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Using Oracle Database Cloud Service describes how to provision, monitor, and manage Oracle Database Cloud Services (Database Cloud Services) and provides references to documentation explaining how to develop and use Database Cloud Service applications.

**Topics:**
- Topic Overview
- Audience
- Documentation Accessibility
- Related Documents
- Conventions

**Topic Overview**

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<td>Chapter 1, &quot;Introducing Oracle Database Cloud Service&quot;</td>
<td>Offers a brief introduction to Oracle Database Cloud Service environment.</td>
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<tr>
<td>Chapter 2, &quot;Developing Applications for Oracle Database Cloud Service&quot;</td>
<td>Describes everything the user needs to know to develop, install, and use Oracle Application Express applications.</td>
</tr>
<tr>
<td>Appendix A, &quot;Database Cloud Service Features and Implementation Considerations&quot;</td>
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**Audience**

Using Oracle Database Cloud Service is intended for Oracle Cloud users who want to provision, monitor, and manage Oracle Database Cloud Services (Database Cloud Services) and Database Cloud Service users who want to develop or use Database Cloud Service applications.
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.

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Screen readers may not always correctly read the code examples in this document. The conventions for writing code require that closing braces should appear on an otherwise empty line; however, some screen readers may not always read a line of text that consists solely of a bracket or brace.

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Related Documents
For more information, see these Oracle resources:

- Getting Started with Oracle Cloud
- Using Oracle Java Cloud Service
- Oracle Application Express Administration Guide
- Oracle Application Express SQL Workshop Guide
- Oracle Application Express End User Guide
- Oracle Application Express API Reference
- Oracle Application Express Application Builder User’s Guide
- Oracle Database Utilities

Conventions
The following text conventions are used in this document:

<table>
<thead>
<tr>
<th>Convention</th>
<th>Meaning</th>
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<tr>
<td><strong>boldface</strong></td>
<td>Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.</td>
</tr>
<tr>
<td><em>italic</em></td>
<td>Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.</td>
</tr>
<tr>
<td>monospace</td>
<td>Monospace type indicates commands within a paragraph, URLs, code in examples, text that appears on the screen, or text that you enter.</td>
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Introducing Oracle Database Cloud Service

This section provides a brief overview of Oracle Database Cloud Service (Database Cloud Service), key Database Cloud Service concepts, and an overview of developing applications for an Oracle Database Cloud Service. To learn more about the Oracle Cloud, see Getting Started with Oracle Cloud.

Topics:
- About Oracle Database Cloud Service
- Understanding Key Database Cloud Service Components
- Security and the Oracle Database Cloud Service
- About Database Cloud Service Users
- About Developing Database Cloud Service Applications

About Oracle Database Cloud Service

The Database Cloud Service is built on Oracle Database technology, running on the Oracle Exadata Database Machine.

The Database Cloud Service has four main components:
- **Oracle Database 11gR2 Enterprise Edition.** The best performing database in the world.
- **Oracle Application Express.** Used to create and deploy all varieties of applications in a browser-based environment. See "Managing Oracle Application Express Database Applications" on page 2-24.
- **RESTful Web Services.** Allows access to the data in your Database Cloud Service through simple URIs. See "Implementing RESTful Web Services" on page 2-39.
- **Packaged Applications and Sample Code.** A set of business productivity applications that are installed with just a few clicks. See "Managing Oracle Application Express Packaged Applications or Sample Code" on page 2-29.

The Oracle Database Cloud Service delivers the following advantages:
- You can access your Database Cloud Service from any supported browser on any platform.
- The Database Cloud Service comes in several sizes, based on a simple storage and transfer metrics.
- The Database Cloud Service has a simple monthly subscription cost, which includes all standard maintenance operations and Oracle Support.
You can provision a complete Database Cloud Service environment in a few minutes and immediately start to be productive. The Database Cloud Service includes simple administrative tools that allow you to monitor usage, and add and drop user access. The Oracle Store allows you to modify your subscription package with a simple interface.

The Database Cloud Service includes a wide variety of tools and utilities, including development wizards and flexible interactive reporting. Most importantly, the Database Cloud Service offers rapid application development and instant deployment, which allows developers and users to work together in real time to create optimal solutions for business needs.

Understanding Key Database Cloud Service Components

The Oracle Database Cloud Service is composed of several components which provide functionality and benefits.

Topics:
- About Oracle Database
- About Oracle Exadata
- About Oracle Application Express
- About RESTful Web Services
- About Packaged and Sample Applications
- About Tools and Utilities

About Oracle Database

The Oracle Database has been the standard for enterprise databases for more than two decades. With the Oracle Database Cloud Service, you get the full power of this legendary platform. You can use the same SQL for data interaction that is used for hundreds of thousands of enterprise applications. You can use PL/SQL, the procedural extensions for the Oracle Database. All the optimizations and data structures which make the Oracle Database so robust are available in your Database Cloud Service.

The Database Cloud Service is used by the Java Cloud Service for all data operations. This support allows you to deploy Java applications with the Java Cloud Service with the enterprise-strength of the Oracle Database.

The Oracle Database Cloud Service uses schema isolation to implement multi-tenancy, which allows full transparency while still providing efficient use of database resources. The Oracle Database is, at its core, a multi-user system for sharing data, so the Oracle Database Cloud Service simply uses the capabilities built up for the Oracle Database to share resources among multiple Database Cloud Service customers.

About Oracle Exadata

The Oracle Database Cloud Service runs on Oracle Exadata hardware - the most advanced database platform in the world today. Oracle Exadata uses a variety of techniques and technology to dramatically improve the operation of the most time-consuming database operations. You get all the benefits of Oracle Exadata with your Oracle Database Cloud Service.
About Oracle Application Express

Oracle Application Express is a robust rapid application development system that is included with the Oracle Database. Oracle Application Express gives developers the ability to create applications in minutes. Once development is complete, the applications are instantly available, allowing for a process of interactive development where developers work with users to quickly create and refine applications to achieve business goals.

The process of application creation with Oracle Application Express can take advantage of a wealth of wizards, which simplify and accelerate development. You can also extend Oracle Application Express applications to meet your specific business needs with PL/SQL, so the range of functionality you can implement is virtually unlimited.

These features mean that Oracle Application Express provides both extremely high levels of productivity for creating standard applications and the ability to create sophisticated mission critical applications.

Oracle Application Express includes a range of user productivity features, such as interactive reports, which let business users shape the analysis and presentation of their data without having to involve development or IT staff. End users can also created Websheets, which act like data-driven wikis, giving them full control of their business applications.

Oracle Application Express also includes capabilities for managing your data structures, as well as functionality to help teams of developers manage their projects and communications.

Applications delivered through the Oracle Cloud can be accessed from a wide variety of client platforms, including Windows, Apple or mobile devices.

Oracle Application Express and your Oracle Application Express applications are built on technology that resides within an Oracle Database, so all your applications can be easily run on any Oracle platform - from the Oracle Database Cloud Service to your in-house data center to Oracle Database XE on your laptop.

About RESTful Web Services

RESTful Web services are services which adhere to an architecture which implements interactions with data sources through the use of URIs. RESTful Web services are one of the standard methods for accessing data in the Cloud.

The Oracle Database Cloud Service includes the ability to use RESTful Web services to access data in your Oracle Database. The Database Cloud Service includes a RESTful Web service wizard, which makes it easy for you to create services which implement any SQL statement or PL/SQL procedure to supply data to applications.

The RESTful Web service wizard lets you simply define a few attributes for a service and then use the full power of SQL and PL/SQL to perform database operations. By default, the wizard returns data in JSON format, although you can use PL/SQL to format data in any way. In addition, the wizard gives you the option of some more complex formats, such as the ability to return data from a result set with embedded links to a more detailed view of the data in the complete row, without any additional coding.

The support of RESTful Web services in the Oracle Database Cloud Service make it easy to use the data in your Oracle Database in virtually any development tool, including dynamic languages.
About Packaged and Sample Applications

The Oracle Database Cloud Service includes a set of business productivity applications and sample code which can be installed with just a few clicks. Sample code is reference implementations of simple applications that can be installed and extended by a developer. Packaged applications and sample code are full production versions designed to provide real functionality, such as project management, shared calendars and shared checklist management.

All of these applications share the same privilege levels of administrator, contributor and reader, which grant differential access to functionality and features. All of these applications and samples can be installed or removed through the same simple administrative interface.

About Tools and Utilities

The Oracle Database Cloud Service includes a variety of tools and utilities which make it easy for you to use the environment. The Database Cloud Service includes browser-based tools for monitoring and modifying all your services from a central management page. You can create users across all your services with a simplified interface to Oracle's Identity Management solution. You can even upgrade your service from this environment for more storage and data transfer with a few clicks.

Each individual service also has a browser-based management console to provide a more detailed look at resource utilization and to install or remove business applications with a few simple clicks. The Oracle Application Express environment contains a set of administration applications which let administrators shape and monitor the environment. You can assign administrative responsibility for one or more services to an individual, giving you complete delegation capabilities to match your organization.

The Database Cloud Service includes Application Express SQL Workshop to manage the underlying Oracle Database and its structures. SQL Workshop is a browser-based component of the Oracle Application Express environment which gives you the ability to browse and manage all of your Oracle objects, run SQL or PL/SQL code, run scripts and even build queries through a graphical interface.

Security and the Oracle Database Cloud Service

One of the key concerns for organizations as they move to a shared resource model on the Cloud is insuring the security of their data. The Oracle Database Cloud Service, like the Oracle Database that is the foundation of the Database Cloud, has been created from the beginning with the utmost concern for security.

This section reviews several aspects of security and the Oracle Database Cloud:

- The basic architecture of the security domains that are used for the Database Cloud
- Security measures that apply to the overall service
- Security measures that apply to individual Database Cloud Services
- Application security options
- Security options for RESTful Web Services that access a Database Cloud Service

Topics:

- Security Architecture
Security Architecture

The Oracle Database Cloud uses a security architecture that includes different security domains and administrative and use privileges within a particular Database Cloud Service.

**Topics:**
- Security Domains
- Security Roles
- Cloud Identity Manager

**Security Domains**

There are several different security domains which are used with the overall implementation of the Database Cloud.

- Accounts
- Identity Domain
- Database Cloud Service

**Accounts**

Each and every Database Cloud Service is owned by an account. An account is the top level in the security hierarchy. The individual who initially sets up an Account is known as the Buyer. A Buyer is automatically an Account Administrator as an Account Administrator can assign themselves privileges at the Identity Domain and Service level.

When you initially sign up for a Database Cloud Service account, you must have an Oracle.com user account. After you initially sign up for an account, you can grant the Account Administrator privilege to any other Oracle.com users. Any Account Administrator can remove the Account Administrator privilege from any other Account Administrator.

Account Administrators can see all services, PaaS or SaaS services, associated with an account.

**Identity Domain**

An Identity Domain is a pool of users. An account can have one or more Identity Domains, but each Domain is separate and distinct. You must define an Identity Domain when you initially request an account, and the requestor is given a username within the Identity Domain.

Identity Domain membership and privileges are defined with the Cloud Identity Manager, which is described in more detail below.

Members of an Identity Domain can have security roles for one or more of the Cloud Services associated with the Identity Domain. These roles are described in more detail below.
Identity Domain Administrators can see all Database Cloud Services associated with the Identity Domain, and can assign and remove all security roles associated with these Cloud Services, including the Administrator role for any of the Services.

**Database Cloud Service**

A Database Cloud Service is an individual Service within the Oracle Database Cloud. Data within an individual Database Cloud Service is completely separated from data in all other Services in the Oracle Database Cloud, as described in more detail below.

Database Cloud Service administrators can define users for the Services that they administer. Database Cloud Service users can be defined with the Cloud Identity Manager or within the Administration area of the development platform for the Database Cloud Service itself. If a user is defined with the Cloud Identity Manager, they must use the same tool to manage their profile; if a user is defined through the Administration area of the development platform, they must manage their profile through that platform. Administrators and developers for a Database Cloud Service must be defined with the Cloud Identity Manager and given the appropriate security role, as described below.

**Security Roles**

There is an Administrator role at the Account, Identity Domain and Service levels. Administrators can grant this role at their level to other defined users.

There are three roles for each Database Cloud Service:

- **Service Administrator**, who can create, modify and delete Database Cloud Service users and their privileges, both in the Cloud Identity Manager and the Administration area of the Database Cloud Service development platform.

- **Developers**, who can use the development platform within a Database Cloud Service to create applications, but who cannot create, modify or delete users for that Database Cloud Service.

- **End users**, who can run applications within the Database Cloud Service.

When a Database Cloud Service is added to an Identity Domain, three individual roles which map to these levels are created within the Identity Domain. The Account Administrator and Identity Domain Administrator are automatically given the Service Administrator role for the initial Database Cloud Service, but all other roles have to be explicitly assigned through the Cloud Identity Manager.

**Cloud Identity Manager**

This tool is used to administer all users and roles defined as part of the Cloud Identity Domain. A Identity Domain or Service administrator can add, delete and modify users with this tool, or to create, delete, assign or delete roles.

Identity Domain Administrators can use the Cloud Identity Manager to access all users defined within their Identity Domain and their roles. Service Administrators only get access to the users defined for their Service, and users of a service can only use the Cloud Identity Manager to modify their own user profile and reset their account password.

For more details on the use of the Cloud Identity Manager, please refer to ”Managing Users and Roles with Oracle Identity Console” in *Getting Started with Oracle Cloud*. 
Database Cloud Security Measures

All security is based on well-thought out and implemented practices and procedures. The Oracle Database Cloud is implemented with rigorous security practices and procedures based on decades of experience.

The security processes used for the overall Oracle Cloud include secure access to data centers, annual security audits by third parties to insure regulatory security compliance and full auditing of the entire Cloud stack on a quarterly basis.

All data stored in the Oracle Database Cloud benefits from the use of Transparent Data Encryption. Transparent Data Encryption encrypts data stored on disk and in backups, protecting against unauthorized direct file access. The encryption and decryption of your data is handled automatically by the Oracle Database, so you do not have to add programmatic steps to use this powerful security feature.

The Database Cloud has to be protected against the introduction of malicious code which could harm all users. To enforce this level of protection while still allowing users to load data into their Database Cloud Service, data loads are sent to a Secure FTP server, where they are scanned for viruses before the data in the files is loaded into the Database Cloud Service using your database account information. With this approach, malicious data can never be loaded in such a way that it affects other accounts or breaches the security isolation. This two step process also automatically compresses the actual data to be loaded, reducing the time needed to upload data to the Oracle Database Cloud.

Database Cloud Service Security Measures

The Database Cloud Service is built on a multi-tenant architecture, with database schemas providing the boundaries of tenant isolation. Schemas have been used in the Oracle Database as a method of separating data for decades. To enforce and protect the absolute security of tenants of the Database Cloud Service, some standard Oracle features have been locked down.

For instance, access to any data dictionary view which allows a tenant to see the existence of other schemas has been prohibited. In addition, some SQL syntax is not allowed, such as GRANT or REVOKE, since these options are used to access objects between one schema to another schema owner.

For a detailed list of syntax, objects and operations disallowed in the Database Cloud Service, please see "Database Cloud Service Features and Implementation Considerations" on page A-1.

Database Cloud Service Application Security Options

Your Database Cloud Service includes Application Express, which you can use to develop and deploy HTML-based applications through a declarative process. Application Express has been in production since 2004, with hundreds of thousands of enterprise applications deployed throughout the world. There are a number of features of Application Express that help you to develop secure applications in your Database Cloud Service.

Application Express supports several authentication schemes, which are used to insure that a particular user is properly identified. Application Express gives developers the ability to use authorization schemes, which are ways of allowing access to specific pages, regions within pages or items within regions, based on user identity. As a developer, you have access to the identity of a user at all times, so you can implement procedural limitations based on user identity.
Although Application Express includes robust monitoring tools, you can add in procedural logic to log application and session specific information for further security analysis.

Application Express includes protection against cross-site scripting attacks by providing a way to reference values that automatically escapes special characters, which will not allow any type of script to be included in pages returned to users through the Database Cloud Service applications.

In addition, Application Express gives you the option to automatically protect navigational URLs from being malicious modified. This option, referred to as Session State Protection, generates checksums which are included with any parameters passed as part of a URL to retrieve a page in an application. In addition, you can prevent a page from ever being accessed by a URL, only allowing access as the destination of a navigation link or branch from another page within the application.

Application Express also includes reports which allow you to rapidly see the security options in force for a particular application, as well as to monitor usage of applications and individual pages in applications.

**RESTful Web Service Security Options**

Application Express also includes reports which allow you to rapidly see the security options in force for a particular application, as well as to monitor usage of applications and individual pages in applications.

You can also specify security on a RESTful Web Service in a number of ways. These ways are different from the traditional method of using schema users to implement security. An Oracle Database Cloud Service is based on a single schema, and all RESTful Web Services which access data in this schema are executed by the user who owns the schema. Without any specific security implementations on a RESTful Web Service, the services will return all data that satisfies an SQL statement or is collected by a PL/SQL block.

There are four ways you can add security to your RESTful Web Services:

- Based on the origin of the RESTful Web Service
- Based on the application using the RESTful Web Service
- Based on the identity of the user calling the RESTful Web Service
- Based on logic implemented in the RESTful Web Service call itself

**Topics:**

- **Origin-based Security**
- **OATH Authentication**
- **Application-based Access**
- **User-based Access**
- **Logic-based Access**

**Origin-based Security**

You can specify that a RESTful Web Service module and its templates and handlers can only be accessed for a specified list of origin domains.
OATH Authentication

RESTful Web Services use the OAUTH2 model of authentication, as shown in the diagram below.

OAUTH2 authentication is one of the standard authentication flows used on the Internet. To understand how to implement application-based or user-based authentication, you need to understand how the OAUTH authentication process flow works.

OAUTH authentication requires two different tokens - a request token, which allows a client to request authorization, and an access token, which grants access to a specific user.

You can use this process flow to implement access to a specific application or to a specific user, as described below.

Application-based Access

To allow a specific application to access RESTful Web Services, you use the OAUTH Request token. To implement this, you would generate a specific token and hard code that token into a specific application client. You would then use OAUTH to check for the request token.

This type of authentication allows you to use a single token to grant access to all of the RESTful Web Services defined in a module to one or more application clients.

User-based Access

You can allow access to a RESTful Web Service based on the identity of the authenticated user. If you want access based only on user identity, you would not require an OAUTH Request token and use privileges defined in your Database Cloud Service to limit access to the Web Service. The process of defining and using these privileges is defined in the next section.
Logic-based Access

The three methods of implementing security described above grant access to one or more specific RESTful Web Services calls, similar to allowing a connection to a database. In traditional database security, access is granted based on the identity of the database user making the request. Since all RESTful Web Services in a specific Database Cloud Service are executed by the same database user, this option is not available for these Services. In recognition of this architecture, the SQL command GRANT is not supported in a Database Cloud Service.

However, this does not mean that you cannot limit access to data based on user identity. The identity of a user is established through the Database Cloud Service authentication process, and this identity is available to developers as the OAM_REMOTE_USER parameter, kept securely in the header of all RESTful Web Service requests.

You can use this value as part of a standard WHERE clause, which, for instance, could be used to limit the rows returned from a query to those for the same department as the current user. You could also use this value in more complex logic in either SQL or PL/SQL.

About Database Cloud Service Users

In addition to the roles and privileges described in "Managing Users and Roles with Oracle Identity Console" in Getting Started with Oracle Cloud, there are the following Database Cloud Service roles used to access, develop and administer Application Express applications:

- **End Users.** End users of an Oracle Application Express application using Oracle Cloud Identity Management or Application Express authentication. Users that have been granted permission to access an Oracle Application Express application.
- **Developers.** Developers of Oracle Application Express applications. Developers have access to the Application Builder and the SQL Workshop.
- **Workspace Administrators.** Administrators given access to all Oracle Application Express application components. Additionally, they can manage application user accounts, groups and development services that use Oracle Application Express authorization.

About Developing Database Cloud Service Applications

Developing applications for an Oracle Database Cloud Service is done through Oracle Application Express. Using Oracle Application Express you can perform the following:

- Create custom applications. See "Managing Oracle Application Express Database Applications" on page 2-24.
- Install packaged applications. See "Managing Oracle Application Express Packaged Applications or Sample Code" on page 2-29.
- Create RESTful Services. See "Implementing RESTful Web Services" on page 2-39.
- Manage application users. See "Managing Application Express Application End Users" on page 2-32.

To learn more, see "Developing Applications for Oracle Database Cloud Service" on page 2-1.
Topics:
- Typical Workflow for Using the Oracle Database Cloud Service
- Launching a Database Cloud Service
- Importing Data
- Managing Data
- Exporting Data
- Managing Oracle Application Express Database Applications
- Managing Oracle Application Express Websheet Applications
- Providing Access to Database Cloud Service Applications
- Monitoring Application Express Application Activity
- Managing Oracle Application Express Packaged Applications or Sample Code
- Managing Application Express Application End Users
- Managing Application Security
- Using Application Express Applications and Websheets
- Sending Emails
- Scheduling Background and Asynchronous Jobs
- Application Archiving
- Implementing RESTful Web Services
- Calling SOAP and RESTful Web Services
- Relevant Links

Typical Workflow for Using the Oracle Database Cloud Service

To start using the Oracle Database Cloud Service, consider the following typical workflow, as described in Table 2-1.
Launching a Database Cloud Service

Table 2–1  Typical Workflow When Using the Oracle Database Service

<table>
<thead>
<tr>
<th>Task</th>
<th>More information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start trial and paid services.</td>
<td>&quot;Requesting a Trial Subscription to an Oracle Cloud Service&quot; in Getting Started with Oracle Cloud, &quot;Purchasing a Subscription to an Oracle Cloud Service&quot; in Getting Started with Oracle Cloud</td>
</tr>
<tr>
<td>Verify the service is activated.</td>
<td>&quot;Viewing Service Details in My Services&quot; in Getting Started with Oracle Cloud</td>
</tr>
<tr>
<td>Launch the service.</td>
<td>&quot;Launching a Database Cloud Service&quot;</td>
</tr>
<tr>
<td>Monitor service.</td>
<td>&quot;Managing and Monitoring Cloud Services&quot; in Getting Started with Oracle Cloud</td>
</tr>
<tr>
<td>Manage Database Cloud Service data.</td>
<td>&quot;Importing Data&quot; and &quot;Managing Data&quot;</td>
</tr>
<tr>
<td>Develop Oracle Application Express applications and Websheets.</td>
<td>&quot;Managing Oracle Application Express Database Applications&quot; and &quot;Managing Oracle Application Express Websheet Applications&quot;</td>
</tr>
<tr>
<td>Give application access to users.</td>
<td>&quot;Providing Access to Database Cloud Service Applications&quot;</td>
</tr>
<tr>
<td>Install Oracle Application Express applications.</td>
<td>&quot;Managing Oracle Application Express Packaged Applications or Sample Code&quot;</td>
</tr>
<tr>
<td>Manage application users.</td>
<td>&quot;Managing Application Express Application End Users&quot;</td>
</tr>
<tr>
<td>Monitor Application Express applications.</td>
<td>&quot;Monitoring Application Express Application Activity&quot;</td>
</tr>
<tr>
<td>Use applications and Websheets.</td>
<td>&quot;Using Application Express Applications and Websheets&quot;</td>
</tr>
<tr>
<td>Implement RESTful Web services to access Database Cloud Service data.</td>
<td>&quot;Implementing RESTful Web Services&quot;</td>
</tr>
<tr>
<td>Access the Resources tab.</td>
<td>&quot;Relevant Links&quot;</td>
</tr>
</tbody>
</table>

Launching a Database Cloud Service

To launch a Database Cloud Service:

1. From the Oracle Cloud home page, click Sign In.
   The My Services Sign In page appears.

2. For Data Center, select the data center and click Sign In to My Services.
   The Sign in to Oracle Cloud dialog displays.

3. Enter the Database Cloud Service credentials and click Sign In.
   The My Services page appears.

4. Next to the Database Cloud Service, click the Launch Service icon.
   The Oracle Application Express home page displays.
Importing Data

Several methods are available for uploading data into the database. For an initial data upload on the Oracle Cloud, use Oracle SQL Developer, the Application Express SQL Workshop Data Upload Utility or the Application Express Data Load utility. The following sections describe the various methods used to load your Cloud Database service with data.

**See Also:** For instructions on using RESTful Services to access data, see "Implementing RESTful Web Services" on page 2-39.

**Video**

**Topics:**
- Using SQL Developer for Data Loading
- Using SQL Workshop Data Upload Utility
- Using Application Express Application Data Load Utility

**Using SQL Developer for Data Loading**

Oracle SQL Developer, in conjunction with your Database Cloud Service SFTP server, provides the ability to upload data to your Database Cloud Service. SQL Developer is used to create a cart containing objects you want to load into your Database Cloud Service, connect to your Database Cloud Service and deploy, also referred to as load, data from the cart to the service.

To deploy objects to your service you must perform the following steps:
1. Create or use an existing Database Cloud Service. See "Creating or Using an Existing Database Cloud Service for Data Loading" on page 2-4.

2. Install SQL Developer locally. This application is used to create the cart of objects to load and to perform the deploying of data from the cart to the service. See "Installing SQL Developer" on page 2-5.

3. Add a Cloud connection from SQL Developer to your Database Cloud Service. See "Configuring SQL Developer Cloud Connection" on page 2-6.


5. Using SQL Developer, create a cart filled with objects and deploy to the Database Cloud Service. See "Creating and Deploying a Cart of Objects" on page 2-11.

6. Configure the Database Cloud Service to allow access to the service from additional SQL Developer users. See "Creating Additional Users for SQL Developer" on page 17.

Topics:
- Creating or Using an Existing Database Cloud Service for Data Loading
- Installing SQL Developer
- Configuring SQL Developer Cloud Connection
- Setting Up Secure FTP Account
- Creating and Deploying a Cart of Objects
- Checking Deployment Status
- Restarting a Deployment
- Removing a Deployment
- Clearing Logs
- Creating Additional Users for SQL Developer

Creating or Using an Existing Database Cloud Service for Data Loading
The first step in the data loading process is to locate the Welcome to Oracle Cloud email received during the Database Cloud Service creation process. If the Database Cloud Service does not yet exist, see "Requesting a Trial Subscription to an Oracle Cloud Service" in Getting Started with Oracle Cloud and "Purchasing a Subscription to an Oracle Cloud Service in Getting Started with Oracle Cloud.

During the service creation process and after your service has been activated, a Welcome to Oracle Cloud email is sent. This email contains important usernames and URLs required for configuring SQL Developer and the Secure FTP site for data loading. See "Configuring SQL Developer Cloud Connection" on page 2-6 and "Setting Up Secure FTP Account" on page 2-9.

Note: Save the Welcome to Oracle Cloud email for the Database Cloud Service you are loading with data. This email contains information required for the data loading configuration process.
Installing SQL Developer

The SQL Developer is used to create carts of data structures, DDLs, and data to deploy to the Database Cloud Service. This section describes how to install SQL Developer.

---

**Note:** The Cloud functionality described here requires the SQL Developer Release 3.2 or later.

---

To install SQL Developer locally:

1. From the Oracle Cloud home page, click **Sign In**.
   The My Services Sign In page appears.

2. For Data Center, select the data center and click Sign In to My Services.
   The Sign in to Oracle Cloud dialog displays.

3. Enter the Database Cloud Service credentials and click **Sign In**.
   The My Services page appears.

4. Select a Database Cloud Service.
   The Overview page displays.

5. Select the **Resources** tab.
   The Resources page displays.

6. Click **Oracle Cloud Downloads** link.
   The Oracle Cloud Downloads page appears.

7. Click the **SQL Developer** link.

8. Download Oracle SQL Developer.

9. Unzip the contents to a local folder.

10. To start SQL Developer, run `sqldeveloper.exe`.

**Note:** If your machine is 64 bit, you may need to run the `sqldeveloper.bat` file instead.
Importing Data

Configuring SQL Developer Cloud Connection

SQL Developer must have a Cloud connection configured to connect to the Database Cloud Service. The connection can use the default username and password provided for Database Cloud Service. Additional users can access the service through SQL Developer if they are given the Developer role in the IDM Console. See Configuring user roles in IDM documentation.

SQL Developer users can also be added through Application Express using the steps outlined in "Creating Additional Users for SQL Developer" on page 2-17.

To add a Cloud connection:

1. Launch SQL Developer locally.
   The SQL Developer home page displays.

2. Under Connections, right click on Cloud Connections.
   The Cloud Connection menu appears.

Note: You must install JDE run time if you do not have JDE runtime installed. For installation and setup instructions, see SQL Developer documentation on the Oracle Technology Network at: http://www.oracle.com/technetwork/developer-tools/sql-developer/downloads/index.html
   The New Cloud Connection dialog appears.

4. Locate the Welcome to Oracle Cloud email you received when this Oracle Database Cloud Service was activated. The following information from the email under Service Details is required to configure the New Cloud Connection:
   - Service Home - The Database Cloud service URL.
   - User - The SFTP user for this Database Cloud Service.
   - Secure FTP Site - The SFTP site URL.

   ![Oracle SQL Developer](image)

5. Make the following entries:
   - Connection Name - Enter the name for this cloud connection.
   - Database
     - Username - Enter the **Username** required during sign in when launching the Database Cloud Service.
Importing Data

URL - Enter the Service Home URL from the Welcome to Oracle Cloud email under Service Details.

SFTP

- Username - Enter the User from the Welcome to Oracle Cloud email under Service Details.
- Hostname - Enter the Secure FTP Site from the Welcome to Oracle Cloud email under Service Details.
- Port - Enter 22.

6. Click OK.


8. Enter the Password required during sign in when launching the Database Cloud Service.

If you have connected successfully the tables and other objects from the Database Cloud Service will display under Cloud Connections.
Setting Up Secure FTP Account

The Secure FTP user password must be reset before you can deploy a data upload. To do this you log into the IDM Console for your Database Cloud Service, find the FTP username and reset the password. The SFTP username is included in the Welcome to Oracle Cloud email received during the activation process.

Note: The Service SFTP user from the Welcome to Oracle Cloud email must be used to access the data uploads. The Domain SFTP user will not see the data upload files.

To reset the Secure FTP username:

1. From the Oracle Cloud home page, click Sign In.
   The Sign In page appears.
2. Under My Services, select the data center and click Sign In to My Services.
   The Sign in to Oracle Cloud dialog displays.
3. If prompted to log in, enter the Database Cloud Service credentials and click Sign In.
   The My Services page appears.
4. Click Identity Console.

5. If prompted to log in, enter the Database Cloud Service credentials and click Sign In.
   The Identity Console home page appears.

6. On the left panel, click Manage Users.
   The Search Users page appears.

7. To view the list of users, click Search.

8. Locate the Secure FTP user included in the Welcome to Oracle Cloud email.

9. Locate and select the Secure FTP user in the Identity Console list of users.

10. Click Reset Password.
    The Reset Password dialog displays.
11. Click **Manually change the password**.

12. For **New password**, enter the new password.

13. For **Confirm new password**, enter the new password.

14. Click **Reset Password**.

   Confirmation dialog appears.

15. Click **OK**.

**Creating and Deploying a Cart of Objects**

To create and deploy a cart of objects to a Database Cloud Service:

1. From SQL Developer, click **View**.

   The View drop down menu displays.

2. From the drop down menu, click **Cart**.

   The Cart window appears on the bottom right.
3. From the left panel, drag the Oracle Database objects you want to load and drop them into the Cart window on the right.

4. If you want to include data with the cart deployment, in the Cart window, click the Data check box.

5. To deploy this cart, click the Deploy Cloud icon at the top left of the Cart window.

The Deploy Objects To Cloud dialog displays.

6. For the Deploy Objects To Cloud dialog, make these changes:

Under Cloud:

These options supply information required to connect to the Secure FTP server.

- Connection - Select the cloud connection for the Database Cloud Service you are deploying to.
- Title - Enter a title for this deployment. The title is restricted to 15 characters long and alphanumeric characters (a-z, A-Z, 0-9), _ (underscore) and - (dash). No special characters, such as spaces, are allowed.
- Server - Enter the Secure FTP URL from the Welcome to Oracle Cloud email.
- Port - Leave as default of 22.

Under Transfer:
This option specifies the cart that is deployed.
- File - Enter or browse for the file you want to deploy. This file is a zip file generated by SQL Developer and contains all objects and optionally data included in the cart.

Under Deploy DDL:
These options determine if the DDL will replace existing objects.
- Do not replace existing destination objects - Creates objects in the destination schema only if objects do not already exist.
- Replace existing destination objects - Drops existing objects in destination schema if they already exist then creates and optionally loads them.

Under Deploy Data:
These options determine how the data is deployed to the destination Database Cloud Service.
- Truncate destination data - Select this option to truncate existing tables before adding rows.
- Disable constraints before moving data - Select this option to disable all constraints before moving the data. Re-enables the constraints after the data has been moved.
- Delimiter - Leave as the default.
- Line Terminator - Leave as the default.
- Left Enclosure - Leave as the default.
- Right Enclosure - Leave as the default.
7. Click **Apply**. The Exporting dialog displays.

Checking Deployment Status

To check on deployment status:

1. From SQL Developer, under Cloud Connections, open a cloud connection.
2. Under the open cloud connection on left panel, click **Deployments**. The list of deployments displays.
3. Under Deployments, click on a deployment. The deployment DETAILS tab displays at the top right.
4. The status value on the DETAILS page indicates the progress of the deployment.
   - **APPROVED** - The deployment passed a virus scan and is waiting for processing.
   - **PROCESSING** - A background daemon process that is scheduled to run periodically, found the APPROVED deployment, changed the status to PROCESSING and started the SQL*loader jobs.
   - **PROCESSED** - The deployment completed successfully.
   - **DENIED** - The deployment is not approved.

5. To view deployment results, click **LOGS**. The LOGS tab displays.

6. To see the latest uploaded tables, on the Connections panel, click the **Refresh** icon.
7. From the SQL Workshop Object browser for your Database Cloud Service, view the progress of the data upload and verify that objects and optionally data has uploaded correctly.

SQL Developer for Data Loading into the Database Cloud Service uses the database utility SQL*Loader to perform the data load. To find out more about restrictions on data loading, see the Oracle Database Utilities book.

**Restarting a Deployment**

To restart a deployment:

1. From SQL Developer, click **Cloud Connections**.
2. Click the cloud connection.
3. Click **Deployments**.
   The list of deployments displays.
4. Right click the deployment.
   Menu options appear.

5. From the menu options, select **Restart**.
6. Follow on-screen instructions.

**Removing a Deployment**

To remove a deployment:

1. From SQL Developer, click **Cloud Connections**.
2. Click the cloud connection.
3. Click **Deployments**.
   The list of deployments displays.
4. Right click the deployment.
   Menu options appear.
5. From the menu options, select **Delete**.
6. Follow on-screen instructions.

**Clearing Logs**
To clear the log for a deployment:

1. From SQL Developer, click **Cloud Connections**.
2. Click the cloud connection.
3. Click **Deployments**.
   The list of deployments displays.
4. Right click the deployment.
   Menu options appear.

5. From the menu options, select **Clear Logs**.
6. Follow on-screen instructions.

**Creating Additional Users for SQL Developer**
SQL Developer users can also be added through Application Express.

To configure an Oracle Database Cloud Service for Data Loading:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
   The Oracle Application Express home page appears.

2. From the Application Express Builder, click **Administration**.
   The Administration home page displays.
3. Click **Manage Users and Groups**.

   The Manage Users and Groups page appears.

4. Click **Create User**.

   The Create User page appears.

5. Enter user information. See "Managing Application Express Users" in the *Oracle Application Express Administration Guide*.

6. Under Password, for Require Change of Password on First User select **No**.

7. Under User Groups (For authentication against Application Express user account repository only), select at least **SQL Developer**.

8. Click **Create User**.

**Using SQL Workshop Data Upload Utility**

The Data Upload utility enables you to upload data from a text file, an XML document or a spreadsheet. The utility is accessed from the Application Express SQL Workshop.
To upload data using the Data Upload utility:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
   The Oracle Application Express home page displays.
2. Click SQL Workshop.
3. Click Utilities.
4. Click Data Workshop.
5. Click one of the following types of data:
   - Text Data
   - XML Data
   - Spreadsheet Data
6. Follow on-screen instructions.

To learn more about uploading data with the Data Upload utility, see "Using the Data Workshop to Manage Data" in the Oracle Application Express SQL Workshop Guide.

Using Application Express Application Data Load Utility

Applications with data loading capability allow application end users to dynamically import data into a table within any schema to which the user has access. To do this, end users run a Data Load Wizard that uploads data from a file or copies and pastes data entered by the end user directly into the wizard.

To learn more about developing Application Express applications with this capability, see "Creating Applications with Data Loading Capability" in the Oracle Application Express Application Builder User’s Guide.

To learn more about how an application end user uses this capability, see "About Uploading Data" in the Oracle Application Express End User Guide.

Managing Data

The SQL Workshop Object Browser enables developers to browse, create, and edit objects in a database. Oracle Application Express has many views defined to make it easier for you to work with the underlying table structures. The views combine multiple base tables and use meaningful column names to minimize complexity and to be more intuitive to use. See Oracle Application Express API Reference for details of the views defined.

To manage data using Object Browser:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
   The Oracle Application Express home page displays.
2. Click SQL Workshop.
3. Click Object Browser.
4. Browse, create, edit and delete database objects.

To learn more, see "Managing Database Objects with Object Browser" in the Oracle Application Express SQL Workshop Guide.
Exporting Data

You can create an Oracle Data Pump export of your data and data structure. Export files are downloadable from your secure FTP download area in the outgoing directory. Files are retained for 48 hours. To initiate a download, click the file names using your SFTP client.

Topics:

■ Creating an Oracle Data Pump Export
■ Downloading a Data Export
■ Cancelling a Data Export Request

Creating an Oracle Data Pump Export

To create an Oracle data pump export of your data, code and data structure:

1. From the Oracle Cloud home page, click Sign In.
   The My Services Sign In page appears.
2. For Data Center, select the data center and click Sign In to My Services.
   The Sign in to Oracle Cloud dialog displays.
3. Enter the Database Cloud Service credentials and click Sign In.
   The My Services page appears.
4. Enter the Database Cloud Service credentials and click Sign In.
   The My Services page appears.
5. Select a Database Cloud Service.
   The Overview page displays.
6. Click the Data Export tab.
   The Export Data page displays.

7. Click Export Data.
   The Data Export page for your service displays.
8. To include data with the data structures, select **Include Data**.

9. Click **Create Data Export**.

   The Export Data page displays and lists the requested data export job.

   **Note:** The Oracle Cloud accepts a maximum of 10 data export requests. If you want to create a data export request and you have already reached the maximum, you must delete an old request or wait 7 days for the data export to expire and be purged.

10. To initiate a download using the Secure FTP client, wait until the status is completed then click the file name.

   **Tip:** Click Refresh to update the data export status.

### Downloading a Data Export

After creating a data export file, see "Creating an Oracle Data Pump Export" on page 2-20, and the data export file has a status of completed, you can download the file.

To download a data export:
1. Locate the Welcome to Oracle Cloud email you received when this Oracle Database Cloud Service was activated. Find your SFTP Account Details included in the email.

![Domain FTP Account Details](image)

**Note:** Your SFTP account password must have been reset at least once since the service was activated.

**Note:** The Service SFTP user from the Welcome to Oracle Cloud email must be used to access the downloads. The Domain SFTP user will not see the data export files.

2. Make sure you have some SFTP client software installed and setup to use for the download. The are examples of SFTP client software:
   - FileZilla ([http://filezilla-project.org/](http://filezilla-project.org/))
   - WinSCP ([http://winscp.net/eng/download.php](http://winscp.net/eng/download.php))

3. For your SFTP client software, create a new connection or SFTP site. You need the host name, username and password. When using FileZilla, enter information then click **Connect**.

   The following screenshot shows using FileZilla Site Manager to do this.

![Site Manager](image)

4. Once connected, you see two folders:
- **upload** - this folder is where the SQL Developer Cloud Deployments arrive
- **download** - this folder is where the Data Exports are delivered

5. Double click the **download** folder.
6. Select the file in the folder to download.

**Cancelling a Data Export Request**

To cancel a data export request:

1. From the Oracle Cloud home page, click **Sign In**.
   The My Services Sign In page appears.
2. For Data Center, select the data center and click **Sign In to My Services**.
   The Sign in to Oracle Cloud dialog displays.
3. Enter the Database Cloud Service credentials and click **Sign In**.
   The My Services page appears.
4. Enter the Database Cloud Service credentials and click **Sign In**.
   The My Services page appears.
5. Select a Database Cloud Service.
The Overview page displays.

6. Click the **Data Export** tab.
   The Export Data page displays.

7. Click the export request you want to cancel.
   The Manage Data Export Request page displays.

8. Select **Confirm Cancel Request**.
9. Click **Cancel Data Export Request**.

Managing Oracle Application Express Database Applications

Database applications are managed with the Application Express Application Builder. The Application Express Application Builder allows you to create, edit and remove applications.

**Topics:**
- Creating a Database Application
- Modifying a Database Application
- Removing a Database Application

Creating a Database Application

The Create Wizard allows you to create a complete application containing multiple pages including reports, interactive reports, forms, tabular forms, and master detail forms. The Create Application Wizard is designed to easily and quickly create Oracle Application Express Database applications.

**Follow these steps to create a Database application:**

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.

   The Oracle Application Express home page displays.

2. Click **Application Builder**.

   The Oracle Application Express Application Builder home page displays.

3. Click **Create**.

   The first page of the Create Application wizard displays.

4. Select **Database** and click **Next**.

5. Follow on-screen instructions.

To learn more about creating Database applications, see "About Database Applications" in the Oracle Application Express Application Builder User’s Guide.

To learn about using Database applications, see the Oracle Application Express End User Guide.

Modifying a Database Application

**To modify a Database application:**

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
The Oracle Application Express home page displays.

2. Click **Application Builder**.

The Oracle Application Express Application Builder home page displays.

3. Click the Database application you want to modify.

The Application Edit page appears.

4. Make modifications.

To learn more about modifying Database applications, see "About Database Applications" in the **Oracle Application Express Application Builder User’s Guide**.

To learn about using Database applications, see the **Oracle Application Express End User Guide**.

---

### Removing a Database Application

To remove a Database application:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.

   The Oracle Application Express home page displays.

2. Click **Application Builder**.

   The Oracle Application Express Application Builder home page displays.

3. Click the Database application you want to remove.

4. Under Tasks on the right panel, click Delete this Application.

5. Follow on-screen instructions.

To learn more about removing Database applications, see "About Database Applications" in the **Oracle Application Express Application Builder User’s Guide**.

To learn about using Database applications, see the **Oracle Application Express End User Guide**.

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### Managing Oracle Application Express Websheet Applications

Websheet applications are created from the Application Express Application Builder. Websheets are applications designed to be created and modified by business users, with no knowledge of SQL necessary. A Websheet is like a wiki, except that Websheets can be driven by data included in the application. These applications are highly dynamic and defined by their users. Websheet applications include navigation controls, search capabilities, and the ability to add annotations such as files, notes, and tags. Websheet applications can be secured using access control lists and several built-in authentication models.

**Topics:**

- Creating Websheet Database Objects
- Creating a Websheet Application
- Modifying a Websheet Application
- Removing a Websheet Application
Creating Websheet Database Objects

Before creating a Websheet application, required database objects must be created. This section describes how to create the required objects.

To create required Websheet database objects:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
2. Click Administration.
3. Under Tasks on the right panel, click Websheet Database Objects.
   The Websheet Database Objects page appears.
4. Click Create Websheet Database Objects.
   The required schemas and objects display.
5. Click Continue.
6. To confirm, click Create.

To learn more, see "Managing Websheet Database Objects" in *Oracle Application Express Administration Guide*.

Creating a Websheet Application

Before creating a Websheet, required Websheet database objects must exist. See "Creating Websheet Database Objects" on page 2-26.

To create a Websheet application:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
2. Click Application Builder.
   The Oracle Application Express Application Builder home page displays.
3. Click Create.
   This first page of the Create Application wizard displays.
4. Select Websheet and click Next.
   The Create Websheet page appears.
5. For Authentication, select one of the following:
   - **Oracle Cloud Identity Management** (default) - Users of this Websheet application are managed through the Identity Console. See "Managing Users and Roles with Identity Console" in *Getting Started with Oracle Cloud*.
   - **Application Express** - Users of this Websheet application are managed from the Application Express Administrator. See Managing Application Express Users in *Oracle Application Express Administration Guide*.
6. Click Create Websheet.
7. To test the Websheet, click Run Websheet.

To learn more about modifying Websheet applications, see "About Websheet Applications" in the *Oracle Application Express Application Builder User’s Guide*.

To learn about using Websheet applications, see "Using Websheets" in the *Oracle Application Express End User Guide*. 
Modifying a Websheet Application

To modify a Websheet application:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
   The Oracle Application Express home page displays.

2. Click Application Builder.
   The Oracle Application Express Application Builder home page displays.

3. Click the websheet you want to modify.
   The websheet Run or Edit Application page appears.

4. Click Edit Properties.
   To learn more about creating Websheet applications, see "About Websheet Applications" in the Oracle Application Express Application Builder User’s Guide.
   To learn about using Websheet applications, see “Using Websheets” in the Oracle Application Express End User Guide.

Removing a Websheet Application

To remove a Websheet application:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
   The Oracle Application Express home page displays.

2. Click Application Builder.
   The Oracle Application Express Application Builder home page displays.

3. Click the websheet you want to remove.
   The websheet Run or Edit Application page appears.

4. Click Edit Properties.
   The Application Properties page appears.

5. Click Delete.
   The Confirm Delete page appears.

6. Click Permanently Delete Now.
   To learn more about creating Websheet applications, see "About Websheet Applications" in the Oracle Application Express Application Builder User’s Guide.
   To learn about using Websheet applications, see “Using Websheets” in the Oracle Application Express End User Guide.

Providing Access to Database Cloud Service Applications

Once an application has been created or installed to an Oracle Database Cloud Service instance, end users with the appropriate authorization and authentication credentials can access it using a Web browser. The application administrator simply provides the end users with the application's URL.
The following URL shows the URL an application end user would use to access an Application Express application 100082 residing within an Oracle Database Cloud Service with an identity domain of trialaejm:


To learn more about using Application Express applications, see Oracle Application Express End User Guide.

Monitoring Application Express Application Activity

You can monitor developer activity and changes to Application Express applications within your service by accessing the Monitor Activity page in the Application Express Builder. The Monitor Activity page features links to over thirty reports that track page views, developer activity, active sessions, login attempts, environment, application errors, and workspace schemas.

To access the Monitor Activity page:

1. From the Oracle Cloud home page, click Sign In.
   The My Services Sign In page appears.
2. For Data Center, select the data center and click Sign In to My Services.
   The Sign in to Oracle Cloud dialog displays.
3. Enter the Database Cloud Service credentials and click Sign In.
   The My Services page appears.
4. Next to the Database Cloud Service, click the Launch Service icon.
   The Oracle Application Express home page displays.
5. From the Application Express Builder, click **Administration**.
   The Administration home page displays.

6. Click **Monitor Activity**.
   The Monitor Activity page appears.

   To learn more, see "Monitoring Activity Within a Workspace" in *Oracle Application Express Administration Guide*.

### Managing Oracle Application Express Packaged Applications or Sample Code

You can install Oracle Application Express packaged applications and sample code.

- **Packaged Applications.** These are applications that can be installed, run and removed. They are fully supported and cannot be modified.

- **Sample Code.** These are samples that illustrate a concept or demonstrate a technique. They can be installed, run, removed, viewed and modified.

**Video**

**Topics:**
- Installing Packaged Applications and Sample Code
- Modifying Sample Code
- Removing Packaged Applications and Sample Code
Installing Packaged Applications and Sample Code

Follow these steps to install a packaged application or sample code:

1. From the Oracle Cloud home page, click **Sign In**.
   The My Services Sign In page appears.
2. For Data Center, select the data center and click **Sign In to My Services**.
   The Sign in to Oracle Cloud dialog displays.
3. Enter the Database Cloud Service credentials and click **Sign In**.
   The My Services page appears.
4. Select a Database Cloud Service.
   The Overview page displays.
5. Click the **Applications** tab.
   The Applications page displays.
6. Click **Install New**.
   The Packaged Applications page displays showing all available packaged applications and sample code.

7. Locate and click the packaged application or sample code you want to install.
   The application information page displays.
8. Click **Install Application**.
9. For Authentication, select one of the following:
   - **Oracle Cloud Identity Management** (default) - Users of this packaged application are managed through the Identity Console. See "Managing Users and Roles with Oracle Identity Console" in *Getting Started with Oracle Cloud*.
   - **Application Express** - Users of this packaged application are managed from the Application Express Administration. See "Managing Application Express Users" in *Oracle Application Express Administration Guide*.
10. On the confirmation page, click **Install Application**.
11. If you selected Application Express authentication, you will have the option of creating a first user for the application by entering the following information:

- **Create Application Express User** - Select this option to create an application user before installation is complete. Otherwise, the user must be created after installation is complete using the Application Express Administration.
- **Username** - Enter the username used to log in to the application.
- **Password** - Enter the password used to log in to the application.
- **Confirm Password** - Enter the same password again to confirm.
- **Email** - Enter user's valid email address.

12. If you selected Oracle Cloud Identity Management, the users currently authorized by Oracle Cloud Identity Management have access to this application. Use the Oracle Cloud Identity Console to add users. See “Managing Users and Roles with Oracle Identity Console” in *Getting Started with Oracle Cloud*.

13. Click **Run Application**.

**Modifying Sample Code**

After installing sample code, it can be modified just like any other Database or Websheet application you have created from scratch or imported. See "Modifying a Database Application" on page 2-24 and "Modifying a Websheet Application" on page 2-27.

**Note:** Installed sample code can be modified. Installed packaged applications can not be modified.

**Removing Packaged Applications and Sample Code**

Follow these steps to remove a packaged application or sample code:

1. From the Oracle Cloud home page, click **Sign In**.
   The My Services Sign In page appears.
2. For Data Center, select the data center and click Sign In to My Services.
   The Sign in to Oracle Cloud dialog displays.
3. Enter the Database Cloud Service credentials and click **Sign In**.
   The My Services page appears.
4. Select a Database Cloud Service.
   The Overview page displays.
5. Click the **Applications** tab.
   The Applications page displays.
6. Next to the packaged application or sample code you want to remove, click **Manage**.
   The Packaged Application or Sample Code information page displays.
7. Locate and click the packaged application or sample code you want to install.
   The application information page displays.
8. Click **Remove Application**.
9. To confirm, click **Remove Application**.

### Managing Application Express Application End Users

Service administrators add and manage users of Oracle Application Express applications from the Oracle Identity Console or Oracle Application Express Administration. During application creation or installation, the method for managing users is defined.

- **Oracle Identity Console** (default). Use the Oracle Identity Console to add and manage application users if Oracle Identity Console is the application's authentication method selected during installation or creation. To learn more, see "Managing Users and Roles with Oracle Identity Console" in *Getting Started with Oracle Cloud*.

- **Oracle Application Express Administration**. Use the Manage Users and Groups page of the Oracle Application Express Administration to add and manage application end users if Application Express is the application's authentication method selected during installation or creation.

To manage Oracle Application Express users:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
   - The Oracle Application Express Application Builder home page appears.
2. Click **Administration**.
   - The Administration home page displays.
3. Click **Manage Users and Groups**.
   - The Manage Users and Groups page appears.

To learn more, see "Managing Application Express Users" in the *Oracle Application Express Administration Guide*.

### Managing Application Security

Below are some topics that describe how to implement security best practices for Oracle Application Express and Oracle Cloud Database Service. Administrators are primarily responsible for ensuring the security of the Oracle Application Express setup, while developers are responsible for building secure applications.

- **Understanding Administrator Security Best Practices**
- **Understanding Developer Security Best Practices**
- **Securing File Uploads**
- **Establishing User Identity through Authentication**
- **Providing Security through Authorization**

To learn more, see "Managing Application Security" in *Oracle Application Express Application Builder User’s Guide*. 
Using Application Express Applications and Websheets

Once an application has been created or installed to an Oracle Database Cloud Service instance, end users with the appropriate authorization and authentication credentials can access it using a Web browser. The application administrator simply provides the end users with the application’s URL.

The following URL shows the URL an application end user would use to access an Application Express application 100082 residing within an Oracle Database Cloud Service with an identity domain of trialaejm:

database-trialaejm.cloud.oracle.com/apex/f?p=100082

To learn more about using Database and Websheet applications, see the Oracle Application Express End User Guide.

Sending Emails

You can use the APEX_MAIL package to send an email from an Oracle Application Express application. APEX_MAIL contains three procedures. Use APEX_MAIL.SEND to send an outbound email message from your application. Use APEX_MAIL.PUSH_QUEUE to deliver mail messages stored in APEX_MAIL_QUEUE. Use APEX_MAIL.ADD_ATTACHMENT to send an outbound email message from your application as an attachment.

Example:

BEGIN
APEX_Mail.Send( 'to@email-address.com', 'from@email-address.com',
    'This is some test plain text',
    'This is some test <b>HTML</b>',
    'Test Email Subject' );
APEX_Mail.Push_Queue_Immediate;
END;
/

Note: There is a built in limit of 5000 emails in any given 24 hour period. If you try to send more, you get an error.

To learn more, see APEX_MAIL in Oracle Application Express API Reference.

Scheduling Background and Asynchronous Jobs

Background jobs are scheduled by using the CLOUD_SCHEDULER package. Since the Database Cloud Service is a true multi-tenant environment, some aspects of the Oracle Database must be restricted to protect the integrity of both the data and the performance characteristics of the Database Cloud Service.

A Database Cloud Service cannot be allowed to have unlimited access to the creation and execution of jobs, as this would allow a single Service, either by accident or due to malicious intent, to overrun the underlying hardware resources. To address this, Database Cloud Service includes an interface which allows the limited use of database jobs.

This interface has the following characteristics:

- Users are allowed to submit jobs for immediate execution or as scheduled tasks
Users are limited to the number of immediate and scheduled jobs. These limits are public. There is a limit of 10 background jobs and 5 active jobs.

When a user submits a job, the interface checks to see if the limit for the number of jobs (of the type of the submitted job) has been reached. If the limit has been reached, the call to the interface returns an error.

All jobs use a set of Resource Manager consumer groups of different priorities. If a job forces a consumer group to exceed the resource limits of its consumer group, the job is moved to a consumer group with a lower priority.

Users are able to use the standard `USER_SCHEDULER_%` views to determine the status and number of jobs submitted, so they can prevent the return of an error from the submission process and take appropriate corrective actions.

---

**Note:** There is a limit of 10 scheduled or defined background jobs and 5 active or running jobs.

---

The `CLOUD_SCHEDULER` package is a wrapper that exactly mirrors the `DBMS_SCHEDULER` package. The only difference between the packages is the `CLOUD_SCHEDULER` includes a simple procedure for running an immediate job. The following example illustrates the immediate execution of the `My_PLSQL_Procedure` job:

```sql
Begin
    CLOUD_SCHEDULER.RUN_JOB( 'My_PLSQL_Procedure;' );
End;
/
```

To learn more, see "DBMS_SCHEDULER" in Oracle Database PL/SQL Packages and Types Reference.

For examples, see "Examples of Using the Scheduler" in Oracle Database Administrator’s Guide.

---

**Application Archiving**

Modifications to your Oracle Application Express applications can be archived to tables in your database schema. Applications that belong to Database Cloud Services with automatic archiving enabled are archived when they are created and when they are changed. The APEX Application Archive packaged application is used to manually archive applications and to view, manage and restore application archives.

**Note:** The archived application content is counted against your tablespace quota. By default, only 5 application versions are maintained. However, you can adjust this value from the APEX Application Archive packaged application. See "Viewing and Managing Application Archives" on page 2-39.

**Topics:**

- Scheduling Daily Automatic Application Archiving
- Installing the APEX Application Archive Packaged Application
- Running the APEX Application Archive Application
- Manually Archiving Applications
- Viewing and Managing Application Archives
Scheduling Daily Automatic Application Archiving

You can schedule daily automatic archiving for all applications that belong to your Database Cloud Service. Automatic daily archiving is enabled and disabled from the Database Cloud Service Administration page. Database Cloud Services enabled with application archiving generate an archive for applications when they are created and when they are changed. You can also manually archive from the APEX Application Archive packaged application. To learn more, see "Manually Archiving Applications" on page 2-39.

To view and manage archives, use the APEX Application Archive packaged application. To learn more, see "Installing the APEX Application Archive Packaged Application" on page 2-36 and "Viewing and Managing Application Archives" on page 2-39.

To schedule automatic application archiving:

1. From the Oracle Cloud home page, click **Sign In**.
   The My Services Sign In page appears.

2. For Data Center, select the data center and click Sign In to My Services.
   The Sign in to Oracle Cloud dialog displays.

3. Enter the Database Cloud Service credentials and click **Sign In**.
   The My Services page appears.

4. Select a Database Cloud Service.
   The Overview page displays.

5. Click the **Administration** tab.
   The Administration page displays.

6. Click Application Archiving **Update**.
   The Update Application Archiving page appears.

7. Select **Enable Application Archive**.
8. Click **Update Application Archiving**.

   The Administration page displays with a current archive status of Auto Archive Daily.

   **Note:** The archived application content is counted against your tablespace quota. By default, only 5 application versions are maintained. However, you can adjust this value from the APEX Application Archive packaged application. See "Viewing and Managing Application Archives" on page 2-39.

**Managing and Viewing Application Archives**

The APEX Application Archive packaged application is used to view and manage archives. Application archives are performed when the Database Cloud Service is enabled for automatic application archiving or when a manual archive is performed. To learn more, see "Scheduling Daily Automatic Application Archiving" on page 2-35 and "Manually Archiving Applications" on page 2-39.

**Topics:**

- Installing the APEX Application Archive Packaged Application
- Running the APEX Application Archive Application
- Viewing and Managing Application Archives

**Installing the APEX Application Archive Packaged Application**

Before you can use the APEX Application Archive packaged application, it must be installed.

**To install the Application Archive packaged application:**

1. From the Oracle Cloud home page, click **Sign In**.
   
   The My Services Sign In page appears.

2. For Data Center, select the data center and click **Sign In** to My Services.
   
   The Sign in to Oracle Cloud dialog displays.

3. Enter the Database Cloud Service credentials and click **Sign In**.
   
   The My Services page appears.

4. Select a Database Cloud Service.
   
   The Overview page displays.
5. Click the Applications tab.
   The Applications page displays.

6. For Packaged Applications, click **Install New**.
   The Packaged Applications page displays showing all available packaged applications and sample code.

7. Locate and click the **APEX Application Archive** application.
   The application information page displays.

8. Click **Install Application**.
   The Install Application dialog appears.

9. For Authentication, select one of the following:
   - **Oracle Cloud Identity Management** (default) - Users of this packaged application are managed through the Identity Console. See "Managing Users and Roles with Oracle Identity Console" in *Getting Started with Oracle Cloud*.
   - **Application Express** - Users of this packaged application are managed from the Application Express Administration. See Managing Application Express Users in *Oracle Application Express Administration Guide*.

10. Click **Install Application**.
    The Application Installed dialog displays.

11. If you selected Application Express authentication, you will have the option of creating a first user for the application by entering the following information:
    - **Create Application Express User** - Select this option to create an application user before installation is complete. Otherwise, the user must be created after installation is complete using the Application Express Administration.
    - **Username** - Enter the username used to log in to the application.
    - **Password** - Enter the password used to log in to the application.
    - **Confirm Password** - Enter the same password again to confirm.
    - **Email** - Enter user's valid email address.
12. If you selected Oracle Cloud Identity Management, the users currently authorized by Oracle Cloud Identity Management have access to this application. Use the Oracle Cloud Identity Console to add users. See "Managing Users and Roles with Oracle Identity Console" in Getting Started with Oracle Cloud.

13. To test the application, click Run Application.

Running the APEX Application Archive Application

The APEX Application Archive packaged application is used to view and manage application archives. Before you can run this application, it must be installed. To learn more, see "Installing the APEX Application Archive Packaged Application" on page 2-36.

To launch the APEX Application Archive packaged application:

1. From the Oracle Cloud home page, click Sign In.
   The My Services Sign In page appears.

2. For Data Center, select the data center and click Sign In to My Services.
   The Sign in to Oracle Cloud dialog displays.

3. Enter the Database Cloud Service credentials and click Sign In.
   The My Services page appears.

4. Select a Database Cloud Service.
   The Overview page displays.

5. Click the Applications tab.
   The Applications page displays.

   The APEX Application Archive application home page appears.
Implementing RESTful Web Services

RESTful Web services enable the declarative specification of RESTful services used to access the database. These services work in conjunction with the Oracle Application Express Listener to enable the consumption of these services.

To create a RESTful Web service:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
2. Click SQL Workshop.
3. Click RESTful Services.
4. To create a RESTful Web service, click Create.

Manually Archiving Applications

You can manually archive applications from the APEX Application Archive packaged application.

To manually archive applications:

1. Install the APEX Application Archive packaged application as described in "Installing the APEX Application Archive Packaged Application".
2. Run the APEX Application Archive application as described in "Running the APEX Application Archive Application".
   The APEX Application Archive home page appears.
3. Click Archive Applications.
4. Follow on-screen instructions.

Implementing RESTful Web Services

RESTful Web services enable the declarative specification of RESTful services used to access the database. These services work in conjunction with the Oracle Application Express Listener to enable the consumption of these services.

To create a RESTful Web service:

1. Launch the Database Cloud Service. See "Launching a Database Cloud Service" on page 2-2.
2. Click SQL Workshop.
3. Click RESTful Services.
4. To create a RESTful Web service, click Create.
5. Follow on-screen instructions.

To learn more about implementing RESTful Web services, see "Using RESTful Services" in the Oracle Application Express SQL Workshop Guide.

**Calling SOAP and RESTful Web Services**

The **APEX_WEB_SERVICE** package allows you to integrate other systems with Application Express by allowing you to interact with Web services anywhere you can utilize PL/SQL in your application. The API contains procedures and functions to call both SOAP and RESTful style Web services. It contains functions to parse the responses from Web services and to encode/decode into SOAP friendly base64 encoding. This API also contains package globals for managing cookies and HTTP headers when calling Web services whether from the API or by using standard processes of type Web service. Cookies and HTTP headers can be set prior to invoking a call to a Web service by populating the globals and the cookies and HTTP headers returned from the Web service response can be read from other globals.

---

**Note:** All Web services must be secured. Only HTTPS services are supported. Simple HTTP requests will be rejected. The proxy server that is usually configurable is preset as an Oracle provided HTTP proxy server and not changeable by users.

---

To learn more, see ”APEX_WEB_SERVICE” in *Oracle Application Express API Reference.*

**Relevant Links**

For your convenience, the Database Cloud Service includes a Resources tab containing several references to relevant documentation, community bulletin boards, sites where you can learn more and find Oracle SQL Developer and Oracle Application Express downloads.

**To access the Resources tab:**

1. From the Oracle Cloud home page, click **Sign In.**
   The My Services Sign In page appears.

2. For Data Center, select the data center and click Sign In to My Services.
   The Sign in to Oracle Cloud dialog displays.

3. Enter the Database Cloud Service credentials and click **Sign In.**
   The My Services page appears.

4. Select a Database Cloud Service.
   The Overview page displays.

5. Click the **Resources** tab.
   The Resources page displays.

6. Click one of the links to navigate to resources and downloads.
The Oracle Database Cloud is a multi-tenant environment, based on schema isolation. To ensure the security of each tenant's data, as well as the overall performance integrity of the entire Oracle Database Cloud environment, some aspects of the Oracle Database, Enterprise Edition, have to be curtailed or completely eliminated.

The limitations required to protect security and performance integrity are detailed in this section. None of the limitations listed in this section were put in place as an attempt to limit the functionality of the Oracle Database Cloud. Virtually all standard SQL and PL/SQL syntax and constructs used with the Oracle Database work in the Oracle Database Cloud.

Topics:
- Database Cloud Service
- Specifications
- SQL Syntax
- Database Object Security
- Oracle Database Cloud Specific Limitations
- Data Dictionary Access
- Resource Limitations

Database Cloud Service

A Database Cloud Service is an individual Service within the Oracle Database Cloud. Data within an individual Database Cloud Service is completely separated from data in all other Services in the Oracle Database Cloud, as described in more detail below.

Database Cloud Service administrators can define users for the Services that they administer. Database Cloud Service users can be defined with the Cloud Identity Manager or within the Administration area of the development platform for the Database Cloud Service itself. If a user is defined with the Cloud Identity Manager, they must use the same tool to manage their profile; if a user is defined through the Administration area of the development platform, they must manage their profile through that platform. Administrators and developers for a Database Cloud Service must be defined with the Cloud Identity Manager and given the appropriate security role, as described below.
Specifications

This section outlines the Oracle Database Cloud Service specifications.

Topics:
- Oracle Database Version and Edition
- Components not Available
- Schemas and Data

Oracle Database Version and Edition

The current version of the Oracle Database Cloud Service is based on Oracle Database 11g Release 2, Enterprise Edition with each quarterly security patch set applied. The only option included in the Oracle Database Cloud Service is the Partitioning Option.

Components not Available

The following features and components are not part of the current version of the Oracle Database Cloud Service:
- Oracle Database Extensions for .NET
- Oracle Database Vault
- Oracle Java VM
- Oracle Label Security
- Oracle Multimedia
- Oracle OLAP
- Oracle Spatial
- Oracle Text
- Oracle Warehouse Builder

Schemas and Data

The following schemas and data are not accessible in the Oracle Database Cloud:
- Sample schemas
- Local Enterprise Manager repository
- Oracle Data Mining RDBMS APIs for file access

SQL Syntax

The following sections describe various SQL syntax in the Oracle Database Cloud Service.

Topics:
- Allowed CREATE Statements
- Removed SQL Statements
- PL/SQL Packages and Types
- Included Supplied PL/SQL Packages and Types
Allowed CREATE Statements

CREATE statements have a broad range of syntax and options. The appendices for this paper list all allowed statements, but this list includes the most common allowed CREATE statements in an Oracle Database Cloud Service:

- CREATE TABLE
- CREATE INDEX
- CREATE VIEW
- CREATE PROCEDURE
- CREATE PACKAGE
- CREATE FUNCTION
- CREATE SEQUENCE
- CREATE TRIGGER
- CREATE SESSION
- CREATE DIMENSION
- CREATE INDEXTYPE
- CREATE OPERATOR
- CREATE TYPE

Removed SQL Statements

The following SQL statements cannot be used in an Oracle Database Cloud Service:

- CREATE CLUSTER
- CREATE JOB (Background jobs can be created through the CLOUD_SCHEDULER package)
- CREATE MATERIALIZED VIEW
- CREATE SNAPSHOT
- CREATE SYNONYM
- CREATE JAVA
- CREATE ROLE
- CREATE DIRECTORY
- CREATE TABLESPACE
- CREATE SYNONYM
- CREATE DATABASE LINK
- Some ALTER SESSION options, although most session level changes for NLS or character sets are still allowed

Additionally, parallel operations are not supported on the Oracle Database Cloud, so any SQL DDL clauses that allow for parallel operations are not supported.
PL/SQL Packages and Types

Oracle Database 11g Release 2 includes many PL/SQL packages to deliver extended functionality. The following sections list the PL/SQL packages that are part of the Oracle Database Cloud Service and some prominent packages which are not included.

Included Supplied PL/SQL Packages and Types

The following PL/SQL packages and types are included in the Oracle Database Cloud Service:

- ANYDATA
- ANYDATASET
- ANYTYPE
- AQ$_AGENT
- AQ$_SIG_PROP
- AQ$_SUBSCRIBERS
- DBMS_APPLICATION_INFO
- DBMS_ASSERT
- DBMS_CRYPTO
- DBMS_DB_VERSION
- DBMS_LCR
- DBMS_LOB
- DBMS_METADATA
- DBMS_OUTPUT
- DBMS_RANDOM
- DBMS_SQL
- DBMS_STANDARD
- DBMS_STATS
- DBMS_TYPES
- All DBMS_XML% packages and types
- DBMS_XPLAN
- All DBMS_XQUERY% packages and types
- DBMSOUTPUT_LINESARRAY
- HTF
- HTP
- All ODCI% packages and types
- All OWA% packages and types
- PLITBLM
- SCN_TO_TIMESTAMP
- STANDARD
Database Object Security

By default, all Application Express applications and RESTful Web Services execute with the privileges of the schema owner. You can create users within the Application Express environment and use authentication schemes to limit access to application objects at all levels in your application through Application Express.

You cannot use a GRANT command to assign access to another user, since other schema owners are not allowed to access your schema objects in the schema-isolation multi-tenant environment of the Oracle Database Cloud.

You can also assign security across multiple dimensions, including origin, application and users, for any RESTful Web Services. Please refer to the white paper on Oracle Database Cloud security for more details on these topics.
Database Object Limitations

The following limitations apply to DDL, Data Definition Language, syntax: You cannot use any PARALLEL syntax in defining tables.

- You cannot use quoted identifiers with special characters.
- You cannot define BFILEs or external LOBs.
- You cannot use external tables.
- You cannot specify any caching for database objects.

Query Limitations

By default, you can use all Oracle SQL syntax for SQL statements used against your Oracle Database Cloud Service. The following limitations apply to SQL queries:

- No PARALLEL hints allowed

Oracle Database Cloud Specific Limitations

The core of the Oracle Database Cloud development environment is Application Express, which is also a no-cost option for all versions of the Oracle Database since Oracle Database 10g Release 2. There are three areas of functionality which are limited when used for applications within the Oracle Database Cloud environment:

- Background Jobs - An Oracle Database Cloud Service will be able to submit jobs, but are limited to a maximum of 10 defined jobs and 5 jobs running or scheduled at any one time. Jobs will be subject to resource limitations imposed by Database Resource Manager, similar to the way overall resources are limited and described below. These limits and conditions will be implemented through a PL/SQL package called CLOUD_SCHEDULER.

- E-mails - An Oracle Database Cloud Service will be limited to 5,000 emails in a 24 hour period.

- Outbound Web Service calls - An Oracle Database Cloud Service application can make outbound Web Service calls through the APEX_WEB_SERVICE PL/SQL package. These calls can only use HTTPS or SSL and will use a proxy server from within the Oracle Database Cloud.

Data Dictionary Access

Access to standard data dictionary objects in the Oracle Database is limited, since the security requirements of schema isolation prevent any user from seeing or knowing the existence of other schemas.

The following data dictionary views and synonyms are accessible from an Oracle Database Cloud Service:

- ALL_ALL_TABLES
- ALL_COL_COMMENTS
- ALL_CONSTRAINTS
- ALL_DEPENDENCIES
- ALL_ERRORS
- ALL_IND_COLUMNS
- ALL_IND_EXPRESSIONS
- ALL_IND_PARTITIONS
- ALL_IND_STATISTICS
- ALL_INDEXES
- ALL_OBJECTS
- ALL_OBJECT_TABLES
- ALL_PLSQL_OBJECT_SETTINGS
- ALL_REFS
- ALL_SEQUENCES
- ALL_SYNONYMS
- ALL_TAB_COLUMNS
- ALL_TAB_COMMENTS
- ALL_TAB_PARTITIONS
- ALL_TAB_SUBPARTITIONS
- ALL_TRIGGERS
- ALL_UPDATABLE_COLUMNS
- ALL_VIEWS
- AUDIT_ACTIONS
- COL
- COLUMN_PRIVILEGES
- DATABASE_COMPATIBLE_LEVEL
- DATABASE_PROPERTIES
- DICTIONARY
- DICT_COLUMNS
- DUAL
- INDEX_HISTOGRAM
- INDEX_STATS
- PRODUCT_COMPONENT_VERSION
- TAB
- NLS_DATABASE_PARAMETERS
- NLS_INSTANCE_PARAMETERS
- NLS_SESSION_PARAMETERS
- ROLE_ROLE_PRIVS
- ROLE_SYS_PRIVS
Resource Limitations

The Oracle Database excels at managing shared resources among thousands of database users. The Oracle Database Cloud Service uses this proven ability to distribute machine resources among tenants.

The Oracle Database Cloud uses Database Resource Manager consumer groups to prevent any tenant from impacting the performance of others tenants. All tenant operations are initially placed in a consumer group with maximum access to resources. If a user exceeds the resource limitations of this initial consumer group, their user process is pushed to a lower priority user group, with a much longer limit on resource consumption, but a lower priority. If a user process exceeds this limit, they are pushed to a lower priority group with a much higher resource limit.

If a user process should exceed this last limit, the process may be terminated. Please be aware that this lowest consumer group allows for the consumption of up to 30 seconds of dedicated CPU time, a threshold which is normally only crossed by runaway processes.