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Certification Exam Preparation Guide

Prepare for Oracle Database Cloud Services 2021 Specialist

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Objectives

- Audience and Prerequisites for this certification
- Exam General Information
- Certification Benefits
- Exam Topics
- Revision of Exam Topics
- Review Sample Questions
- Useful Resources

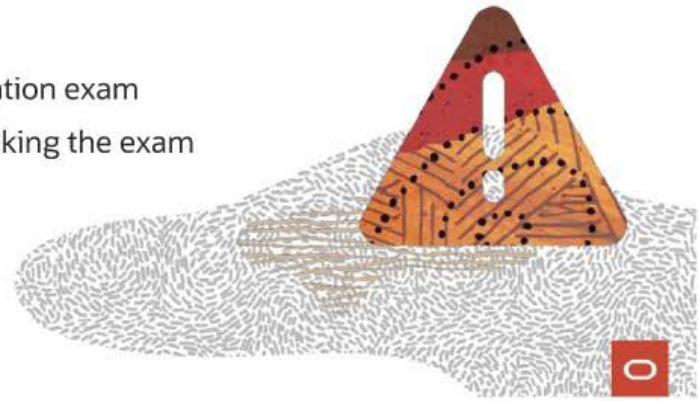
Disclaimer

This session is intended to:

- Expose you to sample questions that are intended to emulate test questions
- Provide test-taking strategies
- Help determine whether you feel prepared for the exam

This session is **NOT** intended to:

- Show questions from the actual certification exam
- Be the only material you study before taking the exam
- Teach new concepts



Audience and Prerequisites

Who can take this exam?

Experienced IT professionals who are aspiring to become cloud DBAs

- Database Administrators
- Cloud Service Administrators

Things to do before taking this exam:

- Hands-on experience (attained via labs and/or field experience) provides the best preparation for passing the exam.

Or

- Follow the learning path:

New - Become an Oracle Cloud Database Services Specialist (2021)

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Certification Benefits

- Stand out among worldwide Cloud professionals.
- Validate your skills and knowledge.
- Secure a digital badge for your social media profile.

Exam Topics

Exam Objectives	Concepts Possibly Tested in this Section
Administering Database Cloud Service on Bare Metal and Virtual Machine DB Systems	• Explain the VM Cloud Service Architecture • Create a DBCS on BMVM • Managing DBCS BMVM (expansion/scaling/state/patching) • Manage the database lifecycle (Patching,/homes/move/backup/restore) • Monitoring and manage databases on BM/VM DB Systems • Configure/Deploy MAA and Data Guard for DB Systems • Management Interfaces on DBCS BMVM
Administering Exadata Cloud Service	• Explain Exadata Cloud Service • Network, Exadata Infrastructure, VM Cluster • Exadata Infrastructure & VM Cluster Management • Lifecycle Management (patching, backup & recovery) • Configure Max Avail Arch (MAA) for Exadata Cloud Service • Management Tools • Explain Monitoring options with Exadata Cloud Service
Administering Exadata Cloud@Customer	• Describe the Infrastructure of Exadata C@C • Describe VM Clusters • Create and Manage Oracle Homes • Describe Backup and Recovery • Explain Patch and upgrade • Explain Deployment of ADB on ExaCC

Exam Topics

Exam Objectives	Concepts Possibly Tested in this Section
Administering MySQL Database Service	• Describe MySQL Database Service • Provision and connect to MySQL Service • Manage MySQL Service • Monitor MySQL • Set up Backup for MySQL • Describe Performance considerations for the MySQL DB • Create, manage, and use HeatWave
Administering NoSQL Database Service	• Explain connecting to the NoSQL Database Cloud Service • Explain Table Security Management • Explain Table Rate Limiting • Explain NoSQL Data Models • Describe Throughput • Describe NoSQL language SDKs
External Database Service Technical Overview	• Describe External Database Service • Install and configure Management Agent • Register External Databases & Enable and Use Database Management • View Fleet Summary and Management features • Use Database Groups and Jobs

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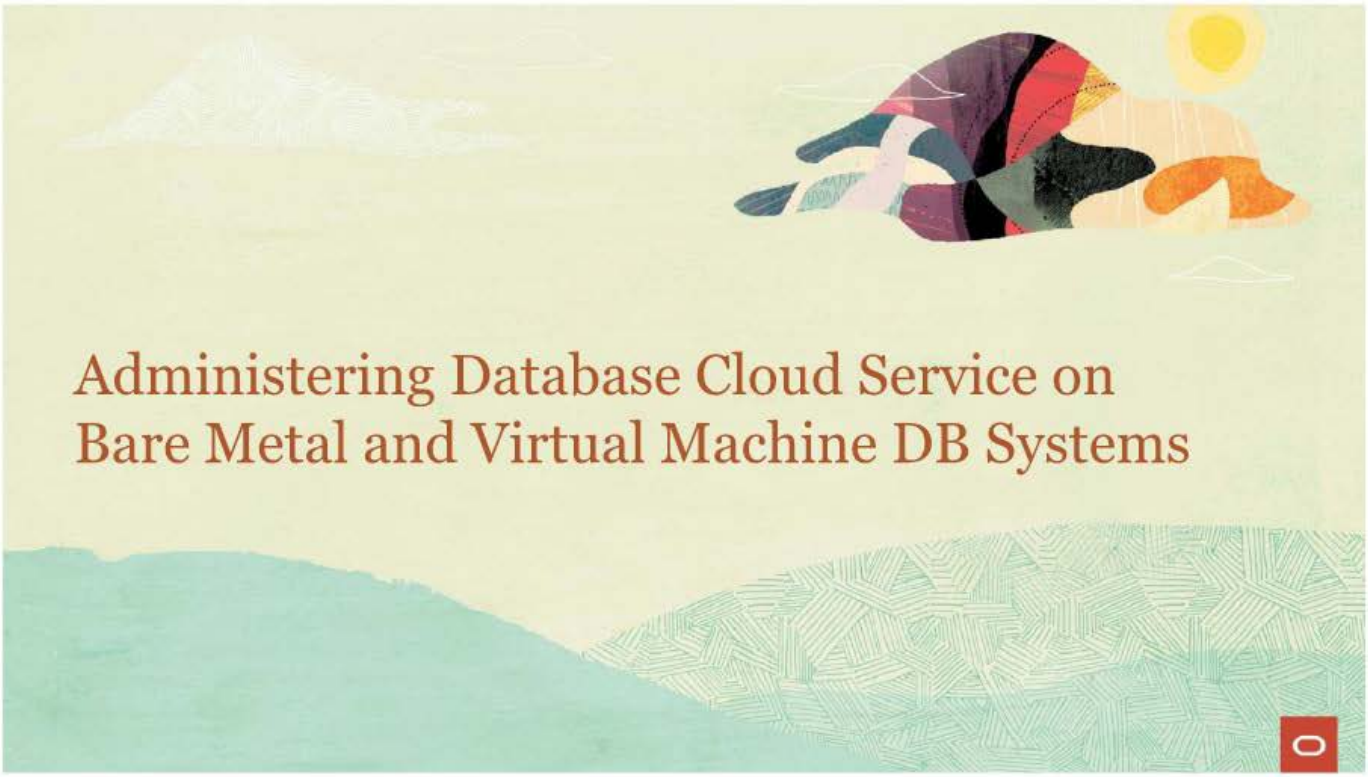
Review of Exam Topics



Oracle Database Cloud Services

	IaaS	Database - VM	Database - BM	Exadata	*Autonomous*
Editions	BYOL	SE2, EE, HP, EP	SE2, EE, HP, EP	EP	N/A
Implementation	Up to customer	1 Dedicated CDB	1+ Dedicated DBs	1+ Dedicated DBs	Serverless / Dedicated
Management	Customer	Customer	Customer	Customer	Oracle
Max DB size	1024 TB	40TB	16 TB	464 TB	128TB
CPU range	1 – 52	1 – 24	2 – 52	1 – 100's	1 – 128
Storage	Block: Elastic per GB	Block: Elastic per GB	Local NVMe:Fixed	Exadata,Flash:Fixed	Exadata,Flash

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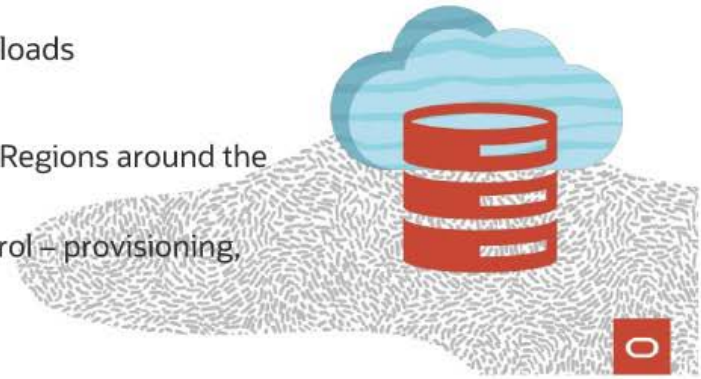
Oracle Database Cloud Service

Full-featured Oracle Database cloud instances

- Enterprise Edition or Standard Edition 2
- Oracle Database 11.2, 12c, 18c, 19c, and 21c
- Four tiers of Oracle Database License Included options or Bring Your Own License

Efficiently run and manage database workloads

- Virtual machine or bare metal shapes
- Available in Oracle Cloud Infrastructure Regions around the world
- Cloud automation under customer control – provisioning, patching, backup, disaster recovery



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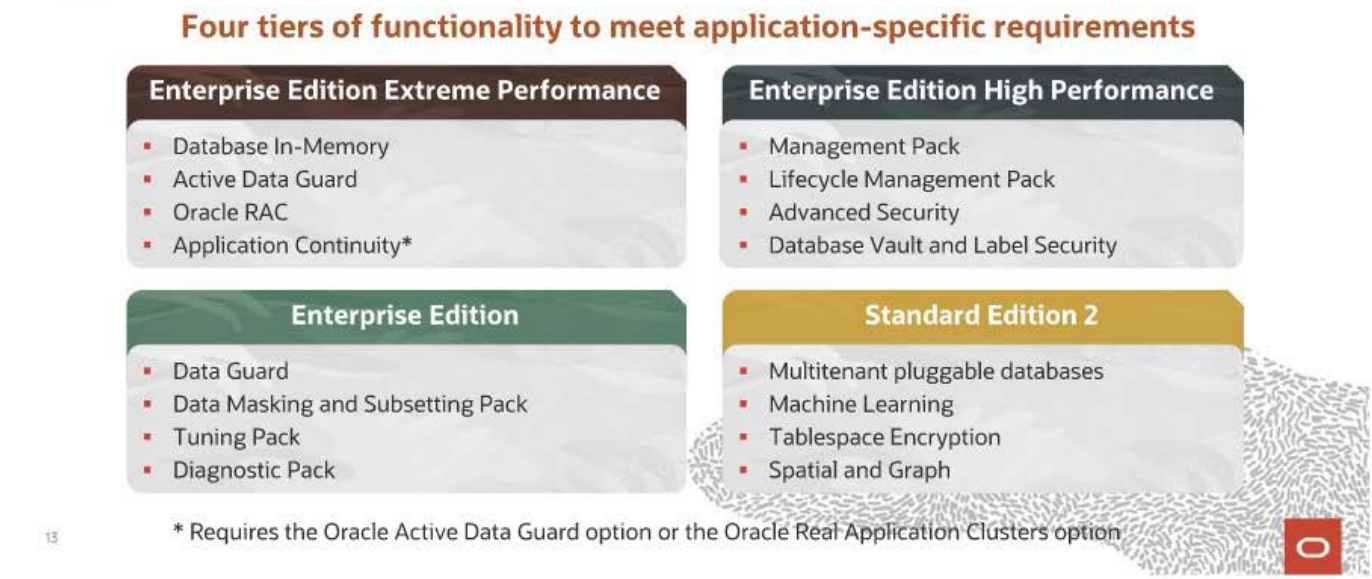
Oracle Database Cloud service provides you the ability to deploy Oracle Databases to the Cloud. You can deploy Enterprise Edition or Standard Edition 2, and any database version from 11.2 and later. You have the option to deploy using virtual machine or bare metal shapes. Database Cloud Service VM and BM Metal DB Systems are deployed in Oracle Cloud Infrastructure Regions around the world.

With Database Cloud Service, you manage the database instance, including provisioning, patching, backup, and disaster recovery using OCI cloud automation tools such as the OCI console, CLI, and API. There is also an SDK that supports a number of different languages.

Using VM shapes, you can deploy Real Application Clusters and scale your storage requirements.

Software-Included Oracle Database Consumption Options



Beginning with Standard Edition 2, features included with the service are multitenant pluggable database and tablespace encryption.

Moving to Enterprise Edition, you add additional database features such as Data Guard and the EM Packs of Data Masking and subsetting, tuning, and diagnostics.

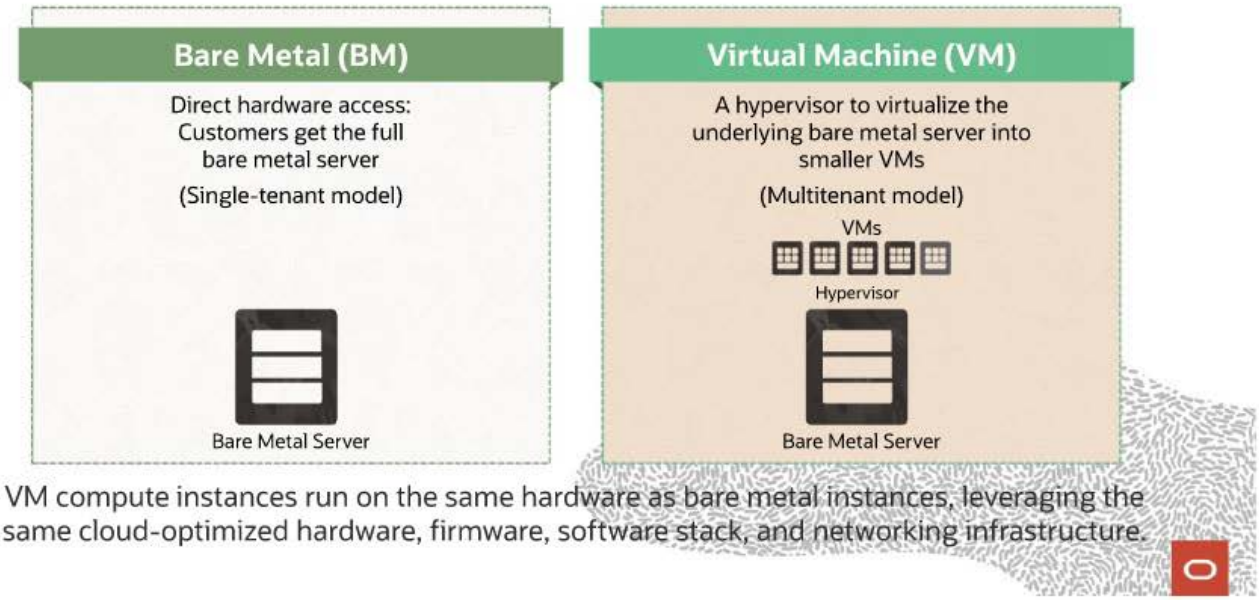
With Enterprise Edition High performance, in addition to the base Enterprise Edition, you add management and lifecycle management packs as well as advanced security and database vault and label security.

And finally, Enterprise Edition Extreme performance has all the previously discussed features plus Active Data Guard, Oracle RAC, and Database In-Memory.

Note that all packages include Oracle Database Transparent Data Encryption (TDE).

You have an option to Bring Your Own License (BYOL), which means you can use your organization's existing Oracle Database software licenses.

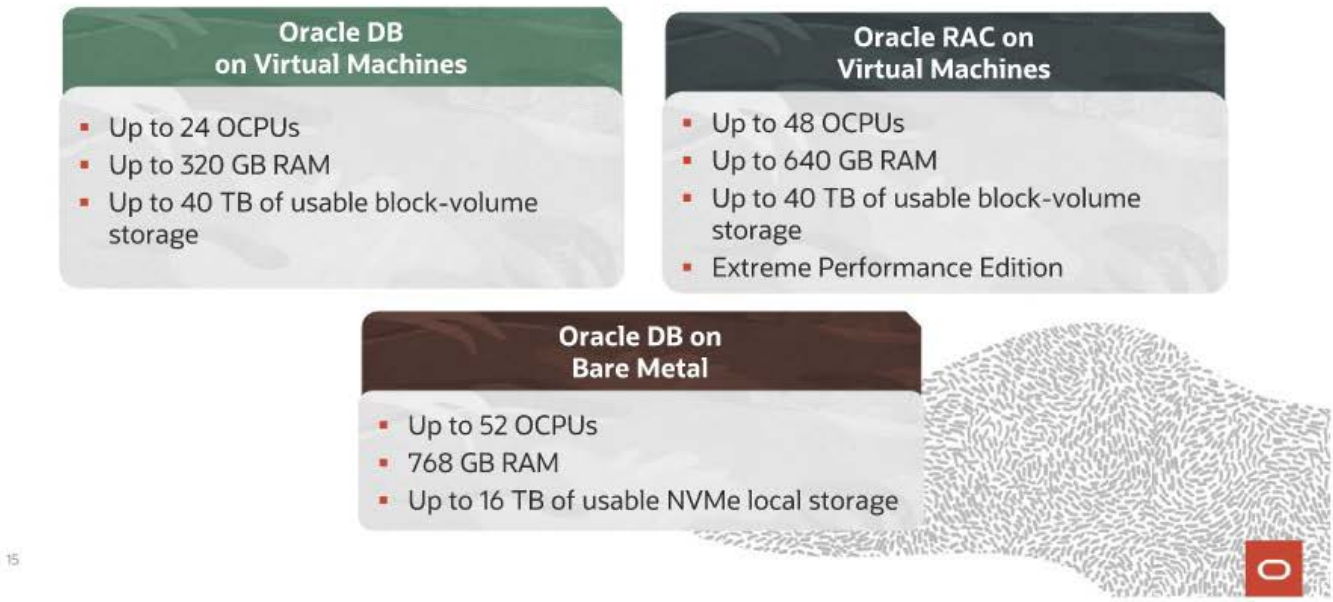
Compute: Bare Metal and Virtual Machines



Oracle Cloud Infrastructure (OCI) is the only public cloud that supports BM and VMs using the same set of APIs, hardware, firmware, software stack, and networking infrastructure. Bare metal instances are single tenant and you have full control over the resources provisioned within the service. Virtual machines follow a multitenant model and share servers that are not overprovisioned.

For databases using bare metal and virtual machine infrastructure, Oracle Cloud Infrastructure uses per-second billing. This means that OCPU and storage usage is billed by the second, with a minimum usage period of 1 minute for virtual machine DB systems and 1 hour for bare metal DB systems. For bare metal servers, there is an infrastructure charge along with the billing for OCPUs.

Virtual Machine and Bare Metal Options



The maximum number of OCPUs, RAM, and storage for your database depends on the shape you choose.

There are two types of DB systems on virtual machines:

- Single-node or 1-node virtual machine DB system consists of one virtual machine.
- 2-node virtual machine DB system consists of two virtual machines of separate servers.

Virtual machine DB systems use Oracle Cloud Infrastructure block storage. Bare metal systems use NVMe local storage and are, therefore, not scalable. Storage scaling is available for all VM shapes. Online OCPU scaling is available for bare metal systems or for 2-node RAC VMs.

Creating DB Systems: Overview

You can use the Console to perform the following tasks:

- Create a VCN to use when creating DB systems.
- Launch a DB system: You can create a database system.
- Check the status: You can view the status of your database creation, and after that, you can view the runtime status of the database.

Launching a DB System: Prerequisites

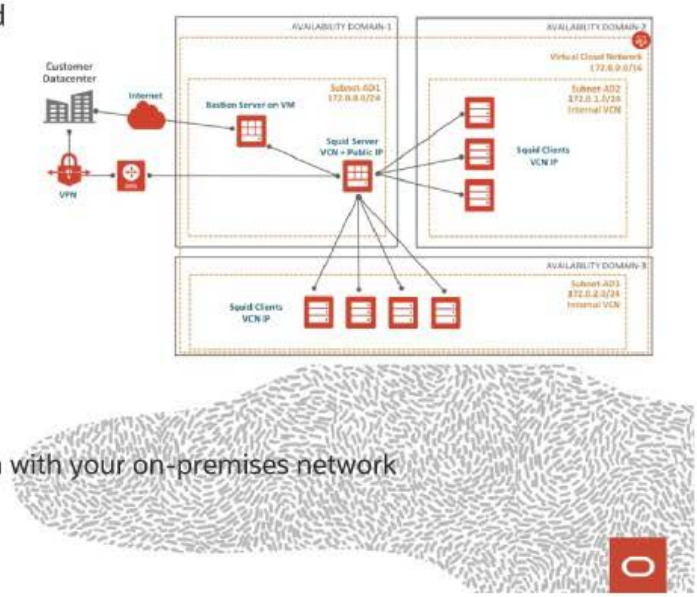
You need the following items to launch any DB system:

- Appropriate IAM policies must be granted and the tenancy needs to have the appropriate service limits
- Public key in OpenSSH format
- Virtual cloud network (VCN) in a region where you want to launch a DB System
- At least one private or public subnet
- An Internet gateway with a public subnet or a service gateway with a private subnet to back up your DB system to Object Storage or use the managed patching feature
- For a 2-node RAC DB system, ensure that port 22 is open for both ingress and egress on the subnet.
- Use the Internet and VCN Resolver or a Custom Resolver for DNS name resolution.

Virtual Cloud Network (VCN)

A Virtual Cloud Network is a software-defined version of a traditional physical network including subnets, route tables, and gateways on which your instances run.

- A VCN resides within a single region but can cross multiple Availability Domains.
- A virtual router provides a single point of entry for remote network paths coming into the VCN.
- Internet gateway provides a path for network traffic between your VCN and the Internet.
- You can use a DRG to establish a connection with your on-premises network via IPSec VPN or FastConnect.



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A VCN within Oracle Cloud Infrastructure is a software-defined version of a traditional physical network. A VCN is a regional service and you can create a VCN by specifying a CIDR range. Each VCN network is subdivided into subnets, and subnets can be either AD-specific or regional.

In addition to subnets, custom route tables are available and security rules control access.

Gateways are also available in a VCN. An optional Internet gateway provides a path for network traffic between your VCN and the Internet. An optional Service Gateway to reach Oracle Cloud resources and optional NAT Gateway to reach public endpoints not supported by the service gateway are also available.

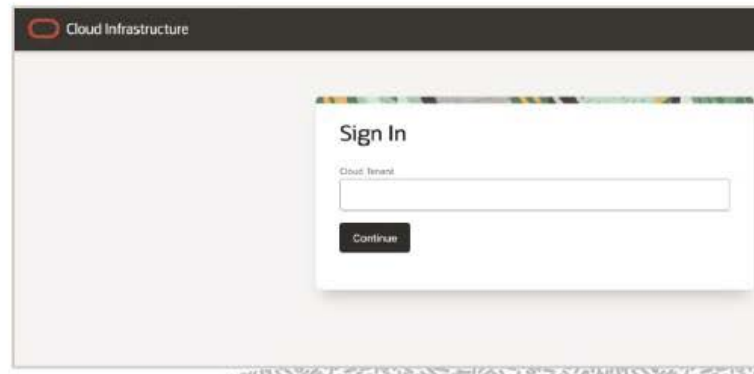
You can use a dynamic routing gateway or DRG to establish a connection with your on-premises network via IPSec VPN or FastConnect.

For more information about Identity and Access Management as well as networking in OCI, refer to the OCI training courses and documentation.

Using the Console

Log in to Oracle Cloud Infrastructure:

- Enter Cloud Tenant.
- Enter OCI User Name.
- Enter OCI Password.



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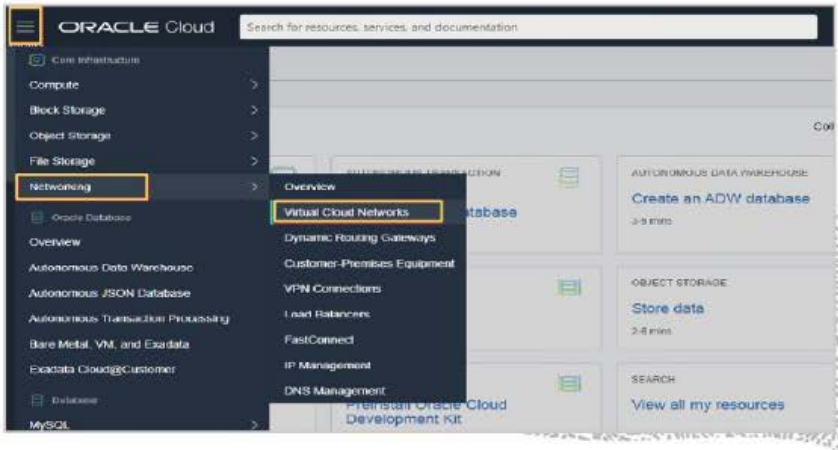
Creating a VCN for a DB System

- Select **Networking** from the menu.
- Select **Virtual Cloud Networks**.



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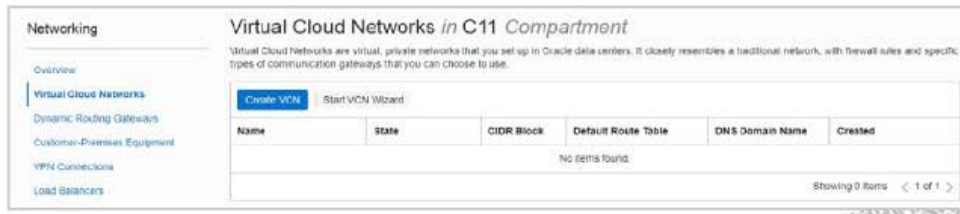
Before you can launch a DB system, you need to have a virtual cloud network (VCN) and subnet to launch it into as we previously discussed.

Open the navigation menu. Under **Core Infrastructure**, go to **Networking** and click **Virtual Cloud Networks**.

Creating a VCN for a DB System

- Click **Create VCN**.
- The **Start VCN Wizard** is not for production.



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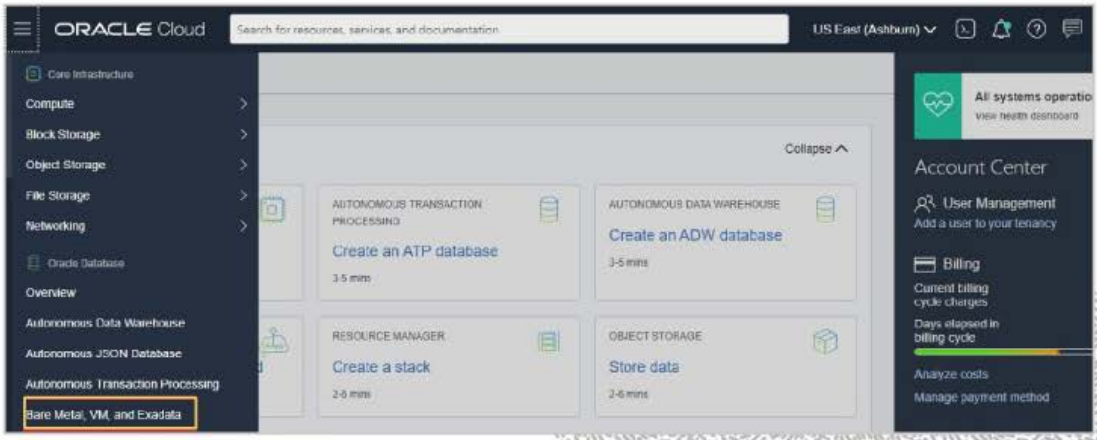
Then you can create a Virtual Cloud Network.

The VCN Creation Wizard is not for Production.

The Networking section of the Console includes a handy wizard that creates a VCN along with related resources. It can be useful if you just want to try launching an instance. However, the wizard automatically creates a public subnet and an Internet gateway. You may not want this for your production network, so Oracle recommends you create the VCN and other resources individually yourself instead of using the wizard.

Using the Console to Launch a DB System

Select **Bare Metal, VM, and Exadata** from the OCI menu.



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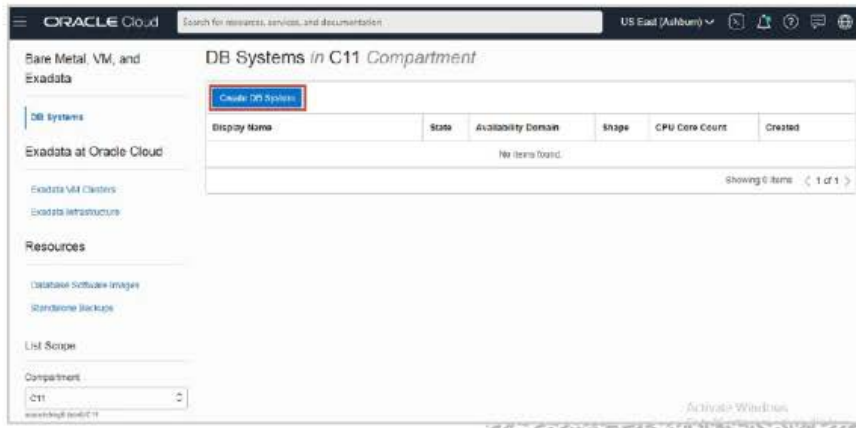
Oracle Cloud Infrastructure offers 1-node DB systems on either bare metal or virtual machines, and 2-node RAC DB systems on virtual machines.

You can manage these systems by using the Console, the API, the Oracle Cloud Infrastructure CLI, the Database CLI (DBCLI), Enterprise Manager, or SQL Developer.

Using the Console to Launch a DB System

- Choose a Compartment.
- Click **Create DB System**.



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Select the compartment in which to create the virtual machine or bare metal DB System from the Compartment section. Click the Create DB System button.

Connecting to a DB System with SSH

- You must use SSH to access the DB System.
- You register or create an SSH public key during DB System creation.
- You retain the SSH private key and use it to authenticate.
- You connect using the `opc` user account.
- You must also ensure that port 22 is accessible through the firewall.

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After you create the DB System, you can connect using SSH.

You register or create an SSH public key during creation of the DB System.

An SSH public key is used for authentication when you use an SSH client to connect. When you connect, you must provide the private key that matches the public key, which is stored in the database server.

You connect to the `opc` user, and then switch to the other OS users.

Port 22 must be open to access the database servers associated with your DB System environment using SSH.

Using the Console to Manage a DB System

- Database Status
- Start, Stop, and Reboot
- Scale OCPUs
- Scale Up Storage
- Terminate DB System
- BYOL Database Licenses
- Tags for DB Systems and Database Resources

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You can launch the Console to start, stop, terminate, scale, manage licenses for, and check the status of a bare metal and virtual machine DB system, and set up DNS for a 1-node or 2-node RAC DB system.

Using Console to Start, Stop, and Reboot a DB System

Different actions of a DB system:

- Start
- Reboot
- Copy OCID

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To use the Console to start, stop, and reboot a DB System:

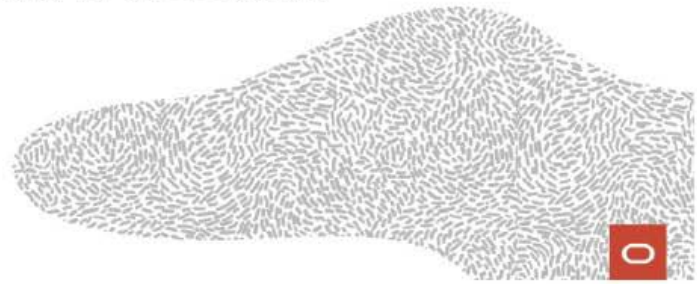
1. Open the navigation menu. Under **Database**, click **Bare Metal**, **VM**, and **Exadata**.
2. Choose your **Compartment**.

   A list of DB systems is displayed.
3. In the list of DB systems, find the DB system you want to stop or start, and then click its name to display details about it.
4. In the list of nodes, click the Actions icon (three dots) for a node, and then click one of the following actions:
   - **Start:** Restarts a stopped node. After the node is restarted, the **Stop** action is enabled.
   - **Stop:** Shuts down the node. After the node is powered off, the **Start** action is enabled.
   - **Reboot:** Shuts down the node, and then restarts it

Note: For 2-node RAC VM systems, you must start/stop and reboot each node individually.

Scaling OCPUs on DB Systems

- Bare Metal DB System processing power can be scaled up or down online by increasing or decreasing the number of OCPUs.
- Virtual Machine DB system OCPUs cannot be changed directly.
  - Scaling the OCPUs of a VM DB system requires that the shape of the system be changed.
  - Online OCPU scaling for VM DB Systems can be done only with 2-node RAC.
  - Storage scaling must be done separately for VM DB Systems.



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Bare Metal DB System processing power can be scaled up or down online by increasing or decreasing the number of OCPUs.

To Scale a CPU for Bare Metal DB System:

1. Open the navigation menu. Under Database, click Bare Metal, VM, and Exadata.
2. Choose your Compartment. A list of DB systems is displayed.
3. In the list of DB systems, find the system you want to scale up and click its highlighted name. The system details are displayed.
4. Click **Scale CPU Cores**, and then change the number in the **CPU Core Count** field. The text below the field indicates the acceptable values, based on the shape used when the DB system was launched.
5. Click **Update**.

Virtual Machine DB system OCPUs cannot be changed directly.

To Change shape of a VM DB system:

1. Open the navigation menu. Under Database, click Bare Metal, VM, and Exadata.
2. Choose your Compartment. A list of database systems is displayed.
3. Click the system you want to scale. The system details are displayed.
4. Click Change Shape.
5. Select the new shape from the list of compatible shapes and click Change.

Online OCPU scaling for VM DB Systems can only be done with 2-node RAC by changing the shape one VM at a time. Storage scaling must be done separately for VM DB Systems.

Create Database

Bare Metal DB Systems support multiple databases on the same system. You can:

- Create a database from a database image on the same DB System
- Create a database from a backup on the same DB System or a new DB System

Virtual Machine DB Systems support only a single database. You can:

- Create a database from backup to a new Virtual Machine DB System
- Clone a database to a new Virtual Machine DB System

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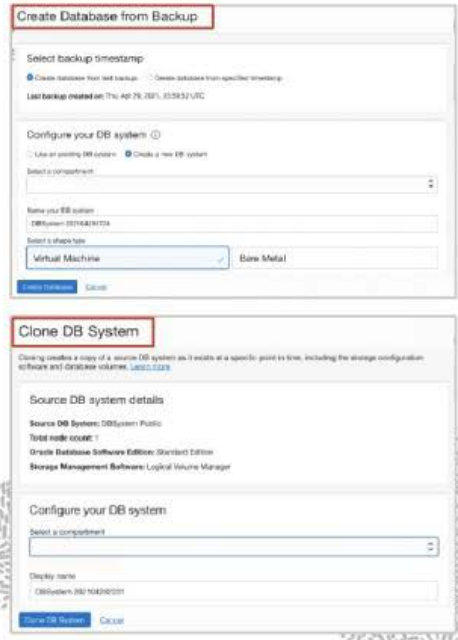


Bare Metal DB Systems support multiple databases. You can create additional databases from a database image or from a backup on the same system. Virtual Machine DB Systems support only a single database. You can create a Database from a backup to a new Virtual Machine DB System or you can clone a Database to a new Virtual Machine DB System. Creating a Database from backup creates only the database on a new DB System. Cloning a database not only clones the database, but the VM as well. Cloning a database is also much quicker than creating a database from backup. However, creating a Database from backup provides the capabilities for a PITR, whereas a Database clone will always be a clone of the actual database.

To create an additional database on Bare Metal DB Systems:

1. Open the navigation menu. Click **Oracle Database**, and then click **Bare Metal, VM, and Exadata**.
2. Choose your **Compartment**.
3. In the list of DB systems, find the Bare Metal DB system in which you want to create the database, and then click its name to display details about it.
4. Click **Create Database**.
5. In the **Create Database** dialog box, enter all the necessary database information.

To create a database from backup:

1. Open the navigation menu. Click **Oracle Database**, and then click **Bare Metal, VM, and Exadata**.
2. Choose your **Compartment**.
3. In the list of DB systems, find the DB system in which you want to create the database from backup.
4. Navigate to the database on the DB system in which you want to create the database from backup.
5. Click **Create Database from Backup.**
6. This will provide you the option to create a database from backup on an existing Bare Metal DB System or create a database on a new Bare Metal or Virtual Machine DB System.
7. Enter all the DB System and Database information, and then click Create Database.

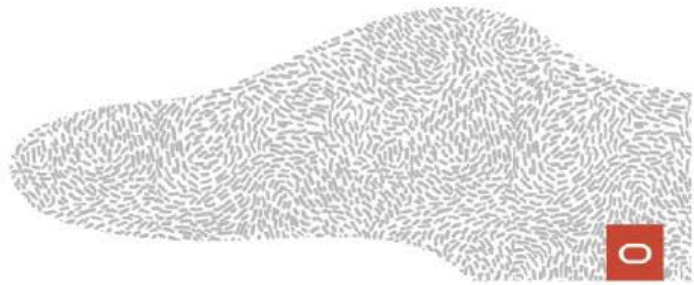
Note that you need the password that matches either the Transparent Data Encryption (TDE) wallet password or RMAN password for the source database. The Oracle Database software version you specify must be the same or a later version as that of the backed-up database.

To Clone a Database:

1. Open the navigation menu. Click **Oracle Database**, and then click **Bare Metal, VM, and Exadata**.
2. Choose the compartment where the source DB system is located.
3. In the list of DB systems, find the virtual machine DB system you want to clone and click its highlighted name.
4. On the DB System Details page of your source DB system, click **Clone DB System.**

Backup Options

- You can use the Oracle Cloud Infrastructure Console to:
  - Enable Automatic Incremental backups
  - Create full backups on demand
  - View the list of managed backups for a database
  - Delete manual (on-demand) backups
- All backups are encrypted with the same master key used for Transparent Data Encryption (TDE) wallet encryption.



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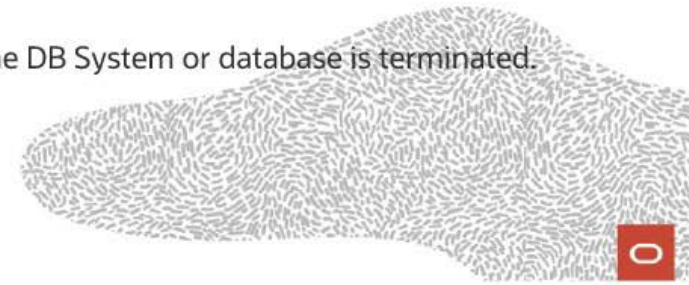
You can use the Console to enable automatic incremental backups, create full backups on demand, and view the list of managed backups for a database. You can also use the Console to delete manual (on-demand) backups. All backups are encrypted with the same master key used for Transparent Data Encryption (TDE) wallet encryption.

The database must be in an "Available" state for a backup operation to run successfully. Oracle recommends that you avoid performing actions that could interfere with availability (such as patching operations) while a backup operation is in progress. If an automatic backup operation fails, the Database service retries the operation during the next day's backup window. If an on-demand full backup fails, you can try the operation again when the database availability is restored.

Oracle recommends using a service gateway with the VCN to enable access to Object Storage for Database backups. To avoid backup failures, ensure that the database's archiving mode is set to ARCHIVELOG (the default).

Automatic Database Backup: Default Configuration

- Database backups occur daily.
- Archived redo log files are backed up every 30 minutes.
- There is a 7-day backup cycle, with one full backup and daily incremental backups.
- The retention period choices:
  - 7, 15, 30, 45, 60 days for backups to cloud storage
- For database deployments with Oracle Data Guard, automatic backups can be executed only on the primary site.
- Automatic backups are deleted when the DB System or database is terminated.



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The following is an outline of the default automatic backup configuration settings:

- Automatic backups are scheduled daily.
- Archived redo log files are backed up every 30 minutes.
- Backups follow a 7-day cycle, consisting of one full backup of the database, followed by daily incremental backups.
- The retention period defines the period for which backups are maintained. Backups to cloud storage are maintained based on the retention choice of 7, 15, 30, 45, or 60 days.
- For database deployments with Oracle Data Guard, automatic backups can only be executed on the primary site.
- Automatic backups are deleted when the DB System or database is terminated.
- The backup data is automatically encrypted using Oracle Transparent Data Encryption.

Best Practices for Updating (patching) Bare Metal and Virtual Machine DB System Databases

- Back up your databases before you apply any updates to your system.
- Patch the DB System before updating a database for DB Systems with Grid Infrastructure/ASM storage management.
- Before you apply any update, run the precheck operation.
- Ensure all servers and database instances are up and running.
- Ensure `/u01` has 15 GB of free space.
- Use the OCI Management Interfaces to perform update operations.
- For 2-node RAC, updates are done in a rolling fashion to maintain system availability. For single instance, provision a Data Guard standby and update it first to maintain system availability.

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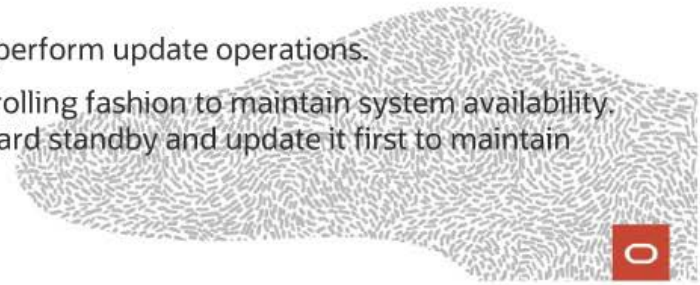


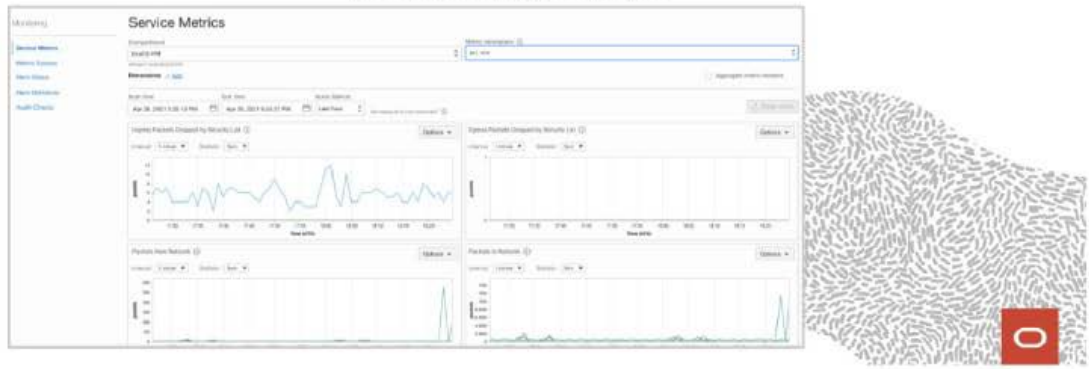
Before proceeding with the patching of Database Cloud Service databases, take a look at the best practices outlined in the slide.

- Back up your databases before you apply any updates to your system.
- Patch the DB System before updating a database for DB Systems with Grid Infrastructure/ASM storage management.
- Before you apply any update, run the precheck operation.
- Ensure all servers and database instances are up and running.
- Ensure `/u01` has 15 GB of free space.
- Use the OCI Management Interfaces to perform update operations.
- For 2-node RAC, updates are done in rolling fashion to maintain system availability. For single-instance, provision a Data Guard standby and update that first to maintain system availability.

There must be connectivity for the DB System to the applicable Swift endpoint for Object Storage where the patches are stored. Oracle recommends using a service gateway with the VCN to enable access to Object Storage. Patching requires a reboot so plan to run it when the users have minimal impact.

Monitoring with OCI Metric Charts

- The Metrics feature relays metric data about the health, capacity, and performance of your cloud resources.
- Resources, services, and applications emit metrics to the Monitoring service.
- Such metrics can provide availability and performance, completed backups and where they are allocated, and network latency.
- To monitor resources, you must be given the required type of access in a policy written by an administrator that gives you access to the monitoring services as well as the resources being monitored.



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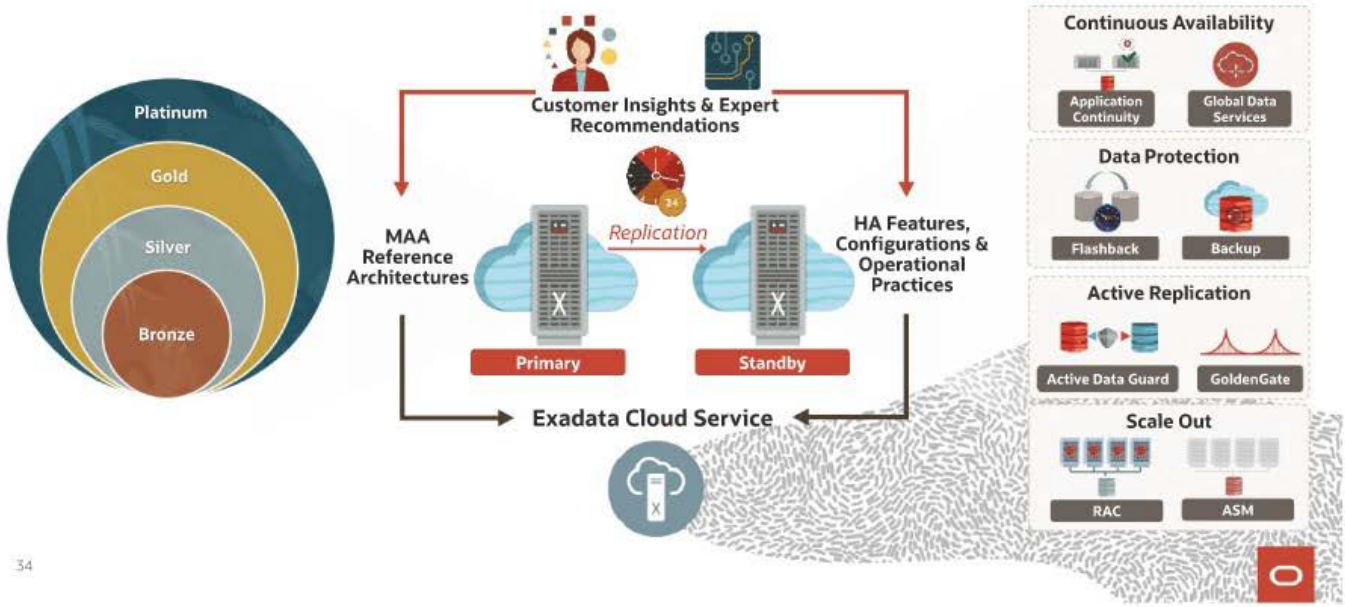
The OCI Metrics feature relays **metric** data about the health, capacity, and performance of your cloud resources. Resources, services, and applications emit metrics to the Monitoring service. Common metrics reflect data related to:

- Availability and latency
- Application uptime and downtime
- Completed transactions
- Failed and successful operations
- Key performance indicators (KPIs), such as sales and engagement quantifiers

By querying Monitoring for this data, you can understand how well the systems and processes are working to achieve the service levels you commit to your customers.

Oracle Maximum Availability Architecture (MAA)



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Availability of data and applications is an important element of every IT strategy. At Oracle, we've used our decades of enterprise experience to develop an all-encompassing framework that we call Oracle MAA, for Maximum Availability Architecture.

Oracle MAA starts with customer insights and expert recommendations. These have been collected from our huge pool of customers and community of database architects, software engineers, and database strategists. Over the years, this has helped the Oracle MAA development team to develop a deep and complete understanding of various kinds of events that can affect availability.

Through this, they have developed an array of availability reference architectures. These reference architectures acknowledge that not all data or applications require the same protection, and that there are tradeoffs in terms of cost and effort. Whatever your availability goals may be, for a database or related applications, Oracle has the product functionality and guidance to ensure you can make the right decision with full knowledge of the tradeoffs in terms of down time, potential data loss, and cost.

These reference architectures use a wide array of our HA features, configurations and Operational Practices.

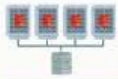
They help our end customers primarily achieve four goals:

- **Data protection** – Reducing data loss through Flashback and backup
- **Active Replication** – Which allows customers connect their applications to replicated sites in an Active-Active HA solution through Active Data Guard and GoldenGate
- **Scale Out** – Which allows customers the ability to scale compute nodes linearly through RAC and ASM
- **Continuous Availability** – Which allows transparent failover of services across sites distributed locally or remote, through AC and GDS

These features and solutions allow customers to mitigate not only planned events – such as software upgrades, data schema changes, and patching, but also unplanned events – such as hardware failures and software crashes due to bugs.

The insights, recommendations, reference architectures, features, configurations, best practices, and deployment choices combine to form a holistic blueprint, which allows customers to successfully achieve their high availability goals.

Database Cloud Services BM: Software Editions

		SE	EE	EE HP	EE EP
	Flashback	Only Flashback Query	✓	✓	✓
	Backup & Recovery	Non parallel only	✓	✓	✓
	Multitenant / Refresh Clone	Multiple CDBs per BM DB System, Max 3 PDBs per CDB starting with 19c	Multiple CDBs per BM DB System, Max 3 PDBs per CDB starting with 19c	Multiple CDBs per BM DB System	Multiple CDBs per BM DB System
	RAC	✗	✗	✗	✗
	Data Guard	✗	Standard Data Guard	Standard Data Guard	Active Data Guard
	Application Continuity	✗	✗	✗	✓

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This chart is an overview of the MAA products and features that can be used with Database Cloud Services Bare Metal.

Flashback can be used with flashback query, which allows the contents of a table to be queried with reference to a specific point in time.

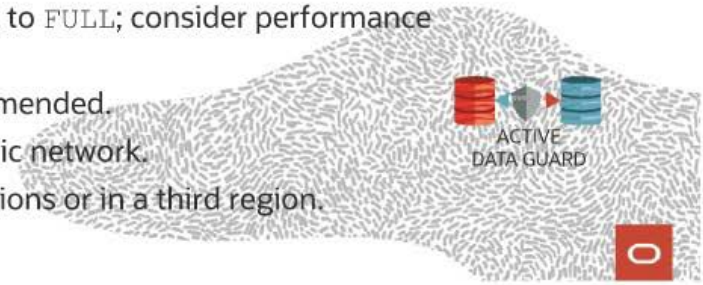
Backup and Recovery is a standard solution that all databases should implement if you have the need to recover data.

Data Guard and Active Data Guard can be implemented for DR solution as well as the ability to offload reporting processing or failover in case there is a primary database failure.

Finally, application continuity can be used with the EE EP edition because it requires the Active Data Guard license.

Database Cloud Services BM: Data Guard Best Practices

- Always use Grid Infrastructure storage management (ASM) for Data Guard environments:
  - Includes Oracle Notification Services (ONS)
  - No static listener entries required
  - Service control (srvctl)
- Always use custom application services.
- Changing listener port is not supported (but additional ports can be added).
- By default, `db_block_checking` is set to `FULL`; consider performance implications when migrating.
- Custom DB software images are recommended.
- Use only VCN connectivity and not public network.
- Put the FSFO observer with the applications or in a third region.



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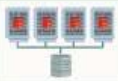
Here is a list of best practices to set up Data Guard with Database Cloud Services BM.

You should always use Grid Infrastructure storage Management, ASM, for Data Guard environments, and always use custom application services. From a network perspective, you should only use VCN connectivity and not public network. And finally, put the FSFO observer with the applications or in a third region.

Database Cloud Services VM: Software Editions

		SE	EE	EE HP	EE EP 1n	EE EP 2n
	Flashback	Only Flashback Query	✓	✓	✓	✓
	Backup & Recovery	Non parallel only	✓	✓	✓	✓
	Multitenant / Refresh Clone	Single CDB per VM DB System, Max 3 PDBs starting with 19c	Single CDB per VM DB System, Max 3 PDBs starting with 19c	Single CDB per VM DB System	Single CDB per VM DB System	Single CDB per VM DB System
	RAC	✗	✗	✗	✗	✓
	Data Guard	✗	Standard Data Guard	Standard Data Guard	Active Data Guard	Active Data Guard
	Application Continuity	✗	✗	✗	✓	✓

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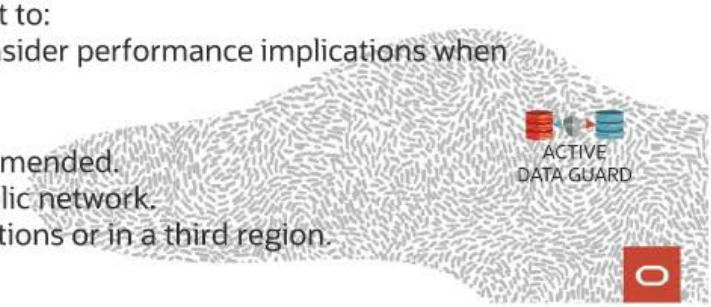
This table is a quick reference to the MAA components and the availability on the VM services, which include Flashback, Backup and recovery, multitenant, RAC, and Data Guard.

Application Continuity is in EE EP only because it requires ADG and/or RAC.

Database Cloud Services VM: Data Guard Best Practices

- Always use Grid Infrastructure storage management (ASM) for Data Guard environments:
  - Includes Oracle Notification Services (ONS)
  - No static listener entries required
  - Service control (srvctl)
- Data Guard on LVM is supported but lacks the above functionalities.
- Always use custom application services.
- Changing listener port is not supported (but additional ports can be added).
- By default, `db_block_checking` is set to:
  - `FULL` on Grid Infrastructure; consider performance implications when migrating
  - `TYPICAL` on LVM
- Custom DB software images are recommended.
- Use only VCN connectivity and not public network.
- Put the FSFO observer with the applications or in a third region.



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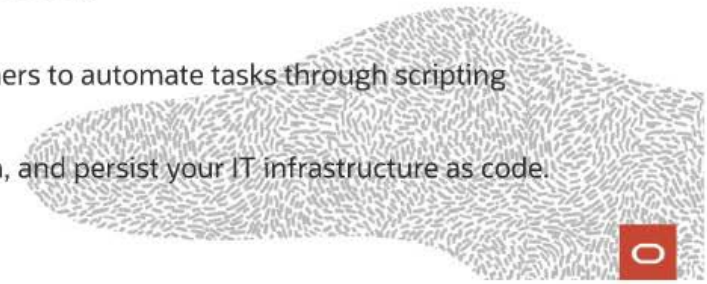
As a best practice, you should always use Grid Infrastructure storage management (ASM) for Data Guard environments. Data Guard is supported on LVM but it lacks ONS and srvctl, and requires static listener entries.

To keep product and standby database stacks the same, it is recommended to use the Customer DB software images.

Also, you should put the FSFO observer with the applications or in a third region.

OCI Management Interfaces

- Oracle Cloud Web-based UI (OCI Console)
  - Browser access via https; great for one-time actions and ad hoc tasks
- Oracle Cloud REST APIs
  - Programmatic access via https
- Software Development Kit (SDK)
  - Build and deploy apps that integrate with Oracle Cloud Infrastructure services.
  - Java SDK, Python SDK, Ruby SDK, Go SDK
- Command Line Interface (CLI)
  - Convenient for developers and others to automate tasks through scripting
- Terraform
  - Programmatically manage, version, and persist your IT infrastructure as code.



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Database Cloud Service provides a wide choice of management interfaces. The easiest to use is the web-browser interface, which we have discussed throughout this course. It allows you to use a browser to graphically configure and initiate operations. This is great for one-time actions, but most customers prefer a more programmatic interface for things done repeatedly, such as provisioning and patching databases. Anything you can do with the browser, you can also do with a corresponding REST API. Similar to the browser, the REST APIs transit the Internet via https, and require no special software installed on the local system. All interfaces are also exposed via a command-line interface that can be used for scripting, and for building custom tooling. There is also a software development kit to integrate with common languages such as Java, Python, Ruby, and Go. If you prefer to manage your infrastructure as code, there is also a Terraform interface.

Oracle Exadata Cloud Service

Oracle Database as a Service running on Exadata

- With All Advanced Database Options or Bring Your Own License
- 100% compatible with existing applications that use Oracle Database

With Simplicity and Elasticity benefits of Public Cloud:

- Elastic scaling
- Pay-per-use
- Oracle experts manage all infrastructure
- User controlled database automation

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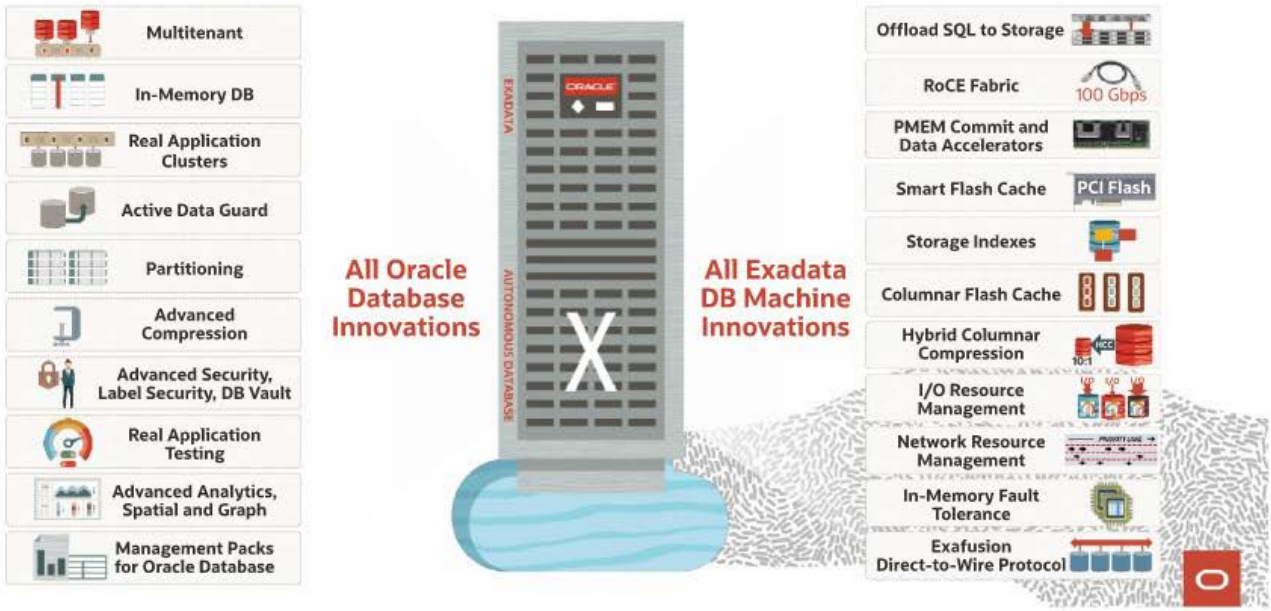
What is Exadata Cloud Service? It's the Oracle database running as a service on an Exadata, in Oracle Cloud Infrastructure. It includes all the advanced database features and options available for the Oracle database. You can license everything as a service, or bring your on-premises licenses to the cloud. Since it runs the same Oracle database you run on premises, it is 100% compatible with any existing applications. For all practical purposes, it looks exactly like an Oracle Database running on an Exadata on-premises. The big difference is the public cloud features and benefits—specifically, the simplicity and elasticity. Elastic scaling means you can grow and shrink your service to match your workload requirements. This means you only pay for what you use, and this pay-per-use capability is how you can really lower your Total Cost of Ownership. In addition, Oracle will manage all the infrastructure for you, so you can focus on your business, and not on infrastructure. And, for those operations you do continue to manage, Exadata Cloud Service provides sophisticated automation making most operations as easy as pushing a button.

Exadata Cloud: Most Powerful Database + Platform



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This is just a quick summary of some of the capabilities you get with Exadata Cloud Service. On the left are all the features available in the Oracle database. On the right, are all the Exadata innovations available with the platform. Everything you expect from Exadata is available with the Exadata Cloud Service.

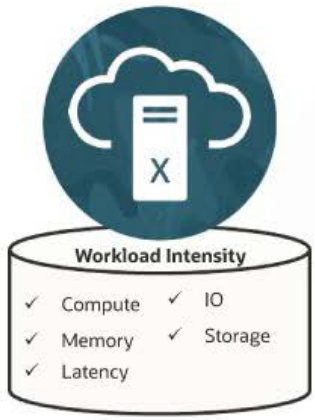
Exadata Cloud Service Shapes

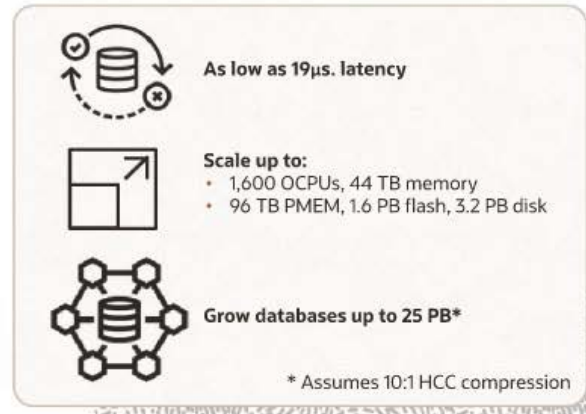
Shapes	Base System*	X8M
Minimum Configuration	Quarter Rack	**Quarter Rack**
Minimum # of Database Servers	2	**2**
Minimum # of Storage Servers	3	**3**
OCPUs per Database Server	24	**50**
Memory per Database Server	360 GB	**1,390 GB**
Usable Capacity per Storage Server	25 TB	**50 TB**
Fabric Network	InfiniBand	**RoCE**
Persistent Memory (PMEM)	No	**Yes**
Shape Options	Quarter	**Multi-Rack**
Shape Expansion	Not Expandible Requires migration to a different shape	**Elastic Server Expansion**

* Base System is hardware generation agnostic and could be based on Exadata Cloud Service X6, X7, or X8 hardware

Currently, Exadata Cloud Service is available in multiple shapes. Customers can choose an entry-level Base System, which is not expandible or subscribe to the Exadata Cloud Service X8M. The X8M shapes start with a Quarter Rack and allow elastic expansion by adding additional database and storage servers to enable higher compute and storage capacity. As you can see from the table, the individual database and storage servers in the Base System also have only a fraction of the OCPU and memory resources as well as storage capacity that is available in Exadata Cloud Service X8M. And, Exadata Cloud Service X8M benefits from the performance improvements associated with persistent memory (PMEM) and RoCE. More on that in a minute…

Exadata Cloud Service delivers massive performance and scale





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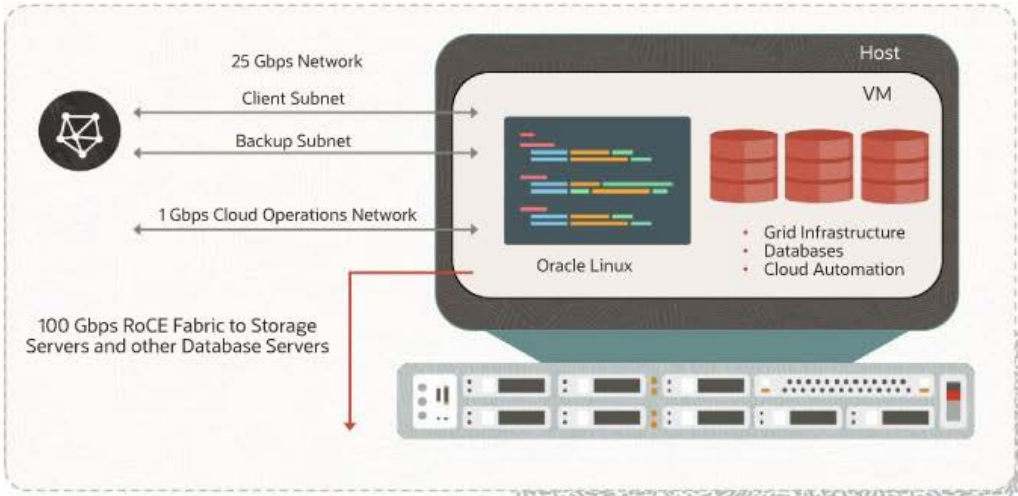
Exadata is co-engineered with the Oracle Database enabling Exadata Cloud Service to provide the best data management platform in the cloud. On top of that, Exadata Cloud Service delivers massive scalability built on a Maximum Availability Architecture supporting up to 1,600 OCPU and databases a large as 25 PB compressed assuming a 10 to 1 ratio with HCC.

Imagine the costs and efficiencies you could save by consolidating databases onto one service.

Simply stated – No database is too demanding or workload too large for ExaCS.

Network Architecture



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The diagram in the slide outlines the high-level network architecture for Exadata Cloud Service.

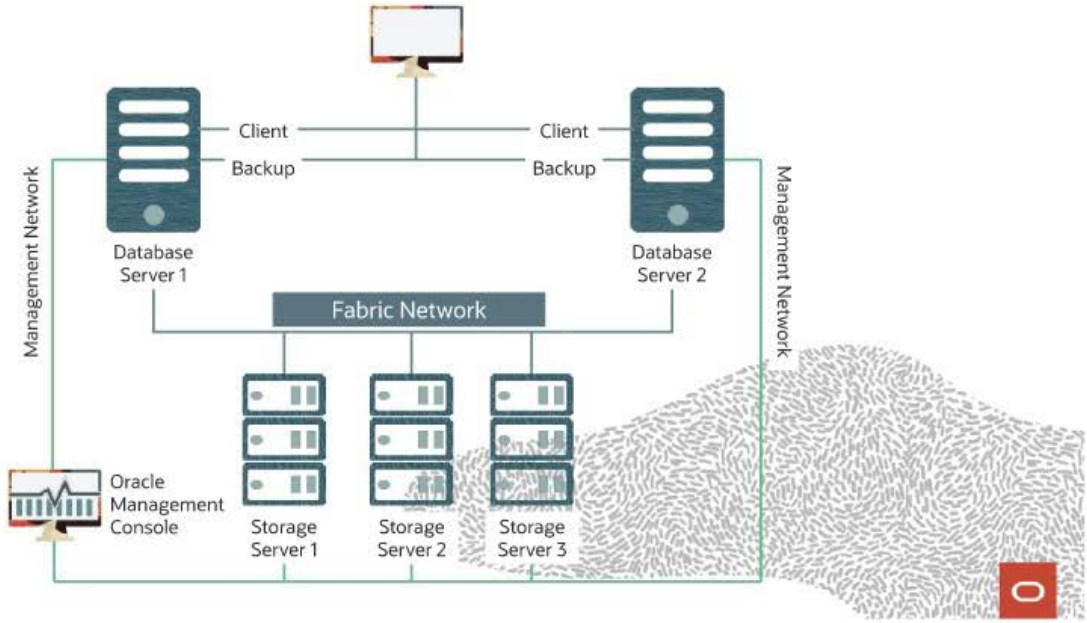
Each Exadata Cloud Service instance is hosted on an Exadata, located inside Oracle Cloud Infrastructure. Each Exadata Cloud Service instance provides two networks for customer access:

- You use the **client network** to connect directly to Exadata Cloud Service. This includes client applications connecting through Oracle Net (SQL*Net) running on Oracle Cloud Infrastructure (OCI) Compute instances or clients located outside of Oracle Cloud, such as your on-premises applications. On Exadata Cloud Service, Oracle Native Network Encryption is configured by default to secure data in transit.
- The **backup network** is also provided. This network separates backup traffic from application connections and is used when Exadata Cloud Service database deployments are backed up to Oracle Cloud Object storage.

Oracle Cloud Operations Network is a dedicated network connection used to perform infrastructure management tasks. This network is solely for infrastructure management purposes by Oracle Operations and cannot be accessed by you.

The networks (client and backup) use a Virtual Cloud Network that is defined in OCI. You must use the OCI console or APIs to configure the VCN you plan to use with Exadata Cloud Service.

Service Architecture



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The diagram in the slide illustrates the Exadata Cloud Service architecture for a Quarter Rack containing two database servers and three storage servers. The database servers are clustered together with Real Application Clusters and ASM triple-mirrors the data across the storage servers. The architecture provides redundancy for high availability. Larger service instances are principally the same, except that they contain additional database and storage servers.

The architecture is also essentially the same as for an on-premises implementation of Exadata, with clustered database servers connected to storage servers through a high-speed, low-latency, fabric network.

Application users and administrators can connect only to the database servers, using the supplied client and backup network interfaces.

Oracle owns and manages the infrastructure. This include the database servers, VM Hosts, storage servers, and the fabric network using the separate cloud operations network I mentioned earlier. Customers can schedule maintenance windows for Oracle to performance infrastructure maintenance.

New Resource Model

The new resource model:

- Separates the Exadata Infrastructure and VM Cluster into separate resources.
  - Cloud Exadata Infrastructure resource:
    - Manages the infrastructure – database and storage servers
    - Schedules infrastructure maintenance
    - Enables the expansion of Exadata Cloud Service X8M database and storage servers
  - Cloud VM Cluster resource:
    - Manages networking, grid infrastructure, OS, database homes, databases, and IORM
    - Enables scale up and down of OCPUs
- Replaces DB System resource with Exadata Cloud Service

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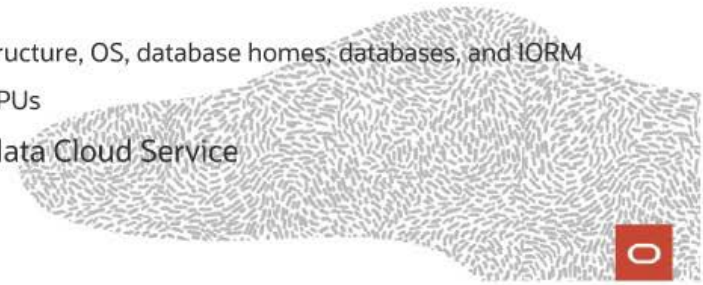


You need two resources, a cloud Exadata Infrastructure and a cloud VM Cluster when you provision Exadata Cloud Service.

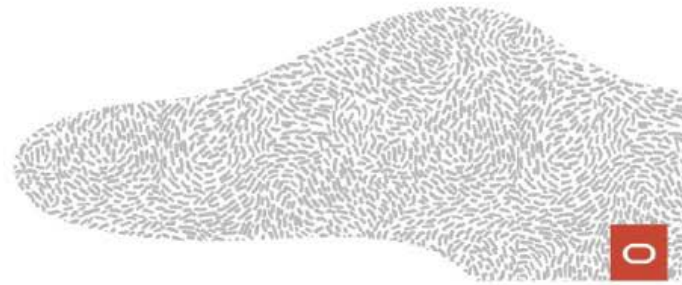
Exadata Cloud Service was historically offered in fixed configuration shapes and used DB System as the resource in OCI. Even though this approach was easy to use, it didn't offer much flexibility. With the release of Exadata Cloud Service X8M, a new resource model was released that separates the Exadata Infrastructure and VM Cluster into separate resources. All previous generation hardware Exadata Cloud Service shapes can switch to the new resource model.

Exadata Cloud Service provisioning starts with the Exadata Infrastructure resource. It enables the management of the infrastructure itself, that is, the database and storage servers. Because the Infrastructure resource acts as a top-level resource, its provisioning is done first. Database and Storage server expansion as well as scheduling Infrastructure maintenance is done with the Exadata Infrastructure resource.
The VM Cluster resource manages the networking, OCPUs, grid infrastructure, OS, database homes, and databases. This is also where you define details of client and backup subnets, OCPUs, IORM, database maintenance, and so on.

At the time when this course was created, Exadata Cloud Service supports only a single VM cluster.

Managing Exadata Cloud Service

- Exadata Cloud Service management is done with the following resources:
  - Cloud Exadata Infrastructure
  - Cloud VM Cluster
- Most management operations occur with the VM Cluster resource.
- Management is done by using Console, REST API with and SDK, CLI, or other tools.
- Security access must be granted with the appropriate policies to perform management operations.



After you have created the Exadata Infrastructure and the VM Cluster resource, you can perform management operations. With the new Exadata Cloud Service resource model, most of the management operations discussed take place in the VM Cluster resource. However, some operations, including those related to infrastructure maintenance, take place in the Exadata Infrastructure resource.

To use Oracle Cloud Infrastructure, you must be granted security access with the appropriate IAM policies. This access is required whether you're using the Console or the REST API with an SDK, CLI, or other tool. If you get a message that you don't have permission or are unauthorized, verify with your access with a tenancy administrator.

For more details about Identity and Access Management, refer to the OCI courses and documentation.

Infrastructure Maintenance Process

- Infrastructure maintenance is mandatory.
- After infrastructure maintenance is scheduled, customers will be notified via an announcement in the control plane and/or configured event.
  - If the customer has not specified a preference for maintenance, a default schedule will be selected, which will be at least two weeks after the availability of the update.
  - The customer can choose to reschedule infrastructure maintenance to a date no more than 180 days since their prior infrastructure maintenance.
- Database server maintenance is done in a rolling manner across the cluster.
  - Will shut down the virtual machines and restart them when the maintenance is completed.
- Storage server maintenance is done in a rolling manner to ensure database availability.
  - ASM high redundancy ensures data protection during maintenance.

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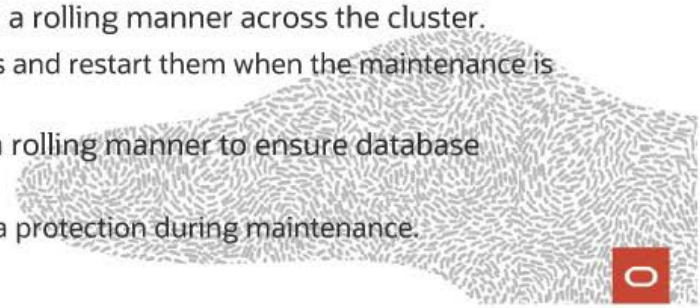

Oracle performs regularly scheduled updates to all cloud services. In addition, there may be a requirement to perform emergency updates from time to time.

You will receive advance communication about these updates to help you plan for them. If there are corresponding recommended updates for your database server virtual machine environment, then Oracle will provide notification about these. Infrastructure maintenance is mandatory and there is no option to opt out of any updates.

Wherever possible, scheduled updates are performed in a manner that preserves service availability throughout the update process. However, there may be some noticeable impact on performance and throughput as individual system components are unavailable for a period of time during the update process.

For example, the database servers may need to be rebooted when a service is updated. In such cases, the database servers are rebooted in a rolling manner, one at a time, to ensure that the service, and the Oracle databases contained therein, remain available throughout the process. However, while each database server is being rebooted, it is not available for a short period of time. Consequently, the service may not be able to cater to the same workload while each individual server is unavailable.

Online Elastic Scaling of a VM Cluster

- Specify the OPU count per VM to scale up or down the VM Cluster OCPUs to meet workload demands.
- OCPUs will be added or removed instantly.
- If you scale down a VM Cluster OCPU count to zero, then the VMs in the VM Cluster will be shut down.

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If an Exadata Cloud Service instance requires more or less processing power, you can scale the number of VM Cluster OCPUs up and down symmetrically across all the nodes in the system.

For example, if you have four database servers provisioned, you can add OCPU cores in multiples of four across all the VMs in the cluster.

You will only be charged for the Exadata Infrastructure until you create a VM Cluster and scale up the OCPUs. You can scale the VM Cluster OCPUs down to zero cores and the VMs will stop. To restart the VMs, scale the OCPUs back up.

Create a Database Home and Database

Create a Database Home

- Provide the Database Home name.
- Select the Database Image.

Create Databases

- Provide the Database name.
- Provide the PDB name.
- Select the Database Version or Database Home.
- Click Create.

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To create a Database Home and Database, open the navigation menu. Click **Oracle Database**, and then click **Exadata at Oracle Cloud.**

1. Choose your **Compartment**.
2. Navigate to the VM Cluster.
3. Under **Exadata at Oracle Cloud**, click **Exadata VM Clusters**. In the list of VM clusters, find the VM cluster you want to access and click its highlighted name to view the details page for the cluster.
4. Under **Resources**, click **Database Homes**.
5. A list of Database Homes is displayed.
6. Click **Create Database Home**.
7. In the **Create Database Home** dialog box:
    1. Enter the following:
        - **Database Home display name:** The display name for the Database Home. Avoid entering confidential information.
        - **Database image:** This determines what Oracle Database version is used for the database. You can mix database versions on the VM Cluster. By default, the latest Oracle-published database software image is selected.

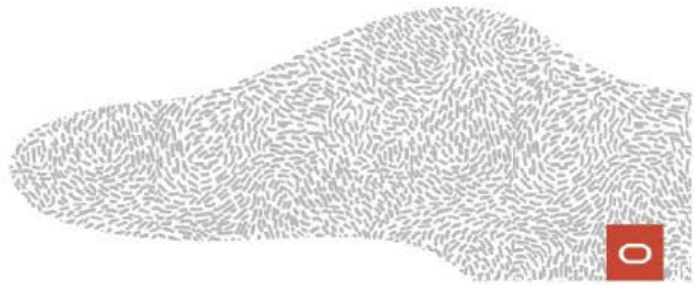
1. Click **Change Database Image** to use an older Oracle-published image or a custom database software image that you have created in advance. Then select an **Image Type**:
    - **Oracle Provided Database Software Images:** These images contain generally available versions of Oracle Database software.
    - **Custom Database Software Images:** These images contain customized configurations of software updates and patches.
2. After choosing a software image, click **Select** to return to the Create Database dialog box.
3. Click **Create**.

To create a database in an existing Exadata Cloud Service VM Cluster, proceed with the following steps:

1. Open the navigation menu. Under **Oracle Database**, click **Exadata at Oracle Cloud**.
2. Choose your **Compartment**.
3. Under **Exadata at Oracle Cloud**, click **Exadata VM Clusters**. In the list of VM clusters, find the VM cluster you want to access and click its highlighted name to view the details page for the cluster.
4. Click **Create Database**.
5. In the **Create Database** dialog box, enter the following:
    - **Database name:** The name of the database. The database name must begin with an alphabetic character and can contain a maximum of eight alphanumeric characters. Special characters are not permitted.
    - **Database version:** The version of the database.
    - **PDB name:** *(Optional)* For Oracle Database 12*c* (12.1.0.2) and later, you can specify the name of the pluggable database.
    - **Database Home:** The Oracle Database Home for the database. Choose the applicable option:
        - **Select an existing Database Home:** The Database Home display name field allows you to choose the Database Home from the existing homes for the database version you specified. If no Database Home with that version exists, you must create a new one.
        - **Create a new Database Home:** A database home will be created using the database version and the Database Home display name you specified.
    - **Create administrator credentials:** A database administrator SYS user will be created with the password you supply.
    - **Select workload type:** Online Transactional Processing (OLTP) or Decision Support System (DSS)
    - **Configure database backups:** Specify the settings for backing up the database to Object Storage
5. Choose **advanced options to** include customer-managed encryption keys.
6. Click **Create**.

Backup Options

- You can use the Oracle Cloud Infrastructure Console to:
  - Enable Automatic Incremental backups
  - Create full backups on demand
  - View the list of managed backups for a database
  - Delete manual (on-demand) backups
- All backups are encrypted with the same master key used for Transparent Data Encryption (TDE) wallet encryption.



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You can use the Console to enable automatic incremental backups, create full backups on demand, and view the list of managed backups for a database. You can also use the Console to delete manual (on-demand) backups. All backups are encrypted with the same master key used for Transparent Data Encryption(TDE) wallet encryption.

The database and infrastructure (the VM cluster) must be in an "Available" state for a backup operation to run successfully. Oracle recommends that you avoid performing actions that could interfere with availability (such as patching operations) while a backup operation is in progress. If an automatic backup operation fails, the Database service retries the operation during the next day's backup window. If an on-demand full backup fails, you can try the operation again when the database availability is restored.

There must be connectivity for Exadata Cloud Service to the applicable Swift endpoint for Object Storage. To avoid backup failures, ensure that the database's archiving mode is set to ARCHIVELOG (the default).

Oracle recommends using a service gateway with the VCN to enable access to Object Storage. You can also use the bkup_api for backup and recovery operations.

Automatic Database Backup: Default Configuration

- Database backups occur daily.
- Archived redo log files are backed up every 30 minutes.
- There is a 7-day backup cycle:
  - With one full backup
  - And daily incremental backups
- The retention period choices:
  - 7, 15, 30, 45, 60 days for backups to cloud storage
- For database deployments with Oracle Data Guard, automatic backups are always executed on the primary site.

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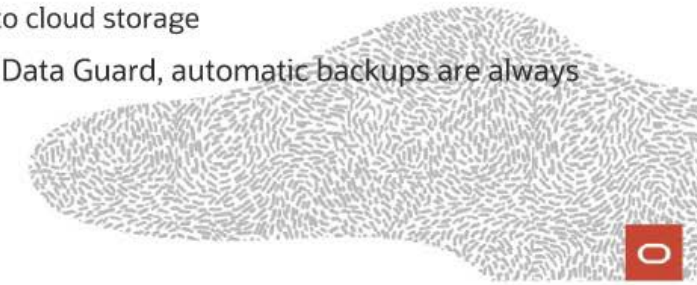

The following is an outline of the default automatic backup configuration settings:

- Automatic backups are scheduled daily.
- Archived redo log files are backed up every 30 minutes.
- Backups follow a 7-day cycle, consisting of one full backup of the database, followed by daily incremental backups.
- The retention period defines the period for which backups are maintained. Backups to cloud storage are maintained based on the retention choice of 7, 15, 30, 45, or 60 days.
- The backup data is automatically encrypted using Oracle Transparent Data Encryption.

Best Practices for Updating (patching) Exadata Cloud Service Databases

- Move the database to a new DB Home if possible instead of updating the DB Home.
- Back up your databases before you apply any updates to the DB Home.
- Update Grid Infrastructure before updating or creating a DB Home.
- Before you apply any updates, run the precheck operation.
- Ensure that all servers and database instances are up and running.
- `/u01/app/x.x.x.x/grid` (GI Home) should have 10 GB of free space before a Grid Infrastructure update.
- `/u02` should have 10 GB of free space before a DB Home update.
- Use the OCI Management Interfaces to perform updating operations.

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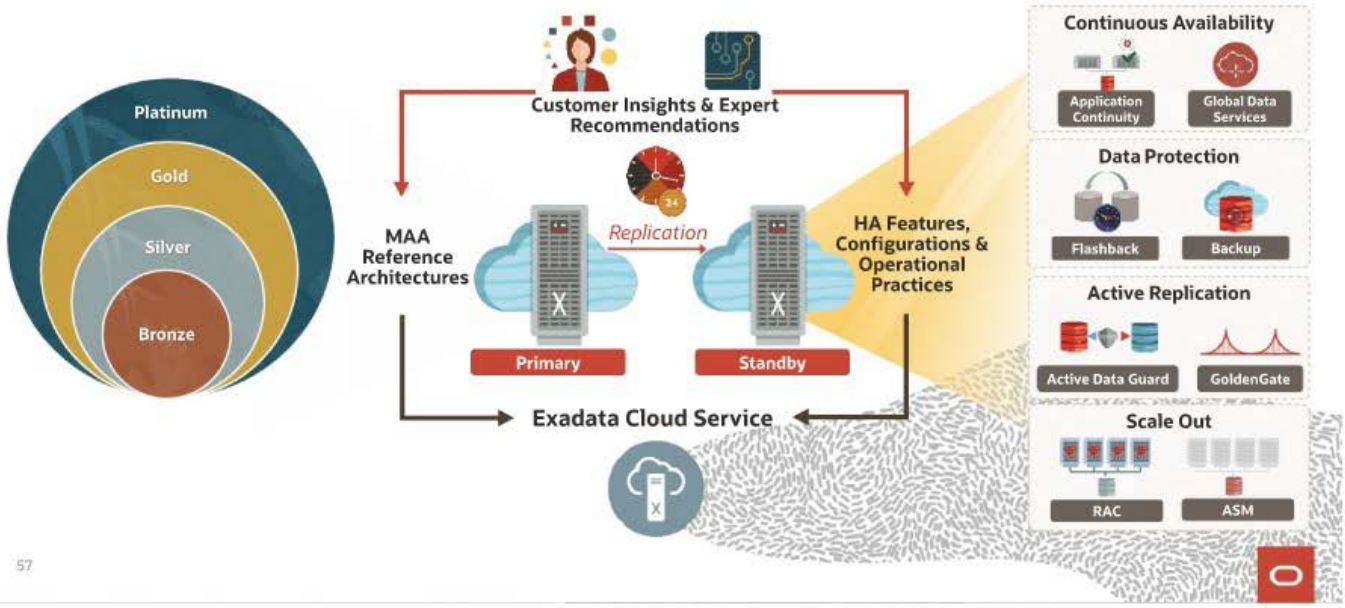
Before proceeding with the patching of Exadata Cloud Service databases, take a look at the best practices outlined in the slide.

Ensure that you:

- Move the database to a new DB Home if possible instead of updating the DB Home
- Back up your databases before you apply any updates to the DB Home
- Update Grid Infrastructure before updating or creating a DB Home
- Before you apply any update, run the precheck operation
- Ensure all servers and database instances are up and running
- `/u01/app/x.x.x.x/grid` (GI Home) should have 10 GB of free space before a Grid Infrastructure update
- `/u02` should have 10 GB free space before a DB Home update
- Use the OCI Management Interfaces to perform updating operations

Oracle Maximum Availability Architecture (MAA)



Availability of data and applications is an important element of every IT strategy. At Oracle, we've used our decades of enterprise experience to develop an all-encompassing framework that we call Oracle MAA, for Maximum Availability Architecture.

Oracle MAA starts with customer insights and expert recommendations. These have been collected from our huge pool of customers and community of database architects, software engineers, and database strategists. Over the years, this has helped the Oracle MAA development team to develop a deep and complete understanding of various kinds of events that can affect availability.

Through this, they have developed an array of availability reference architectures. These reference architectures acknowledge that not all data or applications require the same protection, and that there are tradeoffs in terms of cost and effort. Whatever your availability goals may be, for a database or related applications, Oracle has the product functionality and guidance to ensure you can make the right decision with full knowledge of the tradeoffs in terms of down time, potential data loss, and cost.

These reference architectures use a wide array of our HA features, configurations and Operational Practices.

They help our end customers primarily achieve four goals:

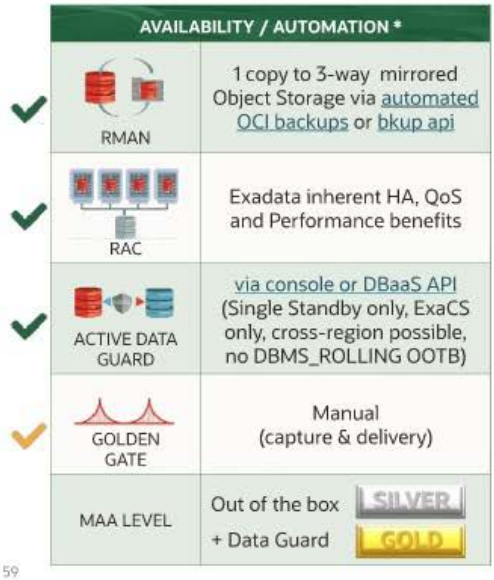
- **Data protection** – Reducing data loss through Flashback and backup
- **Active Replication** – Which allows customers connect their applications to replicated sites in an Active-Active HA solution through Active Data Guard and GoldenGate
- **Scale Out** – Which allows customers the ability to scale compute nodes linearly through RAC and ASM

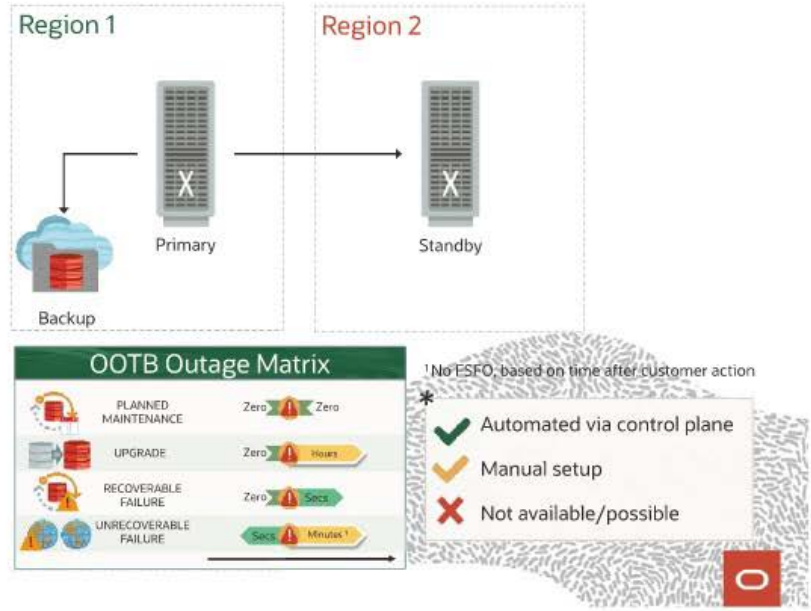
- **Continuous Availability** – Which allows transparent failover of services across sites distributed locally or remote - through AC and GDS

These features and solutions allow customers to mitigate not only planned events – such as software upgrades, data schema changes, and patching, but also unplanned events – such as hardware failures and software crashes due to bugs.

The insights, recommendations, reference architectures, features, configurations, best practices and deployment choices combine to form a holistic blueprint, which allows customers to successfully achieve their high availability goals.

Exadata Cloud Services: Protection Out of the Box





Out of the box Exadata Cloud Service gives you Silver and Gold levels of protection.

Active Data Guard is a comprehensive solution to eliminate single points of failure for mission critical Oracle Databases. It prevents data loss and downtime simply and economically by maintaining a synchronized physical replica (standby) of a production database (primary).

RMAN provides automated, comprehensive foundation for efficiently backing up and recovering the Oracle database.

Real Application Clusters allow customers to run a single Oracle Database across multiple servers in order to maximize availability and enable horizontal scalability, while accessing shared storage. User sessions connecting to Oracle RAC instances can failover and safely replay changes during outages, without any changes to end-user applications, hiding the impact of the outages from end users.

GoldenGate is also available for manual setup of capture and delivery of data from heterogeneous sources and targets.

For UPGRADEs, the RTO is minutes/hours because the DG setup done by the control plane does not allow for DBMS_ROLLING. (It will be explained in the detail slides.)

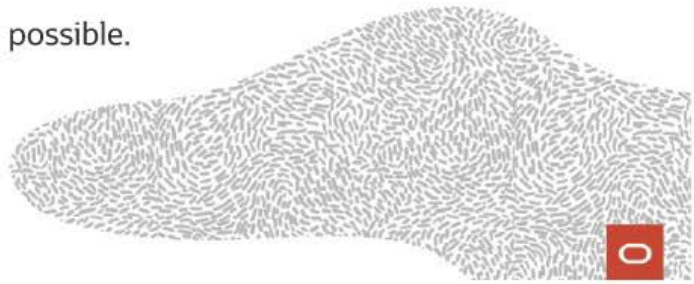
For Unrecoverable failures, the DG setup done by the control plane does not implement FSFO.

Various Management Tools

Two types of Management Tools:

- **OCI Management Interfaces:** Interfaces that use OCI API to perform operations
  - Oracle Cloud Web-based UI (Console), Oracle Cloud REST APIs, Software Development Kit (SDK), Command Line Interface (CLI), Terraform
- **Additional Utilities:** Command-line utilities that run directly on Exadata Cloud Service database servers to perform operations
  - dbaascli, dbaasapi, exacli, bkup_api

Use OCI Management Interfaces whenever possible.



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There are two types of management tools available for Exadata Cloud Service. OCI Management Interfaces are interfaces that use the OCI API to perform operations. There are also additional command-line utilities that run directly on Exadata Cloud Service database servers to perform operations.

We'll discuss the OCI Management Interfaces and Additional Utilities in more detail in just a minute, but it's important to mention that we recommend you use the OCI Management Interfaces whenever possible.

OCI Management Interfaces

Oracle Cloud Web-based UI (Console)

- Browser access via https – great for one-time actions and ad hoc tasks

Oracle Cloud REST APIs

- Programmatic access via https

Software Development Kit (SDK)

- Build and deploy apps that integrate with Oracle Cloud Infrastructure services
- Java SDK, Python SDK, Ruby SDK, Go SDK

Command Line Interface (CLI)

- Convenient for developers and others to automate tasks through scripting

Terraform

- Programmatically manage, version, and persist your IT infrastructure as code

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Exadata Cloud Service can take advantage of a wide choice of OCI management interfaces. The easiest to use is the web-browser interface, which we have discussed throughout this course. It allows you to use a browser to graphically configure and initiate operations. This is great for one-time actions, but most customers prefer a more programmatic interface for things done repeatedly, such as provisioning and patching databases. Anything you can do with the browser, you can also do with a corresponding REST API. Similar to the browser, the REST APIs transit the Internet via https, and require no special software installed on the local system. All interfaces are also exposed via a command-line interface that can be used for scripting, and for building custom tooling, there is a software development kit to integrate with common languages such as Java, Python, Ruby, and Go. If you prefer to manage your infrastructure as code, there is also a Terraform interface.

Monitoring with OCI Metric Charts

- The Metrics feature relays metric data about the health, capacity, and performance of your cloud resources.
- Resources, services, and applications emit metrics to the Monitoring service.
- Such metrics can provide availability and performance, completed backups and where they are allocated, and network latency.
- To monitor resources, you must be given the required type of access in a policy written by an administrator that gives you access to the monitoring services as well as the resources being monitored.

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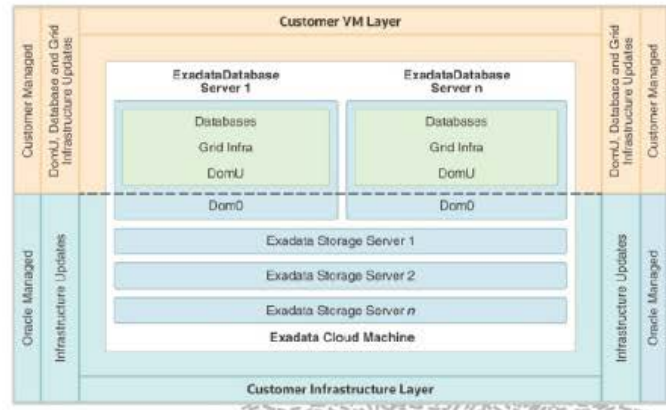
The OCI Metrics feature relays metric data about the health, capacity, and performance of your cloud resources. Resources, services, and applications emit metrics to the Monitoring service. Common metrics reflect data related to:

- Availability and latency
- Application uptime and downtime
- Completed transactions
- Failed and successful operations
- Key performance indicators (KPIs), such as sales and engagement quantifiers

By querying Monitoring for this data, you can understand how well the systems and processes are working to achieve the service levels you commit to your customers.

Enterprise Manager for Exadata Cloud

- Enables you to monitor and manage all Exadata, Exadata Cloud systems along with any other targets, from a single interface
- Automatically identifies and organizes related targets
- Provides a high-level integration point for Enterprise Manager framework features such as incident rules, groups, notifications, and monitoring templates
- Enables you to visualize storage and compute data
- Enables you to view performance metrics of your Exadata components



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Enterprise Manager provides a comprehensive monitoring and management solution for Oracle Database and Engineered Systems deployed in cloud and customer data centers.

You can run Enterprise Manager on-premises and in Oracle Cloud Infrastructure.

One of the ways Enterprise Manager provides improved performance monitoring is by enabling the use of the same Maximum Availability Architecture (MAA) Key performance Indicators (KPI) developed for Oracle Exadata Database Machine.

Monitoring Storage Servers with ExaCLI

- ExaCLI is a command-line tool allowing you to perform monitoring and management functions on Exadata storage servers.
- ExaCLI provides up-to-date information about your Exadata Cloud Service.
- Execute ExaCLI commands from the database compute nodes.
- To connect to ExaCLI example:

```
[opc@exacs-node1 ~]$ exacli -l cloud_user_clustername -c 192.168.136.7
```

- Use the `list` command to view service and options such as objects in the flash cache and storage cell disk attributes.
- Diagnostic status and IORM plans can be viewed, created, and deleted.

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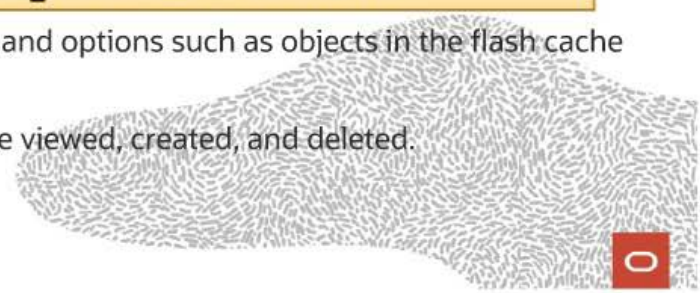
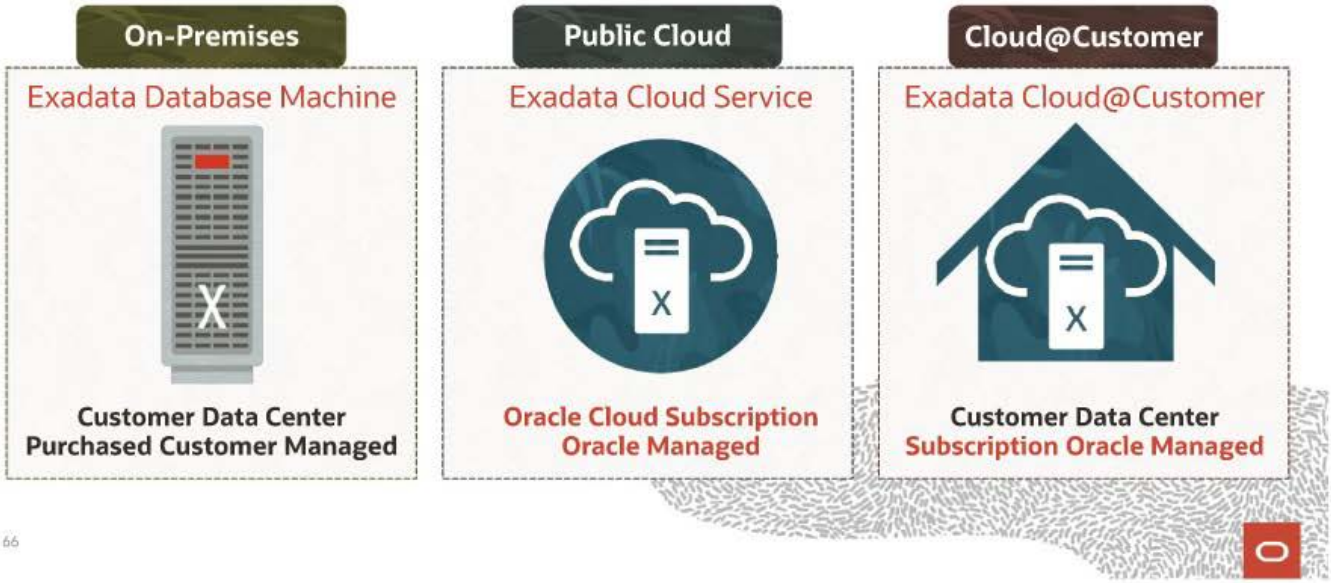


You can execute various ExaCLI commands to monitor and manage Exadata Storage Servers. ExaCLI allows you to get up-to-date, real-time information about your Exadata Cloud Service.

After you have connected to the ExaCLI interface, use the `LIST` command to view all the options.

Refer to your Exadata Cloud Service documentation for more details.

Exadata Deployment Model



Exadata is available on-premises, in the public cloud and running the Exadata Cloud Service in the customer data center known as Exadata Cloud@Customer. Exadata Cloud@Customer is the deployment we will focus on for this presentation.

Gen 2 Exadata Cloud@Customer

Public Cloud Simplicity and Elasticity Behind Your Firewall

High performance Oracle Database Cloud in customer data center

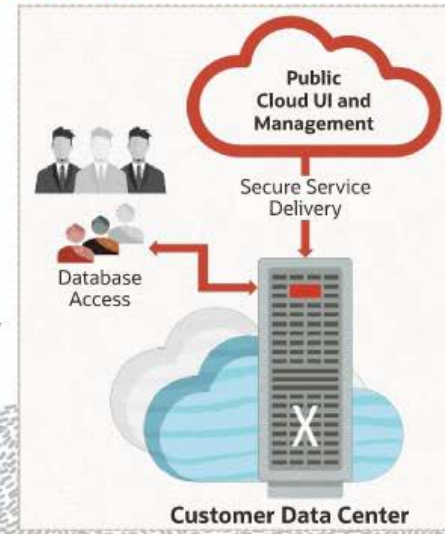
- Databases provisioned and subscribed to, as a service
- Deployed on Exadata, with all best practices (e.g. MAA) built-in
- Customers retain database ownership
- Oracle manages Exadata infrastructure
- Control plane deployed on chosen public cloud (OCI) region

Consistent public cloud experience

- Public Cloud UI/API-driven database provisioning & management
- Same financial model: simply subscribe to infrastructure & compute cores, pay-per-use

Most efficient cloud adoption strategy

- No IT disruption: leverage data center investment / infrastructure
- Maintain data gravity: keep data next to your applications
- Maintain existing data security standards & data residency compliance
- Low risk, high reward: same functionality-rich Oracle database with Exadata scale and cloud agility



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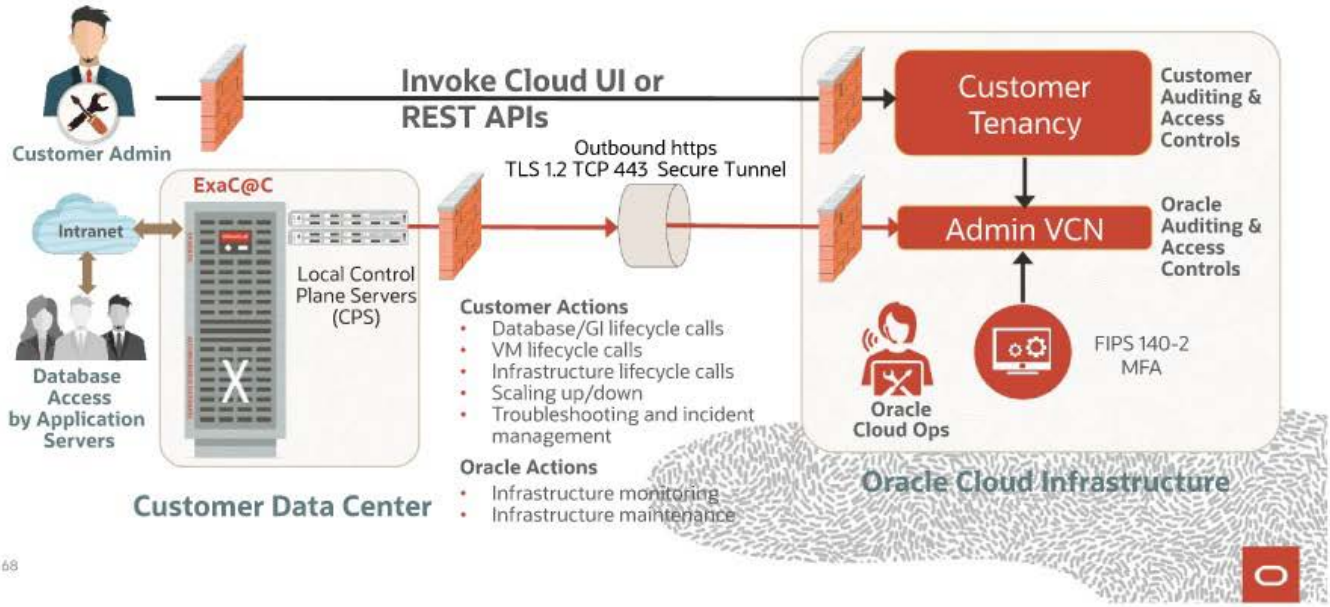
Exadata Cloud@Customer is in its second generation. The service provides the same Oracle Database on Exadata Cloud Service in Oracle Cloud Infrastructure (OCI) experience, utilizing the OCI control plane, running in your chosen public OCI region, to manage the resources deployed on the Exadata Infrastructure running in the customer data center. The Oracle databases provisioned on Exadata Cloud@Customer include all the advanced database features and options. You can license everything as a service or bring your Oracle database licenses to the service. Since it runs the same Oracle database you run on-premises, it is 100% compatible with any existing applications. For all practical purposes, it looks exactly like an Oracle Database running on standard Exadata on-prem hardware. The big difference is the cloud features and benefits—specifically, the simplicity and elasticity. Elastic scaling means you can grow and shrink your service to match your workload requirements. This means you only pay for what you use, and this pay-per-use capability is how you can really lower your Total Cost of Ownership. In addition, Oracle manages all the infrastructure for you, so you can focus on your business, and not on infrastructure. And, for those operations you do continue to manage, Exadata Cloud Service provides sophisticated automation making most operations as easy as pushing a button.

Gen 2 Exadata Cloud@Customer Architecture Overview



Here is an architecture overview of the Gen 2 Exadata Cloud@Customer Service. Customer administrators provision and manage via lifecycle calls invoked through the OCI Cloud UI or APIs.

These calls are communicated with the Exadata Cloud@Customer in the customer data center through control plane servers (CPS) located in the Exadata Cloud@Customer rack. This communication requires no inbound TCP connections. The CPS requires outbound access on TCP/443 to OCI.

Exadata Cloud@Customer database servers connect directly to the customer network.

Exadata Cloud@Customer Service Overview

Service Operation

- Oracle owns and manages Exadata Infrastructure.
- Customers configure and manage VM Guests and Databases.
- Releases support Exadata Hardware and Software.
  - Oracle Database 19c, 18c, 12.2.0.1, 12.1.0.2, 11.2.0.4

Deployment

- Control Plane Available in Oracle Cloud Infrastructure (OCI) regions
- Hardware deployed in customer data center

Lifecycle

- Automated UI, CLI, SDK, API – provisioning, scaling, patching, backup, disaster recovery

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Now I'll provide a brief overview of the service…

In terms of service operation, Oracle manages the Exadata infrastructure. Customers manage everything running in the database VM.

As you would expect, both the Exadata hardware and software releases are supported with Exadata Cloud@Customer and the service currently supports Oracle Database versions 11.2.0.4 to 19c.

Exadata Cloud@Customer simplifies lifecycle tasks such as provisioning, scaling, patching, backup, and disaster recovery through cloud automation.

Autonomous Database Exadata Cloud@Customer

All benefits of Autonomous Database Dedicated in your data center:

- Oracle fully automates and manages VMs and Databases.
  - Self-Driving
  - Self-Securing
  - Self-Repairing

Customizable Isolation Policies

Customizable Operational Policies

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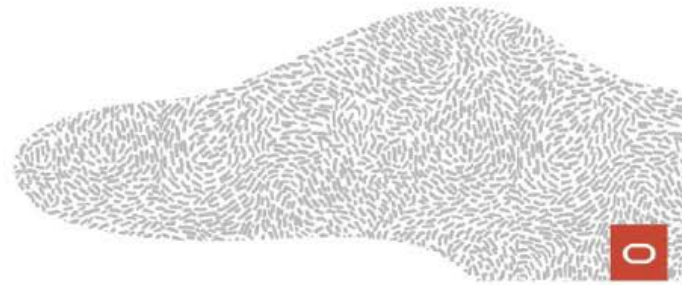
Managing VM Clusters on Exadata Cloud@Customer

- The VM cluster provides a link between your Exadata Cloud@Customer infrastructure and Oracle Database.
- You must create a VM cluster network and associate it with a VM cluster.
- The VM cluster network specifies network resources.



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The VM cluster provides a link between your Exadata Cloud@Customer infrastructure and Oracle Database.

Before you can create any databases on your Exadata Cloud@Customer infrastructure, you must create a VM cluster network, and you must associate it with a VM cluster. Each Exadata Cloud@Customer infrastructure deployment can support one VM cluster network and associated VM cluster.

The VM cluster network specifies network resources, such as IP addresses and host names, that reside in your corporate data center and are allocated to Exadata Cloud@Customer. The VM cluster network includes definitions for the Exadata client network and the Exadata backup network. The client network and backup network contain the network interfaces that you use to connect to the VM cluster compute nodes, and ultimately the databases that reside on those compute nodes.

The VM cluster provides a link between your Exadata Cloud@Customer infrastructure Oracle Databases you deploy. The VM cluster contains an installation of Oracle Clusterware, which supports databases in the cluster. In the VM cluster definition, you also specify the number of enabled CPU cores, which determines the amount of CPU resources that are available to your databases.

Exadata Cloud@Customer – Create VM Cluster Network

VM Cluster Network

- Is required before VM Cluster creation
- Is needed before database creation
- Specifies the network resources allocated to the ExaCC

When you click Create VM Cluster Network, the Data Center Network Details page requires:

- A VM cluster network display name
- Client network details and Backup network details
- VLAN ID, CIDR block, Netmask, Gateway, Hostname Prefix, and Domain Name
  - **Note:** CIDR block is specified only as a convenience for allocating IP addresses, which can be edited manually before configuration is finalized on the subsequent screen.
- DNS and NTP server details

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The VM cluster provides a link between your ExaCC infrastructure and the Oracle Databases.

Before you can create any databases on your ExaCC infrastructure, you must create a VM cluster, and before creating a VM Cluster, you create a VM Cluster Network for the VM Cluster to use.

The VM cluster network specifies IP addresses to use for the Oracle Database environment within each VM and the SCAN addresses. Each Database Server, referenced by host name, will have a VM for a given VM cluster, and each will require relevant IP addresses. The VM cluster network includes definitions for the Exadata client network and the Exadata backup network that are used to connect databases to both database clients and to backup destinations.

When you create a VM Cluster Network, the Data Center Network Details page requires:

- A VM Cluster network display name
- Client network details and Backup network details, including:
  - VLAN ID, CIDR block, Netmask, Gateway, Hostname Prefix, and Domain Name

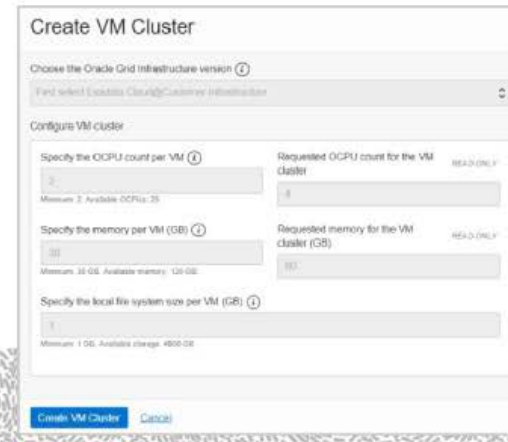
    Note: CIDR block is specified only as a convenience for allocating IP addresses, which can be edited manually before configuration is finalized on the subsequent screen
- DNS and NTP server details

Exadata Cloud@Customer – Create a VM Cluster

To create a VM cluster, choose a Region, and then click the Create VM Cluster button:

- Provide a Compartment.
- Provide a Display name.
- Select the ExaCC Infrastructure.
- Select a VM Cluster Network.
- Choose the Grid Infrastructure version.
- Specify the OCPU count per VM (min. 2).
- Specify the memory per VM (min 30GB).
- Specify the Local File System size per VM (min. 60GB).
- Configure the Exadata Storage.
  - Usable Storage (min. 2TB)
  - Allocation of storage, including Snapshots or Local Backups
- Add a public SSH Key.
- Choose a License Type (BYOL or License Included).
- In Advanced Options, choose a Timezone.

Click Create VM Cluster.



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To create a VM cluster, choose a Region, click the Create VM Cluster button, and then fill in the necessary information. A few things to take note of. When specifying the OCPU count per VM, the minimum is 2 and the maximum is the number of cores that have not been allocated. The amount of memory per VM is specified in multiples of 1 gig. The local file system per VM has a minimum of 60 GB. When configuring Exadata storage, the minimum is 2 TB of usable storage. There are two options for License Type: BYOL and License Included. This selection is based on your organization's choices during time of procurement. If you had chosen to apply your own, previously existing licenses, then select BYOL. If you had procured your Exadata Cloud@Customer to include Database licensing in the cost of the OCPUs, select License Included. Finally, make sure to go into Advanced Options to choose a Timezone. Then click Create VM Cluster.

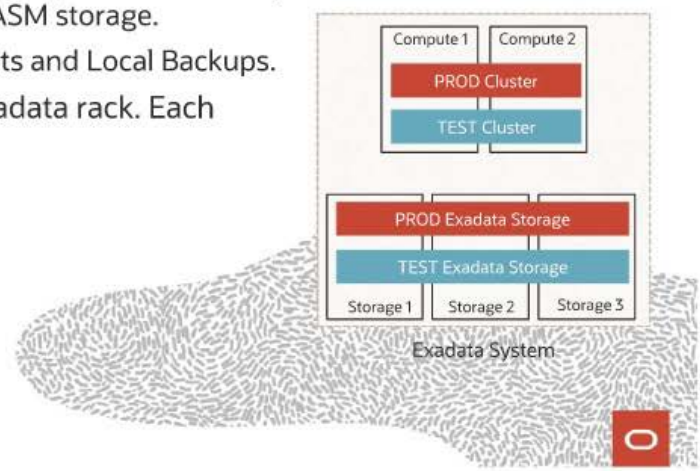
Exadata Cloud@Customer – Multiple VM Clusters

With multiple VM Clusters, customers can better utilize their ExaCC system.

- They provide isolation across departments and uses.
- Each VM cluster is allocated OCPUs (split evenly between nodes) as well as Memory, Local Filesystem, and ASM storage.
- ASM Storage can be allocated for Snapshots and Local Backups.

You can create multiple VM Clusters per Exadata rack. Each VM Cluster:

- Has its own Grid Infrastructure software
- Has complete network isolation
- Has dedicated OS and Storage partitions
- Can run different versions of software
- Has its own public/private key pair access



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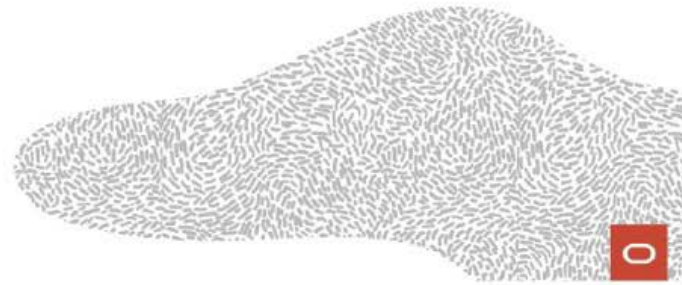
By leveraging multiple VM Clusters, customers can better utilize their ExaCC system. Multiple VM Clusters provide isolation across departments and different use cases such as production and test. Each VM cluster is allocated OCPUs, memory, local file systems, and ASM storage allowing for better resource control. ASM storage can be allocated for Snapshots and local backups.

Each VM Cluster created has its own Grid Infrastructure software, complete network isolation, dedicated OS and Storage partitions, public/private key pair access and can run different versions of software.

Multi-VM Benefits

- Security separation
- Maintenance
- Blast radius
- Resource management
- Administrative separation



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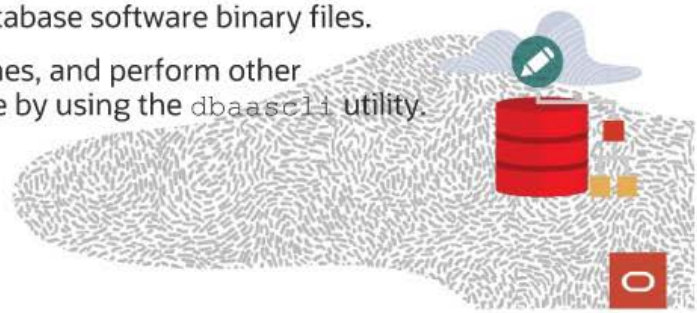
- Security separation
  - Provide separation between Development and Test environments, or between multiple production databases.
  - Virtual Machines can be used to address isolation for data security requirements including PCI data and HIPAA data, including use of distinct VLAN-tagged networks for each VM Cluster.
- Maintenance
  - Isolate group of database and minimize the potential downtime for GI patching.
- Blast radius
  - Virtualization limits the blast radius in case of system failure.
- Resource management
  - Ensures that database receives the resources it requires
  - Minimizes the 'noisy neighbor' issue
- Administrative separation
  - An organization that have multiple system administrator teams

Creating Oracle Database Homes on an Exadata Cloud@Customer System

- You can add Oracle Database Homes to an existing VM cluster by using:
  - Oracle Cloud Infrastructure Console
  - API
  - CLI
- A Database Home is a directory location on the Exadata database compute nodes that contains Oracle Database software binary files.
- You can add and remove Database Homes, and perform other management tasks on a Database Home by using the `dbaascli` utility.



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Avoid entering confidential information when assigning descriptions, tags, or friendly names to your cloud resources through the Oracle Cloud Infrastructure Console, API, or CLI.

Exadata Cloud@Customer – Create Database Homes

Oracle Database Homes

- ✓ Created using Oracle Cloud Infrastructure Console, the API, or the CLI
- ✓ Contains Oracle Database software binary files
- Open the navigation menu. Under **Database**, click **Exadata Cloud@Customer**. Choose your Compartment. From the list of VM Clusters displayed, click the VM cluster on which you want to create the Database Home.
- Under **Resources**, click **Database Homes**.
- Click **Create Database Home**.
- In the dialog box, enter:
  - **Database Home display name**: The display name for the Database Home
  - **Database version**: The Oracle Database version for this Database Home
    - Supported versions are 11*g* Release 2, 12*c* Release 1, 12*c* Release 2, 18c, and 19c.
- Click **Create**. When the Database Home creation is complete, the status changes from Provisioning to Available.

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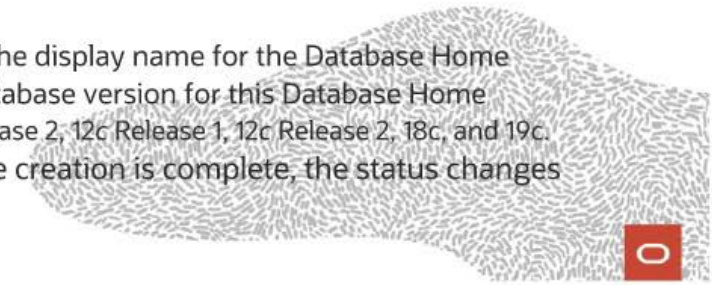


You can add Oracle Database homes (referred to as Database Homes in Oracle Cloud Infrastructure) to an existing VM cluster by using the Oracle Cloud Infrastructure Console, the API, or the CLI. A Database Home is a directory location on the Exadata database compute nodes that contains Oracle Database software binary files. To create an Oracle Database home in an existing VM cluster with the Console, be prepared to provide values for the fields required.

Open the navigation menu. Under Database, click Exadata Cloud@Customer. Choose your Compartment. From the list of VM Clusters displayed, click the VM cluster on which you want to create the Database Home.

Under Resources, click Database Homes.

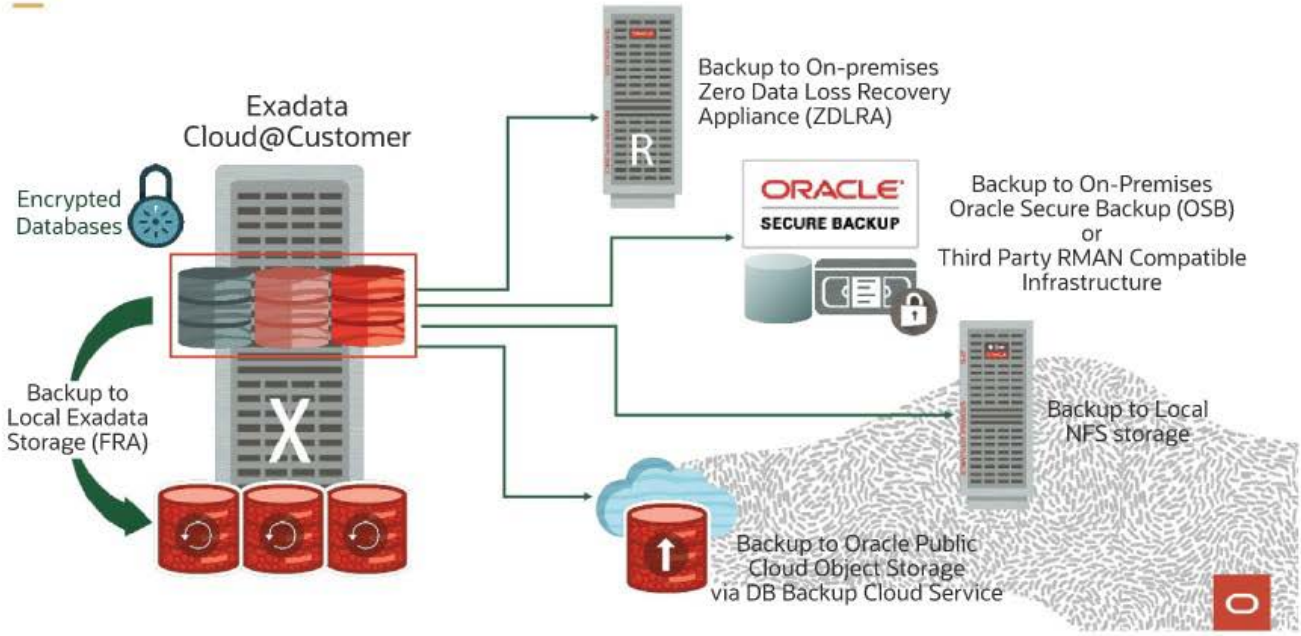
Click Create Database Home.

In the dialog box, enter:

- Database Home display name: The display name for the Database Home.
- Database version: The Oracle Database version for this Database Home. Supported versions are 11*g* Release 2, 12*c* Release 1, 12*c* Release 2, 18c, and 19c.

Click Create. When the Database Home creation is complete, the status changes from Provisioning to Available.

Exadata Cloud@Customer – Database Backup Options



The database backup options with the Exadata Cloud@Customer include using cloud automation to back up to an on-premises zero data loss recovery appliance, an on-premises RMAN compatible infrastructure, local NFS storage, or the Oracle public cloud object storage. You can also manually configure backups to existing on-premises backup infrastructure using backup agents and configuring RMAN.

Database Backup Options with ExaCC:

- Using Cloud Automation
  - Oracle Public Cloud Object Storage
  - Object Storage and Local Exadata Storage (FRA)
  - Zero Data Loss Recovery Appliance
  - Local NFS-attached storage
- Manual configuration to existing on-premises backup infrastructure

Customer must manage backup agents and configure RMAN manually.

Exadata Cloud@Customer – Automatic Backups

Oracle Exadata Cloud@Customer provides automatic database backup facilities that use Oracle Recovery Manager (RMAN). When you create a database, you can specify a backup destination and enable automatic backups.

After database creation, you can also:

- View a list of available backups
- Enable or disable automatic backups
- Edit backup settings
- Restore a database

You can perform these operations by using either the Console or the API.

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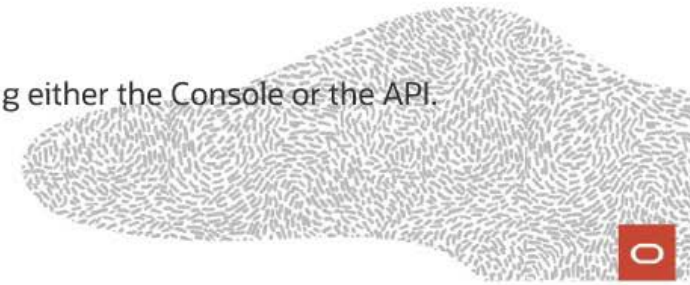


Oracle Exadata Cloud@Customer provides automatic database backup facilities that use Oracle Recovery Manager (RMAN). When you create a database, you can specify a backup destination and enable automatic backups.

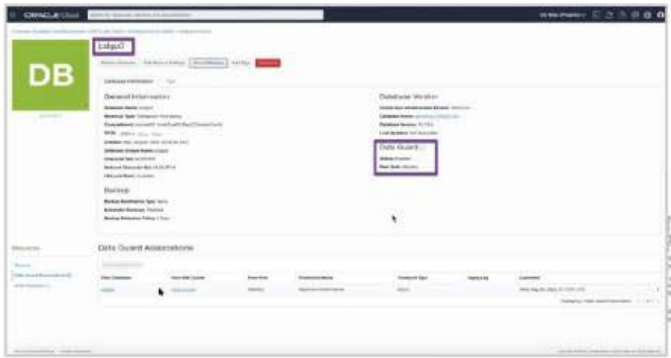
After database creation, you can also:

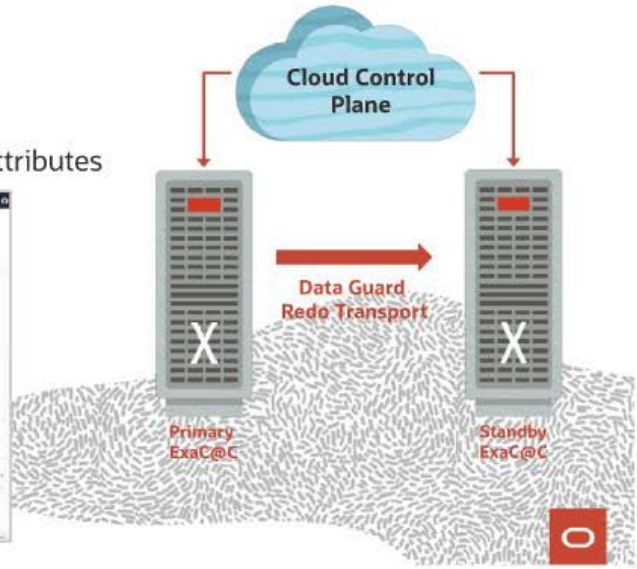
- View a list of available backups
- Enable or disable automatic backups
- Edit backup settings
- Restore a database

You can perform these operations by using either the Console or the API.

Exadata Cloud@Customer – Disaster Recovery Using Data Guard

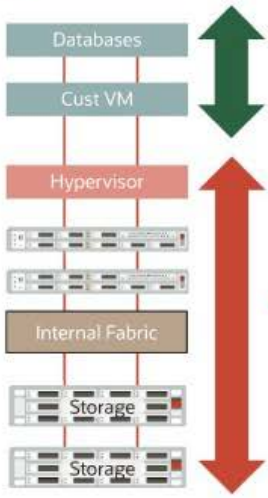
- Real-time, database-optimized disaster recovery
- Ultra-low RTO, zero RPO
- Cloud automation for Create/Delete/Switchover/Failover/Reinstate
- CLI-support to configure additional Data Guard attributes





Oracle Data Guard can also be configured from the Exadata Cloud@Customer OCI Console or API to simplify setting up a Disaster Recovery environment.

Exadata Cloud@Customer – Patching Responsibilities



Customer subscribes to database services in a Customer VM:

- Automation for create, delete, patch, backup, scale up/down, etc.
- Runs all supported Oracle Database versions 11.2.0.4 to 19c
- Customer controls access to customer VM
- Customer can install and manage additional software in customer VM
- Oracle staff not authorized to access customer VM
- Customer responsible for all patching within the Customer VM

Oracle owns, manages, and patches the infrastructure:

- Hypervisor, physical database and storage servers, storage network
- Patching, security scans, security updates
- Monitoring and maintenance
- Customer not authorized to access Oracle infrastructure

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Let's look at the patching responsibilities. Oracle owns, manages and patches the infrastructure. You can see from the list of activities this includes patching, security updates, maintenance and in general, activities that require access to the Oracle infrastructure. Customers subscribe to database services in a Customer VM. They are responsible for patching, access to and activities within the VM itself. Oracle does not have access to the customer VM and so the customer is responsible for these tasks.

Exadata Cloud@Customer – Oracle Updates and Patching

- Oracle updates all of the Oracle-managed system components on ExaCC. This includes:
  - Physical compute nodes (Dom0 / Host OS)
  - Network switches
  - Power distribution units (PDUs)
  - Integrated lights-out management (ILOM) interfaces
  - Exadata Storage Servers
- The customer will usually receive advance communication about these updates to help them plan for them, along with recommended updates for the customer to patch on the virtual machines (VMs).
- Wherever possible, scheduled updates are performed in a manner that preserves service availability throughout the update process. However, there can be some noticeable impact on performance and throughput while individual system components are unavailable during the update process.

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Oracle updates all of the Oracle-managed system components on ExaCC. This includes:

- Physical compute nodes (Dom0 / Host OS)
- Network switches
- Power distribution units (PDUs)
- Integrated lights-out management (ILOM) interfaces
- Exadata Storage Servers

The customer will usually receive advance communication about these updates to help them to plan for them, along with recommended updates for the customer to patch on the virtual machines (VMs).

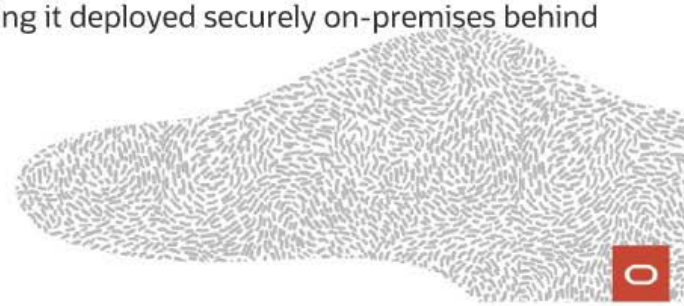
Wherever possible, scheduled updates are performed in a manner that preserves service availability throughout the update process. However, there can be some noticeable impact on performance and throughput while individual system components are unavailable during the update process.

For example, Dom0 patching typically requires a reboot. In such cases, wherever possible, the compute nodes are restarted in a rolling manner, one at a time, to ensure that the service remains available throughout the process. However, each compute node is unavailable for a short time while it restarts, and the overall service capacity diminishes accordingly.

Autonomous Database Cloud@Customer: Introduction

Oracle Autonomous Database on Oracle Exadata Cloud@Customer combines the benefits of:

- Self-driving
- Self-securing
- Self-repairing
- The security and control offered by having it deployed securely on-premises behind your firewall



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Oracle Autonomous Database on Oracle Exadata Cloud@Customer combines the benefits of a self-driving, self-securing, and self-repairing database management system and the security and control offered by having it deployed securely on premise behind your firewall.

After purchasing Autonomous Database on Oracle Exadata Cloud@Customer and creating, provisioning, and activating its Exadata Infrastructure hardware and Oracle Cloud resource, several additional resource types become available in the Exadata Cloud@Customer section of the Oracle Cloud Infrastructure console: Autonomous Exadata VM Clusters, Autonomous Container Databases and Autonomous Databases. You use these resources to create and manage your secure, on-premises deployment of Oracle Autonomous Database.

Autonomous Database Cloud@Customer

All benefits of Autonomous Database Dedicated in your data center

- Oracle fully automates and manages DomUs and Databases
- Self-Driving
- Self-Securing
- Self-Repairing

Customizable Isolation Policies

Customizable Operational Policies

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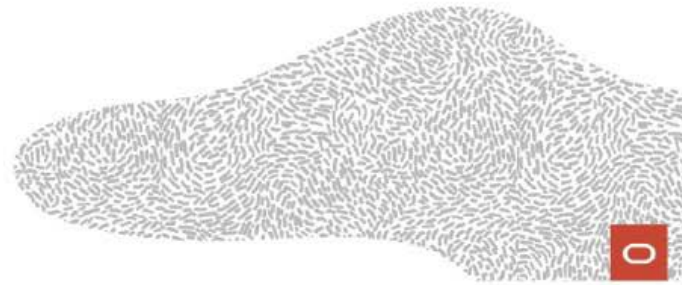
With Oracle Autonomous Database Cloud at Customer, you get all of the benefits of the Autonomous Database Dedicated in your data center. Oracle fully automates and manages DomUs and Databases; you get a database that is self-driving, self-securing, and self-repairing. You also get the ability to customize isolation policies and operational policies.

Autonomous Database Cloud@Customer – Resource Types

- Oracle Exadata Cloud@Customer infrastructure
- Autonomous Exadata VM clusters
- Autonomous Container Database
- Autonomous Database



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Oracle Exadata Cloud@Customer infrastructure: Hardware rack that includes compute nodes and storage servers, tied together by a high-speed, low-latency internal network and intelligent Exadata software.

Oracle Exadata Cloud@Customer infrastructure is common for both Autonomous and Non-Autonomous resources.

Autonomous Exadata VM clusters on Exadata Cloud@Customer infrastructure: Today there is a single VM cluster that is a set of symmetrical VMs across all Compute nodes. Autonomous Container and Database run all the VMs across all nodes enabling high availability. It consumes all the resources of the underlying Exadata Infrastructure.

Autonomous Container Database: Provides a container for multiple Autonomous Databases. Allows you to control isolation of different databases that can have different software versions and different replication architectures to support different Service Level Objectives.

Autonomous Database: You can create multiple Autonomous Databases within the same Autonomous Container Database. You can configure Oracle Autonomous Database for either transaction processing or data warehouse workloads.

Autonomous Exadata Cloud@Customer – Lifecycle

I.T. Fleet Group configures the Exadata infrastructure, and deploys the Autonomous Exadata VM cluster.

With the infrastructure in place, Autonomous Container Databases can then be deployed to the Exadata VM cluster.

- A maximum of 12 container databases can be provisioned on X8.
- A maximum of 20 container databases can be provisioned on X8M.

Database users and developers use self-service UI or API to provision databases within container databases.

- Users just specify DB compute (OCPUs) and max storage.
- CPU and storage can elastically grow or shrink online.
- For X8M up to 250 Autonomous Databases per container database can be deployed (dependent on underlying Exadata physical resources) when using Fractional OCPUs. Containers that deliver an SLO are limited to 200 Autonomous Databases for an 99.95 SLO and 25 Autonomous Databases when using Autonomous Data Guard and a target SLO of 99.995.

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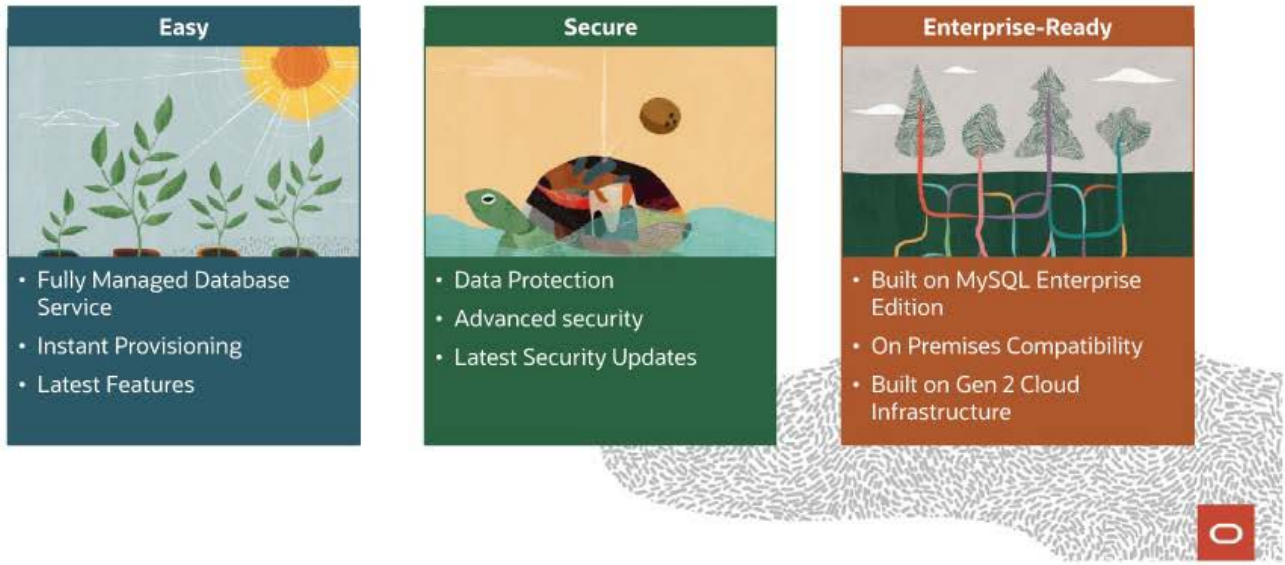
A typical lifecycle is shown here. I.T. Fleet Group configures the Exadata infrastructure, and deploys the autonomous VM cluster to it. With the infrastructure in place, autonomous container databases can then be deployed to the VM cluster. Remember a maximum of 12 container databases can be provisioned. Database users and developers use self-service UI or API to provision databases within container databases. Users just specify DB compute (OCPUs) and max storage. They can then elastically grow or shrink CPU and storage online. Another limit to remember is that up to 200 pluggable autonomous databases per container database can be deployed (dependent on underlying Exadata shape).

MySQL Database Service

100% developed, managed, and supported by the MySQL team



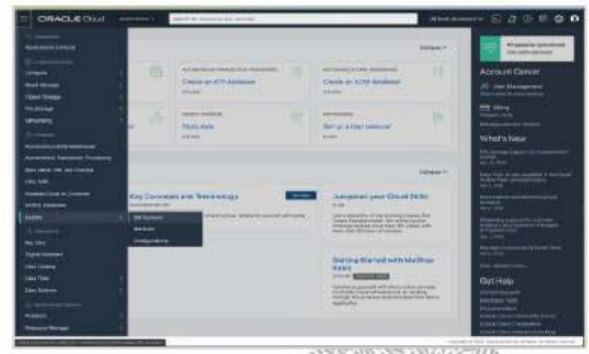
MySQL Database Service in Oracle Cloud Infrastructure is the only MySQL database service built on MySQL Enterprise Edition and 100% built, managed, and supported by the MySQL team.

Let's focus on the three major categories that make MySQL Database Service better than the other MySQL cloud offerings:

- 1. Ease of use
- 2. Security
- and 3. Enterprise readiness

MySQL Database Service: Ease of Use

- **Fully Managed Service**
  - Automate time-consuming tasks
  - Configuration, security patching, backup, and monitoring.
- **Instant Provisioning**
  - Connect to production ready, pre-configured MySQL databases
  - Provision fast, reliable, and secure cloud storage
  - Set up fast, predictable networking
- **Latest Features**
  - Fast paced delivery of new features for modern applications
  - X Dev API, MySQL Shell, Document Store



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DBAs tend to be overloaded with mundane database administration tasks.
They're responsible for many databases, their performance, security, availability and more.
It is really difficult for them to focus on innovation, and on addressing the demands of lines of business.

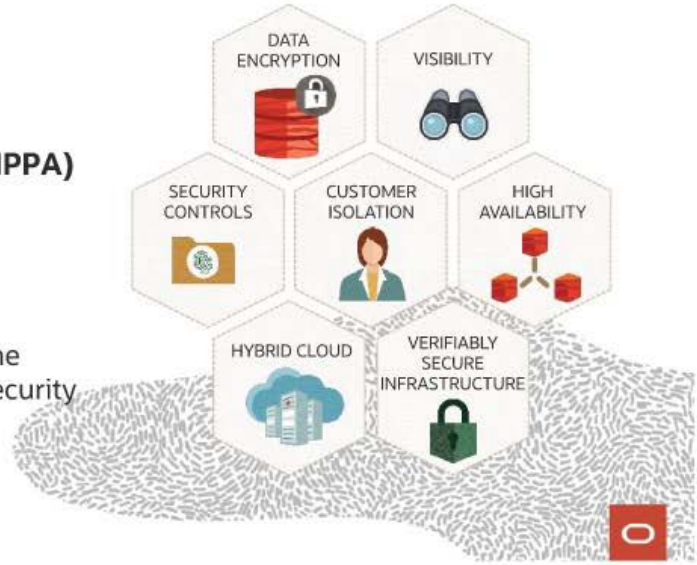
MySQL Database Service automates all those time-consuming tasks so they can improve productivity and focus on higher value tasks.

Developers can quickly get all the latest features directly from the MySQL team to deliver new modern apps.
They don't get that in other clouds who relies on outdated or forked versions of MySQL.

Developers can use the MySQL Document Store to mix and match SQL and NoSQL content in the same database as well as the same application.

MySQL Database Service: Security and Regulatory Compliance

- **Reduce Risk of Data Breaches**
  - Protect your data with encryption, masking, firewall and more
- **Regulatory Compliance (GDPR, PCI, HIPPA)**
  - Advanced Security with MySQL Enterprise Edition
- **Latest Security Updates**
  - Latest MySQL security fixes from the MySQL team to limit exposure to security vulnerabilities



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Data security has become top priority for all organizations.

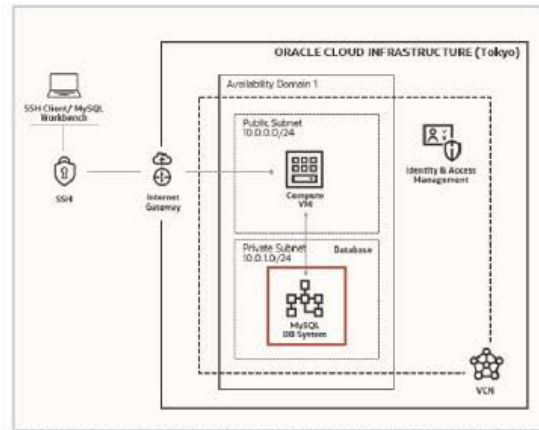
MySQL Database Service can help you protect your data against external attacks as well as internal malicious users with a range of advanced security features.

Those advanced security features can also help you meet industry and regulatory compliance requirements, including GDPR, PCI, and HIPPA.

When a security vulnerability is discovered, you'll get the fix directly from the MySQL team, from the team that actually develops MySQL.

MDS System Architecture

- A compute instance
- Oracle Linux Operating System
- MySQL Enterprise Edition; always upgraded to latest release
- Virtual Network Interface
- Network-attached block storage



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A database system is a logical container for the MySQL instance. It provides an interface enabling management of tasks such as provisioning, backup and restore, monitoring, and so on. It also provides a read/write endpoint enabling you to connect to the MySQL instance using the standard protocols.

A MySQL Database Service DB System consists of the following components:

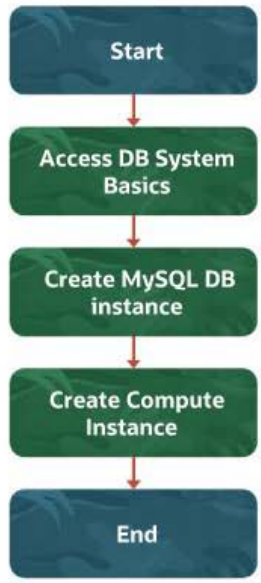
- A compute instance
- An Oracle Linux Operating System
- The Latest version of MySQL Server Enterprise Edition
- A Virtual Network Interface Card (VNIC) which attaches the DB System to a subnet of the Virtual Cloud Network (VCN)
- And Network attached Higher Performance block storage

The diagram on the right illustrates a simple MySQL Database service System framework:

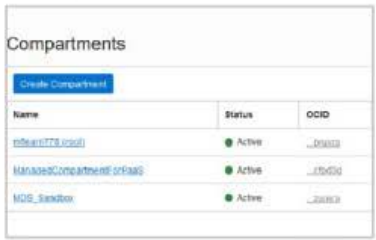
- Let's start with the inside of the Oracle Cloud Infrastructure Region… This one is in Tokyo.
- Our system is one data center, we call it an availability domain. We are using one Virtual cloud network, VCN for short.
- Like traditional data center networks, VCNs give us complete control over the network environment.
- This VCN is divided into two subnets: a public and a private subnet.
- The Oracle Linux computer is on the Public subnet and the MySQL Database Service instance is on the private subnet.
- The user accesses the MySQL Database Service with SSH and the Linux computer.

Let's get started…

MDS DB System Build

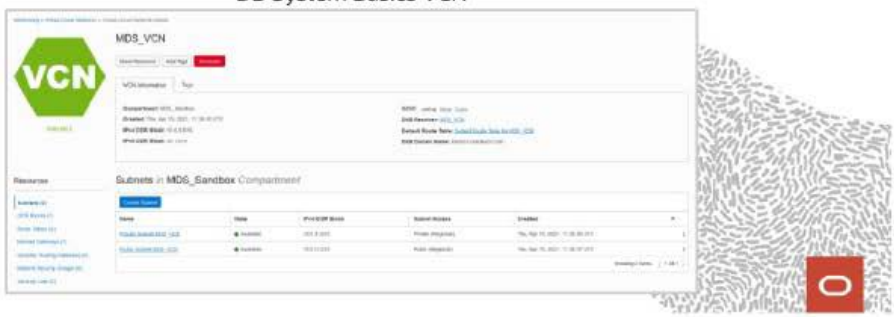


DB System Basics Compartment



DB System Basics Policies

DB System Basics VCN



After successfully log in to your Oracle Cloud Infrastructure tenancy with the OCI console, you can start provisioning your MDS DB system.

You will need to perform the following three major tasks:

1. Access your DB System Basics
2. Create your MySQL DB instance
3. Create your Compute Instance.

Compartment: You or the OCI administrator should have created a compartment to store your resources. You can store everything in the root of the tenancy, but compartments are recommended good practice.

You can find the compartment under the OCI Identity / Compartment menu.

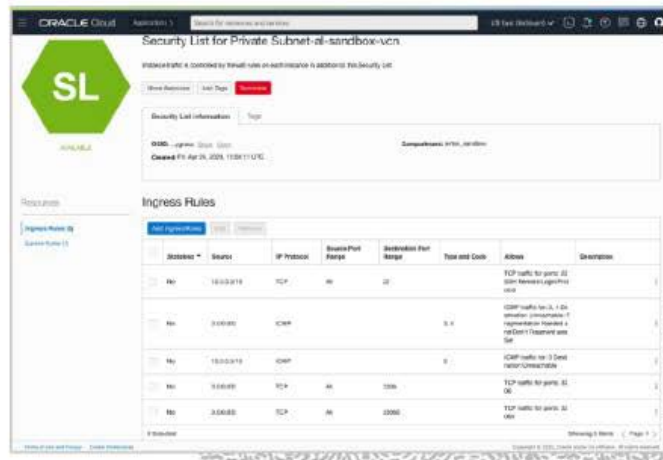
Policies: You or the OCI administrator should have created the MySQL Policies. These policies Isolate who can interact with the database service. You, or your group, should have been granted the policies so you can create and manage the MySQL Database Service system.

You can find the policies under the OCI Identity / Policies menu and typically in the root compartment

VCN: You or the OCI administrator should have created the Virtual cloud Network for the system. The VCN is the Software-defined version of a traditional physical network. We talked about it earlier and we will visit it later on.

You can find the VCN under the OCI Networking / Virtual Cloud Network menu.

MDS Connect and Load



To connect to the new OCI MySQL database, you need to perform the following steps:

- Step 1: Set up your VCN MySQL Port: 3306 access.
- Step 2: Connect to MDS by using MySQL Client.
- Step 3: Or you can connect by using MySQL Workbench.
- Step 4: Load data into the MySQL database.

Let's do Step 1: To configure a network to enable communication between VPN or Compute and DB System, you must configure your VCN's subnets with Security rules.

These rules permit traffic from specific IP addresses and ports between resources.

Use the console menu to go to Networking> Virtual cloud Networks.

Then click the VCN that you are using for the MySQL Database Service Instance. This will open the VCN's Details page.

Select Security Lists from the Resources section.

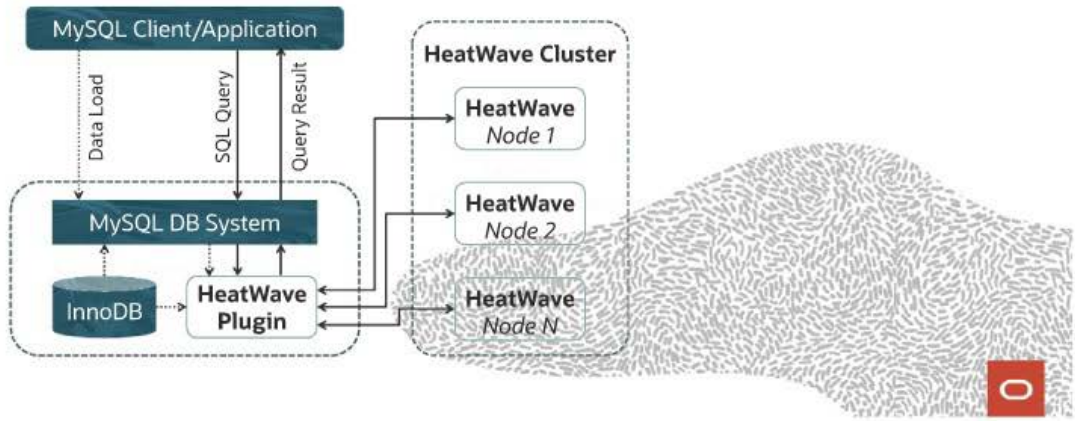
Click **Add Ingress Rules**. The **Add Ingress Rules** dialog box is displayed.

Add the following information to the Ingress Rule:

- **Stateless**: Do not select.
- **Source Type**: CIDR
- **Source CIDR**: The CIDR of the public subnet. You can narrow the range down to more specific IP addresses if it is required.
- **IP Protocol:** TCP
- **Source Port Range**: Leave blank.
- **Destination Port Range**: The port the DB System will listen on. Default is 3306 for MySQL Classic and 33060 for MySQL X Protocol.

HeatWave Architecture: Overview

- Innovative in-memory columnar analytics engine
- Optimized for Oracle Cloud Infrastructure
- Automation of various capabilities



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HeatWave is a distributed, scalable, shared-nothing, in-memory, columnar, query processing engine designed for fast execution of analytic queries. It is enabled when you add a HeatWave cluster to a MySQL DB System.

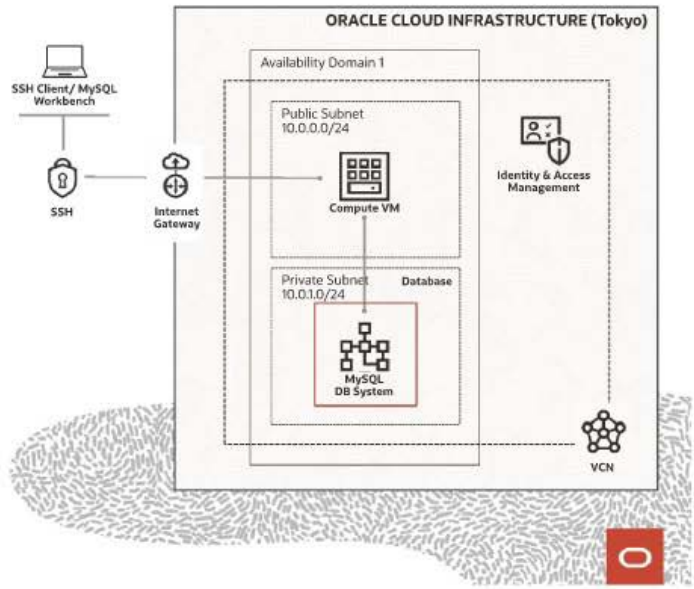
A HeatWave cluster comprises a MySQL DB System node and two or more HeatWave nodes. The MySQL DB System node includes a plug-in that is responsible for cluster management, loading data into the HeatWave cluster, query scheduling, and returning query results to the MySQL DB System. The HeatWave nodes store data in memory and process analytics queries. Each HeatWave node contains an instance of the HeatWave.

The number of HeatWave nodes required depends on the size of your data and the amount of compression that is achieved when loading the data into the HeatWave cluster. A HeatWave cluster supports up to 24 nodes.

HeatWave Prerequisites

Must-haves before using HeatWave:

- An operational MySQL DB System created using a BM.Standard.E2.64 or MySQL.HeatWave.VM.Standard.E3 shape
- A running Compute instance attached to a public subnet on the same VCN as the MySQL DB System, installed with MySQL Shell 8.0.22 or later
- Granted mysql-analytics policies



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Before using HeatWave, ensure that the following are present:

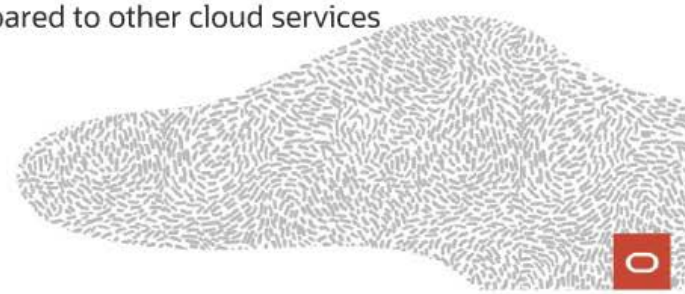
- A working MySQL DB System created using a BM.Standard.E2.64 or MySQL.HeatWave.VM.Standard.E3 shape
- A running Compute instance attached to a public subnet on the same VCN as the MySQL DB System
- MySQL Shell 8.0.22 or later installed on the Compute instance

In addition to the mandatory policies for the MySQL DB System, you, or your group, must have been granted the **mysql-analytics** policies.

MySQL + HeatWave

The only MySQL service with a massively scalable, integrated analytics engine

- Single MySQL database for OLTP & analytics applications
- All existing applications work without any changes
- Enables running analytics on data stored on-premises
- Extreme performance: Accelerates MySQL by orders of magnitude, scales to thousands of cores
- Dramatically faster and lower cost compared to other cloud services



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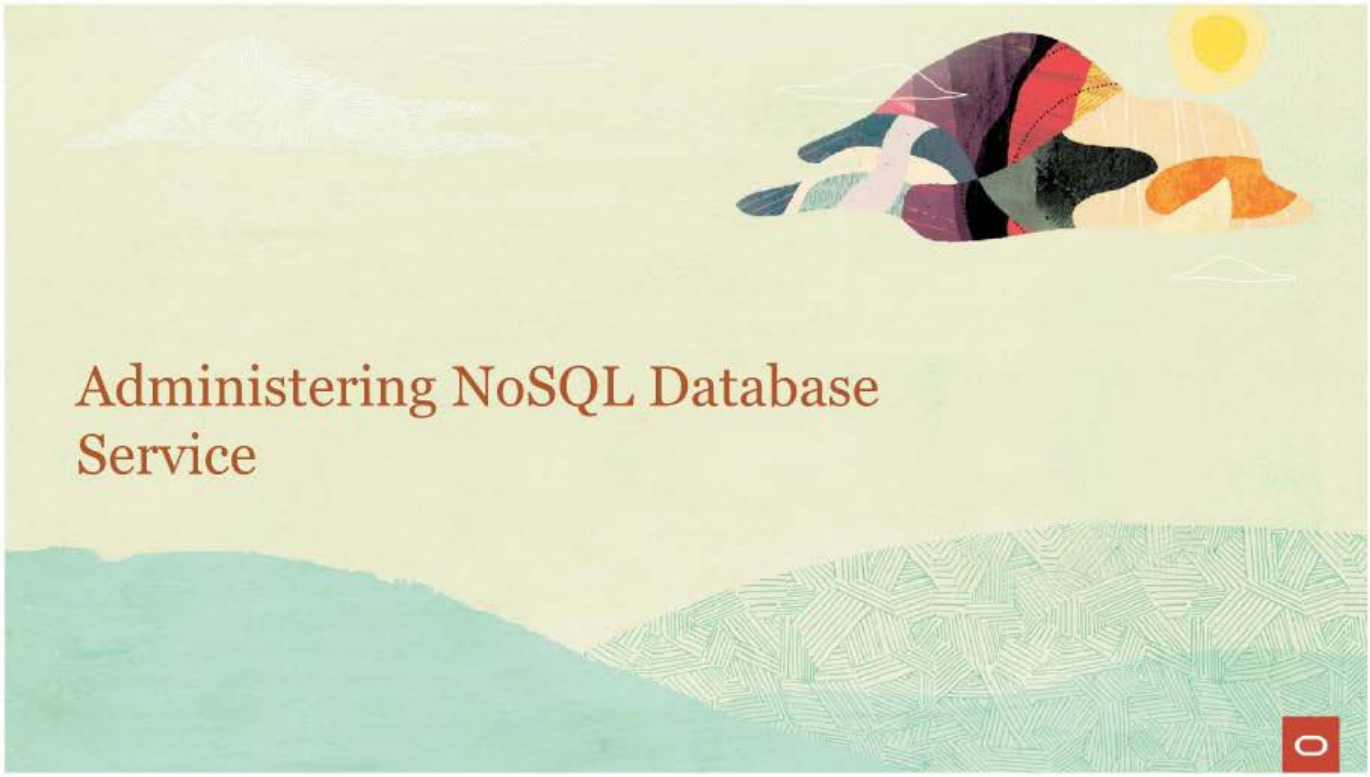
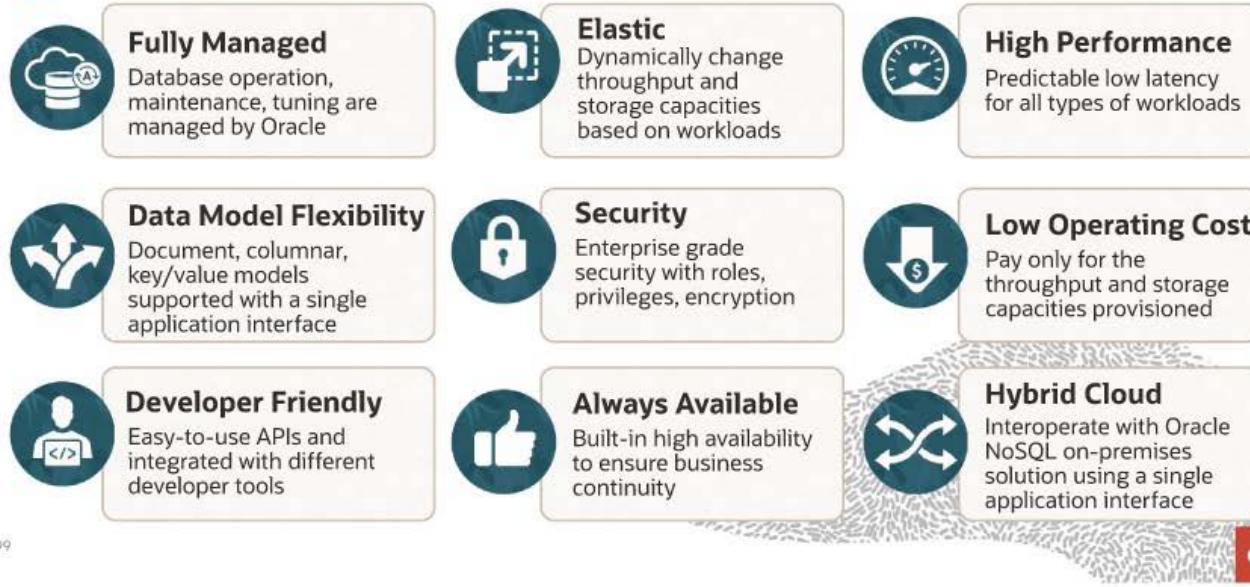
Organizations using MySQL database for managing their enterprise data can now run analytic queries with HeatWave with significantly better performance and lower cost, not requiring Extract Translate Load (ETL) and support for real-time analytics. The service can be deployed in a cloud only or in a hybrid environment, and it simplifies management for both transactional and analytic applications.

Get started today on a better solution than self-managed, on-premises, or in AWS.



Oracle NoSQL Database Cloud Service

Overview



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Oracle NoSQL Database Cloud Service

Fully managed service

Oracle:

- Fully manages:
  - Servers, storage, networking, and security
  - Installation of software and updates, run security inspections
- Monitors the health of the service
- Fully manages replication across multiple Availability Domains for HA

Developer / User manages:

- Application development
- Data model design – decides on how to model the data best for the application
- Sets roles and privileges – determines who can do what with the service

Oracle NoSQL Database Cloud Service

Use cases

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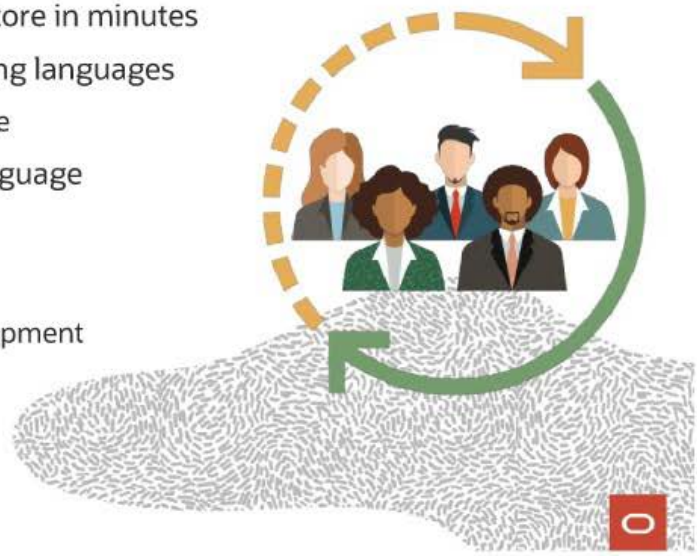
Oracle NoSQL Database Cloud Service

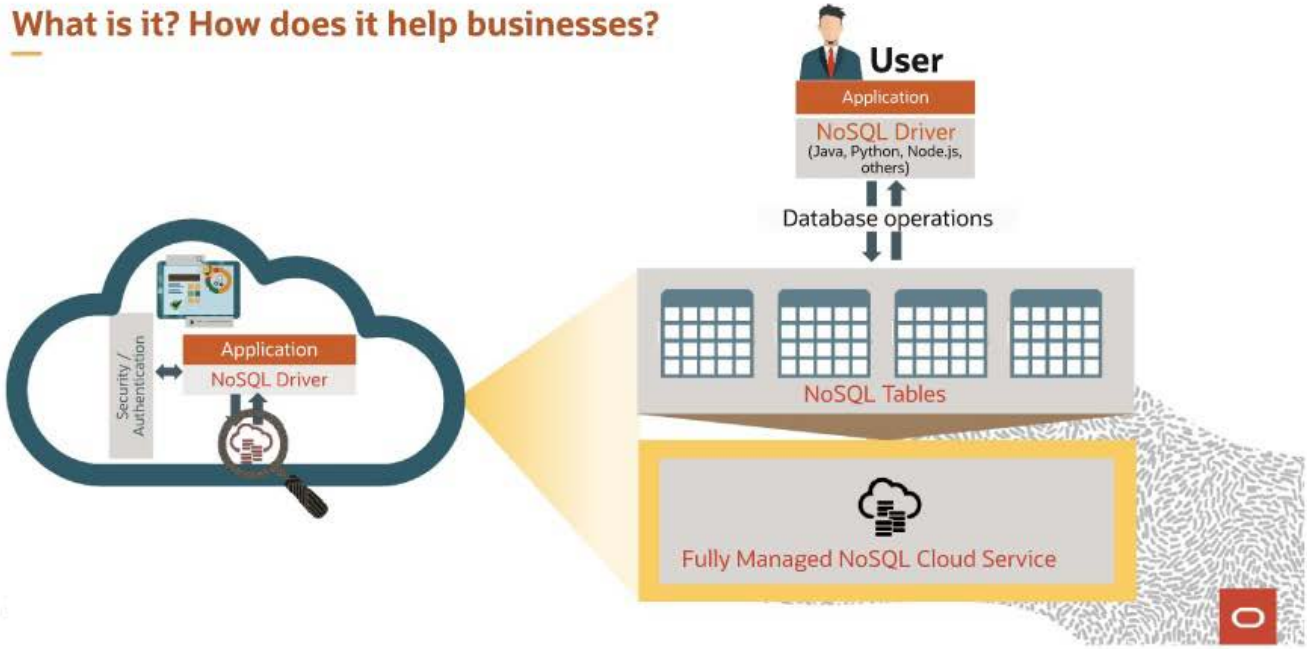
Developer friendly

- Ready to deploy your application data store in minutes
- Drivers available in multiple programming languages
  - Java, Python, Node.js, Go, and more
- Standards open APIs and SQL query language
- Simple and complex data types
- Developer tools
  - Cloud Simulator for test and development
  - Eclipse and IntelliJ integration
- Service console UI for a quick overview



Oracle NoSQL Database Cloud Service

What is it? How does it help businesses?



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Oracle NoSQL Database Cloud Service

Instant elasticity at table level

- Scale up or down the throughput capacity from a few write or read requests per second to millions of requests per second
- Change throughput and storage capacities at any time
- Increase the capacity when throttling occurs and decrease it when the workload eases
- Capacities provisioned in seconds
- Pay only for the throughput and storage capacities provisioned
- Simple API to change the throughput and storage

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In this session, we will discuss instant elasticity at the table level.

- We are fully elastic; we have the ability to scale up or scale down. So let's take a look about this in a little bit more detail. We talked earlier about allocating throughput and storage capacity for a nosql table. Scaling these capacities dynamically can provide a very cost-effective operation for running your application using the Oracle NoSQL database cloud service. Let's look at an example of where a nosql table is created for a website that has online activities during weekdays. A good example of this might be a service that operates Monday through Friday. So, in the first chart on the right, it shows you activities basically Monday through Friday and each one of those charts will be a different day. The first one on the left being Monday, the last one on the far right being Friday. As you can see, the workload tends to increase from Monday through Wednesday, drops a little bit on Thursday, and again it increases on Friday.

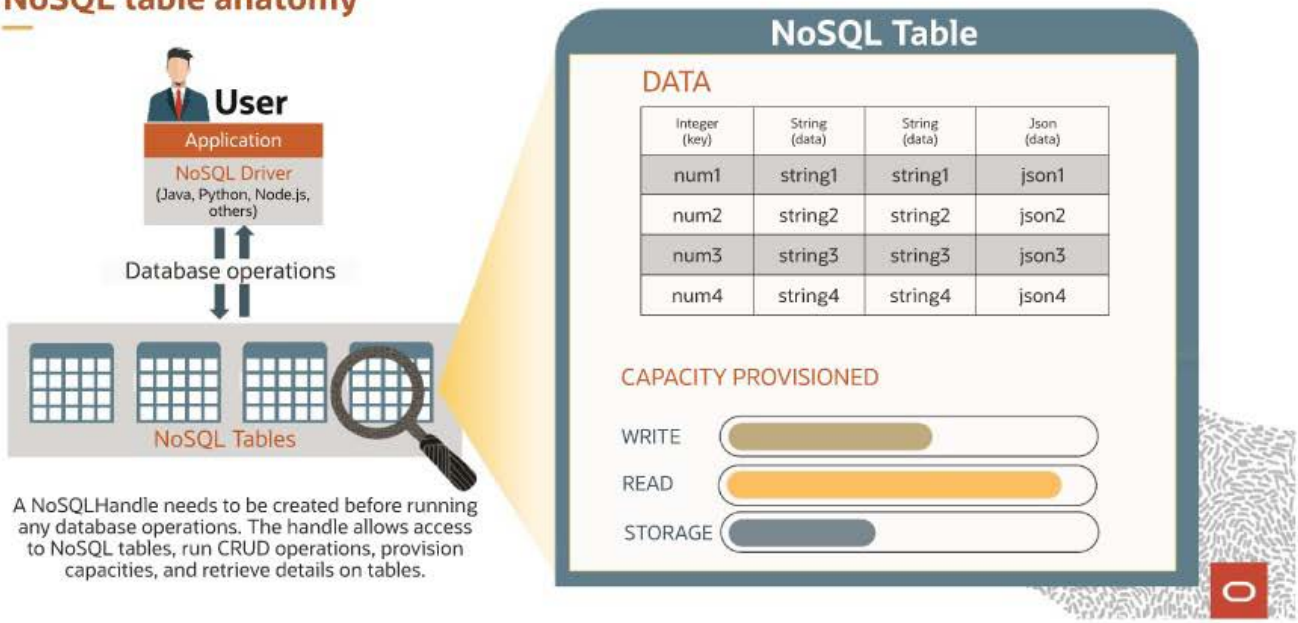
- So assume the support services do queries and insert operation to the table. And the queries and the new data inserts vary everyday based on the workload chart above. For example, we see on Monday the queries and insert are the same. On Tuesday, we see insert operations are higher than queries. Then the reverse is true for Wednesday. And then Thursday and Friday have slightly different operational patterns.

- So based on the queries and the new data insert operations for each day, the right amount of write and read throughput can be provisioned to meet the demand. As you can see in the throughput chart, Wednesday and Friday require higher throughput to handle the higher levels of queries and inserts.

- As you can see in the last chart, the operating cost for each day is different based on the throughput provisioned according to the demands or the requirements of the workload. Businesses no longer need to purchase and maintain the infrastructure to support peak workloads. So this avoids overprovisioning the hardware and paying more than what the workload actually needs. I.T. no longer has to size hardware based upon the server capacity or the OCPU.

Oracle NoSQL Database Cloud Service

NoSQL table anatomy



Each table has two key components, the first one is the data component, which consists of the table definition. We support different data types including integer, string, binary, long, double, JSON, records and many others. And as you can see in the simple example here, each column can be defined to support a specific data type. So the example that we have here is more of a fixed-schema type of approach. In this case, the primary key column is an integer. That's on the far left. The next two columns are strings, and the last column is a JSON data type. So we can intermix the different data types in the same row. The primary key is an index and it's used to access the data. For a more complex table definition, shard keys can also be defined. And the purpose of shard keys is to distribute data across shards for efficiency and to store records with the same shard key in the same shard for a locality of reference and quicker access. Records that share the same shard key will be located very close to one another. The second component to the tables is what we call capacity. The table capacity indicates the resource limits that are allocated to this particular table for its operations. Capacities can be divided up into two types. We have storage and throughput. For storage capacity, it's expressed in the terms of gigabytes. So this is the maximum amount of storage allocated to this particular table. For throughput it captures the reads and the writes that are performed on this table and write capacity is expressed in what we call write units and read capacity is expressed in what we call read units.

Oracle NoSQL Database Cloud Service

Throughput provisioning

Write Unit

- The throughput of up to 1 kilobyte (KB) of data per second for a write operation over a one month period
- Approximately 2.67 million writes per month

Read Unit

- The throughput of up to 1 kilobyte (KB) of data per second for an eventually consistent read operation
- Approximately 2.67 million eventually consistent reads per month
- 2 Read units are needed for an absolutely consistent read

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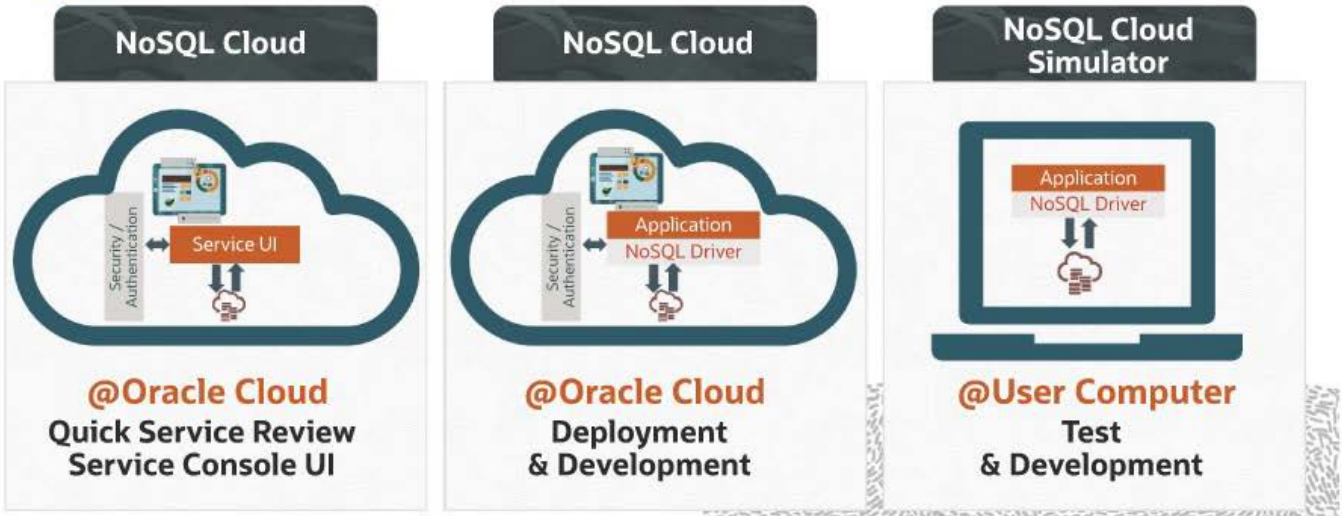
Oracle NoSQL Database Cloud Service

Service Interface, Development Tool



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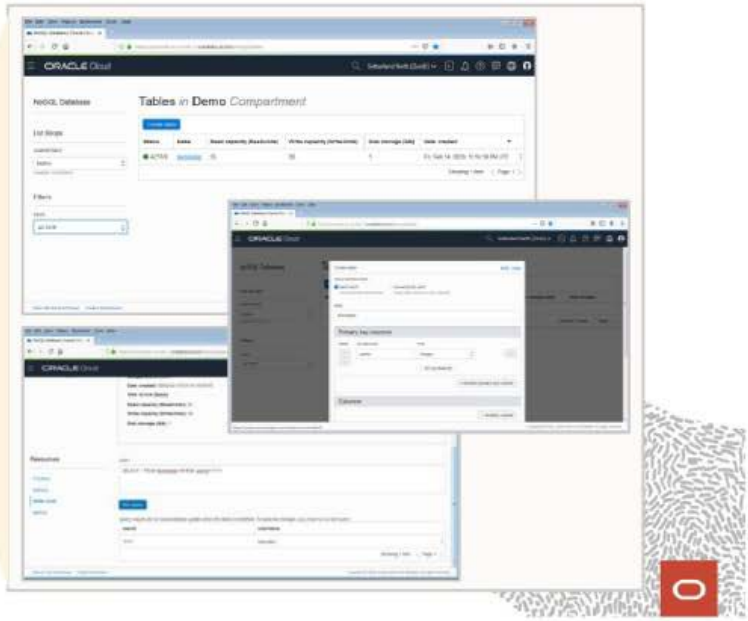
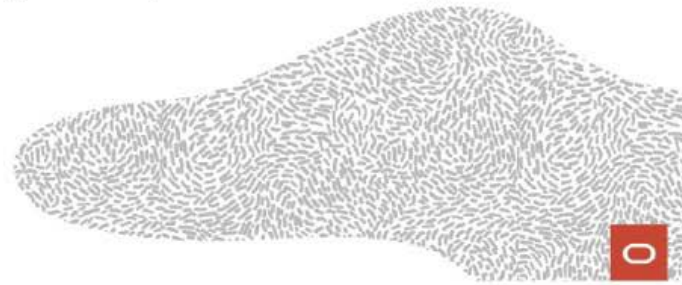
Oracle NoSQL Database Cloud Service

Service Console UI Demo



Generic Steps to Connect Oracle NoSQL Database Cloud Service from Any Application

- Acquire the required credentials (authentication information) and the respective Oracle NoSQL Database Cloud Service with defined endpoint.
- Create a handle object in the application using the API and pass the credentials, authentication information, and Oracle NoSQL Database Cloud Service endpoint to it.
- If there are no connection errors, the Handle object is created successfully.
- Use the Handle object to send different types of requests to Oracle NoSQL Database Cloud Service.



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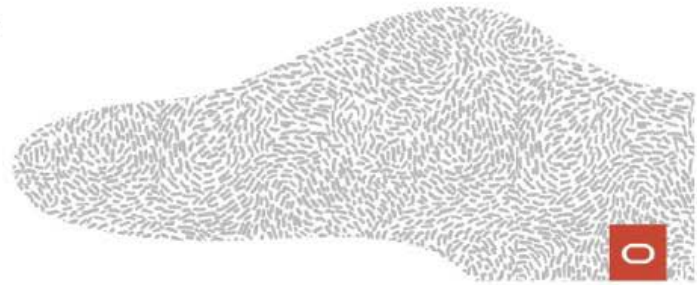
- So this slide covers the generic steps to connect Oracle NoSQL Database Cloud service from any type of application, such as a Java-, Python-, Go language–, or NodeJS-based application.
- So the steps are, acquire the required credentials, including the authentication information, and the respective Oracle NoSQL Database Cloud Service endpoint. Credentials and the NoSQL Database Cloud Service endpoint have to be obtained, and this information comes from the OCI console.
- Followed by this, create a handle object in any type of an application. It can be Java, Python, Go language, or a NodeJS application. This handle object is created using various language-based APIs. To create the handle object, you need to pass the credentials, along with the service endpoint information that you have captured as a part of step one. Once the handle object is created successfully, we can use this handle object for further processing the request. The handle object will only be created if there are no connection errors.
- As the handle object is created, we can query the Oracle NoSQL Database Cloud Service or pass different types of requests to Oracle NoSQL Database Cloud Service using this handle object from the application.
- These are the steps for connecting to Oracle NoSQL Database Cloud Service.

Introduction

- Database Management is a new OCI native service that will provide broad capabilities for managing and monitoring Oracle Databases.
- The service will support databases deployed **External** (on-premises) and on the **Oracle Cloud (OCI)** such as VM/BM, ExaCS, ExaCC, Autonomous DB, and so on.
- Database Management currently supports only External Oracle Databases, which are Oracle Databases located on premises.
- The Database Management Service will offer capabilities for:
  - Fleet monitoring and management
  - Database Groups
  - SQL Jobs



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Oracle has been a leader in Database Management for decades, and now these unique capabilities are available in Oracle Cloud.

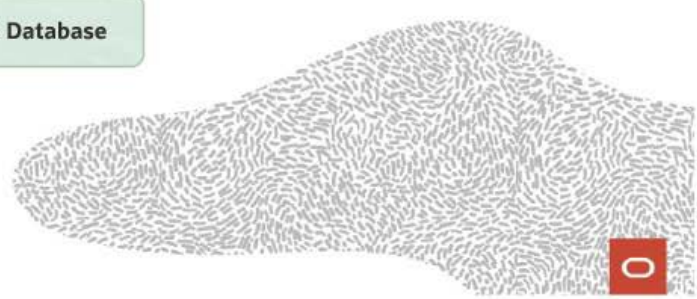
The new Database Management service brings the best of Oracle's industry-leading capabilities from Oracle Enterprise Manager into Oracle Cloud.

This includes fleet-wide monitoring and management for all flavors of Oracle database, whether they live on-premises or in the cloud. So, if you're using Database 11, 12, 18, 19, 21, or the Autonomous Database or the Exadata Cloud, you'll be able to get a comprehensive view of the performance of your Database fleet.
Database Management currently only supports External Oracle Databases, which are Oracle Databases located on-premises

Using Database Management, you can:

- Monitor the key performance and configuration metrics of your fleet of Oracle Databases. You can also compare and analyze database metrics over a selected period of time.
- Group your critical Oracle Databases, which reside across compartments into a Database Group, and monitor them.
- Create SQL jobs to perform administrative operations on a single Oracle Database or a Database Group.

Get Started with Database Management



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The Oracle Cloud Infrastructure service that enables communication and data collection between Database Management Service and an External Database is the Management Agent Cloud Service. For this purpose, the Management Agent Cloud Service uses a Management Agent, which is installed on a host that has a connection to the External Oracle Database.

An Oracle Database must first be registered with the External Database service before Database Management can be enabled. We will make use of the External Database service to register your External Oracle Databases in Oracle Cloud Infrastructure.

Connectivity is established using the Management Agent Cloud Service via the agent.

Fleet Monitoring and Management

- Unified NOC-style view of entire Oracle DB fleet
- Native OCI telemetry for DevOps events and monitoring
- Database Groups enable cross-compartment fleets
- Fleet-level management
  - SQL job execution

Sample Exam Questions

For Oracle Database Cloud Services 2021 Specialist

Sample Questions

Q1	Administering Database Cloud Service on Bare Metal and Virtual Machine DB Systems
Q2	Administering Exadata Cloud Service
Q3	Administering Exadata Cloud@Customer
Q4	Administering MySQL Database Service
Q5	Administering NoSQL Database Service
Q6	External Database Cloud Service Technical Overview

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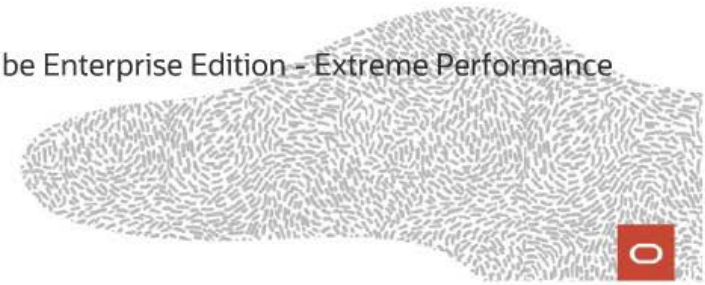
Q1: Administering Database Cloud Service on Bare Metal and Virtual Machine DB Systems

Which two are the minimum prerequisites to launch a DB system?

a. Public key in OpenSSH format
b. Virtual Cloud Network with default security list
c. Private key in OpenSSH format
d. Virtual Cloud Network with default service gateway
e. Dynamic Routing Gateway
f. Oracle Database Software Edition must be Enterprise Edition - Extreme Performance



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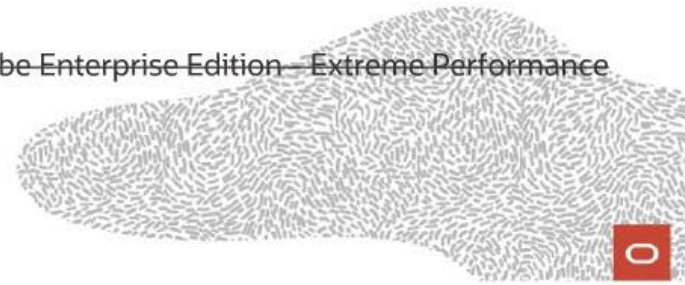

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Q2: Administering Exadata Cloud Service

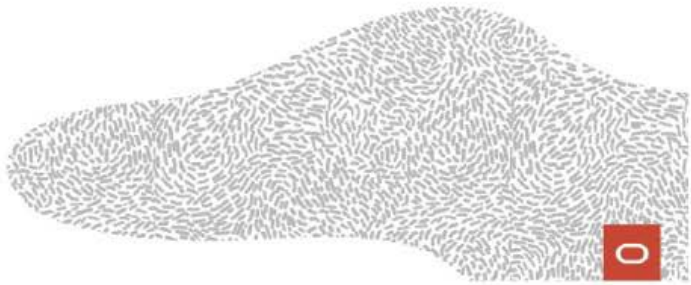
Which versions are currently supported in Exadata Cloud Service?

a. X6, X7, X8, and X8M

b. X7 and X8

c. X6 and X7

d. X5, X6, X7, and X8



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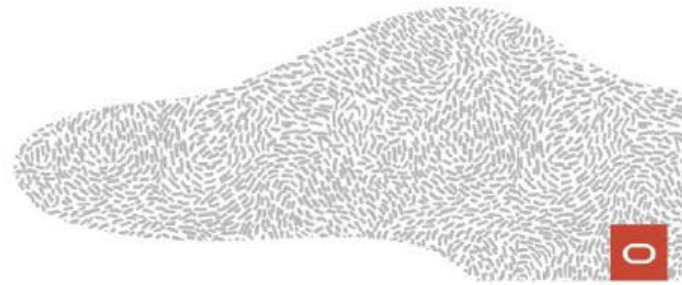

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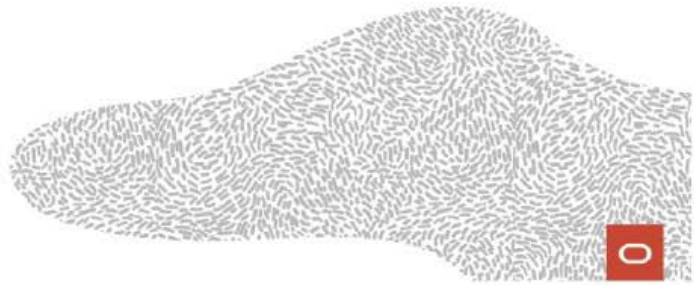
Q3: Administering Exadata Cloud@Customer

What is the maximum number of Enabled CPU Cores in Oracle Exadata X8M-2 Full Rack System?

a. 100
b. 200
c. 400
d. 500



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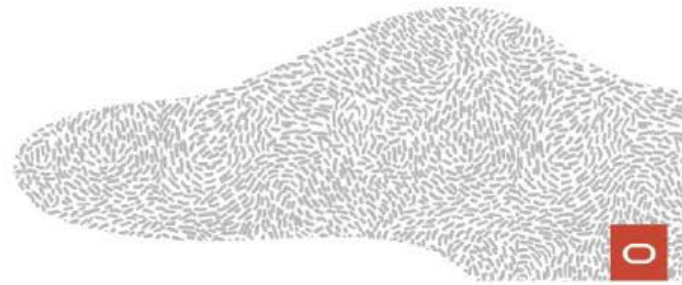

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Q4: Administering MySQL Database Service

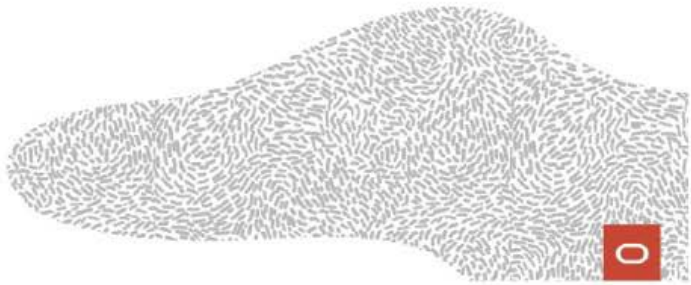
Which two statements are true about MySQL Database Service?

a. It is a fully managed Oracle Cloud Infrastructure service.

b. It is built on MySQL Community Edition.

c. Its users need to perform database and operating system patching tasks.

d. It is built on Gen 2 Cloud Infrastructure for superior performance.



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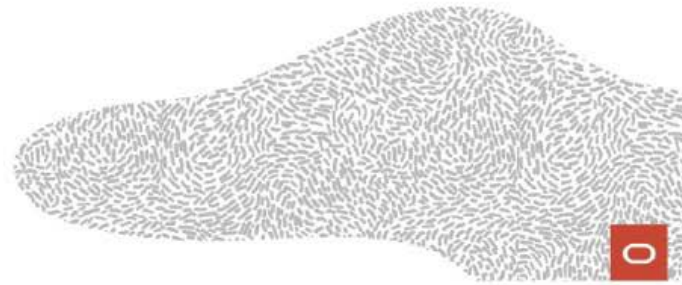

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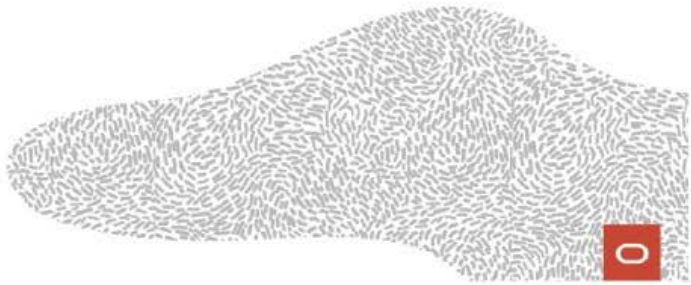
Q5: Administering NoSQL Database Service

Which are the two key components of a table in a NoSQL table?

a. Index Component
b. Data Format
c. Table Capacity
d. Data Component



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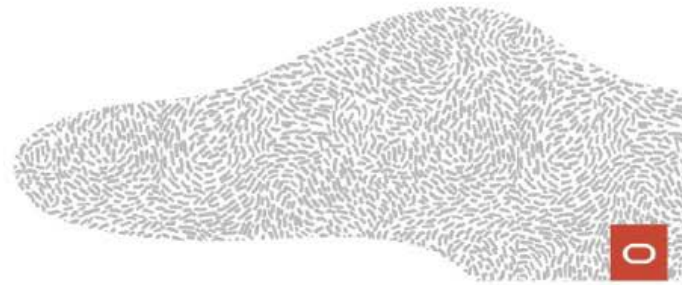

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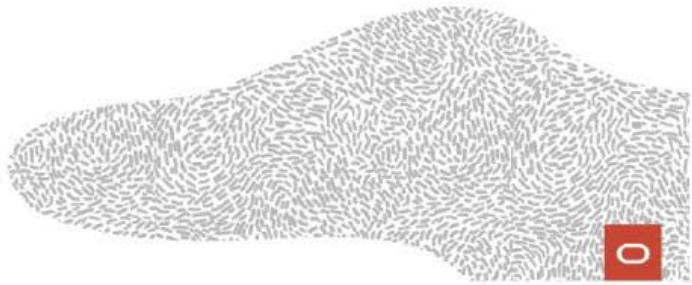
Q6: External Database Cloud Service Tech Overview

Which three are stored in the OCI Database Connection Resource to connect to an External Database?

a. DNS Hostname
b. Database name
c. User Credentials and role
d. Service name
e. DBID
f. Database OCID



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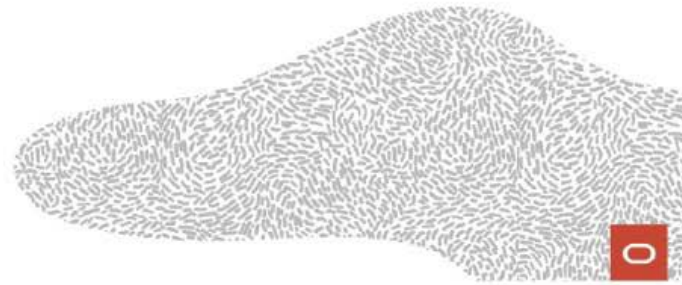

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Useful Resources

- Review
  - Exam Registration Process
  - Oracle Certification Program Candidate Agreement
  - Oracle Certification Program Guidelines
  - DB Service Documentation
  - MySQL Documentation
  - NoSQL Documentation
  - External Database Documentation
- Contact Oracle University

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Exam Registration Process:

Ensure you have a login for Oracle exams delivered through Pearson VUE. To create a login, go to http://www.pearsonvue.com/oracle.

Oracle Certification Program Candidate Agreement:

In order to take your Oracle certification, you will need to agree to the Oracle Certification Program Candidate Agreement. Please review this document by going here: http://education.oracle.com/education/pdf/ocp_candidate_agreement.pdf

Oracle Certification Program Guidelines:

Learn more about Oracle Certification policies by going here: https://education.oracle.com/pls/web_prod-plq-dad/db_pages.getpage?page_id=138

Review Documentation: https://docs.oracle.com/en-us/iaas/Content/Database/Concepts/databaseoverview.htm

Oracle University Contact Information: https://education.oracle.com/OUcontactUs

Summary

In this session, you should have learned the following:

- Audience and prerequisites for this certification
- Exam General Information
- Certification Benefits
- Exam Topics
- Revision of Exam Topics
- Review Sample Question
- Useful Resources