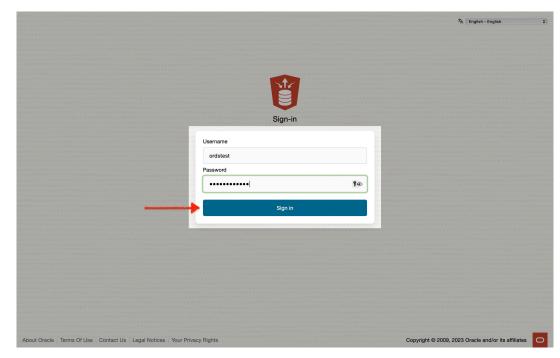


Figure 1-27 Sign-in to Test Path Privilege

10. After you sign-in, the contents of the JSON document can be viewed.

1.1.4 Register an OAuth Client Application to Access the REST API

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 authenticated end user.

Before a third party application can access a REST API:

- It must be registered and
- · The authenticated end user must approve access

Prior to registering the application, it must be assigned a user identity so that the user is allowed to register the applications. Users possessing the SQL Developer role are permitted to register OAuth 2.0 clients.

Note:

In a real application, you must provision specific users who can register OAuth clients. Such users must be granted the OAuth Client Developer role.

Note:

The following example is not intended to serve as a full-featured demonstration for creation and integration for a third party application. The example provided in this section, only outlines the core concepts of the OAuth 2.0 protocol.

1.1.4.1 Registering your Application to Access a REST API

Perform the following steps to register your application to access a REST API:

1. From the REST Workshop dashboard, select **OAuth Clients** option from the **Security** menu.

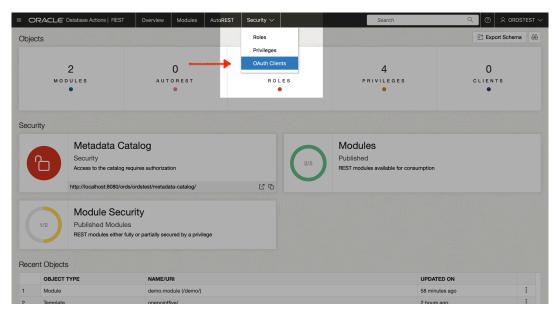


Figure 1-28 Navigating to OAuth Client Menu Option

2. The OAuth Clients dashboard appears. From the OAuth Clients dashboard, click on Create OAuth Client.

Modules	AutoREST	Security \checkmark		Search	Q	0	오 ordstest \smallsetminus
		Roles					
		Privileges				$\left[+ \right]$	Create OAuth Client
Orthu		OAuth Clier	s			L	
Sort by ▼				Page Size: 20	• K	Sor	t by Name: ASC X
		C					
	No rest	ults found match	ng your search terms.				

Figure 1-29 Create OAuth Client

3. The Create OAuth Client slider appears.

les	AutoREST	Security \checkmark		Search	٩ () R ORDSTEST ~
			Create OAuth Client		, i	
			Client Definition *	Roles	Allowed Origins	Privileges
	No rest	Ults found match	Client Definition	Roles	Allowed Origins Grant type * CLIENT_CRED CLIENT_CRED AUTH_CODE IMPLICIT	Privileges
			⑦ Show code			Create Cancel
						Powered by ORDS

Figure 1-30 Checking Client Credentials Selected

- 4. Enter the following values in the **Create OAuth Client** slider:
 - **Name**: example_oauth_client
 - **Description**: An example OAuth 2.0 client using the Client Credentials grant type.
 - Support URI: https://example.com
 - Support Email: email@example.com



v Modules	AutoREST	Security 🗸		Search	٩	⑦ 옷 ORE	ostest 🗸	
			Create OAuth Client					
			Client Definition *	Roles	Allowed Origins	Privil	leges	
			Owner		Grant type *			
, ^q Sort by ▼			ORDSTEST		CLIENT_CRED		•	
			Name *					
			example_oauth_client					
			Description *					
			An example OAuth 2.0 client using the Client Credentials grant type.					
			Support URI *					
			https://example.com					
			Support Email *					
		\cap	email@example.com					
		<u> </u>						
	No resu	ults found match						
			Show code			Create	Cancel	
						Power	ed by ORDS	

Figure 1-31 Entering Values in Create OAuth Client Slider

5. Navigate to the **Privileges** tab of the screen. Locate the privilege you created in the preceding section. Move it from the **Available Privileges** column to the **Selected Privileges** column.

~ ~		Search			Q (?)	옷 ORDSTE	ST 🗸
	Create OAuth Client						
	Client Definition *	Roles		Allowed Origins	s	Privilege	S
C			» > <	Allowed Origins		Privilege	S (*) (*) (*) (*) (*) (*) (*) (*)
	Show code					Create Ca	

Figure 1-32 Move Privilege to Selected Column

Note:

The double arrow moves all the available privileges to the **Selected Privileges** column. The single arrow moves only the currently selected privileges to the **Selected Privileges** column.

- 6. Click on Create.
- 7. After returning to the **OAuth Clients** dashboard, you can find the newly-created OAuth client.

	ents			
DAuth Clients				+ Create OAuth Clien
Search Name	Q		Page Si	ze: 20 🔻 🛛 🕹 💭 🗷 🖉 🖩 Sort by Name: ASC 🗡
	example_oauth_client Grant Type: CLIENT_CRED Response Type: TOKEN An example OAuth 2.0 client using the Client Credentials grant type. (no aloved origins)	1		
U	Support URI: https://example.com	G		
	Client ID: ••••••	• 6		
	Client Secret: ••••••	• 6		

Figure 1-33 OAuth Client Created

8. After the OAuth Token appears, select the correct shell environment.

Figure 1-34 Selecting Correct Shell Environment

OAuth Token	×
Current Token Expires on His7bmak4ftQxiGW_mTdog C 11/7/2023, 7:16:17 PM	Get New Token
Use the code below to get a token in the terminal curl \ user Bx2vfYZkLa9D8_CZXvFL0Q:XHInn_CPtitiWSv0UQXrrg \ data 'grant_type=client_credentials' \ http://localhost:8000/ords/ordstest/oauth/token	Command Prom PowerShell
	Bash

- 9. Copy brearer token curl command to your clipboard.
- **10.** Using the Client ID and Client Secret provided to you, issue the following curl command to obtain an Access Token:

```
curl \
--user Bx2vfYZkLa9D8_CZXvFL0Q..:xH1nn_CPtitiW5v0UQXrrg.. \
--data 'grant_type=client_credentials' \
http://localhost:8080/ords/ordstest/oauth/token
```

11. You will receive an Access Token, with expiration time.

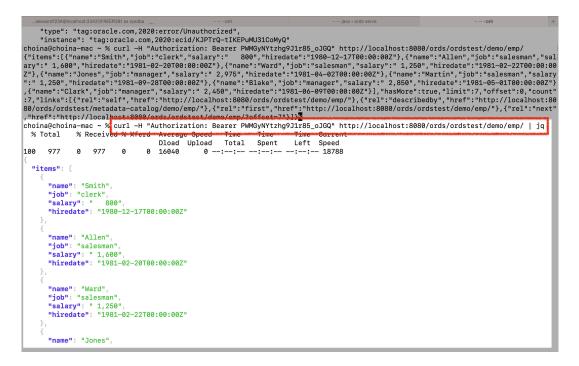




12. You can now access the emp/ endpoint. Create your curl command ensuring that you have included the Access Token as a header in your curl command:

```
curl -H "Authorization: Bearer PWMGyNYtzhg9J1r85_oJGQ" http://
localhost:8080/ords/ordstest/demo/emp/ | jq
```

Figure 1-36 jq Response from the Get Request



Note:

You can *optionally* pipe in the jq command so that the JSON response payload is structured in a readable format.

1.1.5 Creating a RESTful Service Using Oracle SQL Developer

This section describes the steps involved in developing the RESTful services using Oracle SQL developer desktop application (aka client).

Topics:



- REST-Enable a Database Table
- Creating a RESTful Service through the Connections Navigator
- Creating a RESTful Service from a SQL Query
- Protect Resources
- Register an OAuth Client Application

1.1.5.1 REST-Enable a Database Table

To enable a table for REST access, follow these steps.

Note:

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 user ordstest with the following privileges or roles:

```
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.
- 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:

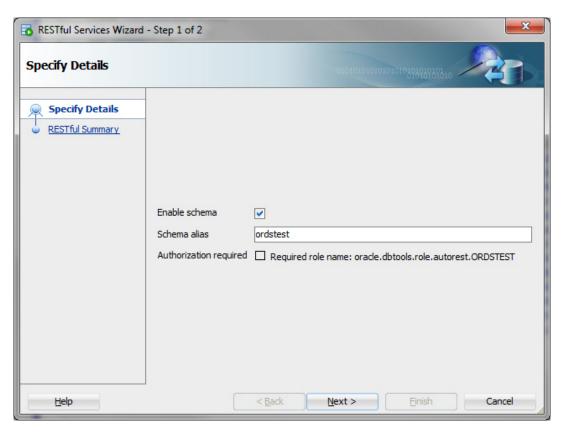


Figure 1-37 Enabling the Schema of the EMP Table for REST

Enable schema: Enable this option.

Schema alias: Accept ordstest for the schema alias.

Authorization required: For simplicity, this tutorial does not require authorization, so disable this option.

Click Next.



- 6. On the RESTful Summary page of the wizard, click Finish.
- 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 1-38 REST Enabling the EMP Table

RESTful Services Wizard	- Step 1 of 2	
Specify Details		01010101010101049494949494949
Specify Details RESTful Summary	Enable object Object alias Authorization required	emp Required role name: oracle.dbtools.role.autorest.ORDSTEST
Help		< Back Next > Einish Cancel

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 .

Note:

DELETE, PUT, POST, and metadata-catalog endpoints are also auto-generated.

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.

```
🎁 http://localhost:8080/ords/... 🗙
                             + (
←
    (i) localhost:8080/ords/ordstest/emp/
                                                                                                          G
👌 Oracle 🧕 Most Visited
{
 • items: [
     • {
           empno: 7369,
           ename: "SMITH",
           job: "CLERK",
           mgr: 7902,
           hiredate: "1980-12-16T18:30:00Z",
           sal: 800,
           comm: null.
           deptno: 20,
         v links: [
             • {
                   rel: "self",
                  href: http://localhost:8080/ords/ordstest/emp/7369
               }
           1
       1.
     • {
           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
               }
           1
       },
```

Figure 1-39 Testing the REST Enabled Table

Related Topics

Automatic Enabling of Schema Objects for REST Access (AutoREST)

1.1.5.2 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.



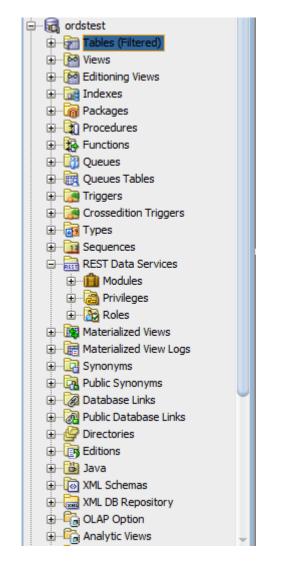


Figure 1-40 REST Data Services option under Connections Navigator

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:



00	RESTful Services Wizard - Step 1 of 3
Specify Module	0101010101010101010101010
Specify Module Specify Template RESTful Summary	Module Name: Demo Universal Resource Identifier URI Prefix: /demo/ Example: http://localhost:8080/ords/ordstest/demo/ Image: Publish - Make this RESTful Service available for use Pagination Size: 25 Image: 25
Help	Origins Allowed

Figure 1-41 Entering Information on the Specify Module Page

Module Name: Any desired name for the connection. For example, ${\tt demo}$

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:

	RESTful Services Wizard - Step 2 of 3
Specify Template	0101010101010101010101010550
Specify Module Specify Template RESTful Summary	Universal Resource Identifier URI Pattern: emp/ Example: http://localhost:8080/ords/ordstest/demo/emp/
	Priority: Image: Secure Hash HTTP Entity Tag Image: Secure Hash ETag: Secure Hash Generate the version id using secure hashing which uniquely identifies the resource version.
<u>H</u> elp	< <u>B</u> ack <u>N</u> ext > <u>Einish</u> Cancel

Figure 1-42 Entering Information on the Specify Template Page

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.

Create Resource Handler	X
Method Handler Method: GET	
Source <u>Type</u> : Collection Query Results Data <u>F</u> ormat: JSON	
Pagination Size: 7	
Help Apply Cano	el

Figure 1-43 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
    INITCAP(ENAME) name,
    lower(job) job,
    TO_CHAR(sal,'9G999','NLS_NUMERIC_CHARACTERS=",."') salary,
    hiredate
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.

- 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 query has been exposed at the /demo/emp/ path.

Figure 1-44 Testing URL in a Web Browser

```
- 0 X
 🎁 localhost:8088/ords/hr/te 🗙
       С
                                                                                                      :
←
   \rightarrow
            http://localhost:8080/ords/ordstest/demo/emp/
▼ {
      "items": [
    Ψ.
        ▼ {
              "name": "Smith",
              "job": "clerk",
              "salary": " 800",
              "hiredate": "1980-12-17T05:00:00Z"
          },
        ▼ {
              "name": "Allen",
             "job": "salesman",
              "salary": " 1,600",
              "hiredate": "1981-02-20T05:00:00Z"
          },
        ▼ {
              "name": "Ward",
              "job": "salesman",
              "salary": " 1,250",
              "hiredate": "1981-02-22T05:00:00Z"
          },
        ▼ {
              "name": "Jones",
              "job": "manager",
              "salary": " 2,975",
              "hiredate": "1981-04-02T05:00:00Z"
          },
        ▼ {
              "name": "Martin",
              "job": "salesman",
              "salary": " 1,250",
              "hiredate": "1981-09-28T04:00:00Z"
          },
        v.
          {
              "name": "Blake",
              "job": "manager",
              "salary": " 2,850",
```



Related Topics

•

Creating a RESTful Service from a SQL Query

1.1.5.2.1 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:

	C	Create Privilege
Name:	Demo	
	Example Privilege	
_	Demonstrate controlling access with	n privileges.
Roles		Selected Roles
	ices oper er iinistrator Is.autorest.any.schema	
Protect Mod Modules	dules Protect Resources	Protected Modules
		Demo
<u>H</u> elp		<u>Apply</u> Cancel

Figure 1-45 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 demo module. However, you have not restricted the privilege to any particular role; this will just require that the user be authenticated before accessing the demo 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:



- • × 🎁 localhost:8088/ords/hr/te 🗙 ← \rightarrow С http://localhost:8080/ords/ordstest/demo/emp/ ▼ { "items": [v ▼ { "name": "Smith", "job": "clerk", "salary": " 800", "hiredate": "1980-12-17T05:00:00Z" }, ▼ { "name": "Allen", "job": "salesman", "salary": " 1,600", "hiredate": "1981-02-20T05:00:00Z" }, ▼ { "name": "Ward", "job": "salesman", "salary": " 1,250", "hiredate": "1981-02-22T05:00:00Z" }, ▼ { "name": "Jones", "job": "manager", "salary": " 2,975", "hiredate": "1981-04-02T05:00:00Z" }, **v** { "name": "Martin", "job": "salesman", "salary": " 1,250", "hiredate": "1981-09-28T04:00:00Z" }, w. { "name": "Blake", "job": "manager", "salary": " 2,850",

Figure 1-46 JSON Document After Signing in

1.1.5.2.2 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.

Role testrole	

Figure 1-47 Entering the New Role Name

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.

1.1.5.3 Creating 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. This option is available when you do not have direct access to the database. 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.

- Create RESTful connection. In SQL Developer, select View > REST Data Services > Development.
- 3. In the REST Development pane, right-click **REST Data Services > Connect**.
- 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:



● ○ ● New RESTful Services Connection				
Connection <u>N</u> ame:	ordstest			
<u>U</u> sername:	test_developer			
● h <u>t</u> tp ○ http <u>s</u>				
H <u>o</u> stname:	localhost			
<u>P</u> ort:	8080			
Ser <u>v</u> er Path:	/ords			
<u>W</u> orkspace	ordstest			
<u>H</u> elp	OK Cancel			

Figure 1-48 Entering Information for New RESTful Services Connection

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 $\texttt{test_developer}$ 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:



$\Theta \cap \Theta$	RESTful Services Wizard – Step 1 of 4
Specify Module	01
Specify Module Specify Template Specify Handler Specify Handler RESTful Summar	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 Torigins Allowed
· ())	
<u>H</u> elp	< <u>B</u> ack <u>N</u> ext > <u>F</u> inish Cancel

Figure 1-49 Entering Information on the Specify Module Page

Module Name: Any desired name for the connection. Example: ${\tt test}$

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:

$\bigcirc \bigcirc \bigcirc$	RESTful Services Wiza	ard – Step 2 of 4	
Specify Templat	te		
Specify Module Specify Templat Specify Handler RESTful Summar	Priority:	0/ords/ordstest/test/ emp /	
	LOW HTTP Entity Tag <u>E</u> Tag: Secure Hash Generate the version id using secu version.	MEDIUM re hashing which uniquely identifies th	HIGH
<u>H</u> elp	< <u>B</u> ac	k <u>N</u> ext > <u>E</u> inish	Cancel

Figure 1-50 Entering Information on the Specify Template Page

URI Template: /emp/

Accept the defaults for the remaining options.

8. Click **Next**, and enter information on the Specify Handler page:



● ○ ●	RESTful Se	rvices Wizard - S	tep 3 of 4		
Specify Handler	r			01010101010104089898989	- Par
Specify Module Specify Template Specify Handler RESTful Summar	Method Handler Method: GET Requires Secure Acces	s			
	Source <u>Type</u> : Collection C Results Data <u>F</u> ormat: JSON	Query 🔻			
	Pagination <u>S</u> ize: 7	÷			
<→					
<u>H</u> elp		< <u>B</u> ack	<u>N</u> ext >	<u>F</u> inish	Cancel

Figure 1-51 Entering Information on the Specify Handler Page:

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 query has been exposed at the /test/emp/ path.

```
Figure 1-52 Testing the RESTful Service Created from a SQL Query
```

```
脊 http://localhost:8080/ords/... 🛪
                                +
        localhost:8080/ords/ordstest/test/emp/
     (i)
  Oracle 🧕 Most Visited
ł
  vitems: [
      • {
            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

Creating a RESTful Service through the Connections Navigator

1.1.5.4 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 1-53 Edit Privilege Dialog Box

$\bigcirc \bigcirc \bigcirc$	E	dit Privilege		
<u>N</u> ame:	test			
<u>T</u> itle:	Example Privilege			
<u>D</u> escription:	Demonstrate controlling access with Privileges			
Roles				Selected Roles
OAuth2 Clie RESTful Serv SQL Develop Schema Adn	er	> >> < <		
Modules		Protected Modules		
		> >> <	est	
<u>H</u> elp			<u>A</u> pply	Cancel

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.

1.1.5.5 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 Creating a RESTful Service from a SQL Query) 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 <code>OAuth Client Developer role</code>.

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 Ows8j7JYu0p07j0FMEA..&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 https:// datatracker.ietf.org/doc/html/rfc2616#section-14.8) as in the following example:

Host: localhost:8080 GET /ords/ordstest/test/emp/ Authorization: Bearer -i_Ows8j7JYu0p07j0FMEA..

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_Ows8j7JYu0p07j0FMEA..' 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":"1980-12-17T00:00:0
0Z","sal":800,"comm":null,"deptno":20},

```
{"empno":7499,"ename":"ALLEN","job":"SALESMAN","mgr":7698,"hiredate":"1981-02-20T00:0
0:00Z","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/"},
```



However, if the Authorization header is omitted, then the status 401 Unauthorized is returned instead.

See Also:

] }



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