

Working Database Systems Bare Metal and Virtual Machine

Student Guide

S1102502GC10

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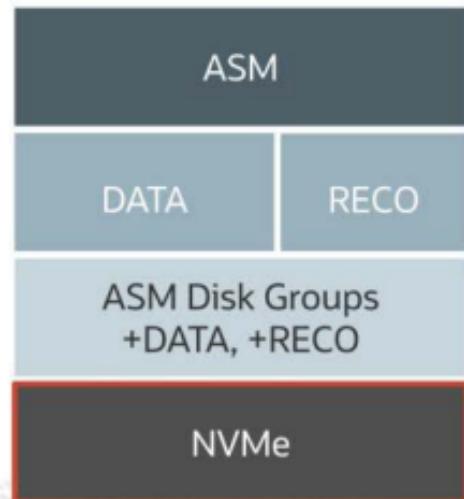
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BM DB Systems Storage Architecture

- Only supports Grid Infrastructure (ASM) storage management
- Tracks the layout, configuration and status of storage.
- Monitors the disks for hard and soft failures.
- Proactively off-lines disks that failed, predicted to fail, or are performing poorly, and performs corrective actions, if possible.
- On disk failure, the DB system automatically creates an internal ticket and notifies the internal team to contact the customer.
- ASM provides a choice of normal or high redundancy of NVMe disks.
- ASM uses DATA and RECO disk groups.



Virtual Machine

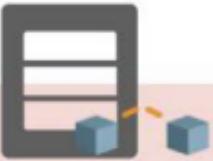
Shared computing resources with provisioned block storage economically run a wide variety of database workloads and business applications.



Faster time to production



Lower cost of ownership with pay-per-use



Improved availability with RAC

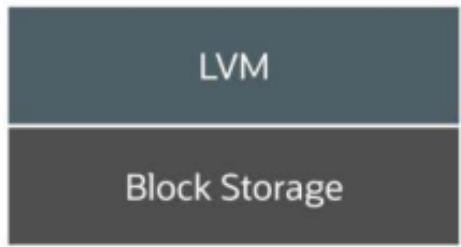
Shapes for Virtual Machine Database Systems

Platform	OCPUs	Memory	Storage	Network	Nodes
VM	1-24	15-320 GB	256 GB-40 TB	1 – 24.6 Gbps	1-2

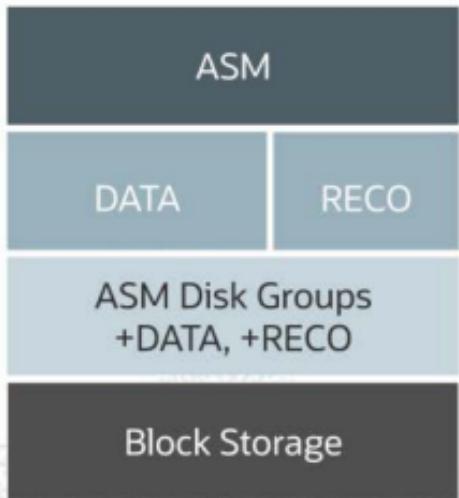
- A VM shape determines the OCPU, Memory, and Network resources allocated to the DB system

Shape	OCPUs	Memory
VM.Standard2.1	1	15 GB
VM.Standard2.2	2	30 GB
VM.Standard2.4	4	60 GB
VM.Standard2.8	8	120 GB
VM.Standard2.16	16	240 GB
VM.Standard2.24	24	320 GB

VM DB Systems Storage Architecture

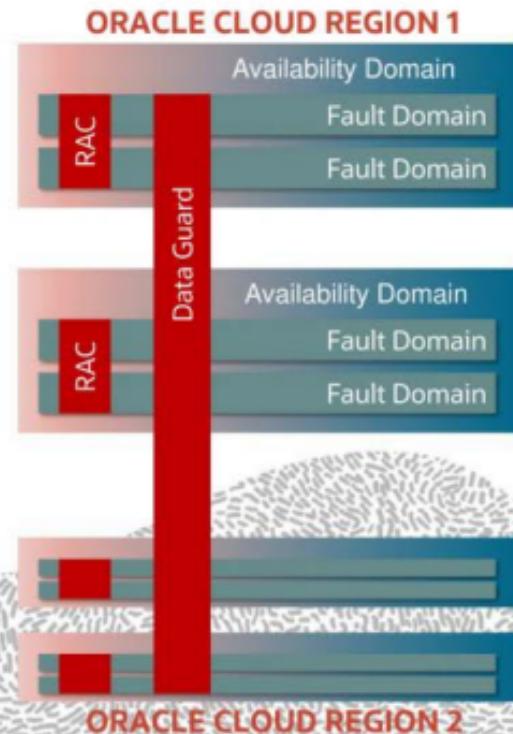


- Choice of LVM or Grid Infrastructure (ASM) storage management
- ASM uses DATA and RECO disk groups
- Block Storage provides triple mirroring of data
- ASM redundancy is set to external
- Support for DB System clones



Fault Domains, Availability Domains, and Regions

- Real Application Clusters (RAC) across Fault Domains provides database instance fault isolation
- Data Guard deployed across Availability Domains within a Region provides high availability
- Data Guard deployed across Regions provides geographic isolation for disaster recovery



End-to-End Security

- Always-on data encryption
- Security-first cloud infrastructure
- Identity access management
- Network controls
- Oracle Database Security options
- Oracle Data Safe
- FIPS and STIG Compliance
- SE Linux Option



Create Database Cloud Service

Bare Metal and Virtual Machine DB Systems

Objectives

After completing this lesson, you should be able to:

- Identify the prerequisites to launch a DB system
- Describe Identity and Access Management (IAM) key concepts
- Describe Virtual Cloud Network (VCN) key concepts
- Create a Virtual Cloud Network (VCN) for a DB system
- Use the Console to launch a DB system
- Connect to a DB System



Overview for Creating DB Systems

You can use the Console to perform the following tasks:

- Create a VCN to use when creating a 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.



Prerequisites to Launch a DB System

You need the following items to launch any DB system:

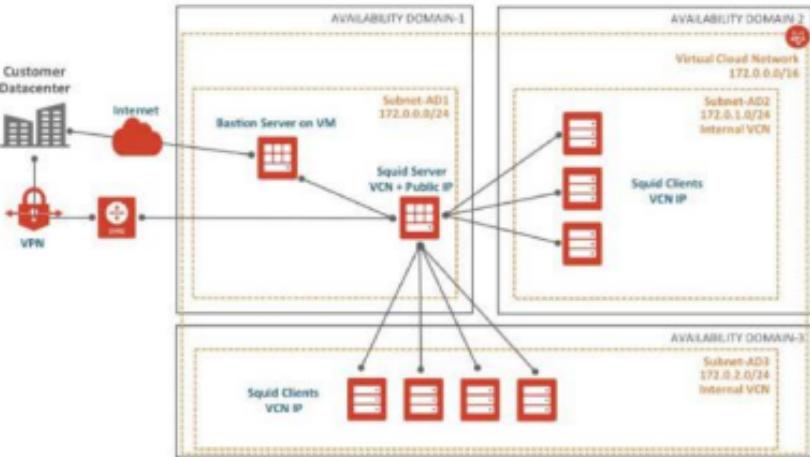
- Appropriate IAM policies must be granted and the tenancy needs to have the appropriate service limits
- Public key in OpenSSH format
- Virtual cloud network (VCN) in a region where you want to Launch a DB System
- At least one subnet (private subnet recommended)
- A service gateway with a private subnet 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
 - 2-node RAC DB system requires Internet and VCN Resolver

Identity and Access Management Service

- Identity and Access Management (IAM) service enables you to control who can do what in your OCI account:
 - Control who can access your OCI account
 - What services and resources they can use
 - How they can use these services and resources
- Resource is a cloud object that you create and use in OCI (for example, compute instances, block storage volumes, and Virtual Cloud Networks).
- IAM uses traditional identity concepts, such as principals, users, groups, and policies.
- OCI IAM introduces a new feature called compartments.

Virtual Cloud Network (VCN)

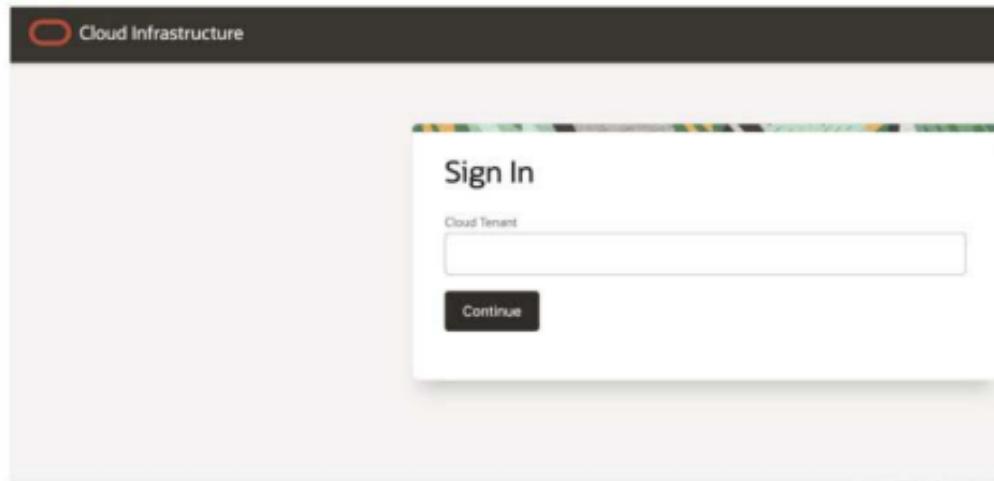
- A Virtual Cloud Network is a software-defined version of a traditional physical network including subnets, route tables, and gateways on which your instances run.
 - A VCN resides within a single region but can cross multiple Availability Domains.
 - A virtual router provides a single point of entry 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.



Using the Console

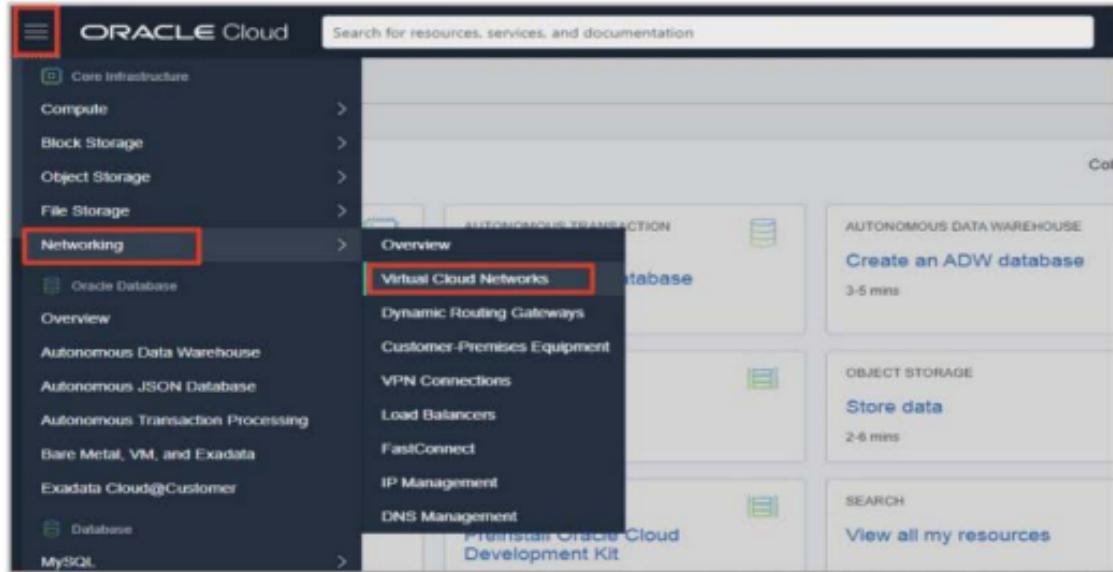
1. Log in to Oracle Cloud Infrastructure using:

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



Creating a VCN for a DB System

2. Select **Networking** from the menu.
3. Select **Virtual Cloud Networks**.



Creating a VCN for a DB System

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

Networking

Virtual Cloud Networks in C11 Compartment

Virtual Cloud Networks are virtual, private networks that you set up in Oracle data centers. It closely resembles a traditional network, with firewall rules and specific types of communication gateways that you can choose to use.

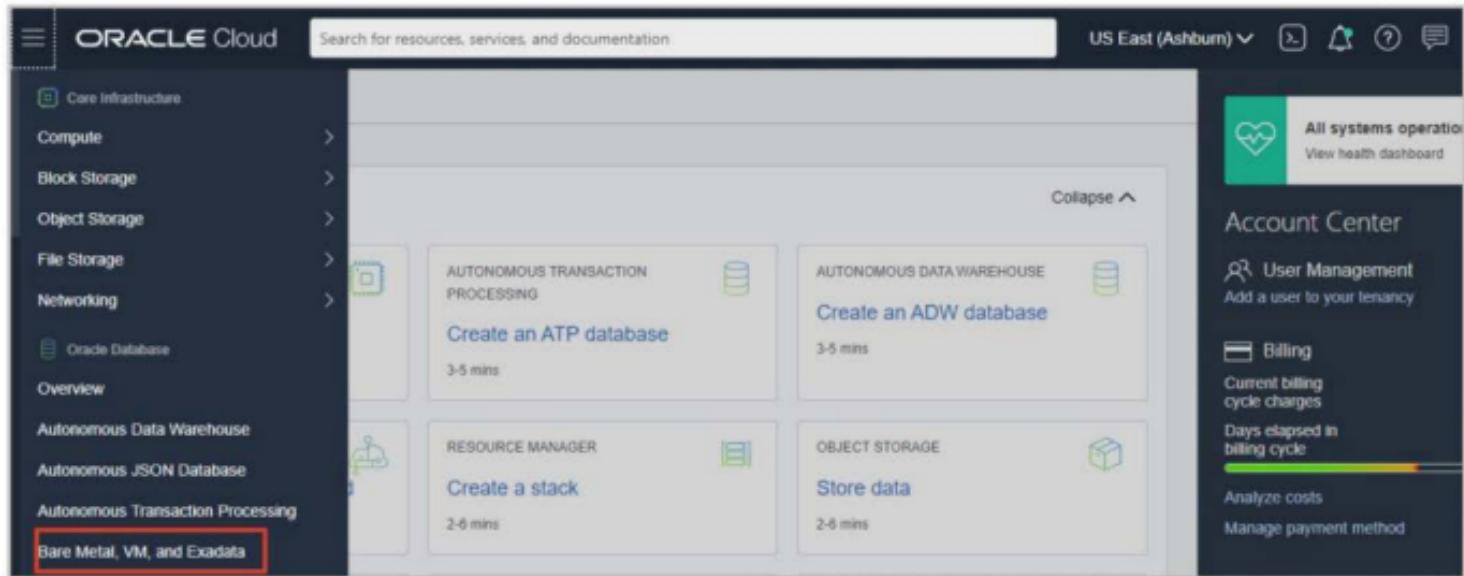
Create VCN Start VCN Wizard

Name	State	CIDR Block	Default Route Table	DNS Domain Name	Created
No items found.					

Showing 0 items < 1 of 1 >

Using the Console to Launch a DB System

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



Using the Console to Launch a DB System

3. Choose a Compartment.
4. Click **Create DB System**.

The screenshot shows the Oracle Cloud interface. The top navigation bar includes the Oracle Cloud logo, a search bar, and a dropdown for 'US East (Ashburn)'. Below the navigation is a sidebar with links for Bare Metal, VM, and Exadata services, and specific sections for DB Systems, Exadata at Oracle Cloud, Exadata VM Clusters, and Exadata Infrastructure. The main content area is titled 'DB Systems in C11 Compartment' and features a prominent blue 'Create DB System' button. A table below lists columns for Display Name, State, Availability Domain, Shape, CPU Core Count, and Created. A message indicates 'No items found'. At the bottom right of the main area, there is a link to 'Activate Windows'.

Steps to Fill in DB System Information

1. Enter Display Name.
2. Select an Availability Domain.
3. Select a Shape.
4. Select a Database Edition.
5. Select a Storage Management Software.

The screenshot shows the OCI Database creation process. Step 1: 'Select a compartment' (C17). Step 2: 'Name your DB system' (MYDBVM). Step 3: 'Select an availability domain' (AD-1). Step 4: 'Select a shape type' (Virtual Machine). Step 5: 'Configure the DB system' (Total node count: 1, Oracle Database software edition: Enterprise Edition Extreme Performance, Choose Storage Management Software: Logical Volume Manager selected).

1. Enter Display Name.

2. Select an Availability Domain.

3. Select a Shape.

4. Select a Database Edition.

5. Select a Storage Management Software.

Steps to Fill in DB System Information

6. Select Available Storage Size.
7. Upload or Generate SSH Public Key.
8. Select License Type.

The screenshot shows three sequential configuration steps:

- Step 6: Configure storage**

Available storage (GB): **6** (The number 6 is highlighted with a red circle.)
The maximum storage amount is 4096 GB.
- Step 7: Add SSH Keys**

You can access the services of your system's databases by using SSH tunneling. When you connect to the system, you will provide the associated private key.

 - Generate SSH key pair
 - Upload SSH key files
 - Paste SSH keys

Download the private key so that you can connect to the database system using SSH. It will not be shown again.

[Save Private Key](#) [Save Public Key](#)
- Step 8: Choose a license type**

Choose a license type

 - License Included
Subscribe to new Oracle Database software licenses and the Database service.
 - Bring Your Own License (BYOL)
Bring my existing Oracle Database software licenses to the Database service.

Steps to Fill in Network Information

1. Select Virtual Cloud Network.
2. Select Client Subnet.
3. Enter Hostname Prefix

The screenshot shows a configuration interface for network information. It includes fields for selecting a virtual cloud network, client subnet, and hostname prefix, along with host domain and URL details. Red circles numbered 1, 2, and 3 indicate the sequence of steps:

- Step 1:** Virtual cloud network in C17 (Change Compartiment) - MYVCN
- Step 2:** Client Subnet in C17 (Change Compartiment) - Public Subnet-MYVCN/regions
- Step 3:** Hostname prefix - MYHOST

Other visible fields include "Use network security groups to control traffic" (unchecked), "Host domain name" (sub01160627970.myvcn.oraclecloud.com), and "Host and domain URL" (MYHOST.sub01160627970.myvcn.oraclecloud.com). A note states: "On-premises subnets that overlap with 192.168.10.16/28, which is used by the Oracle Clusterware private interconnect on the database instance."

Steps to Fill in Database Information

1. Enter Database name.
2. Select Database version.
3. Enter PDB name.
4. Provide Database administration password.
5. Confirm admin password.

Create DB System

① DE System Information
② Database Information

Database name: MYORCL

Database image: Oracle Database 21c Change Database Image

PDB name (OPTIONAL): MYPDB1

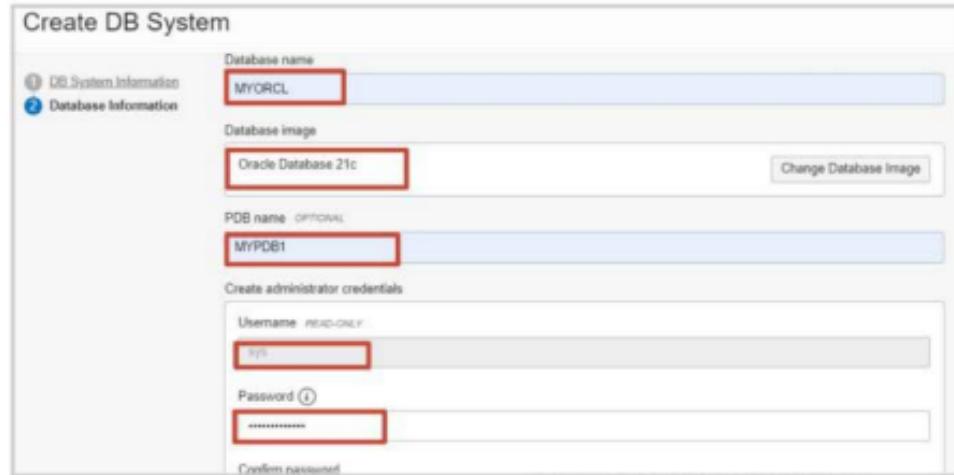
Create administrator credentials

Username (READ-ONLY): sys

Password ⓘ: *****

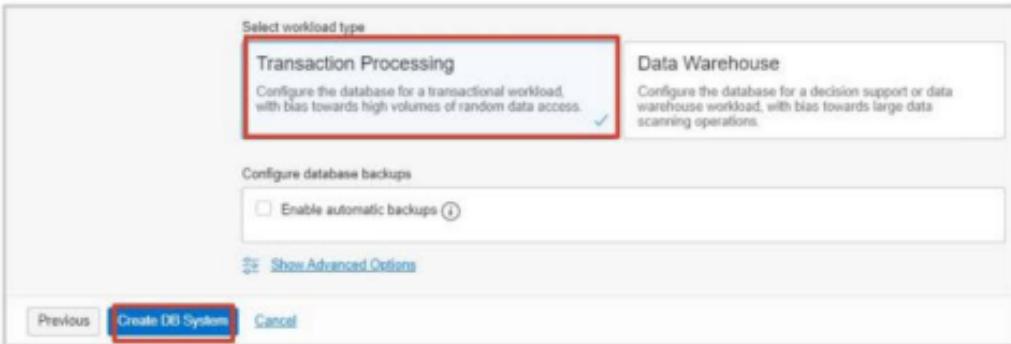
Confirm password: *****

Confirm password: *****



Steps to Fill in Database Information

6. Select workload type.
7. Enable automatic backup.
8. Click **Create DB System**.



Using the Console to Check the Status of a DB System

Different statuses of a DB system:

- Provisioning
- Available
- Updating
- Stopped
- Terminating
- Terminated
- Failed

The screenshot shows the Oracle Cloud interface for managing DB Systems. The top navigation bar includes the Oracle Cloud logo, a search bar, and a dropdown for 'US East (Ashburn)'. Below the navigation is a breadcrumb trail: Overview > Bare Metal, VM and Exadata > DB Systems. The main content area is titled 'DB Systems in C11 Compartment'. On the left, there's a sidebar with links for 'Bare Metal, VM, and Exadata' (selected), 'DB Systems' (which is currently active), 'Exadata at Oracle Cloud', 'Exadata VM Clusters', and 'Exadata Infrastructure'. The main table displays one row of data:

Display Name	State	Availability Domain	Shape	CPU Core Count	Created
MYDBVM	Available	yGPU US-ASHBURN-AD-1	VM Standard.G.2	2	Fri, Dec 18, 2020, 10:14:01 UTC

At the bottom right of the table, it says 'Showing 1 item' and '1 of 1'.

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 creation DB System
- You retain the SSH private key and use it to authenticate
- You connect using opc user account
- You must also ensure that port 22 is accessible through the firewall

Add SSH Keys

You can access the services of your system's databases by using SSH tunneling. When you connect to the system, you will provide the associated private key.

Generate SSH key pair
 Upload SSH key files
 Paste SSH keys

ⓘ Download the private key so that you can connect to the database system using SSH. It will not be shown again.

[Save Private Key](#) [Save Public Key](#)

DB System OS Users

- Preconfigured OS user accounts
- opc
 - Use in conjunction with sudo to gain root access
 - Access using SSH key
- oracle
 - Use to perform database administration
 - Access using sudo su from opc
- root
 - Use for system administration tasks
 - Access using sudo su from opc
- grid
 - Use to administer grid environments
 - Access using sudo su from opc

Summary

In this lesson, you should have learned how to:

- Identify the prerequisites to launch a DB system
- Describe Identity and Access Management (IAM) key concepts
- Describe Virtual Cloud Network (VCN) key concepts
- Create a Virtual Cloud Network (VCN) for a DB system
- Use the Console to launch a DB system
- Connect to a DB System



Manage Database Cloud Service

Bare Metal and Virtual Machine DB Systems

Objectives

After completing this lesson, you should be able to:

- Display DB System and Database State
- Start, Stop, and Reboot a DB System
- Scale DB System OCPUs
- Scale up storage for a VM DB System
- Clone a VM DB system
- Manage Tags for a DB system
- Update the Operating System for a DB System
- Terminate a DB System



Display DB System and Database State

MYDBVM

Scale Storage I/O Change Shape Done Add SSH Keys More Actions ▾

DB System Username: Tags:

General Information

Uptime: 5 days, 2 hours, 45 minutes
Availability Domain: yGLU US-ASHBURN AD-1
OCID: [MyDBVM](#) Status: Available
Shape: VM Standard2.2
Created: Fri, Dec 18, 2020, 10:14:01 UTC
Time Zone: UTC
Compartment: [ocid1.compartment.oc1..natyvCfI](#)
Oracle Database Software Edition: Enterprise Edition High Performance
Storage Management Software: Logical Volume Manager
Available Data Storage: 512 GB
Total Storage Size: 968 GB

Network

VCN: [MYVCN](#)
Client subnet: Public Subnet MYVCN
Port: 1231
Hostname Prefix: myhost
Host Domain Name: sub.12150002360.myvzn.oraclecloud.com
Scan DNS Name: Unavailable
Network Security Groups: None [Edit]

Databases

Name	State	Database Unique Name	Workload Type	Database Version	Created
MYORCL	Available	MYORCL_1edf6q	Transaction Processing	21.1.0.0.0	Fri, Dec 18, 2020, 10:14:01 UTC

Showing 1 item < 1 of 1 >

Start, Stop, and Reboot a DB System

Different actions of DB system:

- Start
- Reboot
- Copy OCID

Nodes					
Name	State	Public IP Address	Floating IP Address	Private IP Address & DNS Name	Fault Domain
myhost	Available	-	-	10.0.0.7 (myhost)	Show Copy FAULT-DOMAIN-3

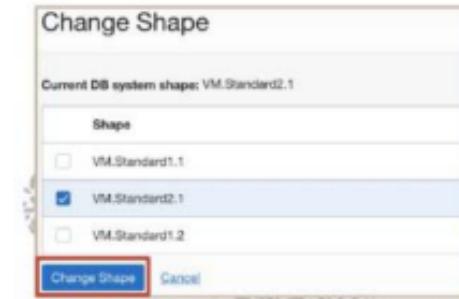
Displaying 1 Node < 1 of 1 >

Resources

- Databases (1)
- Nodes (1)**
- Patches (0)
- Patch History (0)
- Console Connections (0)
- Work Requests (0)

Scale OCPUs

- Bare Metal DB System processing power can be scaled up or down online by increasing or decreasing the number of OCPUs.
- Scaling the OCPUs of a Virtual Machine DB System requires that the shape of the system be changed.
 - The VMs will be rebooted when the shape of the VM DB system is changed.
 - For a 2-node RAC VM DB System, the shape of the VMs will be changed and rebooted one VM at a time in a rolling manner.



Scale Up Storage

- Increase the block storage at any time without impacting a Virtual Machine DB system.

The image shows two screenshots from the Oracle Cloud Infrastructure (OCI) console. On the left, the 'DB System Details' page for 'MYDBVM' is displayed. It shows general information like the compartment ('oci compute vms'), OCID ('ocid1.instance.oc1.ashburn-1'), and storage ('Available Data Storage: 256 GB'). A red box highlights the 'Scale Storage Up' button. On the right, the 'Scale Storage Up' dialog is open. It has fields for 'Available Data Storage (GB)' (set to 512) and 'Total Storage Size (GB)' (set to 968). A red box highlights the 'Update' button. Both screenshots have a red border around them.

- You cannot scale storage for Bare Metal DB Systems.

Clone a Virtual Machine DB System

- Cloning creates a copy of a source DB system as it exists at the time of the cloning operation, including the storage configuration software and database volumes.
- When creating a clone, specify a new SSH key and admin password.

The screenshot shows two main panels. On the left, the 'DB System Details > Nodes' page for 'MYDBVM' is displayed. It features a large green hexagonal icon with 'DBS' and 'AVAILABLE' text. Below it are tabs for 'DB System Information' (selected) and 'Tags'. Under 'General Information', details like Lifecycle State (Available), Availability Domain (yQUJ.US-ASHBURN-AD-1), OCID (myvqa-25ce-22c9), Shape (VM.Standard2.2), and creation date (Fri, Dec 18, 2020, 10:14:01 UTC) are shown. To the right, the 'Network' section lists VCN (MYVCN), Client subnet (Public: Subnet-MYVCN), Port (1121), Hostname Prefix (myhost), Host Domain Name (sub12150002360.myvna.oraclecloud.com), Scan DNS Name (Unavailable), and Network Security Groups (None). On the right, a 'Clone DB System' dialog box is open, prompting for a Hostname prefix ('CLEANMYHOST'), Host domain name ('www.myhost.com'), and Private IP address ('OPTIONAL'). It also includes a 'Fault domain' dropdown and a note about the fault domain being determined by the instance profile and host domain name. At the bottom of the dialog are 'Clone DB System' and 'Cancel' buttons, with the 'Clone DB System' button highlighted with a red box.

Manage Tags

- Tags for DB Systems
- Tags for Database Resources



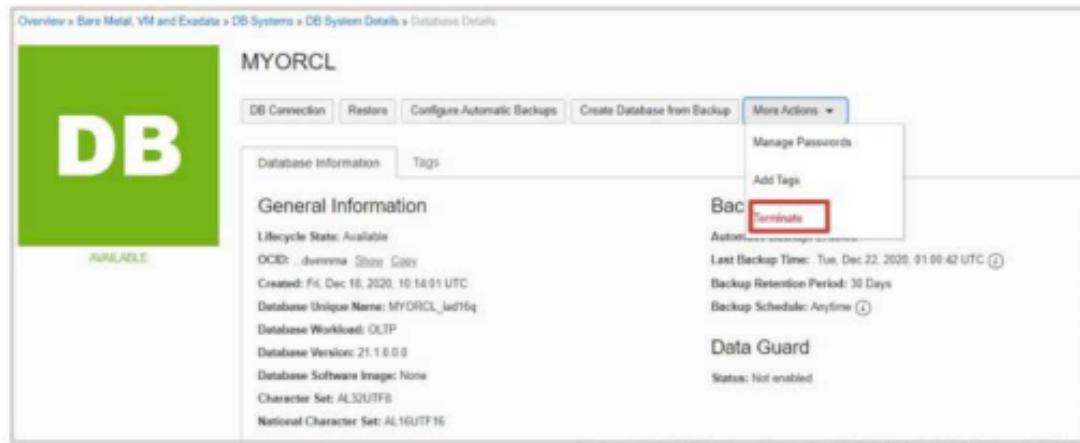
A screenshot of a web-based tag management interface. It features three input fields: "TAG NAMESPACE" (containing "None (apply a free-form tag)"), "TAG KEY" (empty), and "VALUE" (empty). Below these fields is a button "+ Additional Tag". At the bottom of the form is a blue "Apply Tag(s)" button.

Updating (Patching) the Operating System

- Updating the OS is done through the command line.
 - You can update the OS on 2-node RAC virtual machine DB systems in a rolling fashion by updating the OS one node at a time.
- To update the OS, log on to the DB system host as opc, and sudo to the root user.
- Download the repo.
 - Use the region identifier for region that contains the DB System in the download repo command.
- Download the version lock file and overwrite the existing file on the system.
- Run the update command.
- Restart the system and validate that the update was successful.
- Upgrading the OS to the next major version currently requires backup and recovery to a new DB System or setting up Oracle Data Guard on a new DB System (For example: upgrading from Oracle Linux 6 to Oracle Linux 7).

Terminate a DB System

- Terminating a DB system permanently deletes it.
- Full backups remain in Object Storage.
- This removes all automatic incremental backups of all databases from Object Storage.



Summary

In this lesson, you should have learned how to:

- Display DB System and database status
- Start, Stop, and Reboot a DB System
- Scale DB System OCPUs
- Scale up storage for a VM DB System
- Clone a DB system
- Manage Tags for a DB system
- Update the Operating System for a DB System
- Terminate a DB System



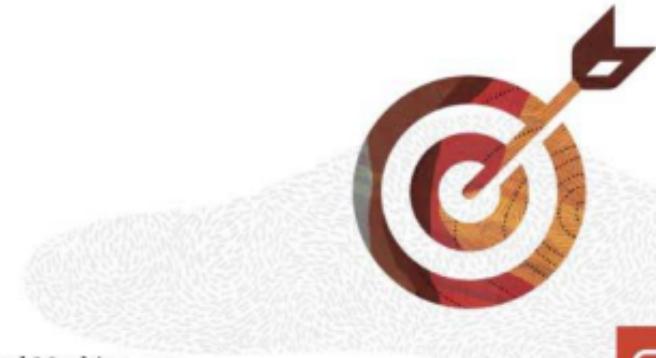
Database Cloud Service Database Lifecycle Management

Bare Metal and Virtual Machine DB Systems

Objectives

After completing this lesson, you should be able to:

- Create Databases
- Manage Pluggable Databases (PDBs)
- Backup and Restore Databases
- Update DB Systems and Databases
- Enable Data Guard



Create Databases

Create Databases

A single container database (CDB) with a single pluggable database (PDB) is created by default when a DB System is created

Bare Metal DB Systems support multiple databases on the same system

- Create additional databases from a database image or backup on an existing Bare Metal DB System

Virtual Machine DB Systems only support a single database

- Create a database from a database image or backup on a new Virtual Machine DB System
- Clone existing DB System to a new Virtual Machine DB System

Create Database

Database name: CDB\$ROOT

Database image: Oracle Database 19c

PDB name:

Create administrator credentials:

Username: Root@
Root

Create Database from Backup

Select backup timestamp:

Create database from last backup Create database from specified timestamp
Last backup created on: Thu, Apr 29, 2021, 23:09:02 UTC

Configure your DB system:

Use an existing DB system Create a new DB system

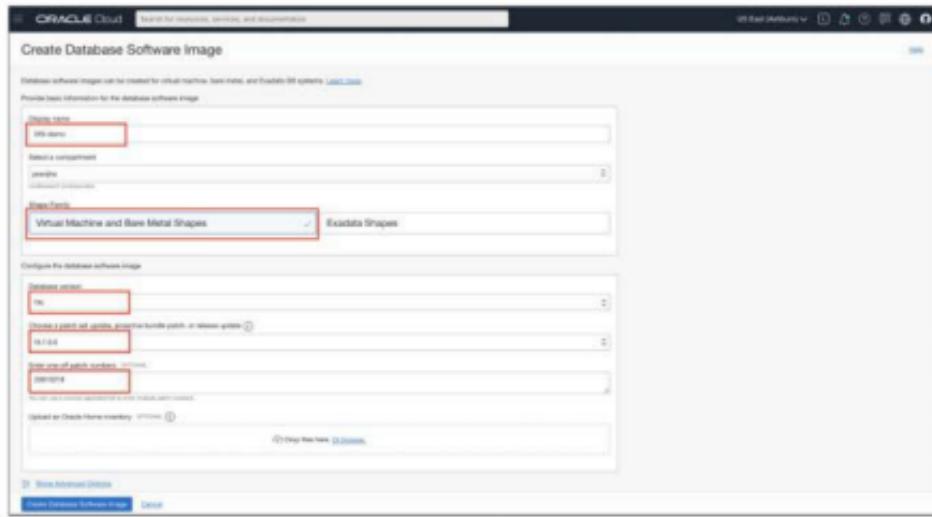
Select a compartment:

Name your DB system: DBSystem-20210429T230902

Select a shape type: Bare Metal

Custom Database Software Image

- Custom database software images
 - Created by specifying a major database version, release update (RU), one-off patches, or Database Home patch inventory (lsinventory)
 - Used to create or update databases



PDB Lifecycle Management

- Create and delete a PDB within the existing container (CDB) database
- Start and stop a PDB
- Clone a PDB into the existing CDB

The screenshot shows the Oracle Database Control interface. On the left, there's a sidebar with 'Resources' and several links: Backups (1), Updates (0), Update History (0), Data Guard Associations (0), Pluggable Databases (2), and Work Requests (1). The 'Pluggable Databases' link is highlighted with a red box. The main area is titled 'Pluggable Databases' and contains a table with two rows. A blue button labeled 'Create Pluggable Database' is visible above the table. The table has columns for Name, State, and Created. The first row shows 'PDB1' as Available, created on Mon, Jun 14, 2021, 12:08:44 UTC. The second row shows 'DB0614_0db1' as Available, created on Mon, Jun 14, 2021, 09:46:34 UTC. At the bottom right of the table, it says 'Showing 2 items < 1 of 1 >'.

Name	State	Created
PDB1	Available	Mon, Jun 14, 2021, 12:08:44 UTC
DB0614_0db1	Available	Mon, Jun 14, 2021, 09:46:34 UTC

Backup and Restore a Database

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.
- Full (on-demand) backups remain in object storage as standalone backups after a DB System or database is terminated

Configure Automatic Backups for a Database

Overview > Bare Metal, VM and Exadata > DB Systems > DB System Details > Database Details

The screenshot shows the Oracle Database System Details page for DB0902. A large green sidebar on the left displays the letters 'DB' and the word 'AVAILABLE'. The main content area has tabs for 'Database Information' and 'Tags'. A navigation bar at the top includes 'DB Connection', 'Restore', 'Configure Automatic Backups' (which is highlighted with a red box), 'Create Database from Backup', and 'More Actions'. The 'Database Information' tab is selected, showing the following details:

General Information	Backup
Lifecycle State: Available	Automatic Backup: Disabled
OCID: ...djzqyq Show Copy	Last Backup Time: Fri, Oct 9, 2020, 01:01:27 UTC ⓘ
Created: Thu, Sep 3, 2020, 05:48:10 UTC	Backup Retention Period: 7 Days
Database Unique Name: DB0902_phx16p	
Database Workload: OLTP	
Database Version: 19.7.0.0.0	
Database Software Image: None	
Character Set: AL32UTF8	
National Character Set: AL16UTF16	

Data Guard

Status: Not enabled

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 only be executed on the primary site
- Automatic backups are deleted when the DB System or database is terminated

Create an On-Demand Full Backup of a Database

The screenshot shows the Oracle Database Control interface. In the top navigation bar, 'Resources' is selected. Under 'Backups', there is a sub-menu with 'Backups (1)', 'Data Guard Associations (0)', and 'Work Requests (0)'. A red callout box points to the 'Create Backup' button, which is highlighted with a red border. Below this, a table displays one backup entry:

Name	State	Type	Encryption Key	Started	Ended
On-Demand Backup	Active	Full Backup, Initiated by User	Oracle-managed key	Tue, Dec 8, 2020, 12:16:24 UTC	Tue, Dec 8, 2020, 12:51:18 UTC

A red callout box also points to the 'Name' column of this table, with the text 'Enter Name for the backup.' A red arrow points from the 'Create Backup' button in the main menu down to the 'Name' field in the modal dialog.

In the bottom left corner of the screenshot, there is a separate 'Create Backup' dialog box. It has fields for 'Name' (set to 'On-Demand Backup') and a note about switching from RMAN or tkup_apr to the console/API. A red callout box points to the 'Name' field in this dialog with the text 'Enter Name for the backup.'

In the bottom right corner, another 'Backups' table is shown, identical to the one at the top. A red callout box points to the 'State' column of the first row, with the text 'State changed to Creating. Once Backup is complete, state changes to Active.'

Restore Database

Overview - Bare Metal, VM and Exadata - DB Systems - DB System Details - Database Details



DB0902

DB Connection **Restore** Configure Automatic Backups Create Database from Backup More Actions ▾

Database Information Tags

General Information

Lifecycle Status: Available
OCID: db-0902-shoe-001
Created: Thu, Sep 3, 2020, 05:48:10 UTC
Database Unique Name: DB0902_phx16p
Database Workload: OLTP
Database Version: 18.7.0.0.0
Database Software Image: None
Character Set: AL32UTF8
National Character Set: AL16UTF16

Backup

Automatic Backup: Disabled
Last Backup Time: Fri, Oct 9, 2020, 01:01:27 UTC ⓘ
Backup Retention Period: 7 Days

Data Guard

Status: Not enabled

Restore Database

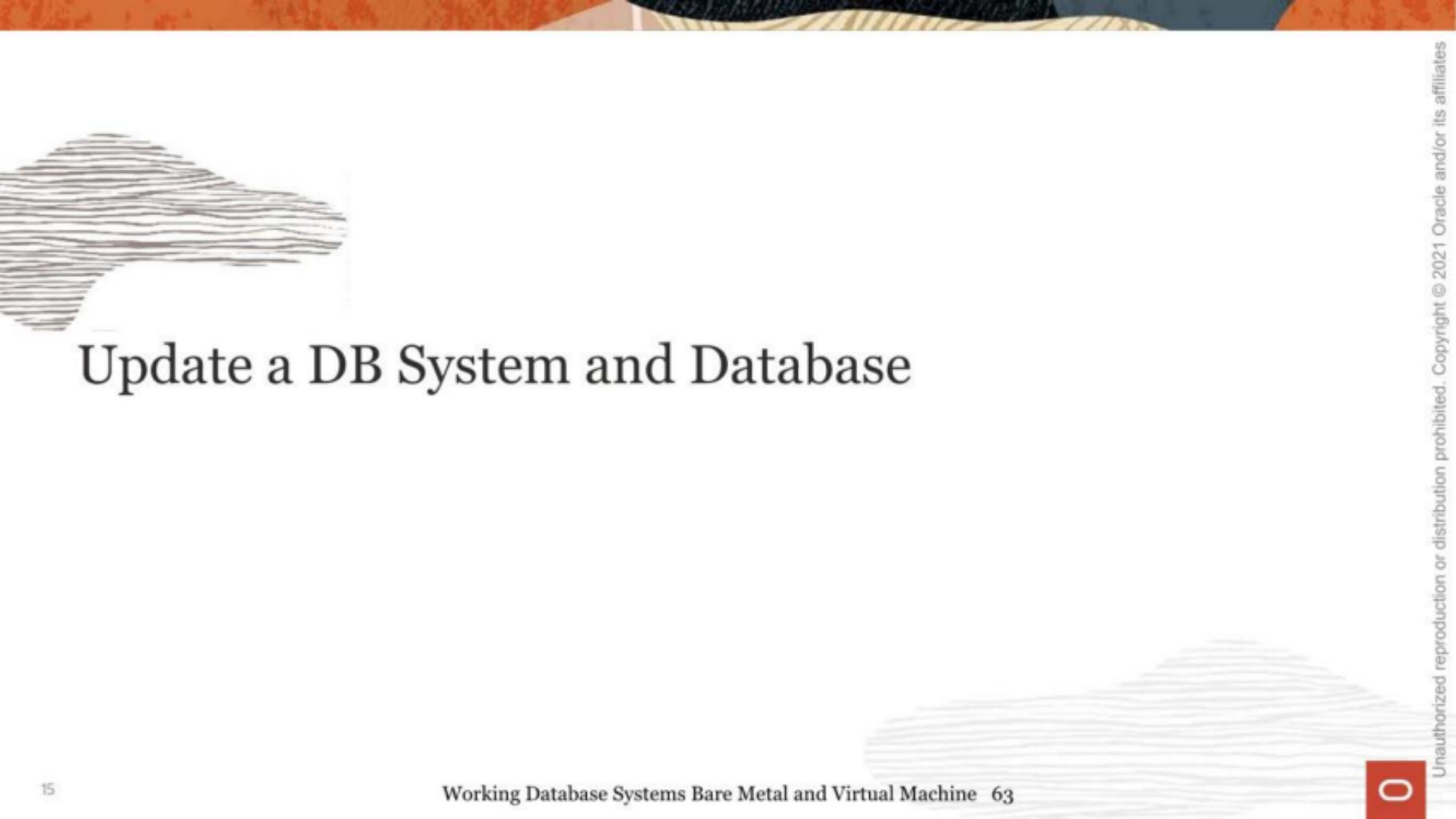
Restore to the latest
The service will restore to the last known good state with the least possible data loss.

Restore to the timestamp
The service will restore to the timestamp specified.

Restore to System Change Number (SCN)
The restore operation will use the backup with SCN (System Change Number) specified. The SCN must be valid for the operation to succeed.

Restore Database Cancel

Restore database by selecting the appropriate backup.



Update a DB System and Database

Best Practices for updating 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 updating 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 it first to maintain system availability

Update a DB System

- Update the DB System for systems with Grid Infrastructure/ASM storage management
 - Updates the Grid Infrastructure
 - Not applicable for Virtual Machine DB Systems with LVM storage management
 - 2-node RAC Virtual Machine DB System updates are rolling
 - Operating System updates must be done separately

Resources	Patches				Run DB System Precheck and Apply update when ready
	Patch description	State	Version	Release date	
Databases (1)	Apr 2021 19c Db System patch	Available	19.11.0.0.210420	Tue, Apr 20, 2021 01:00:00 UTC	
Nodes (1)					
Patches (2)					
Patch History (2)	Jan 2021 19c Db System patch	Applying	19.10.0.0.210119	Tue, Jan 19, 2021 01:00:00 UTC	<div><button>Run Precheck</button> <button>Apply</button> <button>Copy OCID</button></div>
Console Connections (0)					
Work Requests (3)					

Update a Database

- Choose an Oracle Provided Database Software Image or a Custom Database Software Image you have previously created
- 2-node RAC Virtual Machine DB System database updates are rolling

Updates

Choose Database Patch Precheck and Apply update when ready

Patch description	Type	State	Version	Release date	Action
Apr 2021 19c Database patch	Patch	Available	19.11.0.0.210420	Tue, Apr 20, 2021, 01:00:00	Precheck
Jan 2021 19c Database patch	Patch	Available	19.10.0.0.210119	Tue, Jan 19, 2021, 01:00:00	Apply
Oct 2020 19c Database patch	Patch	Available	19.9.0.0.201020	Tue, Oct 20, 2020, 01:00:00	Copy OCID
Jul 2020 19c Database patch	Patch	Available	19.8.0.0.200714	Tue, Jul 14, 2020, 01:00:00 UTC	...

Upgrade a Database to 19c

- Choose an Oracle Provided Database Software Image or a Custom Database Software Image you have previously created for Oracle Database 19c
- Database upgrades are not rolling and require downtime
- Oracle Linux 7 is required to upgrade the database to 19c
- Grid Infrastructure 19c is required for DB Systems with Grid Infrastructure/ASM storage management

Updates

The screenshot shows a table of software images. The first row is for 'Oracle Provided Database Software Images'. The second row is for 'Custom Database Software Images'. The third row is for 'Patch description: Database Release Update 18.15.0.0.210720', which is a 'Patch' type and 'Available'. The fourth row is for 'Oracle Database 19.0.0.0', which is an 'Upgrade' type and 'Available'. The fifth row is for 'Oracle Database 19.10.0.0', which is an 'Upgrade' type and 'Available'. The sixth row is for 'Oracle Database 19.11.0.0', which is an 'Upgrade' type and 'Available'. A red box highlights the 'Upgrade' row for Oracle Database 19.0.0.0. A pink callout bubble with the text 'Choose Database Upgrade Precheck and Apply Upgrade when ready' points to the 'Precheck' and 'Upgrade' buttons in the row for Oracle Database 19.0.0.0.

Oracle Provided Database Software Images					Custom Database Software Images
Patch description	Type	State	Version	Release date	
Database Release Update 18.15.0.0.210720	Patch	Available	18.15.0.0.210720	Tue, Jul 20, 2021, 00:00:00 UTC	
Oracle Database 19.0.0.0	Upgrade	Available	19.0.0.0	-	<button>Precheck</button> <button>Upgrade</button>
Oracle Database 19.10.0.0	Upgrade	Available	19.10.0.0	-	
Oracle Database 19.11.0.0	Upgrade	Available	19.11.0.0	-	

View DB System and Database Patch History

Resources

Databases (1)

Nodes (1)

Patches (2)

Patch History (2)

Console Connections (0)

Work Requests (3)

Patch History

Description	State	Operation Type	Started	Ended	...
Jan 2021 19c Db System patch	● Applying	Apply	Fri, Apr 30, 2021, 05:02:59 UTC	—	...
Jan 2021 19c Db System patch	● Precheck Passed	Precheck	Fri, Apr 30, 2021, 04:36:24 UTC	Fri, Apr 30, 2021, 04:43:01 UTC	...

Showing 2 Items < 1 of 1 >

Enable Data Guard

Enable Oracle Data Guard

- Data Guard ensures high availability, data protection, and disaster recovery. It maintains the standby database by transmitting and applying redo data from the primary database
- Enabling Data Guard requires two DB Systems, one for the primary database and one containing the standby database
 - For a virtual machine DB System database, a new DB System with the standby database is created
 - For a bare metal DB system, the DB system with the database that you want to use as the standby must already exist
- Only one standby database can be enabled for each primary database with the console



Data Guard Requirements

- Both DB Systems must be in the same compartment
- If your primary and standby databases are in the same region, then both must use the same virtual cloud network (VCN)
- If your primary and standby databases are in different regions, then you must peer the virtual cloud networks (VCNs) for each database
- Both DB Systems must be the same shape type (for example, both primary and standby must be either Bare Metal or Virtual Machine DB Systems and either single-node or 2-node RAC)
- The database versions and editions must be the same
- Each database in a Data Guard association must have a unique name `DB_UNIQUE_NAME` value; the primary and standby database can use the same database name `DB_NAME` value
- Configure the security list ingress and egress rules for the subnets of both DB systems in the Oracle Data Guard association to enable TCP traffic to move between the applicable ports; ensure that the rules you create are stateful (the default)

Data Guard Configuration Options and Operations

- Choice of protection mode is set when Data Guard is enabled and it can be changed at any time
 - Maximum Performance supports only ASYNC transport type
 - Maximum Availability supports only SYNC transport type
- Switchover or failover is used to transition the primary to the standby database
 - Switchover – ensures no data loss by reversing the primary and standby database roles
 - Failover – transitions the standby database into the primary role after the primary database fails or becomes unreachable
- Reinstate is used return a failed database into service after correcting the cause of failure

Summary

In this lesson, you should have learned to:

- Create Databases
- Manage Pluggable Databases (PDBs)
- Backup and Restore Databases
- Update DB Systems and Databases
- Enable Data Guard



Monitoring a Database on Bare Metal and Virtual Machine DB Systems

Objectives

After completing this lesson, you should be able to:

- Monitor a database with the OCI Metric Charts
- Describe the Enterprise Manager monitoring options
- Explain Enterprise Manager benefits
- Monitor a database with Enterprise Manager Database Control
- Open ports on the DB system
- Update the security list for the DB System



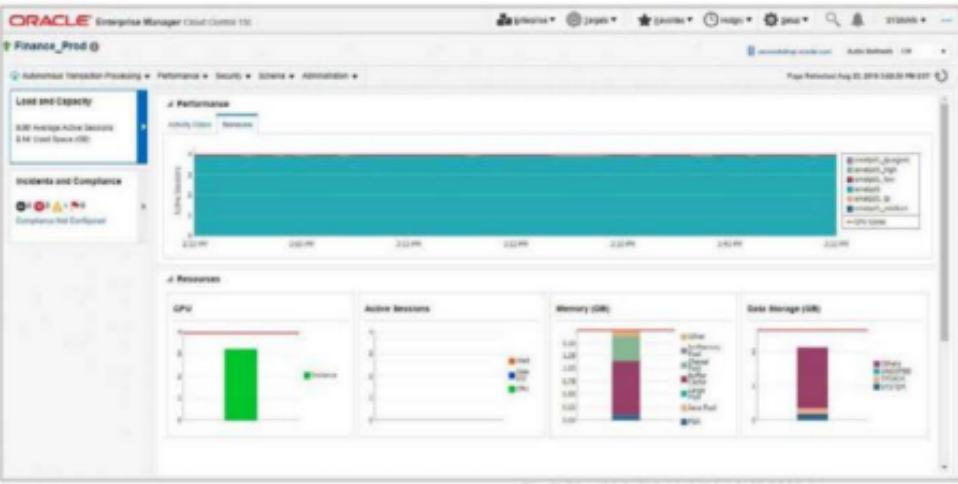
Monitoring with OCI Metric Charts

- 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.



Enterprise Manager: Features

- It provides a comprehensive monitoring and management solution for Oracle Database and Engineered Systems deployed in cloud and customer data centers.
- Run Enterprise Manager on-premises and in Oracle Cloud Infrastructure.
- Find, fix, and validate problems faster with integrated, automated, and deep dive interactive analytics.
- Automate database lifecycle management from discovery, provisioning and cloning, patching, configuration and compliance management, and ongoing change management.



Enterprise Manager: Benefits

Hybrid Cloud Management

- Fleet monitoring, management, and data movement across entire IT estate – on-premises and in the cloud
- Support for OCI Database resources – Autonomous DB, ExaCS, and ExaCC

Ops Automation

- Enhanced automation and modernization of key management tasks
- Self-service deployment of databases across on-premises and OCI with **Hybrid DB-as-a-Service**
- Simplifies data movement from on-premises to OCI with **DB Migration Workbench**

Extensibility

- Open standards-based extensions for interoperability with third-party ecosystems (Grafana etc.)

Enterprise Manager: Monitoring Options

Set up:

- An Enterprise Manager Database Control console to monitor a 11.2.0.4 database
- Enterprise Manager 13c and later to monitor 11.2.0.4 and later database versions





Enterprise Manager Database Control Console to Monitor an 11.2.0.4 Database

Enabling Enterprise Manager Database Control

By default, the EM Database Control console is not enabled on 11.2.0.4 database.

To enable EM Database Control:

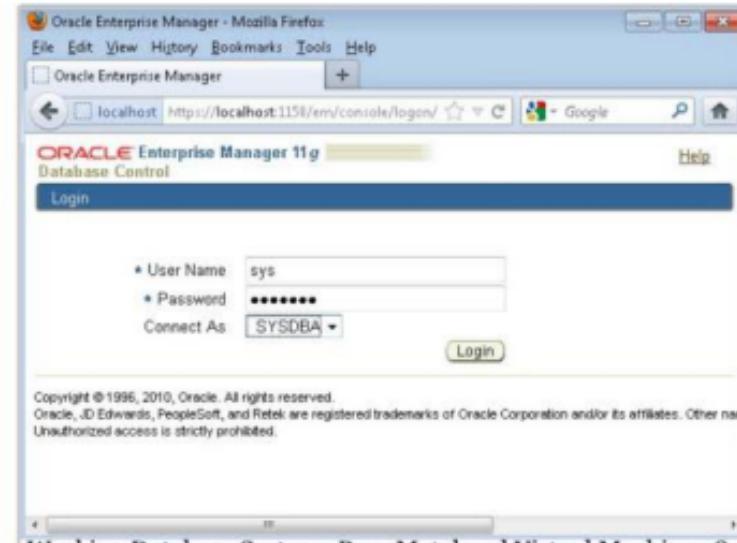
1. SSH to the DB system, log in as `opc`, and sudo to the `oracle` user.
2. Use the following command to get the port number:

```
$ emctl status dbconsole
```

3. Open the console's port.
4. Update the security list for the console's port.

Connecting to EM Database Control Console

- From a web browser, connect to the console by using:
`https://<ip_address:<port>/em`
- A login page is displayed. Enter valid database credentials.



Opening Ports on the DB System

Ports needed for the DB system:

- **6200**: For Oracle Notification Service (ONS)
- **1158**: For EM Database. 1158 Control is the default port. Additional DB console enabled will have a different port.

Opening a Port on the DB System

1. SSH to the DB system. Log in as `opc` and then sudo to the root user.
2. Save a copy of iptables as a backup:

```
[root@dbsys ~]# iptables-save > /tmp/iptables.orig
```

3. Dynamically add a rule to iptables to allow inbound traffic on the console port:

```
[root@dbsys ~]# iptables -I INPUT 8 -p tcp -m state --state NEW  
-m tcp --dport 1158 -j ACCEPT -m comment --comment "___".
```

4. Make sure that the rule was added:

```
[root@dbsys ~]# service iptables status
```

5. Save the updated file to `/etc/sysconfig/iptables`:

```
[root@dbsys ~]# /sbin/service iptables save
```

The change takes effect immediately.

6. Update the DB system's security list.

Updating the Security List for the DB System

1. Review the list of ports.
2. For every port open in iptables, update the security list or create a new security list.
3. Port 1521, the default port for Oracle listener, is included in the iptables.



Updating an Existing Security List

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. Locate the DB system in the list.
4. Note the DB system's subnet name and click its Virtual Cloud Network.
5. Locate the subnet in the list, and then click its security list under Security Lists.
6. Click **Edit All Rules** and add an ingress rule with source type = CIDR, source CIDR=<source CIDR>, protocol=TCP, and port=<port number or port range>.



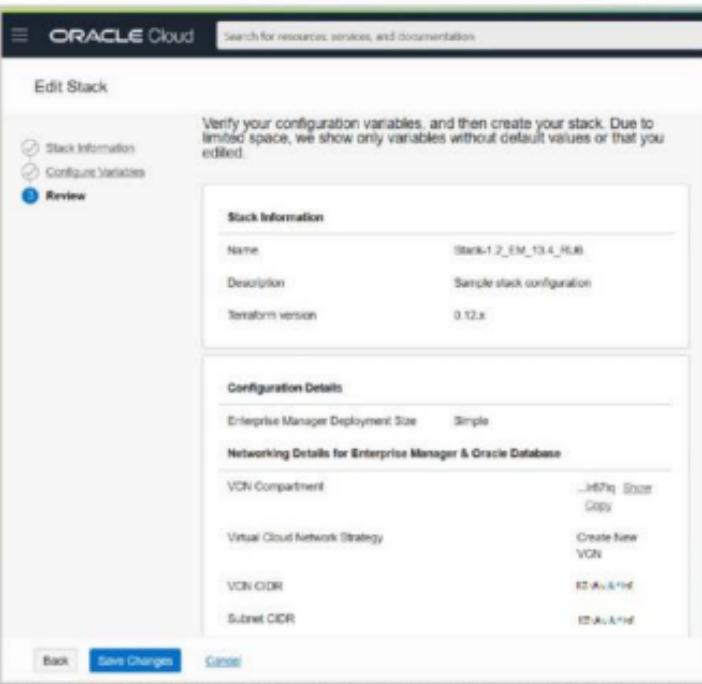
Enterprise Manager 13c and Later to Monitor 11.2.0.4 and Later Database Versions

Enterprise Manager 13.4

- Oracle Enterprise Manager 13.4 on Oracle Cloud Infrastructure can be deployed on both Single and Multi-Node configurations allowing you to customize Oracle Enterprise Manager to your specific infrastructure needs.
- Enterprise Manager 13.4 on Cloud Infrastructure uses the latest OCI Linux image: OL 8.
- It provides the ability to create and define your own OCI resources.
- Configure credentials for Enterprise Manager and databases at spin up time.
- OMR is on the latest version of 19c pluggable database that is also TDE (Transparent Data Encryption) enabled, ensuring safety on the Cloud.
- OMS Nodes and Bastion can be scaled to fit your needs by rerunning the stack and selecting a new shape for both. This applies for both Single and Multi-Node deployments.

Enterprise Manager 13.4: Single Node Deployments

1. Before deploying Oracle Enterprise Manager, review and perform all prerequisite tasks, such as shape recommendation to support number of targets, OCI Services limits to support the shape, and network requirements.
2. Log in to OCI Marketplace and search for Enterprise Manager.
3. Specify the Deployment type Simple and Number of OMS Nodes of 1.
4. Enter the VCN Network details, the OMS details (passwords, shape, storage size), WebLogic password, and the Oracle Database System details (password, license, shape, storage).
5. Click Save Changes to finalize editing the stack and initiate stack deployment automatically.



Required Ports for Enterprise Manager 13.4: Single Node

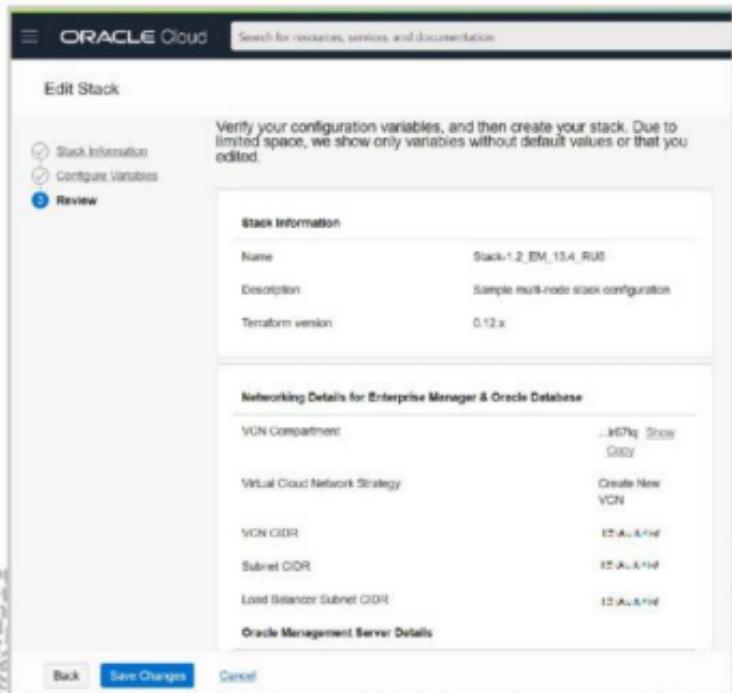
Port	Service
TCP/22	SSH for Bastion and Enterprise Manager
TCP/7799	Enterprise Manager Console
TCP/7101	Enterprise Manager Web Logic Console and Admin Server
TCP/7401	Enterprise Manager Node Manager
TCP/7301	Managed Server / Java Virtual Machine Diagnostics (JVMD)
TCP/4900	Enterprise Manager Agent Upload
TCP/3872	Enterprise Manager Agent Listen (OMS & Database Nodes)
TCP/9899	BI Publisher Console
TCP/1521	Database Listener
TCP/22	Database Node

Enterprise Manager 13.4: Multi-Node Deployments

- Multi-node deployments can be set up for High Availability.
 - **Oracle Cloud Infrastructure Load Balancing service:** The Load Balancer nodes will be on different Availability Domains for High Availability.
 - **Oracle Management Service:** Choose different Availability Domains for each OMS node if you require High Availability.
 - **OMR:** The OCI Database System provides an option to have nodes on different Fault domains but will be on the same Availability Domain.
- Oracle Cloud Infrastructure Load Balancing service can be placed either in public or private subnet.
- The bastion host is required and always deployed since both Enterprise Manager and Database are deployed in a private subnet.

Enterprise Manager 13.4: Multi-Node Deployments

1. Before deploying Oracle Enterprise Manager, review and perform all prerequisite tasks such as shape recommendation to support number of targets, OCI Services limits to support the shape, and network requirements.
2. Log in to OCI Marketplace and search for Enterprise Manager and filter by type “Stack.”
3. Specify the Deployment type Multi-node.
4. EM Deployment Size: Small, Medium, Large and Number of OMS Nodes of 2.
5. Enter the VCN Network details, the OMS details (passwords, shape, storage size), WebLogic password, and the Oracle Database System details (password, license, shape, storage).
6. Click Save Changes to finalize editing the stack and initiate stack deployment automatically.



Required Ports for Enterprise Manager 13.4: Multi-Node

Port	Service
TCP/22	SSH for Bastion and Enterprise Manager, Database Node
TCP/443	Console Load Balancer
TCP/7799	Enterprise Manager Console
TCP/7101	Enterprise Manager Web Logic Console and Admin Console
TCP/7401	Enterprise Manager Node Manager
TCP/7301	Managed Server / Java Virtual Machine Diagnostics (JVMD)
TCP/4900	Enterprise Manager Agent Upload
TCP/3872	Enterprise Manager Agent Listen (OMS & Database Nodes)
TCP/5443	BI Publisher Console
TCP/3872	Agent Listen (OMS and Database Nodes)
TCP/1521	Database Listener
TCP/6200	DB Nodes (ONS/FanManager)
UDP/111 UDP/2048 TCP/111 TCP/2048-2050	NFS Service

Summary

In this lesson, you should have learned how to:

- Monitor a database with the OCI Metric Charts
- Learn about Enterprise Manager monitoring options
- Explain Enterprise Manager benefits
- Monitor a database with Enterprise Manager Database Control
- Open ports on the DB system
- Update the security list for the DB System



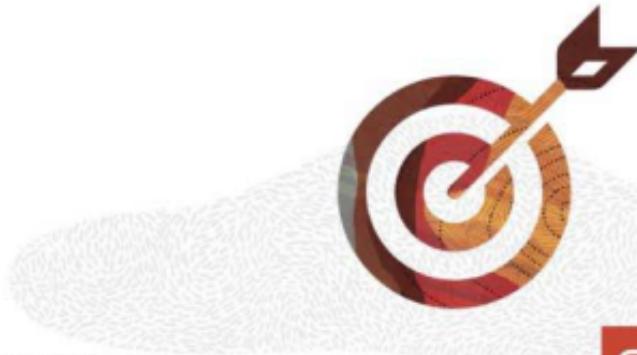
Database Cloud Service Maximum Availability Architecture

Bare Metal and Virtual Machine DB Systems

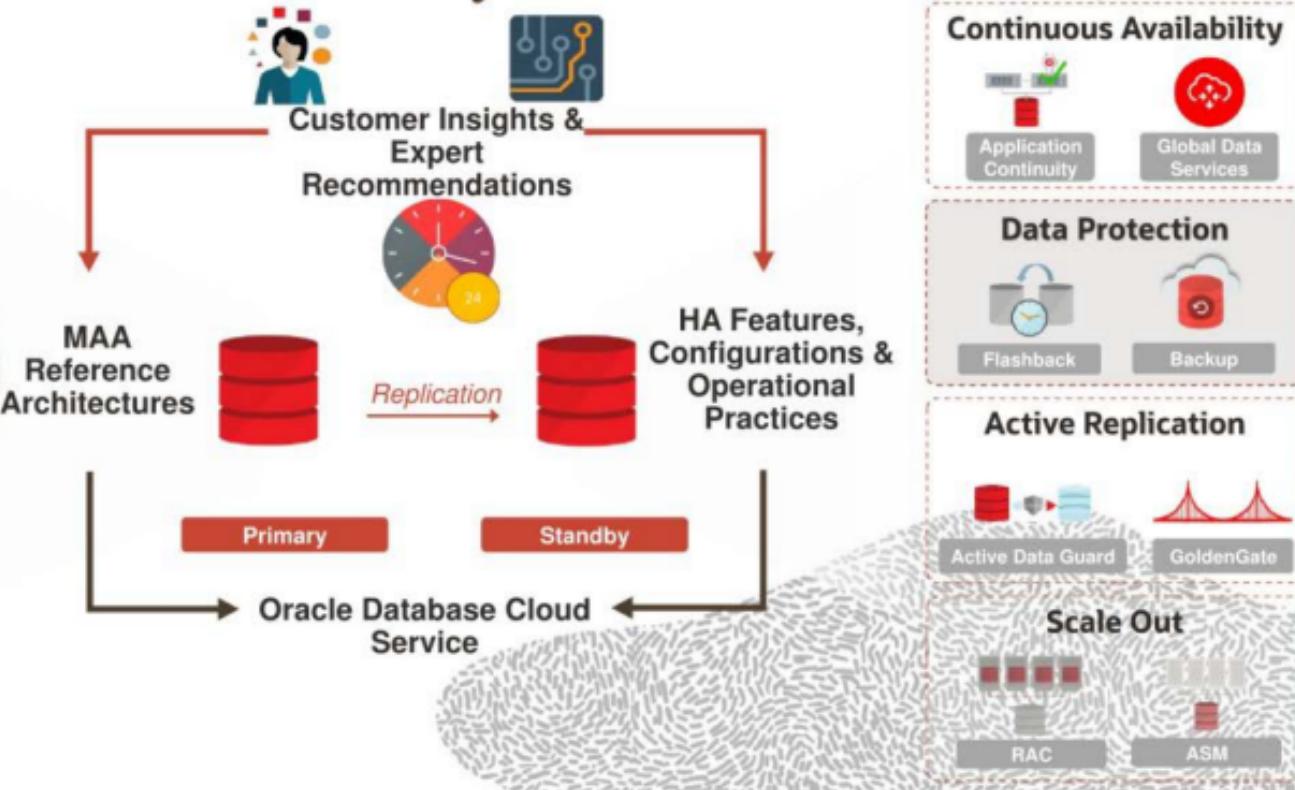
Objectives

After completing this lesson, you should be able to:

- Describe the Maximum Availability Reference Architecture for Bare Metal and Virtual Machine DB Systems



Oracle Maximum Availability Architecture (MAA)



Database Cloud Service

Maximum Availability Architecture

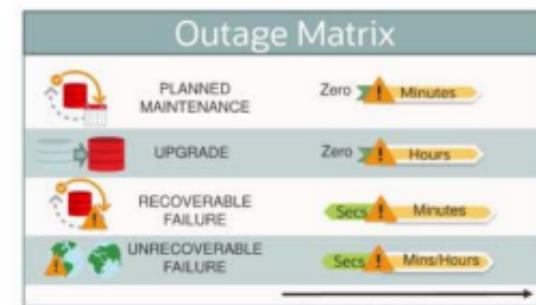
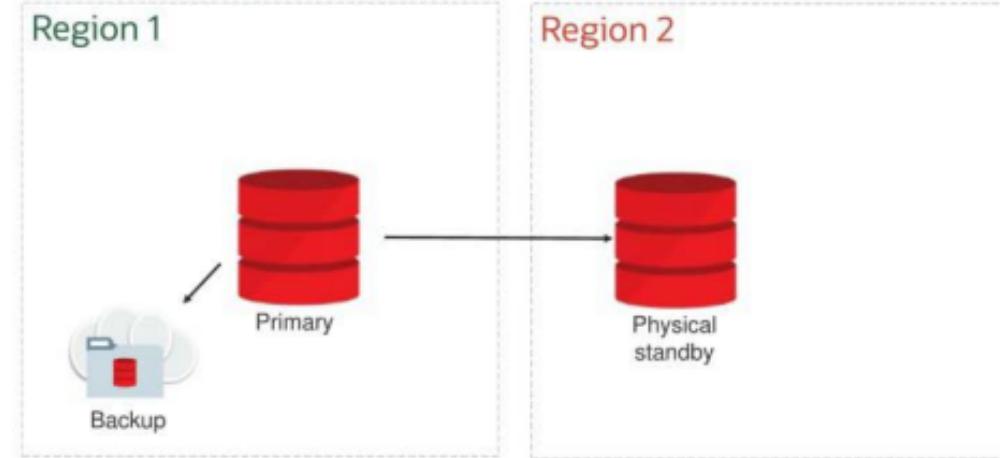
Bare Metal DB Systems

Database Cloud Service 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 			

Database Cloud Service BM: protection out of the box

AVAILABILITY / AUTOMATION *	
RMAN	1 copy to 3-way mirrored Object Storage via automated OCI backups
RAC	Not possible
ACTIVE DATA GUARD	Standard Data Guard only, via console or DBaaS API (1 SB only, symmetric only)
GOLDEN GATE	Manual (capture & delivery)
MAA LEVEL	Out of the box



- * Automated via control plane
- Manual setup
- Not available/possible

Database Cloud Service

Maximum Availability Architecture

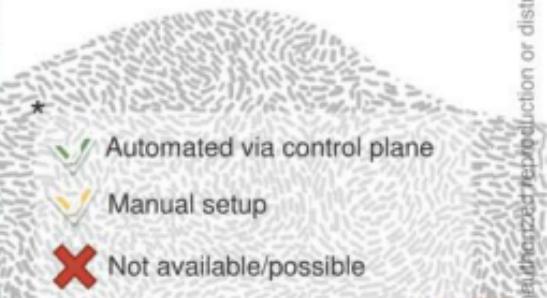
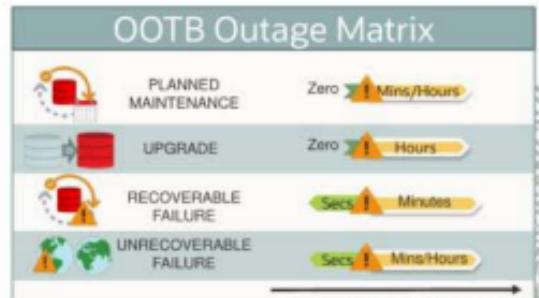
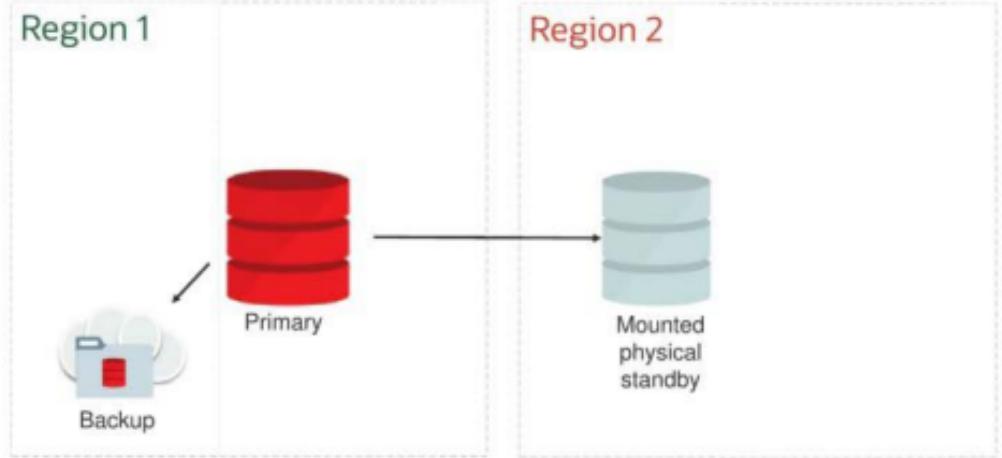
Virtual Machine DB Systems

Database Cloud Service 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					

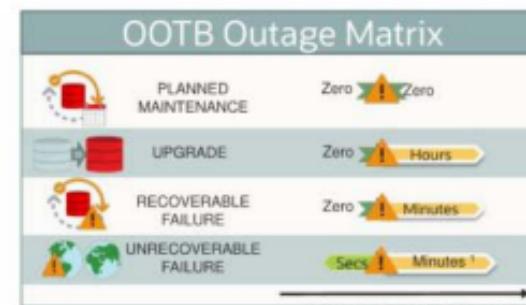
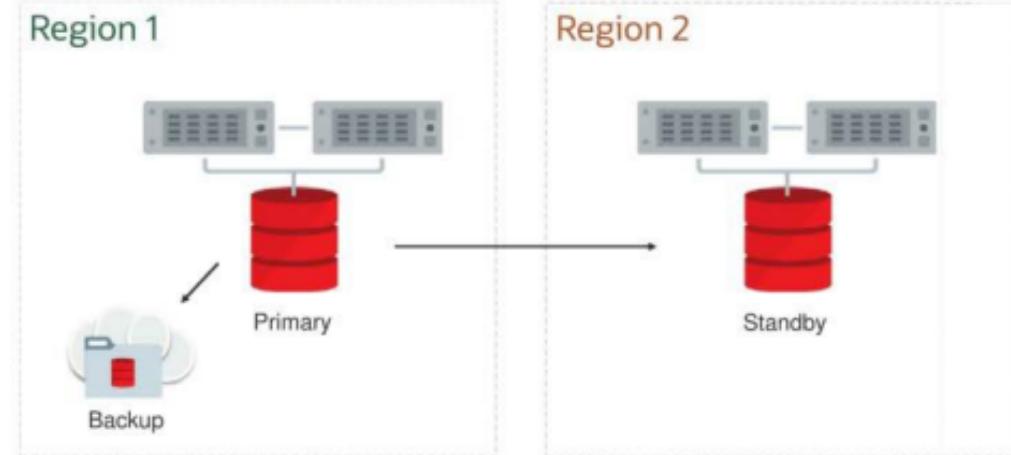
Database Cloud Service VM 1-Node: protection out of the box

AVAILABILITY / AUTOMATION *	
RMAN	1 copy to 3-way mirrored object storage via automated OCI backups
RAC	Only for 2 nodes EE Extreme Performance
ACTIVE DATA GUARD	Standard Data Guard only, via console or DBaaS API (1 SB only, symmetric only)
GOLDEN GATE	Manual (capture & delivery)
MAA LEVEL	Out of the box



Database Cloud Service VM RAC: protection out of the box

AVAILABILITY / AUTOMATION *	
	RMAN 1 copy to 3-way mirrored object storage via automated OCI backups
	RAC Only for 2 nodes EE Extreme Performance
	ACTIVE DATA GUARD Via console or DBaaS API (1 SB only, symmetric only)
	GOLDEN GATE Manual (capture & delivery)
MAA LEVEL	Out of the box + Data Guard SILVER GOLD



* No FSFO, based on time after customer action

 Automated via control plane

 Manual setup

 Not available/possible

Database Cloud Service: Data Guard via control plane

	SETUP	<ul style="list-style-type: none">• 1-click setup from control plane• Uses Data Guard broker• Only via DUPLICATE FROM ACTIVE DATABASE	 ACTIVE DATA GUARD
	TOPOLOGY	<ul style="list-style-type: none">• No far sync, cascade or multiple standby databases• Possible only between DBCS BM or VMs• Not supported between RAC and single instance	
	PROTECTION	<ul style="list-style-type: none">• Asynchronous configuration by default (protection level MAX PERFORMANCE)• Synchronous configuration (protection level MAX AVAILABILITY)• Data Guard fast-start failover is a manual setup	
	ROLE CHANGES	<ul style="list-style-type: none">• Out-of-band role transition is not recommended but DB role status will be resynchronized in minutes	
	OPEN MODE	<ul style="list-style-type: none">• It depends on Database software edition (ADG only with Extreme Performance)	
	PATCHING UPGRADE	<ul style="list-style-type: none">• No guided patching of databases but control plane understands the role and does not apply datapatch on a standby• No support for rolling upgrade	

Database Cloud Service: Data Guard best practices

- Always use Grid Infrastructure storage management (ASM) for Data Guard environments
 - It includes Oracle Notification Services (ONS)
 - No static listener entries required
 - Service control (srvctl)
- Data Guard on LVM is supported but lacks above functionalities
- Always use custom application services
- Changing listener port is not supported (but additional ports can be added)
- db_block_checking is set by default to:
 - FULL on Grid Infrastructure, consider performance implications when migrating
 - TYPICAL on LVM
- Custom DB software images are recommended
- Only use VCN connectivity and not public network
- Put FSFO observer with the applications or in a 3rd region

Summary

In this lesson, you should have learned to:

- Describe the Maximum Availability Reference Architecture for Bare Metal and Virtual Machine DB Systems



Database Cloud Service Management Interfaces

Bare Metal and Virtual Machine DB Systems

Objectives

After completing this lesson, you should be able to explain the different Management Interfaces for Bare Metal and Virtual Machine DB Systems.



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

Using the CLI to Create and Manage DB Systems

- OCI CLI is the command-line interface for OCI console functionality and is the preferred method to perform tasks via command line.
 - Example: `oci db backup create [OPTIONS]`
- Database CLI (dbcli) is a command-line interface that is available only on bare metal and virtual machine DB systems and must be run on the host. It contains some additional functionality that is not available in OCI CLI.
 - Example: `dbcli update-database` to associate a backup configuration with a database
 - `dbcli` is in the `/opt/oracle/dcs/bin/` directory. This directory is included in the path for the root user's environment.
 - Use the `cliadm update-dbcli` command to update `dbcli` with the latest new and updated commands. On RAC VM DB Systems, execute command on each node.

Summary

In this lesson, you should have learned how to explain the different Management Interfaces for Bare Metal and Virtual Machine DB Systems.

