

Cloud Engineering

Week 9 Intro



Typical Week

Typical Week

Watch Lecture Videos for the week before your first class

Attend every Q&A session – useful assessment tips

Attend every Lab

- Read Entire Instructions before Class
- Can get ahead on labs using Lab Reports to free up time

Start working on assignments and preparing for tests early

Typical Week

Typical Week

Consultation

- Every Teaching Week
- Underutilised

Discussion Board on Swinburne Canvas

- General questions

Lectures to watch

Lectures to watch

Swinburne Lectures

- High Level Overview
- Needed to pass

Oracle Lecture Videos

- Deep Dive
- More Topics and More Depth
- Aiming for high marks
- Prepare for certification

Week 9 Intro

This week:

Storage:

- Block Volume
- File storage
- Object Storage

Database:

- Available DB Systems on OCI
- Autonomous DB (ADB)
- Data Guard



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Storage Services

Week 9 Intro - Storage Services

Storage Services

Block Volume

File Storage

Object Storage

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Database

Available DB Systems on OCI

Exadata

RAC

Bare Metal

VM

Autonomous DB (ADB)

Full automation of all DB Operations

SQL Commands – can't access OS or container

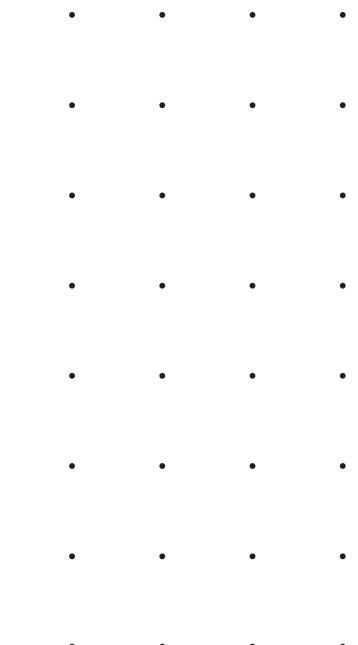
Exadata Performance

Use Cases: Data Warehouse or Transaction Processing

Data Guard

Replica (Standby Database)

- High Availability
- Data Protection
- Disaster Recovery



Next week

Week 9 Intro – Next Week

Next Week

Security

- IAM Policies
 - Data Encryption
 - WAF
 - Monitoring

Billing and Cost Management

Lecture References

References

Recommend Viewing

Swinburne Lecture – High Level Overview

Oracle Academy – Deeper dive



Cloud Engineering

Storage Intro and Block Volume



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Storage Intro and Block Volume

This Presentation:

- Storage Intro
- Local NVMe
- Block Volume
 - Creating/Attaching/Detaching/Deleteing
 - Resize
 - Backup and Restoration
 - Clone and Volume Groups
 - Boot Volumes



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Storage Intro and Block Volume

Storage Intro

Traditional Storage

USB key/thumb drive, HDD, SSD, Tape Drive, CD, DVD, Blu-Ray etc.

Servers, NAS, SAN, DAS, PCs, laptops etc.

Different drives for different use cases

Storage Intro and Block Volume

Storage Intro

Cloud Storage

Block Storage

File Storage

Object Storage

OCI Storage Services

	Local NVMe	Block Volume	File Storage	Object Storage	Archive Storage
Type	NVMe SSD based temporary storage	NVMe SSD based block storage	NFSv3 compatible file system	Highly durable Object storage	Long-term archival and backup
Durability	Non-persistent; survives reboots	Durable (multiple copies in an AD)	Durable (multiple copies in an AD)	Highly durable (multiple copies across ADs)	Highly durable (multiple copies across ADs)
Capacity	Terabytes+	Petabytes+	Exabytes+	Petabytes+	Petabytes+
Unit Size	51.2 TB for BM, 6.4-25.6 TB for VM	50 GB - 32 TB/vol. 32 vols/instance	Up to 8 Exabyte	10 TB/object	10 TB/object
Use cases	Big Data, OLTP, high performance workloads	Apps that require SAN like features (Oracle DB, VMW, Exchange)	Apps that require shared file system (EBS, HPC)	Unstructured data incl. logs, images, videos	Long term archival and backups (Oracle DB backups)

Local NVMe Storage

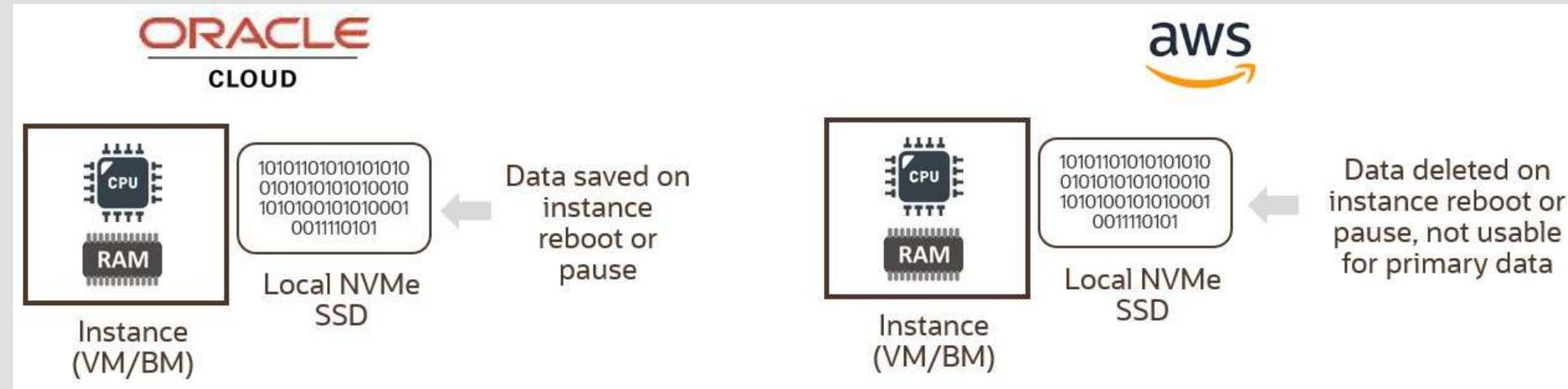
Local NVMe SSD Devices

- Some instance shapes in OCI include locally attached NVMe devices
- Local NVMe SSD can be used for workloads that have high storage performance requirements
- Locally attached SSDs are not protected and OCI provides no RAID, snapshots, backups capabilities for these devices
- Customers are responsible for the durability of data on the local SSDs

Instance type	NVMe SSD Devices
BM.DenseIO2.52	8 drives = 51.2 TB raw
VM.DenseIO2.8	2 drive = 6.4 TB raw
VM.DenseIO2.16	4 drives = 12.8 TB raw
VM.DenseIO2.24	8 drives = 25.6 TB raw

```
[opc@nvme ~]$ lsblk
NAME   MAJ:MIN RM  SIZE RO TYPE MOUNTPOINT
nvme0n1 259:0    0  5.8T  0 disk
nvme1n1 259:3    0  5.8T  0 disk
nvme2n1 259:1    0  5.8T  0 disk
nvme3n1 259:2    0  5.8T  0 disk
nvme4n1 259:5    0  5.8T  0 disk
nvme5n1 259:6    0  5.8T  0 disk
nvme6n1 259:4    0  5.8T  0 disk
nvme7n1 259:7    0  5.8T  0 disk
sda      8:0      0 46.6G 0 disk
└─sda2   8:2      0   8G  0 part [SWAP]
└─sda3   8:3      0 38.4G 0 part /
└─sda1   8:1      0 200M 0 part /boot/efi
```

NVMe SSD Persisted - Reboot/Pause



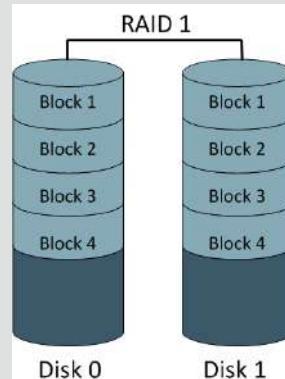
“With Oracle Cloud Infrastructure, companies can leverage NVMe for persistent storage to host databases and applications. However, other cloud providers typically do not offer such a capability. In cases where NVMe storage was an option with other vendors, it was not persistent. This meant that the multi-terabyte database that researchers loaded to this storage was lost when the server stopped.”

- Accenture

Protecting NVMe SSD Devices

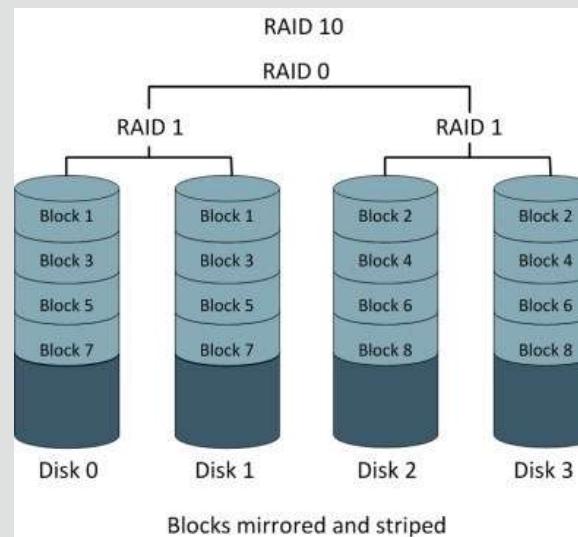
RAID 1:

An exact copy (or mirror) of a set of data on two or more disks



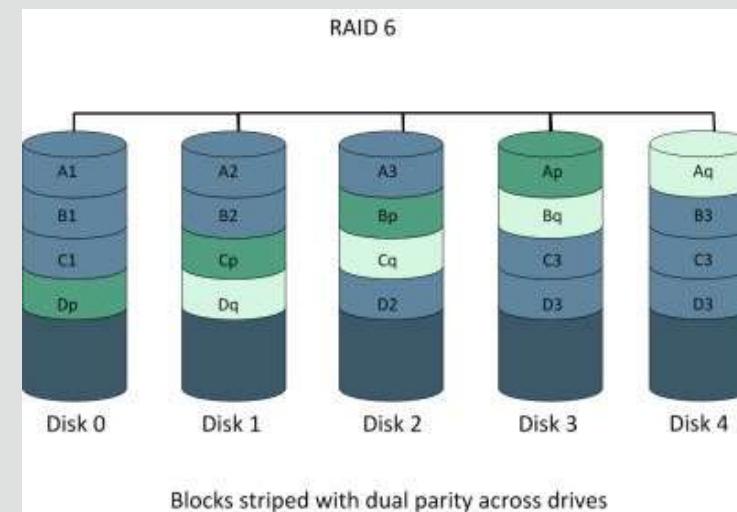
RAID 10:

Stripes data across multiple mirrored pairs. As long as one disk in each mirrored pair is functional, data can be retrieved



RAID 6:

Block-level striping with two parity blocks distributed across all member disks



SLA For NVMe Performance

Shape	Minimum Supported IOPS
VM.DenseIO1.4	200k
VM.DenseIO1.8	250k
VM.DenseIO1.16	400k
BM.DenseIO1.36	2.5MM
VM.DenseIO2.8	250k
VM.DenseIO2.16	400k
VM.DenseIO2.24	800k
BM.DenseIO2.52	3.0MM

- OCI provides a service-level agreement (SLA) for NVMe performance
- Measured against 4k block sizes with 100% random write workload on Dense IO shapes where the drive is in a steady-state of operation
- Run test on Oracle Linux shapes with 3rd party Benchmark Suites, <https://github.com/cloudharmony/block-storage>

Block Volume Storage

Block Volume

- Remote NVMe Storage
- Can persist beyond compute instance lifespan
- Raw Storage – using protocol e.g. iSCSI
- Create/Attach/Connect/Move as needed

Block Volume – Typical Use Cases

- Persistent Storage
- Durable Storage
- Add Storage (Expand)
- Instance scaling

Block Volume Service continued

Capacity	Configurable: 50 GB to 32 TB (1GB increments)
Perf: disk type	NVMe SSD based
Perf: IOPS	60 IOPS/GB - up to 25K IOPS*
Perf: Throughput/Vol	480 KBPS/GB - up to 320 MBPS**
Perf: Latency (P95)	Sub-millisecond latencies
Perf: Per-instance Limits	<ul style="list-style-type: none">• 32 attachments/instance, up to 1 PB (32 TB/volume x 32 volumes/instance)• Up to 620K or more IOPS, near line rate throughout.
Durability	Multiple replicas across multiple storage servers within the AD
Security	Encrypted at rest and transit

* For Bare Metal or 8-core+ VM compute instance, using 4KB blocks. VM perf is limited by VM network bandwidth.

** 256 KB block size

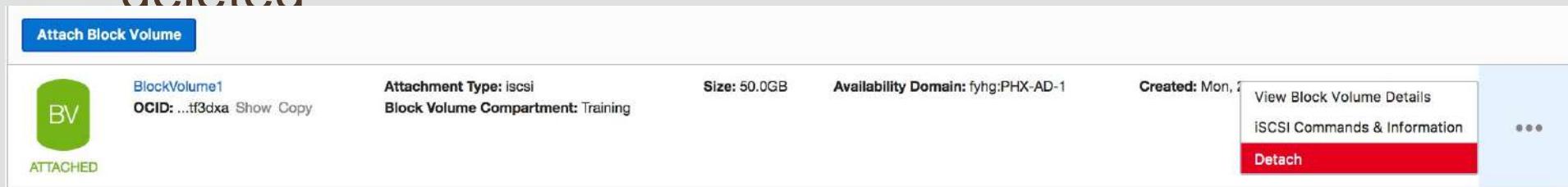
Creating and Attaching a Block Volume

The image shows two side-by-side screenshots from the Oracle Cloud Infrastructure (OCI) console. On the left is the 'Create Block Volume' interface, which includes fields for NAME (empty), CREATE IN COMPARTMENT (set to 'intoraclerohit (root)'), AVAILABILITY DOMAIN (set to 'dKYS:US-ASHBURN-AD-1'), SIZE (IN GB) (set to '1024'), COMPARTMENT FOR BACKUP POLICIES (set to 'intoraclerohit (root)'), BACKUP POLICY (with a note to 'Select a Backup Policy'), and ENCRYPTION (with options for 'ENCRYPT USING ORACLE-MANAGED KEYS' selected and 'ENCRYPT USING CUSTOMER-MANAGED KEYS'). On the right is the 'Attach Block Volume' interface, which asks 'Choose how you want to attach your block volume.' It has two radio button options: 'ISCSI' (selected and highlighted with a red box) and 'PARAVIRTUALIZED' (unchecked). Below this are sections for ACCESS (with options for 'READ/WRITE - SINGLE INSTANCE', 'READ/WRITE - MULTIPLE INSTANCES', and 'READ-ONLY'), and BLOCK VOLUME COMPARTMENT ('intoraclerohit (root)'). The final field shown is the 'BLOCK VOLUME' input, which contains the value 'backupBV'.

- Paravirtualization is a light virtualization technique where a VM utilizes hypervisor APIs to access remote storage directly as if it were a local device
- iSCSI block storage attachment utilizes the internal storage stack in the guest OS and network hardware virtualization to access block volumes. Hypervisor is not involved in the iSCSI attachment process
- By default, all Block Volumes are Read/Write
- Block Volume can also be read-only to prevent against accidental modification

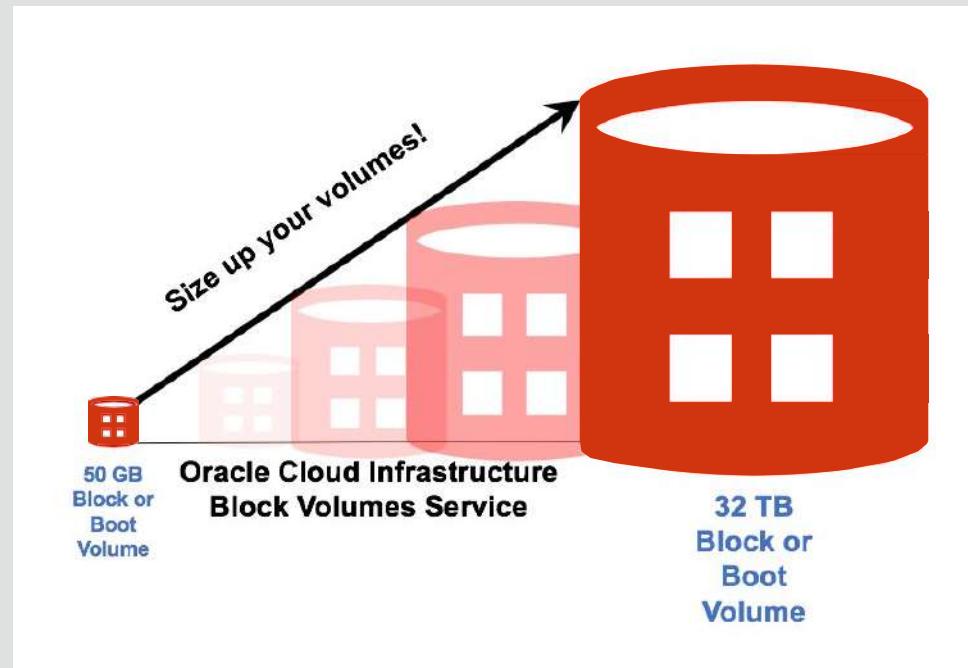
Detaching and Deleting Block Volumes

- When an instance no longer requires a block volume, you can disconnect and then detach it from the instance without any loss of data
- When you attach the same volume to another instance or to the same instance, **DO NOT FORMAT** the disk volume. Otherwise, you will lose all the data on the volume
- When the volume itself is no longer needed, you can delete the block volume
- You cannot undo a delete operation. Any data on a volume will be permanently deleted once the volume is deleted



Block Volume Offline Resize

The Oracle Cloud Infrastructure Block Volume service lets you expand the size of block volumes and boot volumes. You have three options to increase the size of your volumes:



- Expand an existing volume in place with offline resizing (cannot resize an attached volume)
- Restore from a volume backup to a larger volume.
- Clone an existing volume to a new, larger volume.

You can only increase the size of the volume, **you cannot decrease the size**

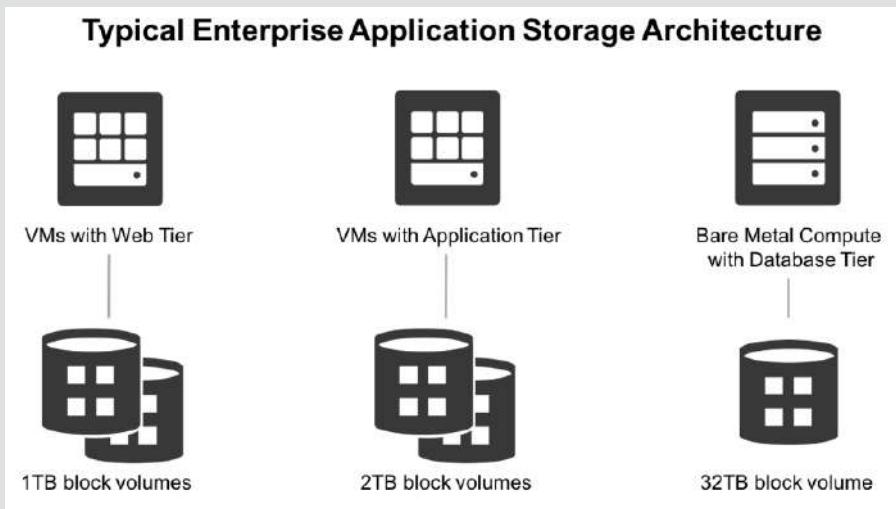
Block Volume – Backup and Restoration

- Point-in-time Snapshots – No interruption to Applications
- Encrypted, Stored in Object Storage
- Restore to new volumes in any AD in same Region
- Copy backups to another Region
- On-demand – full or incremental
- Automated – Bronze/Silver/Gold policies

Block Volume - Clone

- Copy volume without backup/restore
- Point-in-time deep copy
- Immediate, background
- Same AD, no detachment of volume
- Cannot be copied to different region

Volume Groups



- Group together block and boot volumes from multiple compartments across multiple compute instances in a volume group.
- You can use volume groups to create volume group backups and clones that are point-in-time and crash-consistent.
- Manually trigger a full or incremental backup of all the volumes in a volume group leveraging a coordinated snapshot across all the volumes.
- This is ideal for the protection and lifecycle management of enterprise applications, which typically require multiple volumes across multiple compute instances to function effectively
- Volume Group feature is available with no additional charge

Boot Volumes

- A compute instance is launched using OS image stored on a remote boot volume
- Boot volume is created automated and associated with an instance until you terminate the instance
- Boot volumes are encrypted, have faster performance, lower launch times, and higher durability for BM and VM instances
- Launch another instance with a boot volume
 - First create a custom image of your boot volume and then using the custom image launch the instance
 - Alternately, you can launch a new instance directly from an unattached boot volume if you don't wish to create a custom image
- Delete boot volume
 - You can delete an unattached boot volume.
 - You can optionally choose to automatically delete the boot volume when terminating an instance by selecting the checkbox in the delete confirmation dialog.
 - OCI does not allow you to delete the boot volume currently attached to an instance.

Boot Volumes

- Possible to take a manual backup, assign backup policy or create clone of boot volumes
- Attach a Boot Volume to an instance as a block volume for troubleshooting
 - You can attach any boot volume to an instance as block storage in order to debug issues. You will first need to detach a boot volume from its associated compute instance in order to attach it to a different instance.
 - You can follow the steps below to debug your boot volume:
 - 'Stop' the instance you want to debug and click on 'Boot Volume' filter, and then select the 'Detach Boot Volume' button. Alternately, you can terminate your instance which persists your boot volume by default.
 - Navigate to a new running instance you want to use to debug your boot volume and click the 'Attach Block Volume' button.

Custom Boot Volumes

- You have the option of specifying a custom boot volume size
- In order to take advantage of the larger size, you must first extend the root (Linux-based images) or system (Windows-based images) partition

BOOT VOLUME SIZE (IN GB)

Selected image's default boot volume size: 46.6 GB



CUSTOM BOOT VOLUME SIZE

100

Volume performance varies with volume size. Size must be an integer between selected image's default boot volume size. ([Learn more](#))

Linux default size is 46.6 GB

BOOT VOLUME SIZE (IN GB)

Selected image's default boot volume size: 256.0 GB



CUSTOM BOOT VOLUME SIZE

500

Volume performance varies with volume size. Size must be an integer between selected image's default boot volume size. ([Learn more](#))

Windows default size is 256GB

References

Storage Intro and Block Volume - References

References

Oracle Cloud Academy Foundations I Section 5

Cloud Engineering

File Storage Service



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File Storage Service

This Presentation:

- File Storage Service



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OCI Storage Services

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File Storage Service – Use Cases



Oracle Applications
Lift and Shift



General Purpose
File Systems



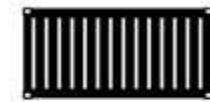
Big Data &
Analytics



HPC
Scale Out Apps



Test / Dev
Databases

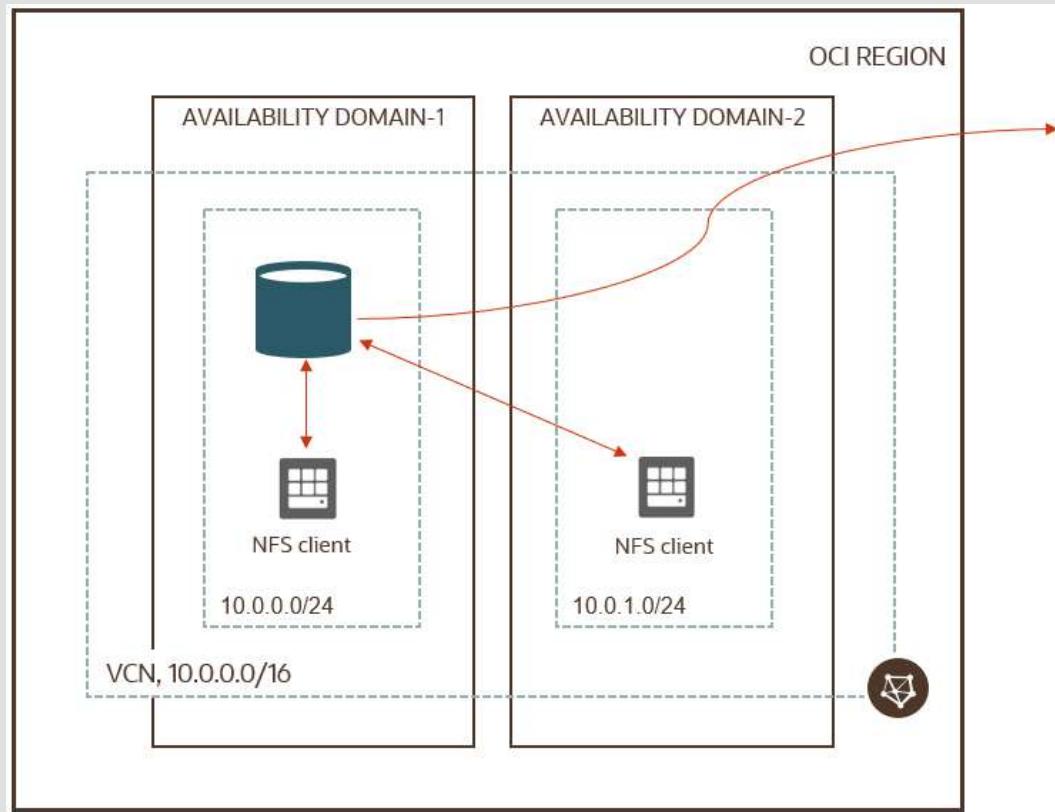


MicroServices
Containers

File Storage Service Features

- AD-Hoc service, available in all OCI regions and Availability Domains
- Supports NFS v.3
- Network Lock Management (NLM) for file locking
- Full POSIX semantics
- Data Protection: Snapshots capabilities; 10,000 snapshots per file system
- Security: 128-bit, data-at-rest encryption for all file systems & metadata
- Console management, APIs, CLI, data-path commands, and Terraform
- Create 100 file systems and 2 mount targets per AD per account

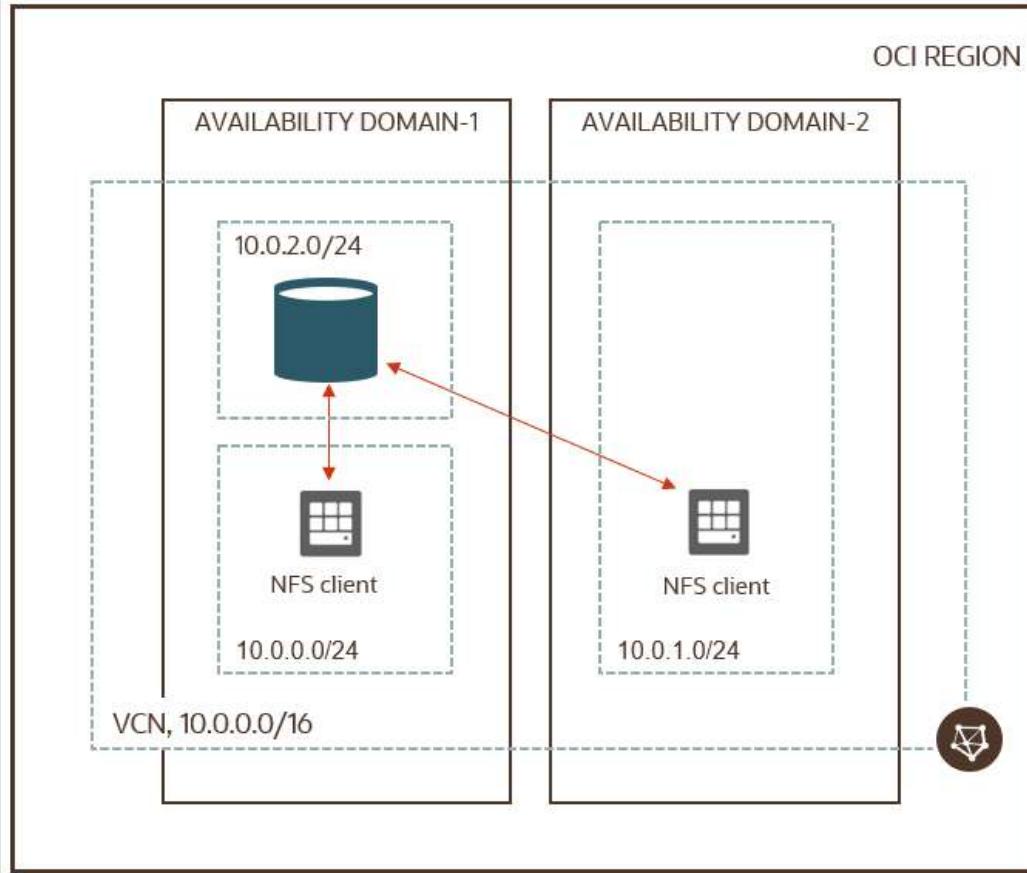
Mount Target



Mount Target

- NFS endpoint that lives in your subnet of choice; AD-specific
- Mount target has an IP address and DNS name that you can use in your mount command.
E.g. 10.0.0.6
- Requires three private IP addresses in the subnet (don't use /30 or smaller subnets for the FSS)
- Two of the IP addresses are used during mount target creation; 3rd IP used for HA

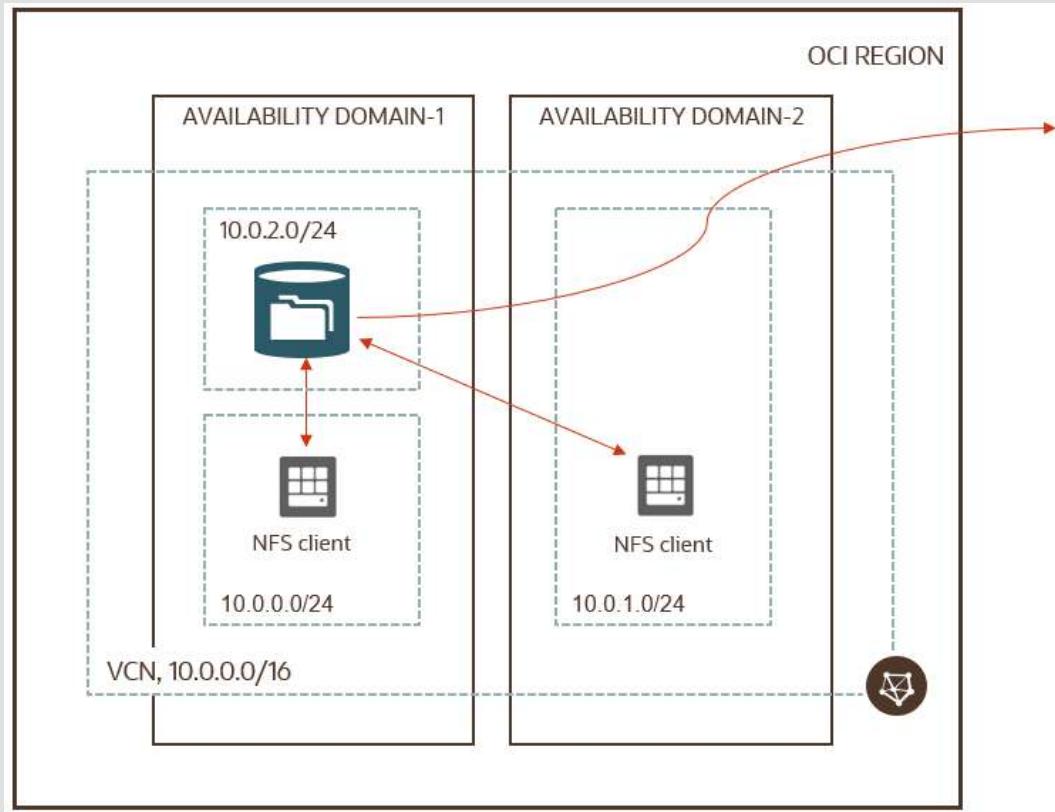
Mount Target



Mount Target

- Placing NFS clients and mount target in the same subnet can result in IP conflicts, as users are not shown which private IPs are used for mount target
- Place FSS mount target in its own subnet, where it can consume IPs as it needs

File System



File System

- Primary resources for storing files in FSS
- To access your file systems, you create a new (or use an existing) mount target
- 100 File Systems per Mount Target
- AD-specific
- Accessible from OCI VM/BM instances
- Accessible from on-premises through FastConnect/VPN

FSS Paths

- Export Path: unique path specified when the file system is associated with a mount target during creation
- No two File systems associated with the same mount target can have overlapping export paths (e.g. FS paths like /example and /example/path are not allowed)



Mount target (NFS endpoint): 10.0.0.6
Export Path1: /example1/path
Export Path1 2: /example2/path

- Export path, along with the mount target IP address, is used to mount the file system to an instance
- `sudo mount 10.0.0.6:/example1/path /mnt/mountpointA`
- `sudo mount 10.0.0.6:/example2/path /mnt/mountpointB`
- /mnt/mountpointA and /mnt/mountpointB are path to the directory on the NFS client instance on which the external file systems are mounted

Mounting an OCI File System

- Launch OCI instance from console
- Use NFSv3 protocol to mount the FSS volume
- Install nfs-utils (Oracle Linux and CentOS) or nfs-common (Ubuntu) in your Linux system
- Create a directory
- On the FSS console, click on Mount Targets
- Use the Private IP address information to mount the volume using nfs command:

```
opc@node01:~$ sudo mkdir -p <user's target directory>
```

```
opc@node01:~$ sudo mount <IPaddress>:<path-name>  
<user's target directory>
```

```
opc@node01:~$ sudo yum install nfs-utils
```

```
opc@node01:~$ sudo mkdir -p /mnt/nfs
```

```
opc@node01:~$ sudo mount 10.0.0.3:/fss-shared /mnt/nfs
```

NOTE: We recommend not to pass mount options to achieve best performance with File Storage Service. This approach leaves it to the client and server to negotiate the window size for Read & Write operations.

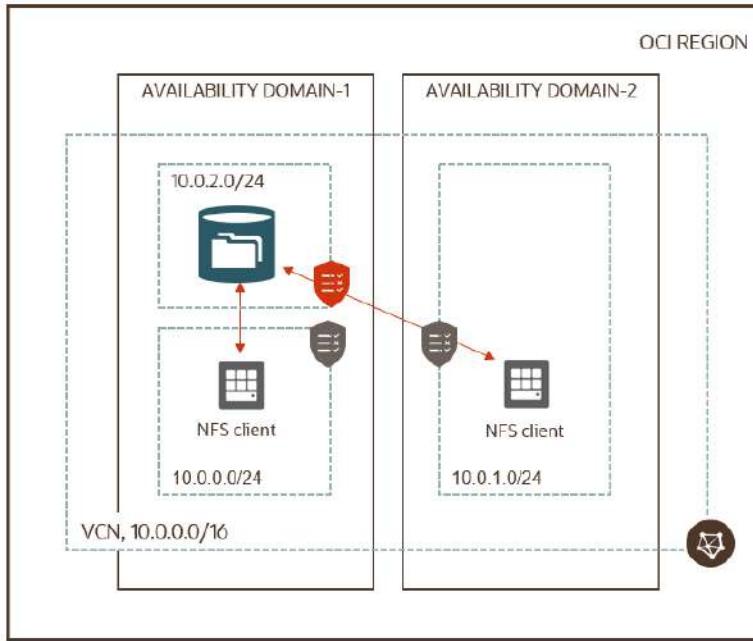
Security

- Four distinct and separate layers of security with its own authorization entities and methods to consider when using FSS

Security layer	Uses these..	To control actions like these..
IAM Service	OCI users, policies	Creating instances (NFS clients) and FSS VCNs. Creating, listing, and associating file systems and mount targets
Security Lists	CIDR blocks	Connecting the NFS client instance to the mount target
Export Options	Export options, CIDR blocks	Applying access control per-file system based on source IP CIDR blocks that bridges the Security Lists layer and the NFS v.3 Unix Security layer
NFS v3. Unix Security	Unix users	Mounting file systems ¹ , reading the writing files, file access security

- ¹When mounting file systems, don't use mount options such as nolock, rsize, or wsize. These options cause issues with performance and file locking

Security Lists



- Security List can be used as a virtual firewall to prevent NFS clients from mounting an FSS mount target (even in the same subnet).

FSS needs:

- Stateful ingress TCP ports 111, 2048 – 2050
- Stateful ingress UDP ports 111 and 2048
- Opening these ports enables traffic from Solaris, Linux, and Windows NFS clients



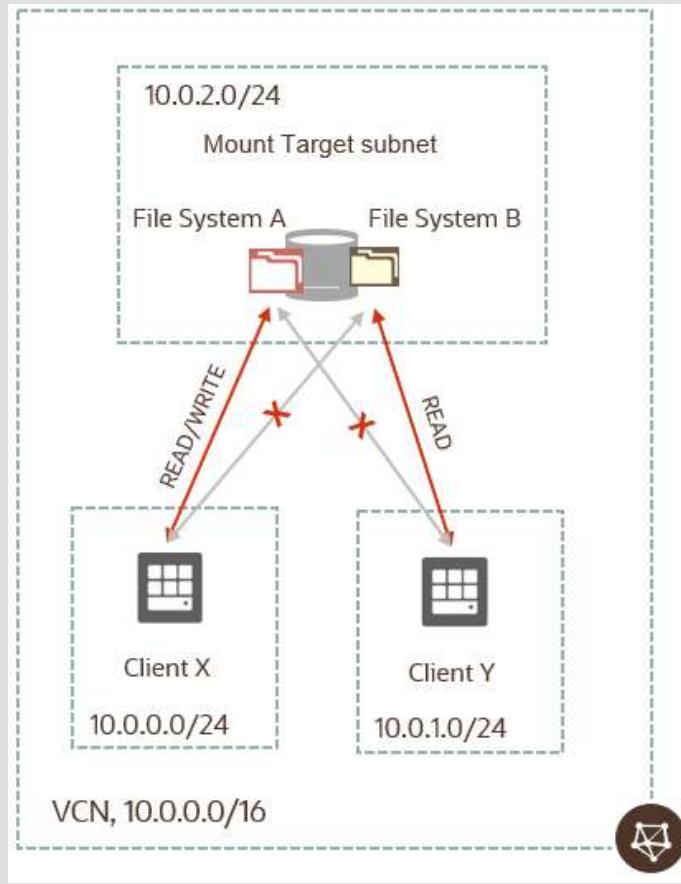
Type	Source CIDR	Protocol	Source Port	Dest Port
Ingress	10.0.0.0/24 ¹	TCP	All	2048-2050
Ingress	10.0.0.0/24	TCP	All	111
Ingress	10.0.0.0/24	UDP	All	2048
Ingress	10.0.0.0/24	UDP	All	111

- ¹For all subnets within VCN (e.g. 10.0.1.0/24) to access File System, change destination CIDR to 10.0.0.0/16; all rules stateful

Export Option

- Security List is all or nothing approach – the client either can or cannot access the mount target, and therefore all file systems associated with it
- In a multi-tenant environment, using NFS export option, you can limit clients' ability to connect to the file system and view or write data
- Export controls how NFS clients access file systems; info stored in an export includes the file system OCID, export path, and client access options
- When you create file system and associated mount target, the NFS export options for that file system are set to allow full access for all NFS clients :
 - Source: 0.0.0.0/0 (All)
 - Require Privileged Source Port: False
 - Access: Read_Write
 - Identity Squash: None

Export Option



- Client X, assigned to 10.0.0.0/24, requires Read/Write access to file system A, but not file system B
- Client Y, assigned to 10.0.1.0/24, requires Read access to file system B, but no access to file system A
- Both file systems A and B are associated to a single mount target

```
oci fs export update --export-id
<FS_A_export_ID> --export-
options '[{"source":"10.0.0.0/24
","require-privileged-source-
port":"true","access":"READ_W
RITE","identity-
squash":"NONE","anonymous-
uid":"65534","anonymous-
gid":"65534"}]
```

```
oci fs export update --export-id
<FS_B_export_ID> --export-
options '[{"source":"10.0.1.0/24
","require-privileged-source-
port":"true","access":"READ_ON
LY","identity-
squash":"NONE","anonymous-
uid":"65534","anonymous-
gid":"65534"}]'
```

File Storage Service Snapshot

- Snapshots provide a read-only, space efficient, point-in-time backup of a file system
- Snapshots are created under the root folder of file system, in a hidden directory named .snapshot
- You can take up to 10,000 snapshots per file system
- You can restore a file within the snapshot, or an entire snapshot using the cp or rsync command –

```
cp -r .snapshot/snapshot_name/* destination_directory_name
```
- If nothing has changed within the target file system and you take a snapshot, it does not consume any additional storage



The screenshot shows the OCI console interface. On the left, there's a sidebar with 'Resources' and two items: 'Mount Targets (1)' and 'Snapshots (2)'. The 'Snapshots (2)' item is selected, highlighted in blue. The main content area is titled 'Snapshots' and displays two entries:

Snapshot Name	Created
Snap-01-31-2018	Wed, 31 Jan 2018 17:04:56 GMT
Snap-01-31-2018-10AM	Wed, 31 Jan 2018 17:17:19 GMT

```
[opc@node01 fs-shared]$ cd .snapshot/
[opc@node01 .snapshot]$ ls -la
total 4
drwxr-xr-x. 8 root root 6 Jan  4 21:58 .
drwxr-xr-x. 7 root root 6 Jan  4 21:58 ..
drwxr-xr-x. 4 opc  opc 4 Dec 14 20:00 snapshot-dec14
drwxr-xr-x. 5 opc  opc 5 Dec 14 20:06 snapshot-dec14-2PM
drwxr-xr-x. 8 opc  opc 8 Dec 18 19:23 snapshot-dec18
drwxr-xr-x. 7 root root 6 Dec 19 21:02 snapshot-dec19
drwxr-xr-x. 7 root root 6 Dec 20 16:45 snapshot-dec20
drwxr-xr-x. 9 root root 8 Dec 20 14:44 snapshot-test
[opc@node01 .snapshot]$
```

References

File Storage - References

References

Oracle Cloud Academy Foundations I Section 6

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Object Storage



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Object Storage

This Presentation:

- Object Storage Service
- Object Storage Service Capabilities



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OCI Storage Services

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Object Storage Service

- An internet-scale, high-performance storage platform
- Ideal for storing unlimited amount of unstructured data (images, media files, logs, backups)
- Data is managed as objects using an API built on standard HTTP verbs
- Regional service, not tied to any specific compute instance
- Offers two distinct storage classes to address the need for performant, frequently accessed "hot" storage, and less frequently accessed "cold" storage
- Supports private access from Oracle Cloud Infrastructure resources in a VCN through a Service Gateway
- Supports advanced features such as cross-region copy, pre-authenticated requests, lifecycle rules and multipart upload

Object Storage Scenarios

- Content Repository - highly available and durable content repository for data, images, logs, and video etc.
- Archive/Backup - use of object storage for preserving data for longer periods of time
- Log Data - application log data for analysis and debugs/troubleshooting
- Large Data Sets - Large data; e.g., pharmaceutical trials data, genome data, and Internet of Things (IoT)
- Big Data/Hadoop Support
- Use as a primary data repository for big data enables ~50% improvement in performance
- HDFS connector provides connectivity to various big data analytic engines like Apache Spark and MapReduce

Object Storage Service Features

- Strong consistency
 - Object Storage Service always serves the most recent copy of the data when retrieved
- Durability
 - Data stored redundantly across multiple storage servers across multiple ADs
 - Data integrity is actively monitored, and corrupt data detected and auto repaired
- Performance
 - Compute and the Object Storage Services are co-located on the same fast network
- Custom metadata
 - Define your own extensive metadata as key-value pairs
- Encryption
 - Employs 256-bit Advanced Encryption Standard (AES-256) to encrypt object data

Object Storage Resources

- Object
 - All data, regardless of content type, is managed as objects (e.g., logs, videos)
 - Each Object is composed of object itself and metadata of the object
- Bucket
 - A logical container for storing objects; Each object is stored in a bucket
- Namespace
 - A logical entity that serves as a top-level container for all buckets and objects
 - Each tenancy is provided one unique namespace that is global, spanning all compartments and regions
 - Bucket names must be unique within your tenancy, but can be repeated across tenancies
 - Within a namespace, buckets and objects exist in flat hierarchy, but you can simulate a directory structure using prefixes and hierarchies

Object Naming

- Service prepends the Object Storage namespace string and bucket name to object name,
`/n/<object_storage_namespace>/b/<bucket>/o/<object_name>`
 - `https://objectstorage.us-phoenix-1.oraclecloud.com/n/gse00014346/b/DatabaseBackup/o/database1.dbf`
- Flat hierarchy
- For large number of objects, use prefixes and hierarchies,
 - `/n/ansh8tvru7zp/b/event_photos/o/marathon/finish_line.jpg`
 - `/n/ansh8tvru7zp/b/event_photos/o/marathon/participants/p_21.jpg`
- You can use the CLI to perform bulk downloads and bulk deletes of all objects at a specified level of the hierarchy, without affecting objects in levels above or below
- E.g. above, you can use CLI to download or delete all objects at the `marathon/` level without downloading or deleting objects at the `marathon/participants` sublevel

Object Storage Tiers

- Standard Storage Tier (Hot)
 - Fast, immediate, and frequent access
 - Object Storage Service always serves the most recent copy of the data when retrieved
 - Data retrieval is instantaneous
 - Standard buckets can't be downgraded to archive storage
- Archive Storage Tier (Cold)
 - Seldom or rarely accessed data but must be retained and preserved for long periods of time
 - Minimum retention requirement for Archive Storage is 90 days
 - Objects need to be restored before download
 - Archive Bucket can't be upgraded to Standard storage tier
 - Time To First Byte (TTFB) after Archive Storage restore request is made: 4 Hours

Create Bucket help cancel

Specify the storage tier for this bucket. Storage tier for a bucket can only be specified during creation.

BUCKET NAME

STORAGE TIER STANDARD ARCHIVE

Create Bucket

Object Storage Capabilities

Managing Access and Authentications

- Pre-Authenticated Requests
 - Provides a way to let users access a bucket or an object without having their own credentials
 - Can access via a unique URL E.g.
<https://objectstorage.us-ashburn-1.oraclecloud.com/p/p09Nx-f4UaLCN-MMOxGQIpbmMchgHQrSQv4Lr-aSzs/n/intoraclerohit/b/Image/o/kvm>
 - Can revoke the links any time (much easier than S3)
- Public Buckets
 - At creation, a bucket is considered private and access to the bucket requires authentication and authorization
 - Service supports anonymous, unauthenticated access to a bucket by making a bucket public (read access to the bucket)
 - Changing the type of access doesn't affect existing pre-authenticated requests. Existing pre-authenticated requests still work

Create Pre-Authenticated Request

NAME	KVM Image
PRE-AUTHENTICATED REQUEST TARGET	<input checked="" type="radio"/> BUCKET <input checked="" type="radio"/> OBJECT
	kvm
ACCESS TYPE	<input checked="" type="radio"/> PERMIT READS ON THE OBJECT <input type="radio"/> PERMIT WRITES TO THE OBJECT <input type="radio"/> PERMIT READS ON AND WRITES TO THE OBJECT
EXPIRATION DATE/TIME	2018-11-07 06:10 GMT
Create Pre-Authenticated Request	

Cross-region Copy

Cross Region Copy

DESTINATION NAMESPACE i

intoraclerohit

DESTINATION REGION

Please select destination region ...

DESTINATION BUCKET

OVERWRITE RULE

ETag matching rules allow you to control the copying or overwriting of objects based on their ETag values
[Learn more about ETag matching in cross region copy.](#)

OVERWRITE DESTINATION OBJECT
 DO NOT OVERWRITE ANY DESTINATION OBJECT
 OVERWRITE DESTINATION OBJECT ONLY IF IT MATCHES THE SPECIFIED ETAG
 COPY OBJECT ONLY IF THE SOURCE MATCHES THE SPECIFIED ETAG

ETAG MATCH

- Copy objects to other buckets in the same region and to buckets in other regions
- Must authorize the service to manage objects on your behalf (separate policy for each region). E.g.
 - **allow service objectstorage-us- ashburn-1 to manage object- family in tenancy**
- Must specify an existing target bucket
- Bulk copying is not supported
- Objects cannot be copied from Archive storage

Object Lifecycle Management

- Define lifecycle rules to automatically archive or delete objects after a specified number of days
- Must authorize the service to manage objects on your behalf (separate policy/region). E.g.
 - allow service objectstorage-us-ashburn-1 to manage object-family in tenancy
- Applied at the bucket or object name prefix level. If no prefix is specified, the rule will apply to all objects in the bucket
- A rule that deletes an object always takes priority over a rule that would archive that same object
- Enable or disable a rule to make it active or inactive

Create Lifecycle Rule

Create a rule to automatically archive or delete objects after a specified number of days. If no prefix is specified, the rule will apply to all objects in the bucket.

NAME

Delete Objects

The name of the lifecycle rule.

LIFECYCLE ACTION

Delete

Objects deleted by a lifecycle policy cannot be restored.

NUMBER OF DAYS

30

Delete objects that are older than 30 days and that match any of the specified object name prefixes.

Object Name Prefix

PREFIX

Name prefix of objects to match

STATE

ENABLED DISABLED

Your rule will be active upon creation.

For objects, /n/ansh8tvru7zp/b/apparel/o/gloves_27_dark_green.jpg,
/n/ansh8tvru7zp/b/apparel/o/gloves_27_light_blue.jpg, gloves_27 is the prefix

Managing Multipart Uploads

With multipart uploads, individual parts of an object can be uploaded in parallel to reduce the amount of time you spend uploading. Steps involved -

1. Create object parts
 - Perform a multipart upload to upload objects larger than 100 MiB. Individual parts can be as large as 50 GiB or as small as 10 MB
 - Assign part numbers from 1 to 10,000
2. Initiate an upload
 - Initiate a multipart upload by making a `CreateMultipartUpload` REST API call
3. Upload object parts
 - Make an `UploadPart` request for each object part upload
 - If you have network issues, you can restart a failed upload for an individual part. You do not need to restart the entire upload
4. Commit the upload
 - When you have uploaded all object parts, complete the multipart upload by committing it; add a bullet on checksum etc.

References

Object Storage - References

References

Oracle Cloud Academy Foundations I Section 7

Cloud Engineering

Available DB Systems on OCI



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Databases

This Presentation:

- Introduce Oracle Database Service
- Available DB Systems on OCI
 - Bare Metal
 - Virtual Machine
 - Exadata
 - Real Application Cluster
- DB System Storage Architecture
- DB Editions
- Managing & Patching
- DB Backups



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Available DB Systems on OCI

Recommendation

Watch the following videos first

Compute

Block Volume

Object Storage

Available DB Systems on OCI

• • • •

Recommendation

• • • •

Extra Reading on Oracle Databases

• • • •

Watch OCI Academy Lecture Videos

• • • •

• • • •

Available DB Systems on OCI

• • • •

Recommendation

• • • •

Review AWS Lecture on Databases

• • • •

• • • •

• • • •

• • • •

Converged Database: <https://blogs.oracle.com/database/post/what-is-a-converged-database>

Fragmented Features vs. Converged Product

Phone calls, messaging, photos, music, etc. originally required **separate products**

- Now are largely features of Smartphones

Similarly, ML, JSON, Blockchain, etc. originally required **separate databases**

- Now are features of a **Converged Database**

Converged is inherently simpler

Synergy makes the whole more than the sum of the parts



22.

Oracle Cloud - Database Cloud Services

Broad service offering at every scale to meet diverse business requirements



Enterprise or Standard
Database Service



Exadata Database Service
Dedicated, fully elastic



Autonomous Database
Transaction Processing or Data Warehouse

Most Versatile

Highly Differentiated

Leading Edge

Managed Infrastructure

Fully Managed

Singular / Smaller Workloads

Best performance, availability with massive scale

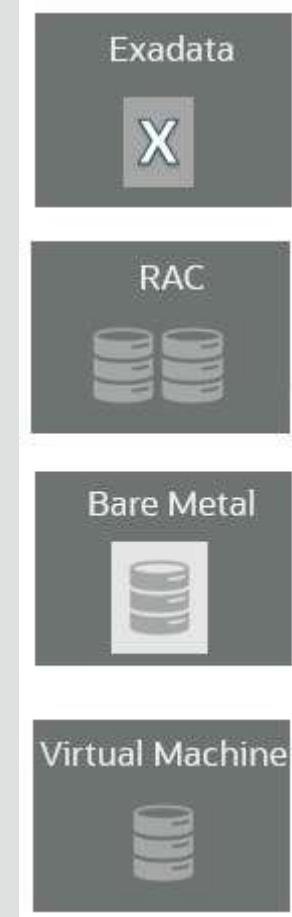


Automation

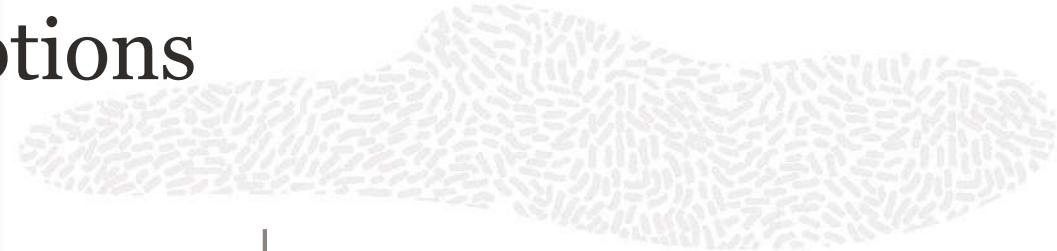


OCI Database Service

- Mission critical, enterprise grade cloud database service with comprehensive offerings to cover all enterprise database needs
 - Exadata, RAC, Bare Metal, VM
- Complete Lifecycle Automation
 - Provisioning, Patching, Backup & Restore
- High Availability and Scalability
 - RAC & Data Guard
 - Dynamic CPU and Storage scaling
- Security
 - Infrastructure (IAM, Security Lists, Audit logs)
 - Database (TDE, Encrypted RMAN backup / Block volume encryption)
- OCI Platform integration
 - Tagging, Limits and Usage integration
- Bring Your Own License (BYOL)



Virtual Machine & Bare Metal Options



Oracle DB on Virtual Machines

- Up to 24 OCPUs
- Up to 320 GB memory
- Up to 40 TB of usable block-volume storage

Oracle RAC on Virtual Machines

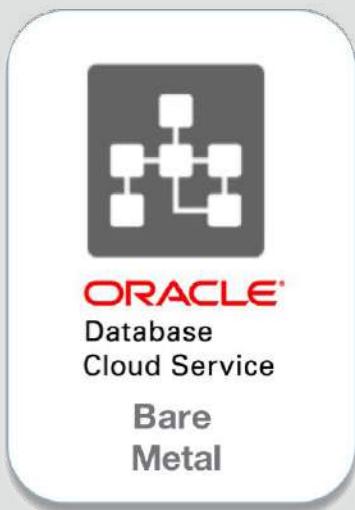
- Up to 48 OCPUs
- Up to 640 GB memory
- Up to 40 TB of usable block-volume storage
- Extreme Performance Edition

Oracle DB on Bare Metal

- Up to 52 OCPUs
- 768 GB memory
- Up to 16 TB of usable NVMe local storage

Oracle Cloud – Bare Metal

- Oracle Cloud is the only Cloud providing dedicated bare metal servers for the Oracle Database, offering the best in class performance.



Memory	Up to 768 Gb of RAM
Cores	Scale up to 52 Cores
Storage	Up to 51.2 TB of local NVMe SSD Database Storage
Database	Standard or Enterprise Edition 11.2, 12.1, 12.2, 18c, 19c
Migration Solutions	ZDM, SQL Developer, RMAN, Data Pump, MAA, Plug/Unplug, Remote Cloning

Available DB Systems on OCI

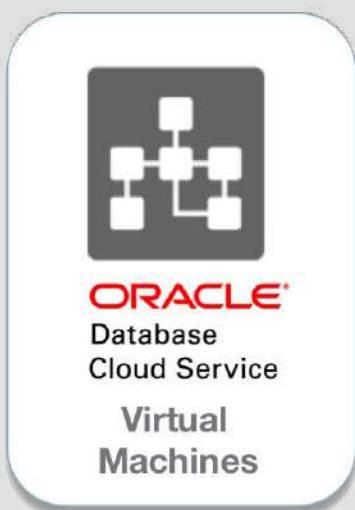
Multi-Cloud

Oracle Database in OCI

Access database from another cloud e.g. AWS

Oracle Cloud – Virtual Machines

- Single instance or RAC-enabled choices, Oracle Cloud Infrastructure offers elastic database virtual machine services for application development, test, and production deployment.



Memory	Up to 640 Gb of RAM
Cores	Scale up to 48 Cores
Storage	Up to 40 TB of remote NVMe SSD Block Volumes
Database	Standard or Enterprise Edition 11.2, 12.1, 12.2, 18c, 19c
Migration Solutions	ZDM, SQL Developer, RMAN, Data Pump, MAA, Plug/Unplug, Remote Cloning

Oracle Cloud – Exadata Cloud Service

- Oracle highest-performance engineered system, catering for all your enterprise needs, supporting OLTP, Data Warehouse and real-time analytic and mixed database workloads.



Memory	Up to 5.7 TB of RAM & over 300 TB of NVMe Flash Cache
Cores	Scale up to 368 Cores
Storage	Up to 340 TB of Database Storage
Database	Enterprise Edition 11.2, 12.1, 12.2, 18c, 19c
Migration Solutions	ZDM, SQL Developer, RMAN, Data Pump, MAA, Plug/Unplug, Remote Cloning

Oracle Cloud – Exadata Cloud at Customer

- Oracle highest-performance engineered system, catering for all your enterprise needs, supporting OLTP, Data Warehouse and real-time analytic and mixed database workloads, in your data center and managed by Oracle.



Memory	Up to 5.7 TB of RAM & over 300 TB of NVMe Flash Cache
Cores	Scale up to 368 Cores
Storage	Up to 340 TB of Database Storage
Database	Enterprise Edition 11.2, 12.1, 12.2, 18c, 19c
Migration Solutions	ZDM, SQL Developer, RMAN, Data Pump, MAA, Plug/Unplug, Remote Cloning

Introducing MOVE to the Oracle Cloud

www.oracle.com/goto/move



The image shows the 'Move to the Oracle Cloud' landing page. At the top left is a 'Database Cloud Migration' icon showing a server and a cloud. The main title 'Move to the Oracle Cloud' is centered above the subtitle 'Move your Database to the Oracle Cloud'. Below this, there are four sections: 'Simple & Efficient', 'Cost Effective', 'Flexible', and 'Highly Available & Scalable'. Each section contains a brief description. At the bottom is a 'Cloud Migration Advisor' icon showing a database迁移到云中。

Move to the Oracle Cloud

Move your Database to the Oracle Cloud

Simple & Efficient

Oracle automated tools make it seamless to move your on-premises database to the Oracle Cloud with virtually no downtime. Using the same technology and standards on-premises and in the Oracle Cloud, you can facilitate the same products and skills to manage your cloud-based Oracle Databases as you would on any other platform.

Cost Effective

The same flexibility that lets you directly migrate your Oracle Database to the Oracle Cloud is applied to finding the most cost effective solution for the purpose and duration of the migration. Even if the automated tools determine that an Oracle licensable product should be used to optimize your migration, Oracle will provide a cost neutral solution.

Flexible

You can directly migrate your Oracle Database to the Oracle Cloud from various source databases into different target cloud deployments depending on your requirements and business needs. A well-defined set of tools gives you the flexibility to choose the method that best applies to your needs.

Highly Available & Scalable

The tight integration of all migration tools with the Oracle Database lets you maintain control and gain better efficiency when moving your databases to the Oracle Cloud, while the Maximum Availability Architecture (MAA)-approved tools as well as Zero Downtime Migration (ZDM)-based migrations ensure that your migration is handled as smoothly as possible.

Cloud Migration Advisor

Zero Downtime Migration



**Simple Migration to the
Oracle Cloud**

**Back Up / Restore for
DB Instantiation**

**Leverages Oracle MAA
Best Practices**

Zero Downtime Migration

Zero Data Loss

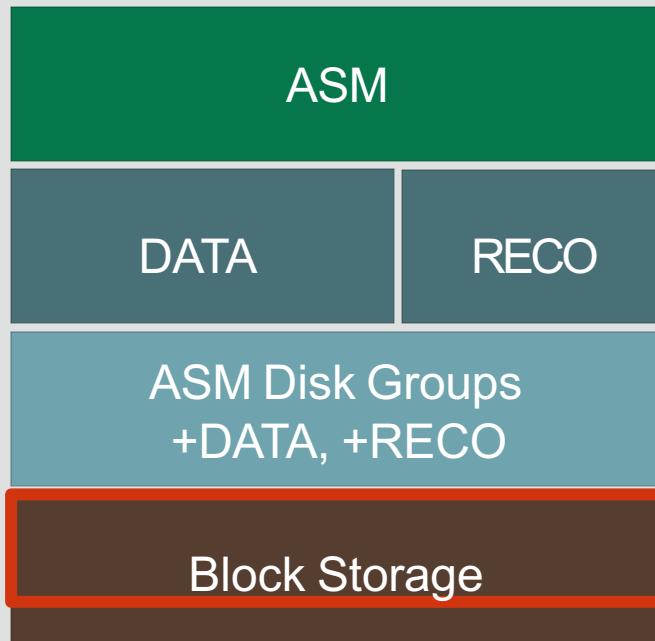
Cloud Security Enabled

FREE

Virtual Machine (VM) Database (DB) Systems

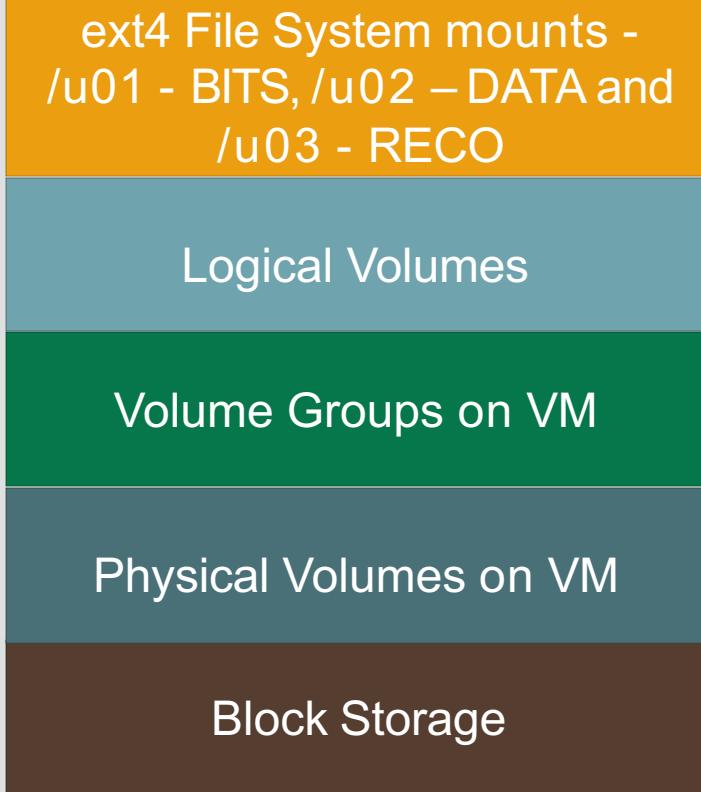
- There are 2 types of DB systems on virtual machines:
 - A 1-node VM DB system consists of one VM.
 - A 2-node VM DB system consists of two VMs clustered with RAC enabled.
- VM DB systems can have only a single database home, which in turn can have only a single database.
- Amount of memory allocation for the VM DB system depends on the VM shape selected during the provisioning process.
- Size of storage is specified when you launch a VM DB system, and you scale up the storage as needed at any time.
- The number of CPU cores on an existing VM DB system cannot be changed.
- If you are launching a DB system with a virtual machine shape, you have option of selecting an older database version. Check Display all database versions to include older database versions in the drop-down list of database version choices.
- When a 2-node RAC VM DB system is provisioned, the system assigns each node to a different fault domain by default.
- Data Guard within and across ADs is available for VM DB systems (requires DB Enterprise Edition).

VM DB Systems Storage Architecture



- ASM relies on OCI Block Volume (based on NVMe) for mirroring data
- Block volumes are mounted using iSCSI
- ASM uses external redundancy relying on the triple mirroring of the Block Storage
- Different Block Storage volumes are used for DATA and RECO
- Monitors the disks for hard and soft failures
- These actions ensure highest level availability and performance at all times
- This storage architecture is required for VM RAC DB systems

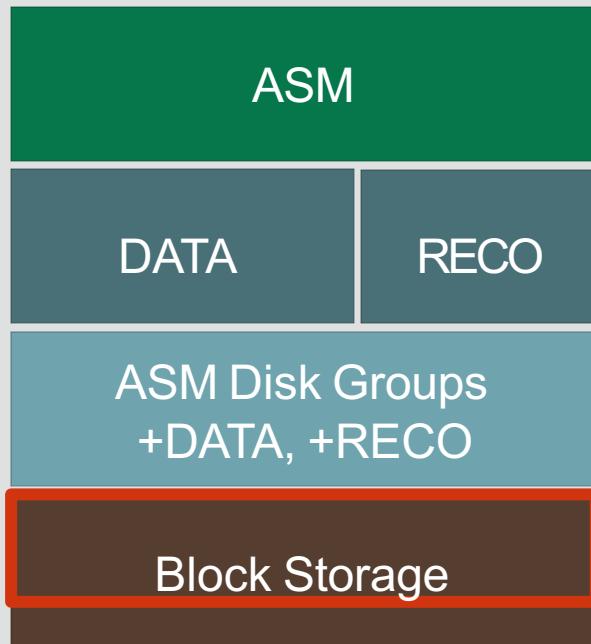
VM DB Systems Storage Architecture – Fast Provisioning Option



- Linux Logical Volume Manager manages the filesystems used by the database for storing database files, redo logs, etc.
- Block volumes are mounted using iSCSI
- The available storage value you specify during provisioning determines the maximum total storage available through scaling**
- VM RAC DB Systems cannot be deployed using this option
- Currently supports Oracle Database 18c and 19c releases

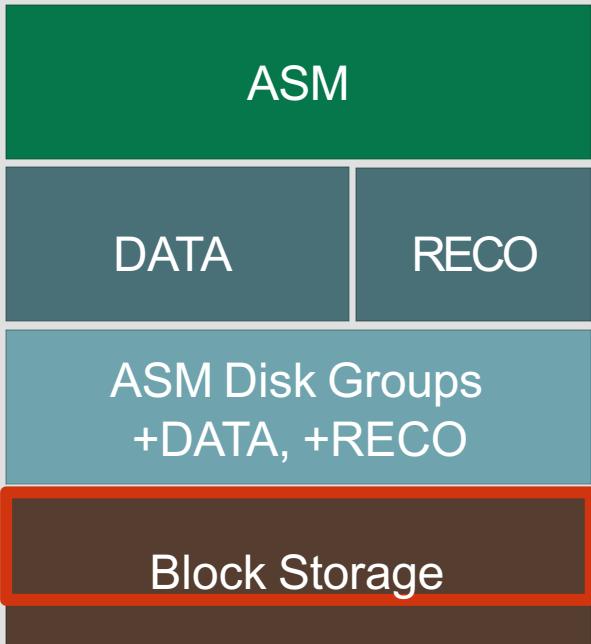
**Please refer to <https://docs.cloud.oracle.com/iaas/Content/Database/References/fastprovisioningstorage.htm> for more information

Bare Metal DB Systems Storage Architecture



- ASM manages mirroring of NVMe disks
- Disks are partitioned – one for DATA and one for RECO
- Monitors the disks for hard and soft failures
- Proactively offlines disks that failed, predicted to fail, or are performing poorly & performs corrective actions, if possible
- On disk failure, the DB system automatically creates an internal ticket and notifies internal team to contact the customer
- These actions ensure highest level availability and performance at all times

Exadata DB Systems Storage Architecture



- Backups provisioned on Exadata storage: ~ 40% of the available storage space allocated to **DATA** disk group and ~ 60% allocated to the **RECO** disk group
- Backups not provisioned on Exadata storage: ~ 80% of the available storage space allocated to **DATA** disk group and ~ 20% allocated to the **RECO** disk group
- After the storage is configured, the only way to adjust the allocation without reconfiguring the whole environment is by submitting a service request to Oracle

DB Systems – VM, BM, Exadata

	Virtual Machine (VM)	Bare Metal (BM)	Exadata
Scaling	Storage (number of CPU cores on VM DB cannot be changed)	CPU (amount of available storage cannot be changed)	CPU can be scaled within a $\frac{1}{4}$, $\frac{1}{2}$ and Full rack. Storage cannot be scaled
Multiple Homes/Databases	No, single DB and Home only**	Yes (one edition, but different versions possible)	Yes
Storage	Block Storage	Local NVMe disks	Local spinning disks and NVMe flash cards
Real Application Clusters (RAC)	Available (2-node)	Not Available	Available
Data Guard	Available	Available	Available*

*You can manually configure Data Guard on Exadata DB systems using native Oracle Database utilities and commands. dbcli is not available on Exadata DB systems

**The database can be a container database with multiple pluggable databases, if the edition is High Performance or Extreme Performance.

Database Editions and Versions

	VM DB Systems	BM DB Systems	Exadata DB Systems	DB Versions
Standard Edition	Yes	Yes	No	11.2.0.4
Enterprise Edition	Yes	Yes	No	12.1.0.2
High Performance	Yes	Yes	No	12.2.0.1
Extreme Performance	Yes	Yes	Yes	18.1.0.0 19.3*
BYOL			Yes	

*Note that Oracle Database 19c is only available on VM DB and Exadata DB Systems (as of September 2019)

Database Editions and Options

Standard Edition	Enterprise Edition	EE High Performance	EE Extreme Performance
<ul style="list-style-type: none">• Full database instance• Includes Transparent Data Encryption	<p>Adds...</p> <ul style="list-style-type: none">• All standard EE features• Data Masking and Subsetting• Diagnostics and Tuning• Real Application Testing	<p>Adds...</p>  <ul style="list-style-type: none">• Multitenant  <ul style="list-style-type: none">• Partitioning  <ul style="list-style-type: none">• Advanced Compression  <ul style="list-style-type: none">• Advanced Security, Label Security, Database Vault  <ul style="list-style-type: none">• OLAP, Advanced Analytics, Spatial and Graph  <ul style="list-style-type: none">• Management Packs	<p>Adds...</p>  <ul style="list-style-type: none">• Real Application Clusters (RAC)  <ul style="list-style-type: none">• In-Memory  <ul style="list-style-type: none">• Active Data Guard

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

Managing DB Systems

You can use the console to perform the following tasks:

- Launch a DB System: You can create a database system
 - Status check: You can view the status of your database creation and after that, you can view the runtime status of the database
- Start, stop, or reboot DB Systems
 - Billing continues in stop state for BM DB Systems (but not for VM DB)
- Scale CPU cores: scale up the number of enabled CPU cores in the system (BM DB systems only)
- Scale up Storage: increase the amount of Block Storage with no impact (VM DB systems only)
- Terminate: terminating a DB System permanently deletes it and any databases running on it

Patching DB Systems

- **Automated Applicable Patch Discovery:** Automatic patch discovery and pre-flight checks/tests
- **On demand patching:** N-1 patching (previous patch is available if it hasn't been applied), pre-check and patching at the click of a button
- **Availability during patching:** For Exadata and RAC shapes, patches are rolling. For single node systems if Active Data Guard is configured this can be leveraged by the patch service.
- **2 step process:** patching is a 2 step process, one for DB System and one for the database. DB System needs to be patched first before the database is patched
- **Identity and Access Controls:** Granular Permissions – its possible to control who can list patches, apply them, etc.

The image displays two separate screenshots of the Oracle Cloud Infrastructure patch management interface, both titled "Patches".

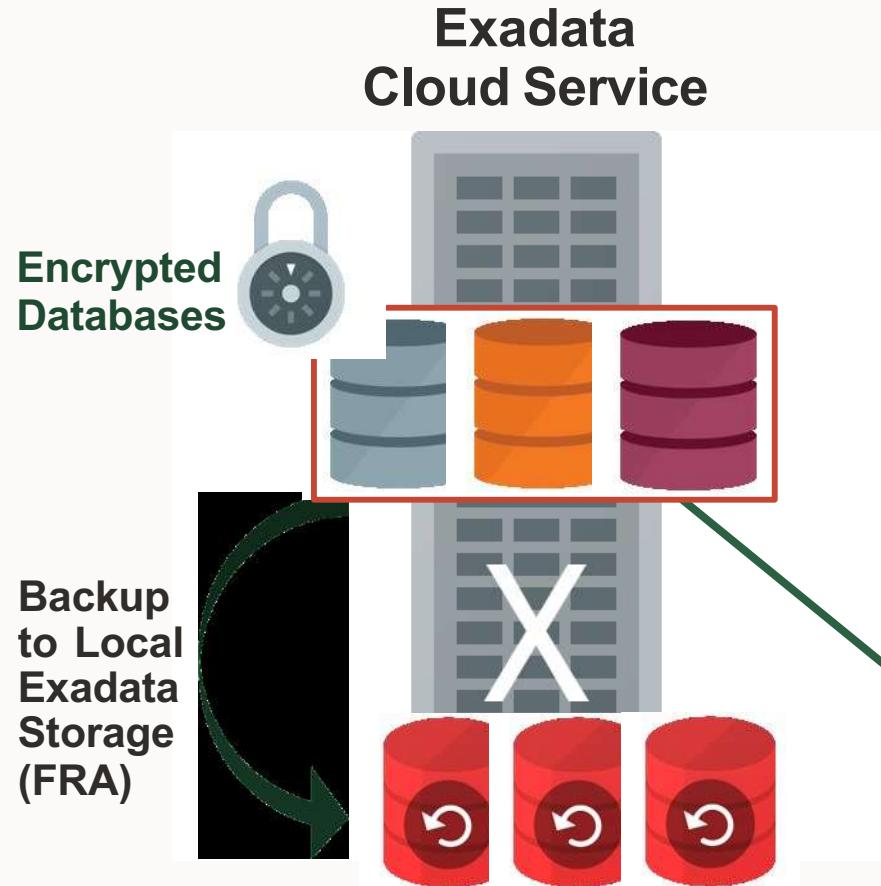
Screenshot 1 (Top): DB System Patch

- Header:** Patches, Displaying 1 Dat
- Patch Details:**
 - OCID:** ...oydy7a **Show** **Copy**
 - Version:** 12.2.0.1.180417
 - Patch Description:** Apr 2018 12.2.0.1 Db System patch
 - Release Date:** Wed, 25 Apr 2018 01:00:00 GMT
- Actions:** Pre-check, Apply

Screenshot 2 (Bottom): Database Patch

- Header:** Patches, Displaying 2 Da
- Patch Details:**
 - OCID:** ...fp34sa **Show** **Copy**
 - Version:** 12.2.0.1.180417
 - Patch Description:** Apr 2018 12.2.0.1 Database patch
 - Release Date:** Wed, 25 Apr 2018 01:00:00 GMT
- Actions:** Pre-check, Apply

Oracle Database Cloud Service Backup Options



Configure Automatic Backups

Enable automatic backup (i)

Important: All [prerequisites](#) for backing up to Oracle Cloud Infrastructure Object Storage must be met for automatic backups to work.

Backup retention period: 30 days

Backup scheduling (UTC): Anytime

Save Changes **Cancel**

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

Backup and restore with Object Storage

- Schedule automatic backups and retention policy
- Create on-demand backups
- Create databases from backup
- Receive notifications for successful and failed backups
- Restore databases to the latest backup, point-in-time, or scn

References

Available DB Systems on OCI - References

References

Oracle Cloud Academy Foundations I Section 10

Oracle Cloud Academy Foundations II Section 10

<https://blogs.oracle.com/database/post/what-is-a-converged-database>

Converged Database Simplifies Data Management: <https://www.youtube.com/watch?v=QnTzm9SShBs>

OCI Database Quick Start: <https://www.youtube.com/watch?v=rjmeRaB2650>

Cloud Engineering

Autonomous Databases



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Autonomous Databases

This Presentation:

- Autonomous Database
- Data Warehouse and Transaction Processing
- Serverless v Dedicated



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Oracle Cloud - Database Cloud Services

Broad service offering at every scale to meet diverse business requirements



Enterprise or Standard
Database Service



Exadata Database Service
Dedicated, fully elastic



Autonomous Database
Transaction Processing or Data Warehouse

Most Versatile

Highly Differentiated

Leading Edge

Managed Infrastructure

Fully Managed

Singular / Smaller Workloads

Best performance, availability with massive scale

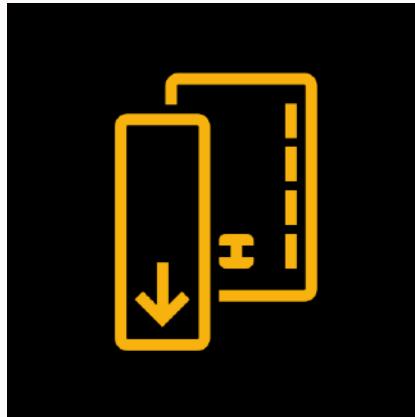


Automation



Oracle Autonomous Database

One Oracle Database, Optimized By Workload and Business need



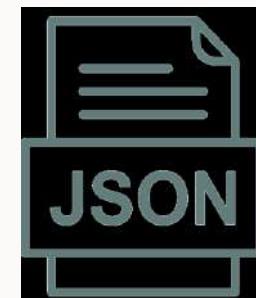
Transaction Processing

Optimized for transactions,
mixed-workloads, or
developing data-driven apps



Data Warehouse

Optimized for data warehouses, data marts, data science sandboxes, or developing analytics apps



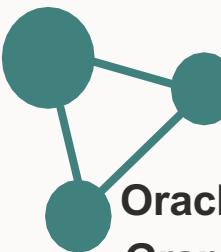
JSON

Optimized for JSON documents and JSON-centric AppDev



Oracle APEX Application Development

Optimized to develop and deploy low-code Apps on a fully managed, and secured environment

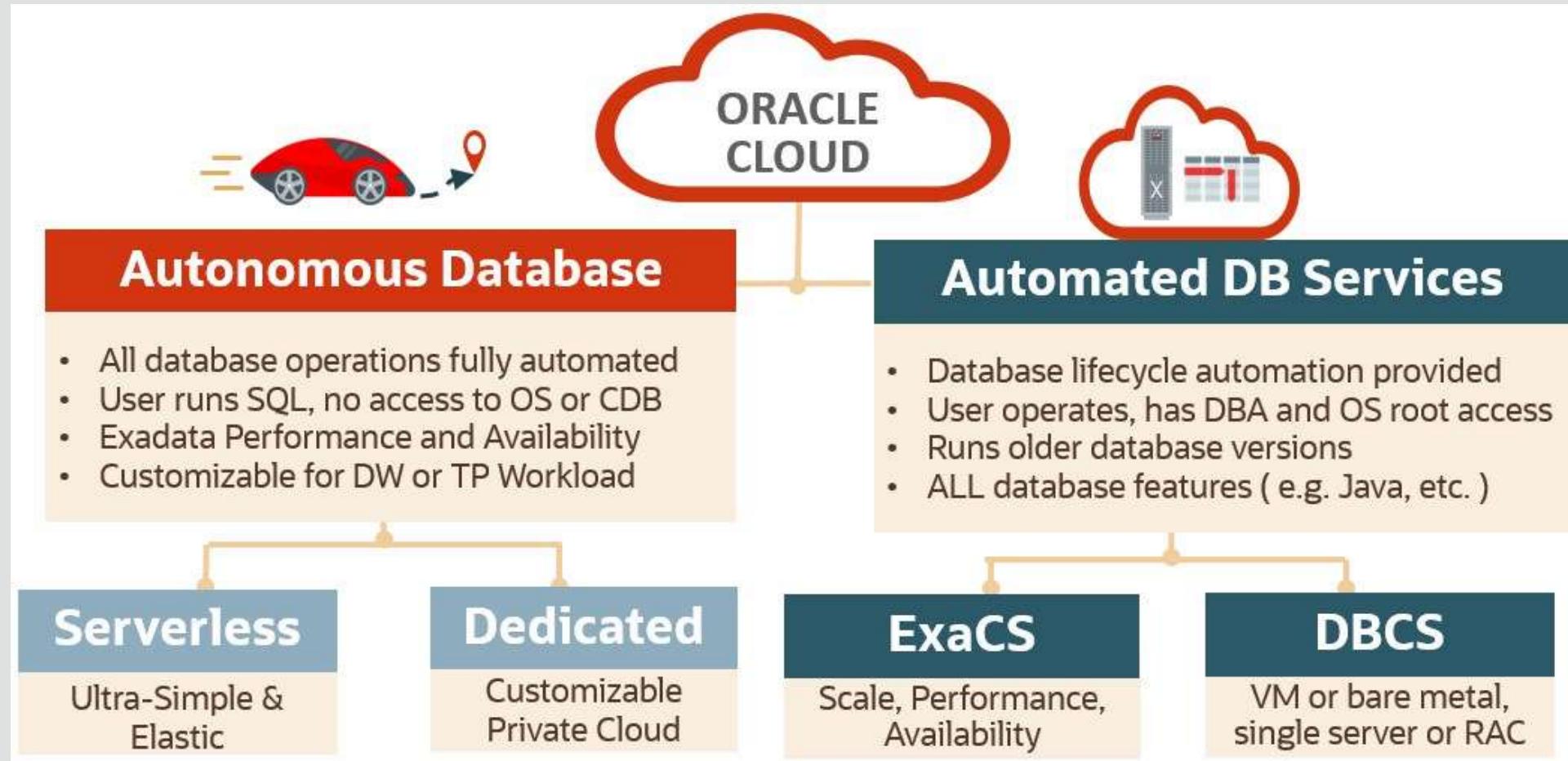


Oracle Graph



Oracle Machine Learning

Oracle Databases



Oracle Databases



Autonomous Database

World's Best Fully Self-Driving Database

Oracle Builds and Operates Exadata Infrastructure and Databases
User runs SQL, no Access to OS or Container DB



Oracle Database Cloud Services

World's Best Automated Database Cloud

Oracle Builds and Operates Infrastructure

User Operates Databases Using Provided Lifecycle Automation
User Has Full Control, including DBA and Root Access



Exadata

World's Best Database Platform

Oracle Builds, Optimizes, and Automates Infrastructure

All In-Database Automation Features Included



Oracle Database

World's Best Database

Runs Anywhere

User Builds and Operates Databases and Infrastructure

Use Cases

Cloud elasticity, Machine Learning, Self driving
Instant Provisioning, Always online operation
All workloads, JSON Documents,
Graphs, and more

Use cases

Availability, Flexible Version and Features,
Small to Large DB deployment,
Single Instance or RAC, Automated Backup,
Patching, Customer controls

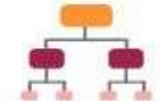
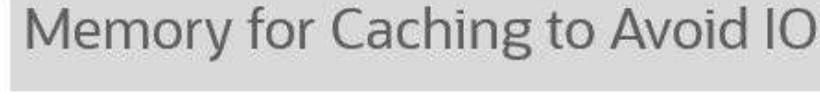
Use Cases

Private/Public Cloud on-premise, Consolidation,
Highest Performance, Scalability for Mission
Critical Workload

Use Cases

Small to Big Database transactional need
as well DWH needs, Customer Data Center,
DIY model

Autonomous Optimizations - Specialized by Workload

Autonomous Data Warehouse	Autonomous Transaction Processing
 Columnar Format	 Row Format
 Creates Data Summaries	 Creates Indexes
 Memory Speeds Joins, Aggs	 Memory for Caching to Avoid IO
 Statistics updated in real-time while preventing plan regressions	

Autonomous Database - Choice of Cloud Deployment



	DBaaS VM or Bare Metal	Exadata Cloud Service or Cloud @ Customer	Autonomous Serverless	Autonomous Dedicated
Management	Customer	Customer	Oracle	Oracle
Private Network	Yes	Yes	No	Yes
Single/Multi Tenant	Single/Multi	Single/Multi	Single	Single/Multi
Software Updates	Customer Initiated	Customer Initiated	Automatic	Customer Policy Control
Private Cloud	No	Yes	No	Yes
Offers Availability SLA	No	99.95%	SLO	SLO
Database Versions	11g,12c,18c,19c	11g,12c,18c,19c	18c	19c
Disaster Recovery	Yes Across ADs & Regions	Yes Across ADs & Regions	No	No
Hybrid DR	Yes	Yes	No	No
Consolidation	Yes	Yes	No	Yes

Autonomous Database Cloud Service – Deployment Options

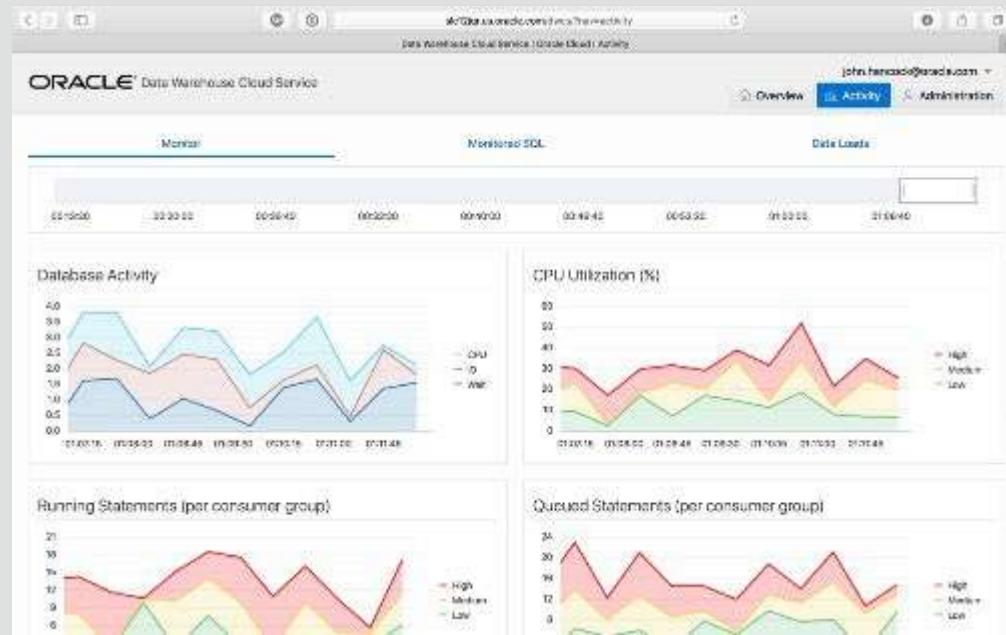
- Oracle Autonomous Database can be deployed in 2 ways – dedicated and serverless.
- Dedicated deployment is a deployment choice that enables you to provision autonomous databases into their own dedicated Exadata cloud infrastructure, instead of a shared infrastructure with other tenants.
- With serverless deployment, the simplest configuration, you share the resources of an Exadata cloud infrastructure. You can quickly get started with no minimum commitment, enjoying quick database provisioning and independent scalability of compute and storage.
- Both deployment options are available for Autonomous Transaction Processing and Autonomous Data Warehouse.

Autonomous Serverless

Automated Tuning in Autonomous Database

“Load and go”

- Define tables, load data, run queries
 - No tuning required
 - No special database expertise required
 - No need to worry about tablespaces, partitioning, compression, in-memory, indexes, parallel execution
- Fast performance out of the box with zero tuning
- Simple web-based monitoring console
- Built-in resource-management plans



Autonomous Database – Fully-elastic

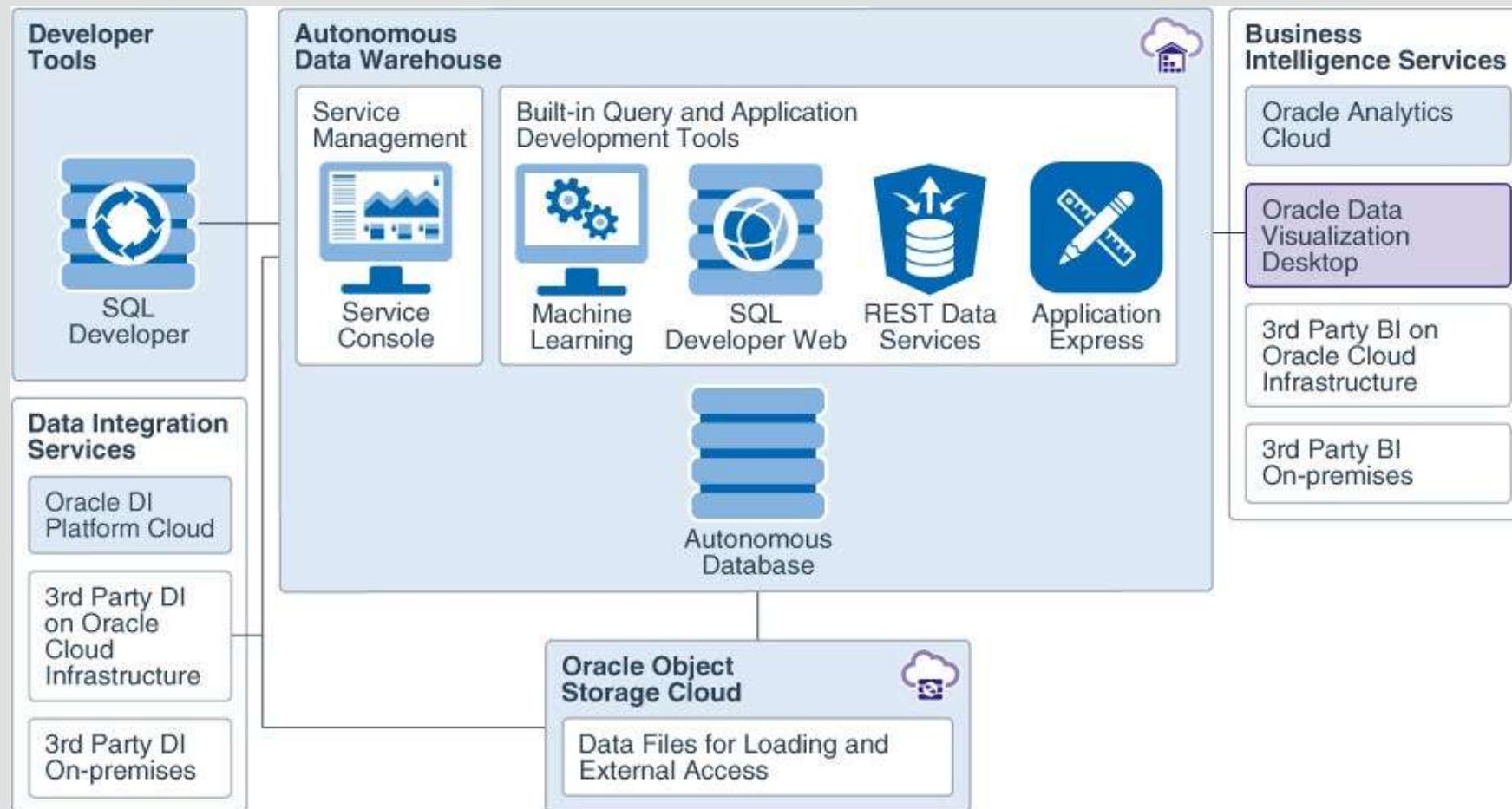
- Size the database to the exact compute and storage required
 - Not constrained by fixed building blocks, no predefined shapes
- Scale the database on demand
 - Independently scale compute or storage
 - Resizing occurs instantly, fully online
- Shut off idle compute to save money
 - Restart instantly
- Auto scaling:
 - Enable auto scaling to allow Autonomous Database to use more CPU and IO resources automatically when the workload requires it

Full Support of Database Ecosystem

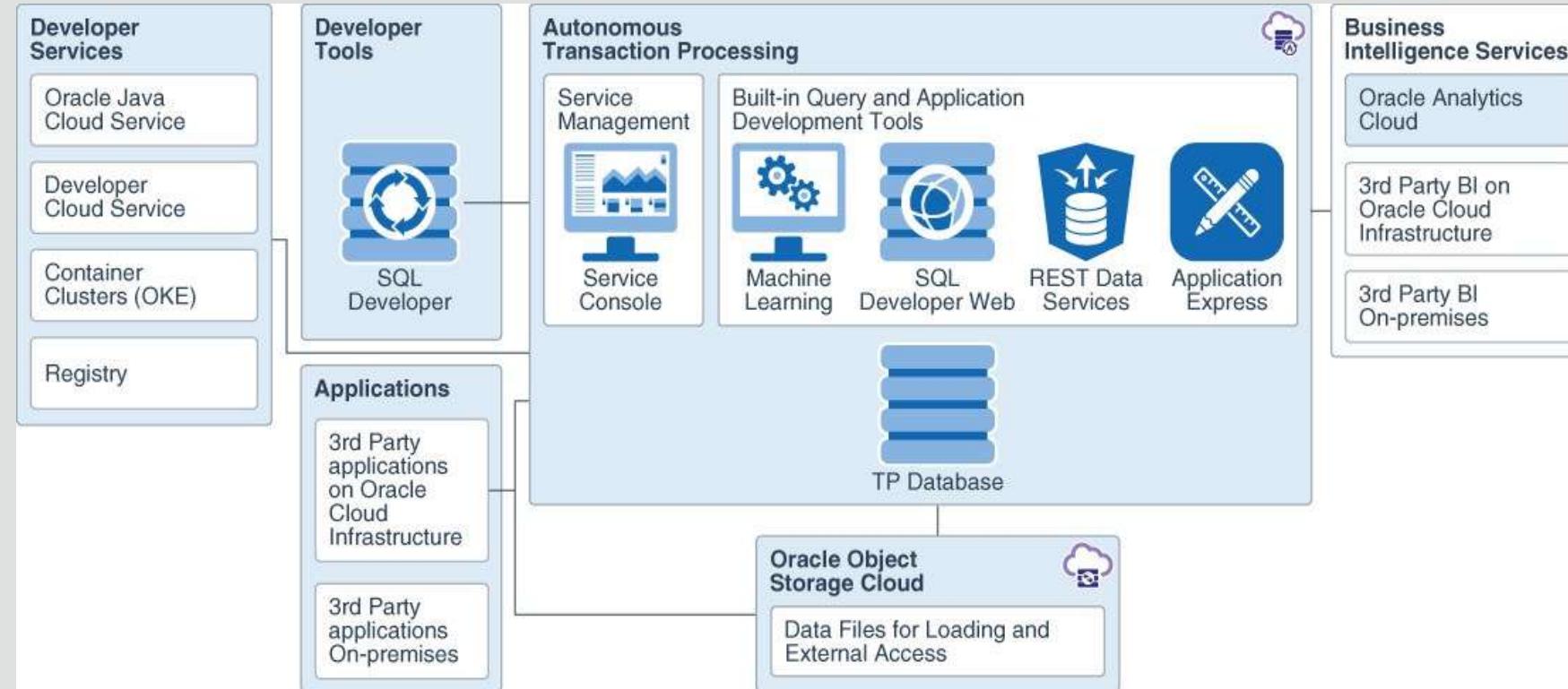
Autonomous Database service supports :

- Existing tools, running on-premises or in the cloud
 - Third-party BI tools
 - Third-party data-integration tools
 - Oracle BI and data-integration tools: BIEE, ODI, etc.
- Oracle cloud services: Analytics Cloud Service, GoldenGate Cloud Service, Integration Cloud Service, and others
- Connectivity via SQL*Net, JDBC, ODBC

Autonomous Data Warehouse: Architecture



Autonomous Transaction Processing: Architecture

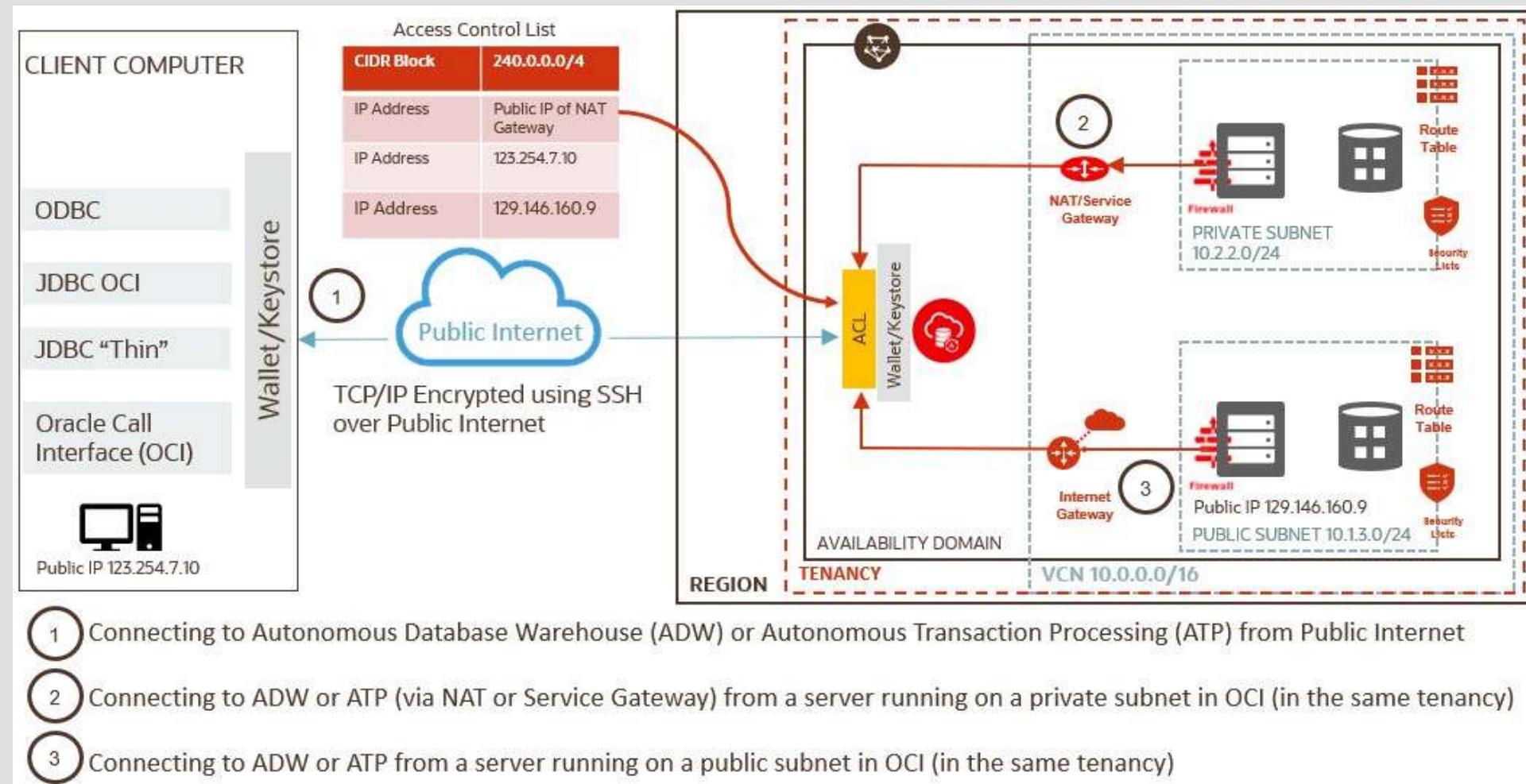


Getting Started with Autonomous Database

- Provisioning an ADB database requires only answers to 7 simple questions:
 - Database name?
 - Which data center (region)?
 - How many CPU cores?
 - How much storage capacity (in TBs)?
 - Admin password?
 - License Type?
 - Enable Auto scaling?
- New service created in a few minutes (regardless of size)
 - Database is open and ready for connections

The screenshot shows the 'Create Autonomous Database' wizard interface. It begins with a header 'Provide basic information for the Autonomous Database...' followed by a 'Choose a compartment' dropdown set to 'Sandcast'. Below this, there are two input fields: 'Display name' containing 'DB 201607081051' and 'Database name' containing 'DB201607081051'. A note below the database name states: 'The database automatically refreshes once every 24 hours and has a maximum of 12 hours retention.' The next section, 'Choose a workload type', contains two options: 'Data Warehouse' (described as supporting data warehousing workload with analytical, log, data loading operations) and 'Transaction Processing' (described as supporting transactional workload with high volume of read/write access). The 'Configure the database' section includes fields for 'CPU core count' (set to 1) and 'Storage (TB)' (set to 1). Below this is the 'Autonomous Database' configuration section, which includes fields for 'Username' (set to 'PDBADMIN'), 'Password', and 'Generate password'. The 'Autonomous Database Type' section offers the choice between 'Using Your Own License' (selected) and 'License Included'. A note under 'Using Your Own License' says: 'My organization already uses Oracle Database software license. Bring your existing entitlements from your current database vendor to the database cloud provider.' The 'License Included' section notes: 'Oracle Database 19c Standard Edition License and the Database Cloud Service license are included in the price of the database instance.' At the bottom of the form is a 'Create Autonomous Database' button.

Connecting to the Autonomous Database



Monitoring

- Service Console based monitoring
 - Simplified monitoring using the web-based service console
 - Historical and real-time database and CPU utilization monitoring
 - Real Time SQL Monitoring to monitor running and past SQL statements
 - CPU allocation chart to view number of CPUs utilized by the service
- Performance Hub based monitoring
 - Natively integrated in the OCI console and available via a single click from the ADB detail page
 - Active Session History (ASH) analytics
 - Real Time SQL monitoring

Autonomous Database (ADB) Cloud – Backup and recovery

- Autonomous Database Cloud automatically backs up your database for you. The retention period for backups is 60 days. You can restore and recover your database to any point-in-time in this retention period.
- Autonomous Database Cloud automatic backups provide weekly full backups and daily incremental backups.
- Manual backups for your ADB database is not needed.
- But, you can do manual backups using the cloud console if you want to take backups before any major changes, for example before ETL processing, to make restore and recovery faster. The manual backups are put in your Cloud Object Storage bucket. When you initiate a point-in-time recovery Autonomous Database Cloud decides which backup to use for faster recovery.
- You can initiate recovery for your Autonomous Database using the cloud console. Autonomous Database Cloud automatically restores and recovers your database to the point-in-time you specify.
- Network Access Control Lists (ACL)s are stored in the database with other database metadata. If the database is restored to a point in time the network ACLs are reverted back to the list as of that point in time.

Pre-defined Services for Autonomous Data Warehouse

- 3 pre-defined database services identifiable as high, medium and low
 - Choice of performance and concurrency for ADW
- **HIGH**
 - Highest resources, lowest concurrency
 - Queries run in parallel
- **MEDIUM**
 - Less resources, higher concurrency
 - Queries run in parallel
- **LOW**
 - Least resources, highest concurrency
 - Queries run serially

Example for a database with 16 OCPUs

	No of concurrent queries	Max idle time	CPU shares
HIGH	3	5 mins	4
MEDIUM	20	5 mins	2
LOW	32	1 hour	1

*When connecting for replication purposes, use the LOW database service name. For example, use this service with Oracle GoldenGate connections.

Pre-defined Services for Autonomous Transaction Processing

- Five pre-defined database services controlling priority and parallelism
- Different services defined for Transactions and Reporting/Batch

SERVICES NAME	RESOURCE MANAGEMENT PLAN SHARES	PARALELLISM
HIGH	4	Operations run in parallel and are subject to queuing
MEDIUM	2	Operations run in parallel and are subject to queuing
LOW	1	None
TPURGENT	12	Manual
TP	8	None

■ For Transaction Processing

■ For Reporting or batch processing

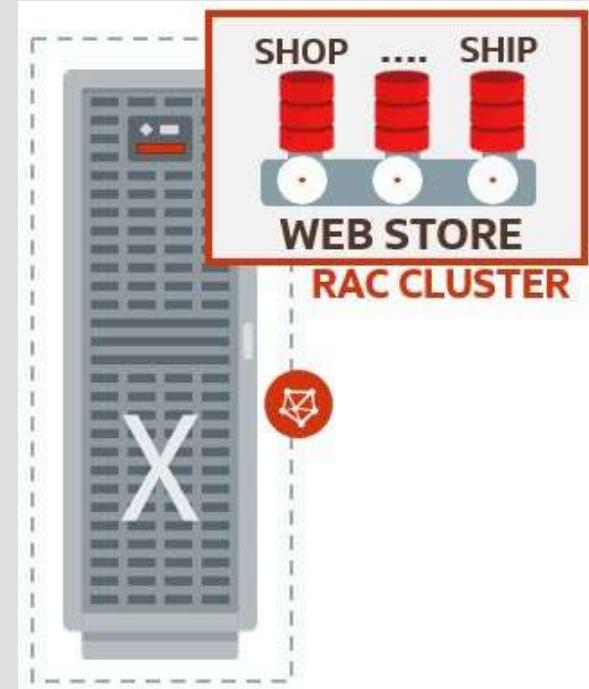
Autonomous Database - Dedicated

- The Autonomous Dedicated database service provides a private database cloud running on dedicated Exadata Infrastructure in the Public Cloud.
- It has multiple levels of isolation protects you from noisy or hostile neighbors.
- Customizable operational policies give you control of provisioning, software updates, availability and density.

Autonomous Database- Dedicated

Physical Characteristics and constraints

- Quarter rack X7 Exadata Infrastructure
 - 2 servers(92 OCPU, 1.44TB RAM)
 - 3 Storage Servers (76.8TB Flash, 107TB Disk)
- Cluster / Virtual Cloud Network
 - 1 Cluster per quarter rack
- Autonomous Container Database
 - Maximum of 4 per Cluster
- Autonomous Database
 - High Availability SLA – Maximum 100 DBs
 - Extreme Availability SLA – Maximum 25 DBs



Autonomous Cloud | General Migration Path



References

References

Oracle Cloud Academy Foundations I Section 11

Oracle Cloud Academy Foundations II Section 10

OCI Database Quick Start: <https://www.youtube.com/watch?v=rjmeRaB2650>

Cloud Engineering

Data Guard



Image licensed under creative commons

Databases

This Presentation:

- Data Guard
- Active Data Guard



Images licensed under creative commons.

Data Guard

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Data Guard

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Standby/Replica database

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Single Standby/Replica in OCI

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Failover

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Data Guard

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Data Guard

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Disaster Recovery

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Automatic Failover

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Database Upgrades

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Zero data loss

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DataGuard on Database Cloud Service – VM/BM

- Data Guard and Active Data Guard provide disaster recovery (DR) for databases with recovery time objectives (RTO) that cannot be met by restoring from backup.
- Active Data Guard extends Data Guard capabilities by providing advanced features for data protection and availability as well as offloading read-only workload and fast incremental backups from a production database. Active Data Guard is included in the Extreme Performance Edition and Exadata Service.
- Once Data Guard is instantiated, it maintains synchronization between the primary database and the standby database.
- To configure a Data Guard system across regions or between on-premises and Oracle Cloud Infrastructure DB systems, you must access the database host directly and use the DGMGRL utility.

DataGuard on Database Cloud Service – VM/BM continued

- Oracle recommends that the DB system of the standby database be in a different availability domain.
- The standby databases in Oracle Cloud Infrastructure Database are physical standbys.
- Currently 3 major operations are supported on OCI DbaaS VM
 - SetupDataguard
 - SwitchOvar/Failover/Reinstate
 - DeleteStandbyDatabase
- Note: You can't terminate a primary database that has a Data Guard association with a peer (standby) database. Delete the standby database first. Alternatively, you can perform a switchover to the standby database, and then terminate the primary database. You can't terminate a DB system that includes Data Guard enabled databases. To remove the Data Guard association: For a bare metal DB system database - terminate the standby database. For a virtual machine DB system database - terminate the standby DB system.

DataGuard on Database Cloud Service – Prerequisites

- A Data Guard implementation requires two DB systems, one containing the primary database and one containing the standby database.
- When you enable Data Guard for a virtual machine DB system database, a new DB system with the standby database is created and associated with the primary database.
- For a bare metal DB system, the DB system with the database to be used as the standby must already exist before you enable Data Guard (**Create a database in the required AD and subnet before you attempt DG association**).
- Note: A Data Guard configuration on the Oracle Cloud Infrastructure is limited to one standby database per primary database.

DataGuard on Database Cloud Service – Prerequisites continued

- Both DB systems must be in the same compartment, and they must be the same shape.
- The database versions and editions must be identical. Data Guard does not support Standard Edition. (Active Data Guard requires Enterprise Edition - Extreme Performance.)
- The database version determines whether Active Data Guard is enabled. If you are using the BYOL licensing model and if your license does not include Active Data Guard, you must either use Enterprise Edition - High Performance or set up Data Guard manually. See [Using Oracle Data Guard with the Database CLI.](#)
- Both DB systems must use the same VCN, and port 1521 must be open.

Data Guard

Data Guard

Has additional networking requirements

Stateful security list rules

Data Guard Configuration Supported from Console

- The Console allows you to enable a Data Guard association between databases, change the role of a database in a Data Guard association using either a switchover or a failover operation, and reinstate a failed database.
- When you enable Data Guard, a separate Data Guard association is created for the primary and the standby database.
- You can use console to perform following operations
 - To enable Data Guard on a bare metal DB system
 - To enable Data Guard on a virtual machine DB system
 - To perform a database switchover
 - To perform a database failover
 - To reinstate a database
 - To terminate a Data Guard association on a bare metal DB system
 - To terminate a Data Guard association on a virtual machine DB system
- Note: Data Guard Fast Start Failover as well across region DR is manual as of today - No cloud tooling.

Data Guard

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Data Guard

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Enable

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Switchover

• • • •

Failover

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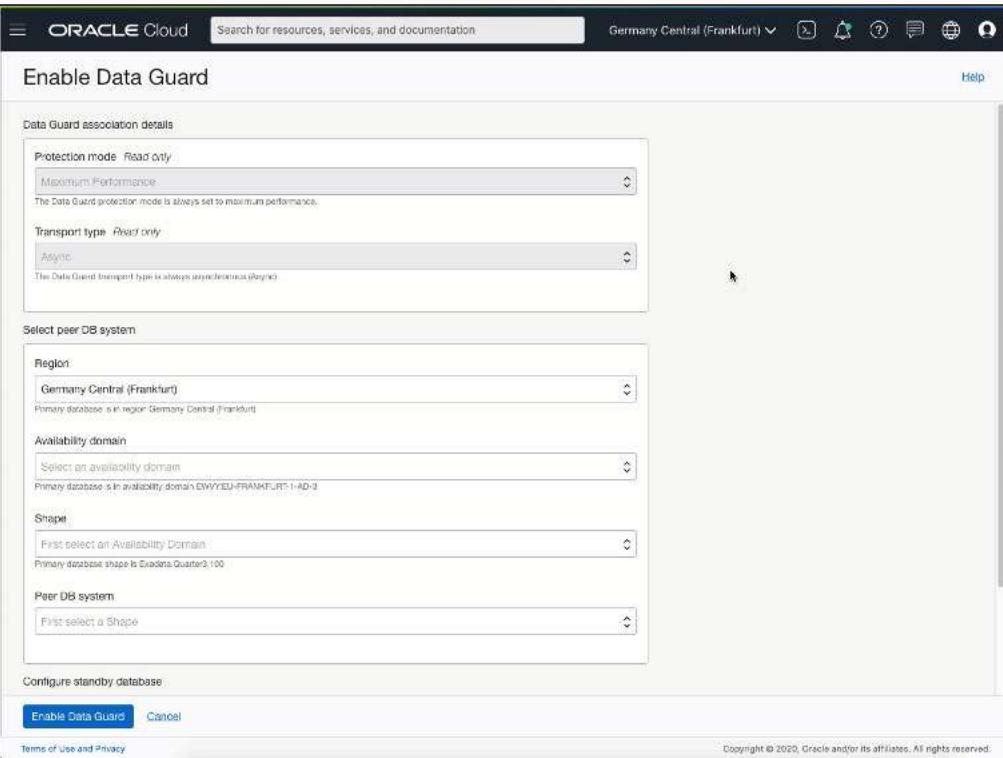
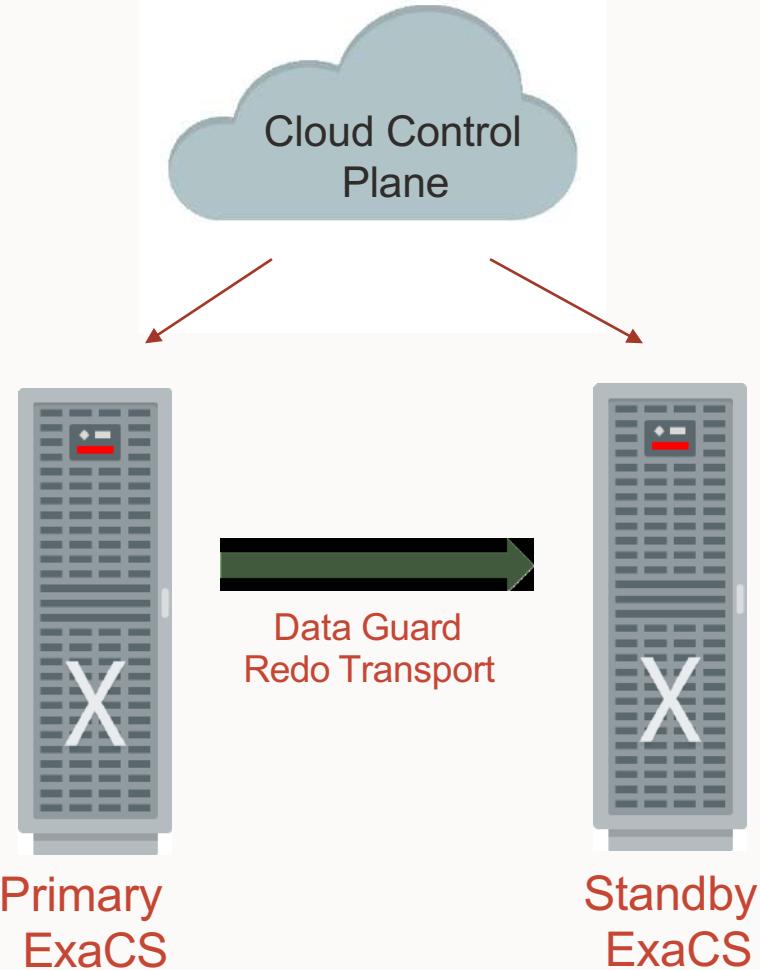
Reinstate

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Terminate

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Active Data Guard



- Cloud automation to instantiate standby, fail or switch over, and reinstate
- Standby supports symmetric or asymmetric configurations and can reside across availability domains and regions
- Provides asynchronous replication for maximum performance
- Supports manual setup for automatic failover (fast-start failover)

References

Data Guard - References

References

Oracle Cloud Academy Foundations II Section 9

OCI Database Quick Start: <https://www.youtube.com/watch?v=rjmeRaB2650>

Oracle Data Guard page: <https://www.oracle.com/database/data-guard/>