

ORACLE

# Oracle Cloud Maximum Availability Architecture

---

**Oracle Database High Availability, Scalability, and Maximum Availability  
Architecture team**

August 2025

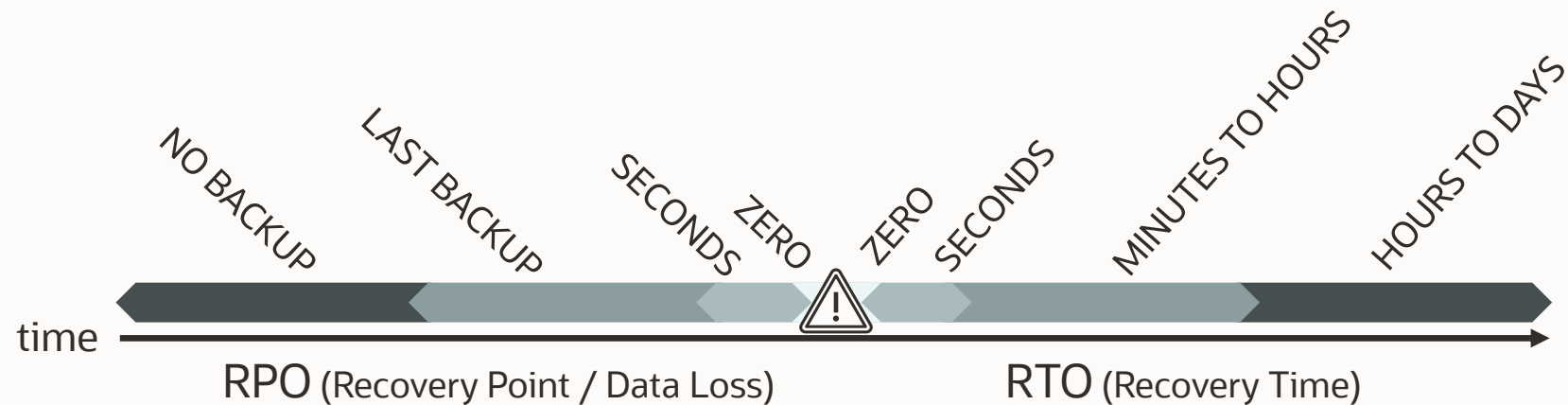


# Types of Downtime and Recovery Objectives

## Types of downtime



## Recovery objectives

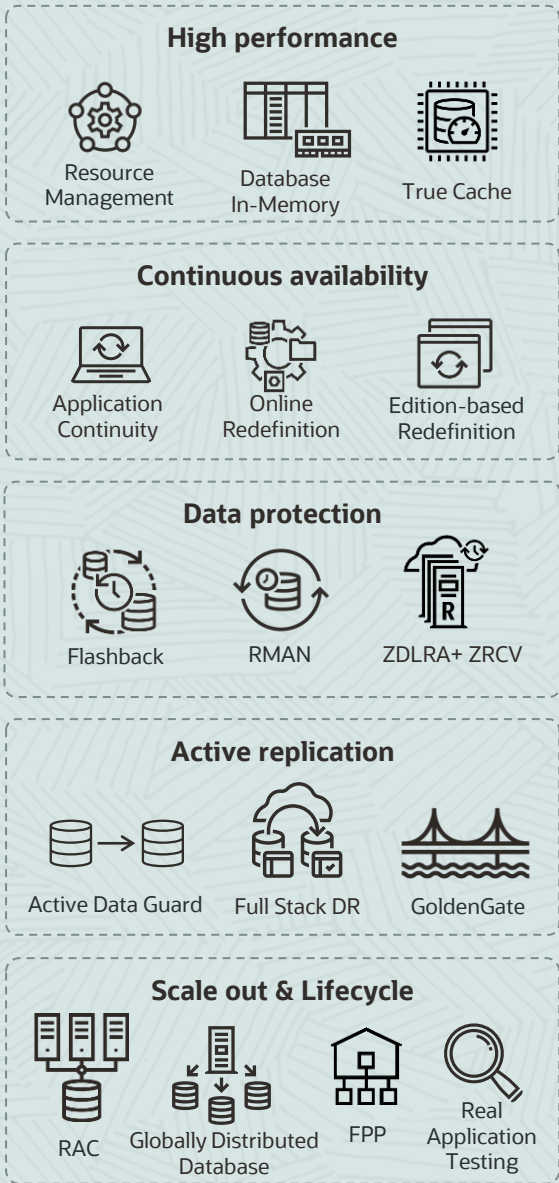
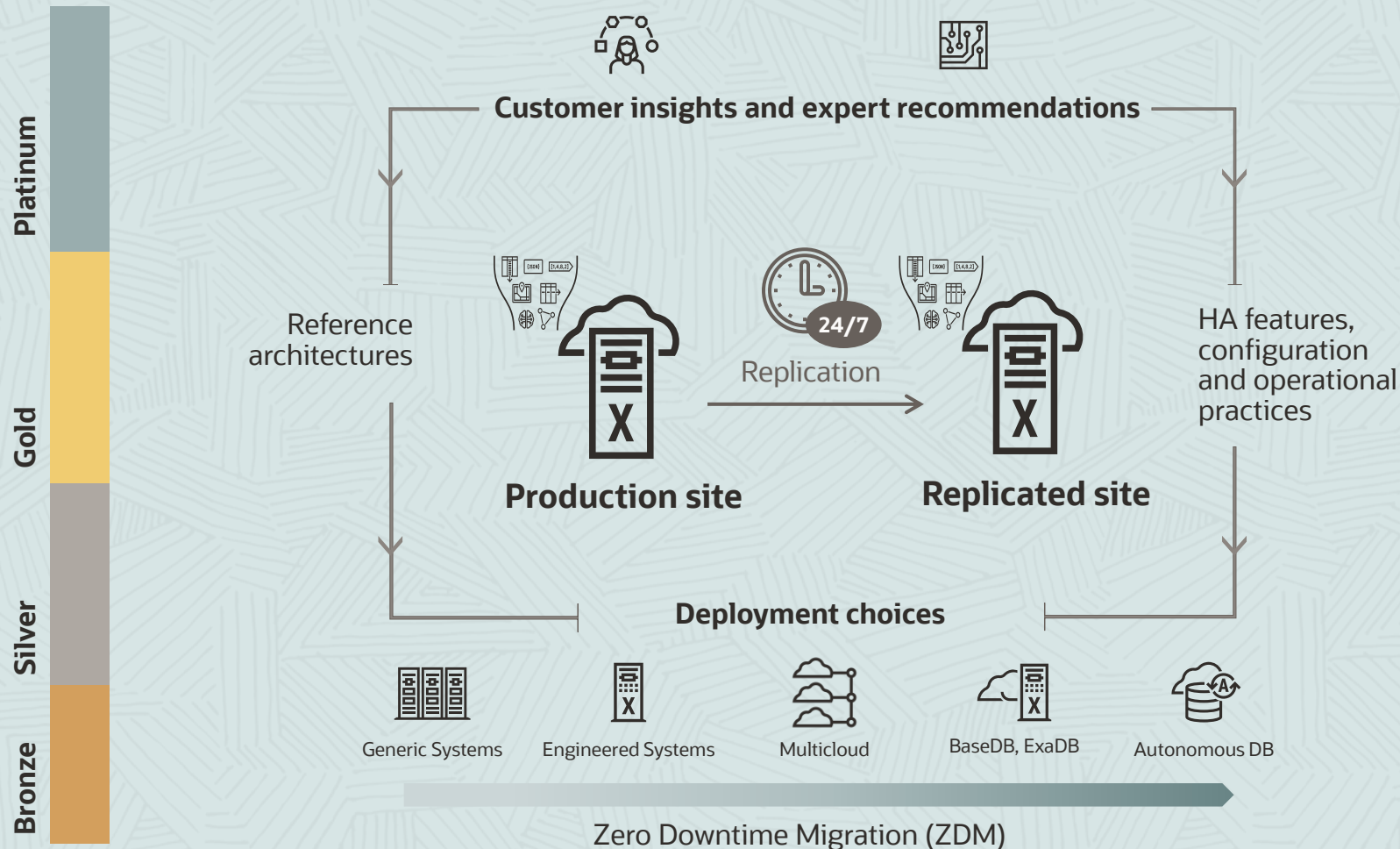


# From Single Instance to 99.999%

---

Maximum Availability Reference Architectures

# Oracle Maximum Availability Architecture (MAA)





# Single Instance Protection

## Underlying Technologies



- ACID transactions
- Standard protection
- Automatic Restart



- Online table redefinition and partition maintenance
- Less planned downtime



- PDB and CDB isolation
- Protection from noisy neighbors



- Protection from wrong transactions



- Basic DB protection
- Protection from data loss

## Local site



BACKUP



REPLICATED  
BACKUP

## Remote site

## Bronze Outage Matrix



PLANNED  
MAINTENANCE

ZERO  MINS/HOURS



RECOVERABLE  
FAILURE

ZERO  MINS/HOURS



UNRECOVERABLE  
FAILURE

LAST BACKUP  HOURS (1)



UPGRADE

ZERO  MINS/HOURS




BRONZE




# Protection from Recoverable Failures


### Underlying Technologies



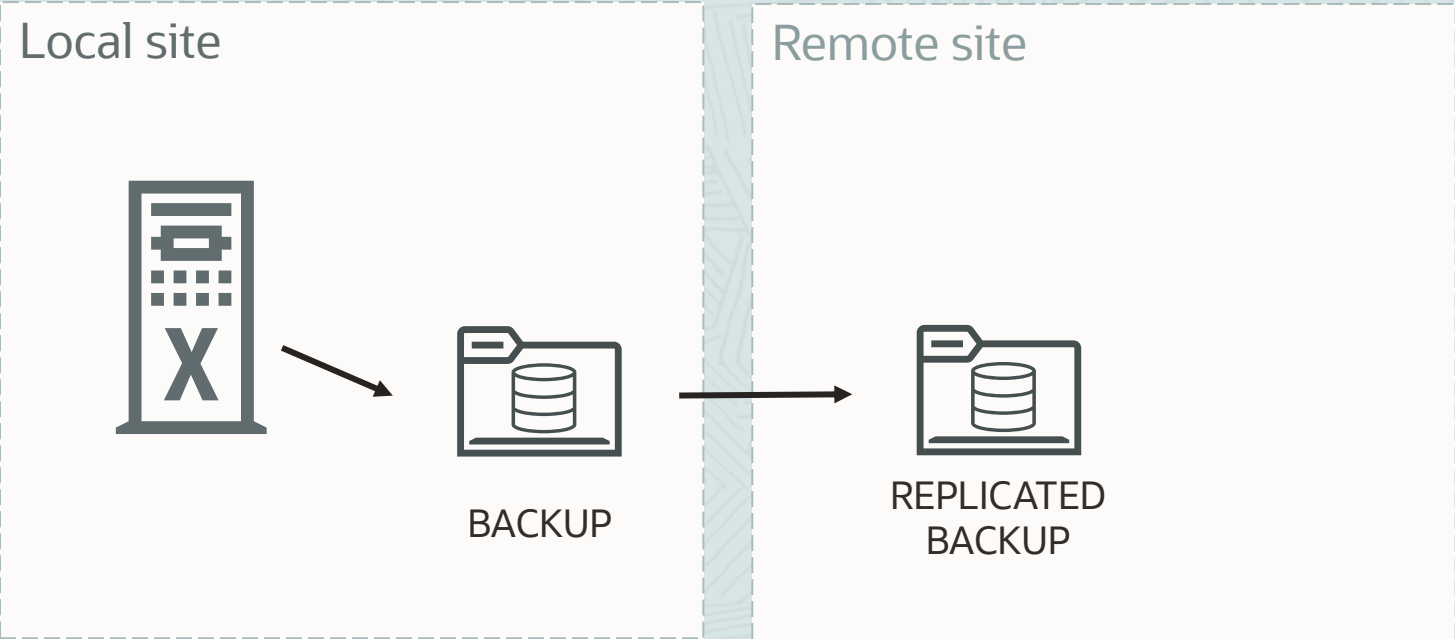
- Node failure protection
- Zero downtime software maintenance
- Elastic changes (CPU, mem, storage) with no downtime











- (Almost) Transparent unplanned maintenance




- Exadata scalability, performance and availability
- Exadata agility with changing number of VMs, storage, compute resources
- Data protection and Exadata QoS for DB operations




Silver Outage Matrix		
	PLANNED MAINTENANCE	ZERO  ZERO
	RECOVERABLE FAILURE	ZERO  SECONDS
	UNRECOVERABLE FAILURE	LAST BACKUP  HOURS (1)
	UPGRADE	ZERO  MINS/HOURS



(1) RPO can be seconds with Autonomous Recovery Service (ZRCV) 

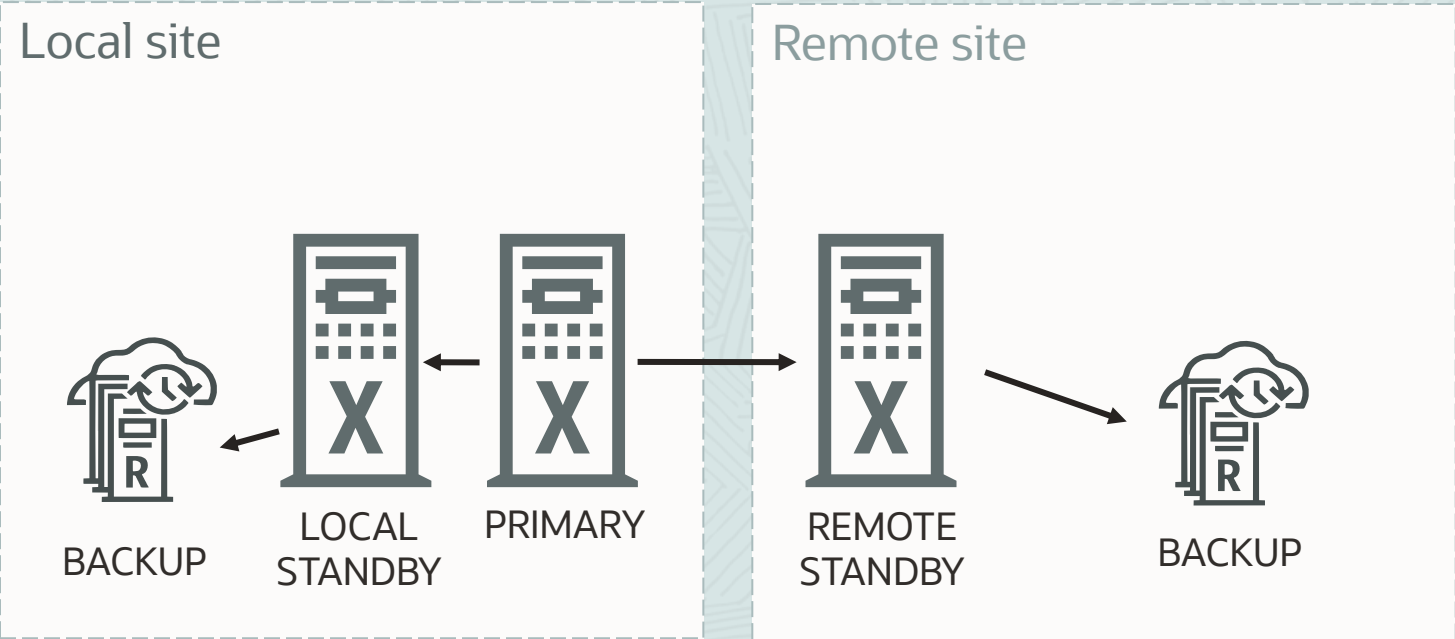










# Protection from Unrecoverable and Site Failures



ACTIVE  
DATA GUARD

- Site failure protection
- Comprehensive corruption prevention
- Rolling upgrades
- Offload work to standby with read-mostly scale-out



Gold Outage Matrix		
	PLANNED MAINTENANCE	ZERO  ZERO
	RECOVERABLE FAILURE	ZERO  SECONDS
	UNRECOVERABLE FAILURE	ZERO  SECONDS
	UPGRADE	ZERO  SECONDS



# Highest Availability

## Underlying Technologies



- Active/Active
- Always online
- Online database upgrades
- Site switch with zero database downtime
- Read-write scale-out
- The application must be aware of the replica(s)

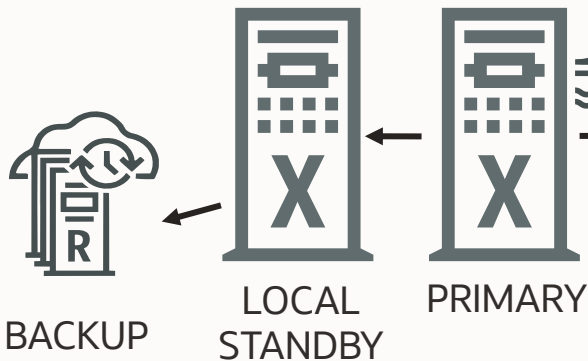


- Online application upgrades

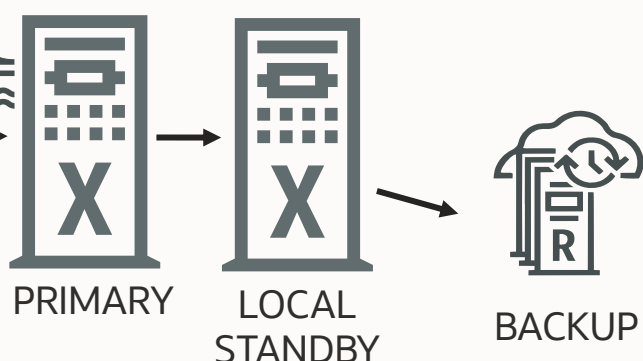


- Distributed
- Best scale-out

## Local site



## Remote site



## Platinum Outage Matrix

	PLANNED MAINTENANCE	ZERO  ZERO
	RECOVERABLE FAILURE	ZERO  ZERO
	UNRECOVERABLE FAILURE	ZERO  ZERO
	UPGRADE	ZERO  ZERO



PLATINUM

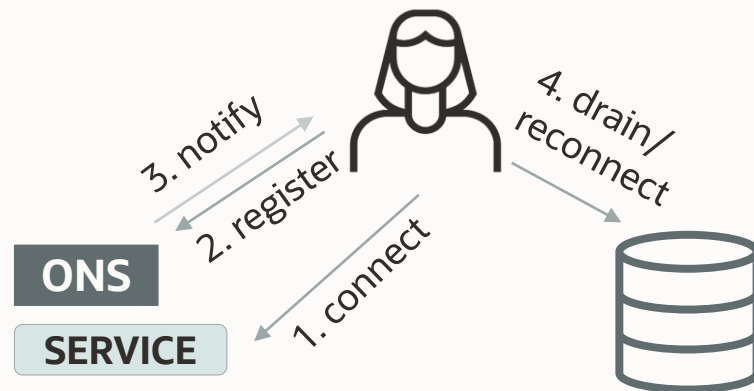


# Client-side Required Technologies

Client draining/failover is a crucial part of high availability for applications connecting to the database.

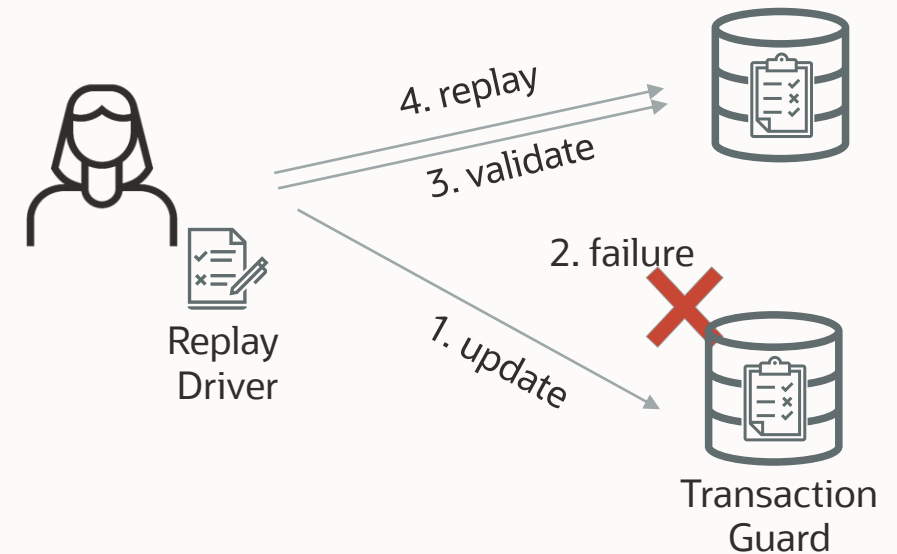
## PLANNED MAINTENANCE

Fast Application Notification  
(Session Draining)







## UNEXPECTED FAILURES

Transparent Application Continuity <sup>1</sup>  
(Transaction Replay)



[Level 1: Use Services, Connect String, Level 2: FAN, Level 3: TAC Configuring Continuous Availability for Applications \(oracle.com\)](#)

# MAA Validated Solutions

MAA Tier	BaseDB VM	ExaDB-D	ExaDB-C@C	ADB-S	ADB-D
 BRONZE	Base DB – Single Instance	NA	NA	NA	NA
 SILVER	Base DB – Two RAC Node	ExaDB-D (Default)	ExaDB-CC (Default)	ADB-S (Default)	ADB-D (Default)
 GOLD	Base DB – Two RAC Node w/ADG	ExaDB-D w/(A)DG	ExaDB-CC w/(A)DG	ADB-S w/AuDG	ADB-D w/AuDG
 PLATINUM	Base DB – Two RAC Node w/ADG & OGG	ExaDB-D w/ADG & OGG	ExaDB-CC w/ADG & OGG	Planned	Manual OGG deployment

# Oracle Cloud Infrastructure Topology

---

Maximum Availability Architecture

# MAA Best Practices

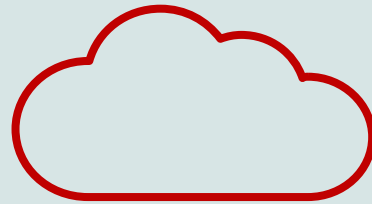
MAA Validations and Recommendations Everywhere

On-premises



[MAA Best Practices - Oracle Database](#)

Oracle Cloud



[MAA Best Practices for the Oracle Cloud](#)

Hybrid Cloud



[Hybrid Cloud and Multicloud Best Practices](#)

Multicloud



[MAA Best Practices for Oracle Database@Azure](#)



MAA Best Practices for Oracle Database@Google Cloud





# Oracle Cloud Infrastructure global footprint

October 2024 – 165 live or planned regions<sup>1</sup>

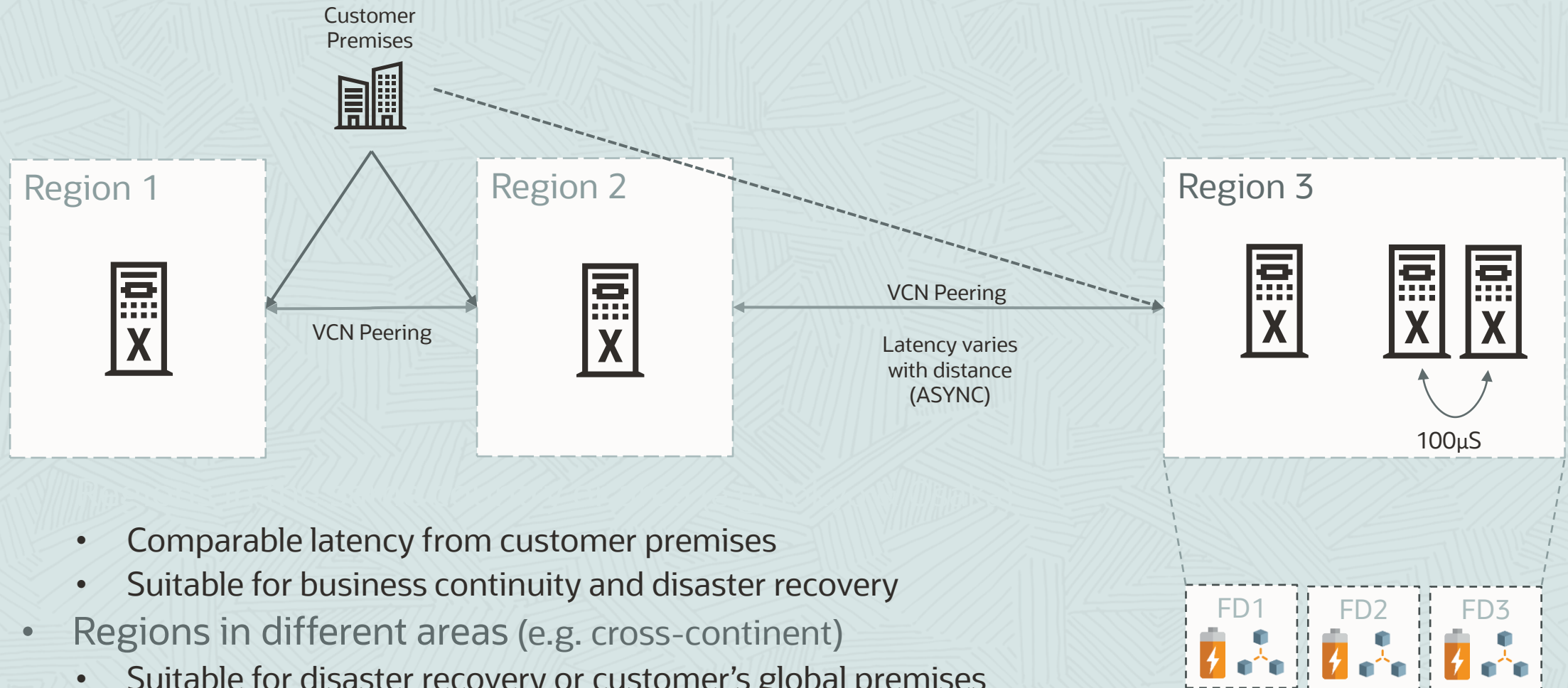
100% renewable energy by 2025



<sup>1</sup>Not all regions listed on map



# Oracle Cloud Infrastructure topology

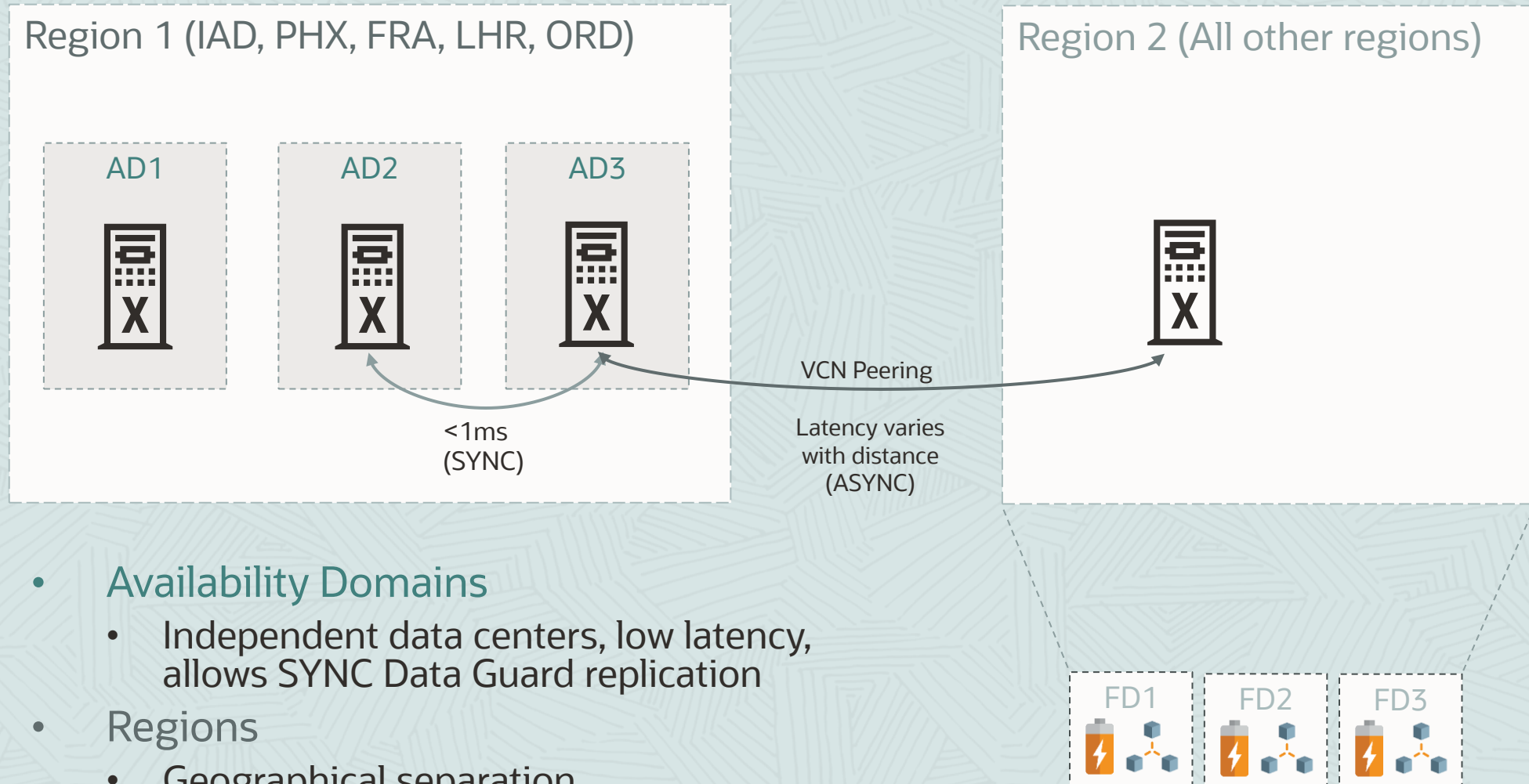


- Comparable latency from customer premises
- Suitable for business continuity and disaster recovery
- Regions in different areas (e.g. cross-continent)
  - Suitable for disaster recovery or customer's global premises
- Fault Domains
  - Isolated Power & Network

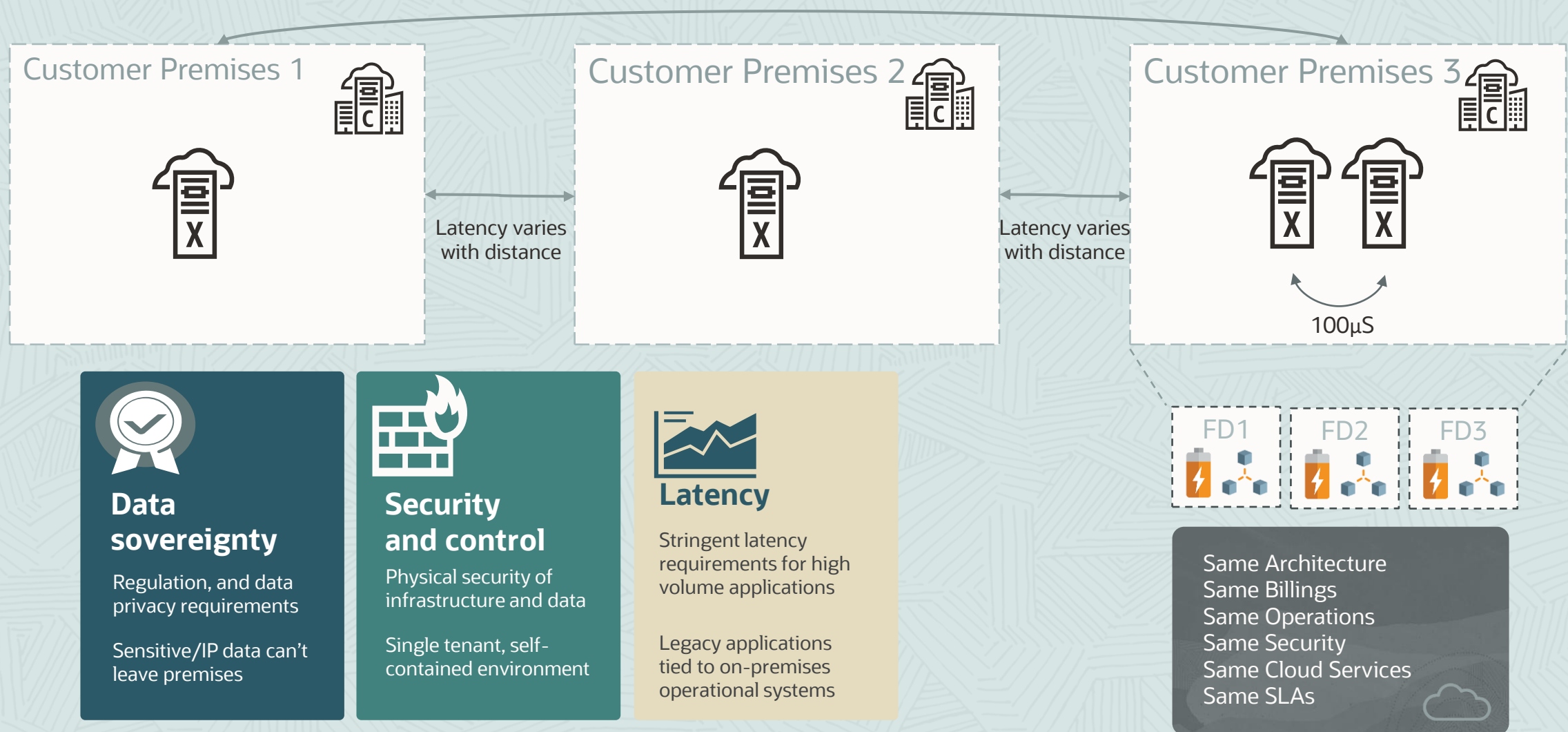


# Oracle Cloud Infrastructure topology

Ashburn, Phoenix, Frankfurt, London and Chicago

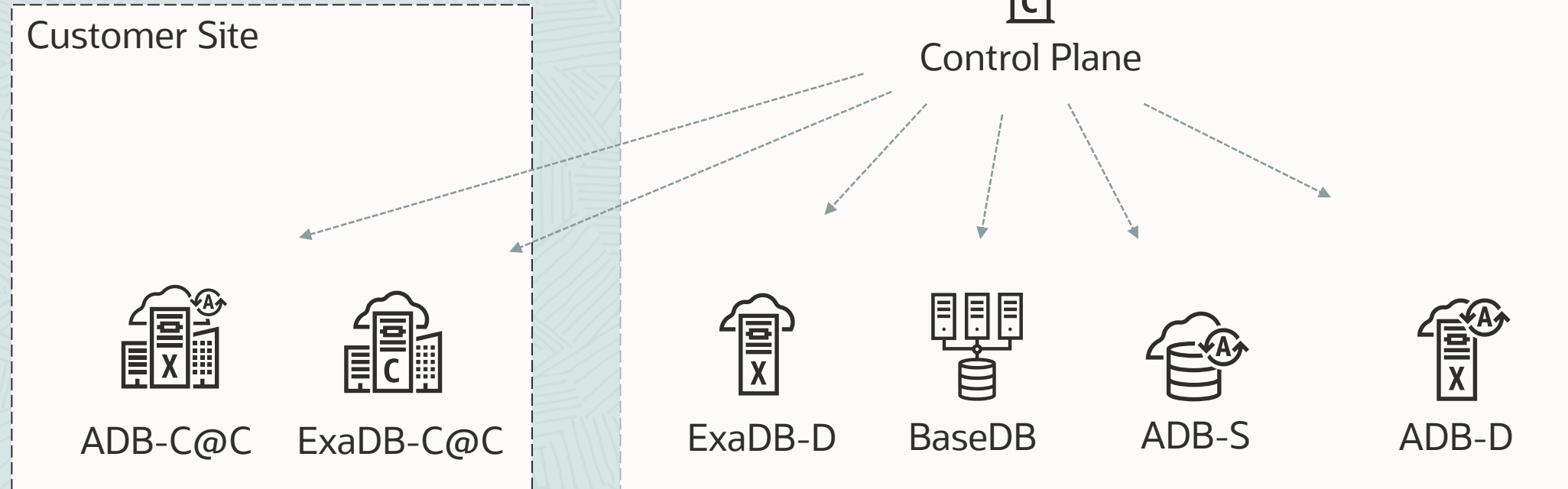


# Oracle Cloud Infrastructure Dedicated Region





# Oracle Cloud automation









- Cloud automation can be either:
  - 100% managed by the service
  - Achieved with the OCI Tooling, through the Control Plane:  
OCI User Interface, OCI Rest API, SDK, OCI CLI, Terraform OCI Provider, etc.

# Oracle Exadata Database Service on Dedicated Infrastructure (ExaDB-D)

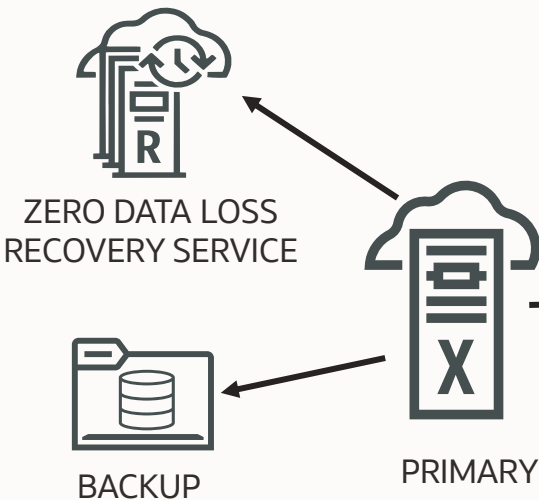
---

Maximum Availability Architecture

# Exadata Database Service: protection out of the box









AVAILABILITY / AUTOMATION *		
✓ 	Recovery Service (default) or via <a href="#">automated OCI backups</a> or <a href="#">Dbascli</a>	
✓ 	Exadata inherent HA, QoS, and Performance benefits plus <i>Exadata Fleet Update</i> for gold image patching	
✓ 	<a href="#">Via console or DBaaS API</a> (Up to 6 Standby DBs in ExaDB-D, cross-region possible, DBMS_ROLLING with cloud API)	
✓ 	Manual (Capture & Delivery)	
MAA LEVEL	 SILVER Out of the Box	 GOLD + Data Guard

Region 1



Region 2



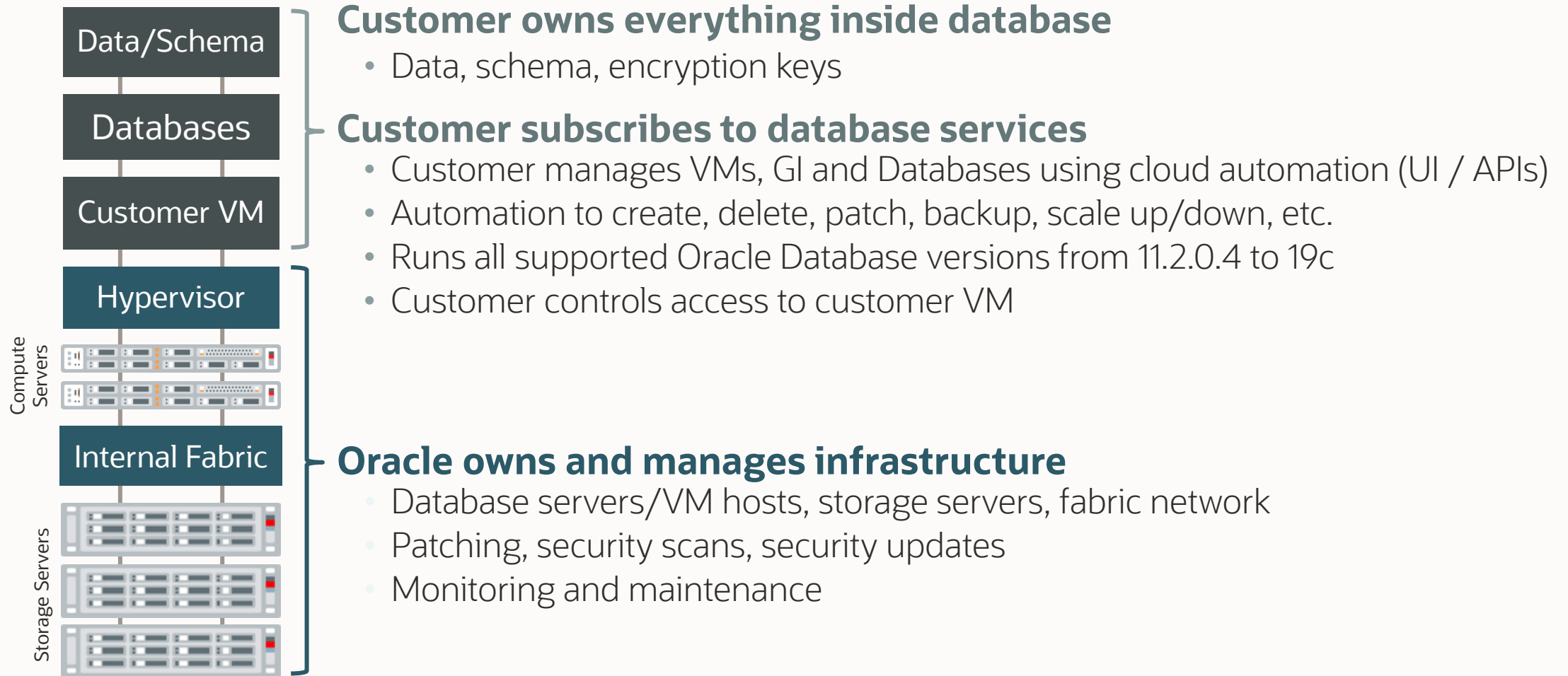
Outage Matrix		
	PLANNED MAINTENANCE	ZERO  ZERO
	RECOVERABLE FAILURE	ZERO  SECONDS
	UNRECOVERABLE FAILURE	SECONDS  MINUTES (1)
	UPGRADE	ZERO  SECONDS

(1) No FSFO, based on time after customer request

- \* Legend:
- ✓ Out of the box
  - ✓ Automated via control plane
  - ✓ Manual setup
  - ✗ Not available/possible











# Exadata Database Service: responsibility overview













# Exadata Database Service: Oracle Managed Backups

1-click configuration automatic simple backup (default/recommended)

 SCHEDULING	<ul style="list-style-type: none"> <li>• Done by control plane. Ability to change backup time for full and incremental backups, and the day for full backups</li> <li>• Automatic archivelog backup every 30 minutes, the frequency can be changed via dbaascli</li> </ul>
 DESTINATION	<ul style="list-style-type: none"> <li>• Default is Database Autonomous Recovery Service with optional real time redo transport for near zero RPO</li> <li>• ExaDB-D managed backup storage, no direct control by the customer</li> <li>• Long term backup retention is available with alternative managed backup service: Object Storage Service (OSS)</li> </ul>
 REPLICAS	<ul style="list-style-type: none"> <li>• Back-ups are highly redundant and can survive a complete storage outage</li> </ul>
 CREDENTIALS	<ul style="list-style-type: none"> <li>• Managed by the control plane</li> <li>• Automatic password rotation done by control plane</li> </ul>
 WALLET	<ul style="list-style-type: none"> <li>• TDE wallet backed up automatically, but not its password or the autologin Wallet</li> </ul>
 RESTORE	<ul style="list-style-type: none"> <li>• Restore CDB and PDB capabilities.</li> <li>• Restore on the same host or different host within the same or cross region.</li> <li>• Restore the database using the same or different ORACLE_HOME, via control plane</li> </ul>
 FAILOVER	<ul style="list-style-type: none"> <li>• Backup runs independently and can tolerate node or storage failures</li> </ul>
 STANDBY	<ul style="list-style-type: none"> <li>• Backup and restore from the standby are possible using the object storage as destination</li> </ul>

# Exadata Database Service: User Configured Backups









## RMAN backup via dbaascli

 <p>SCHEDULING</p>	<ul style="list-style-type: none"> <li>No Control Plane (Cloud Console) backup scheduling</li> <li>Scheduled by customer provided scheduler (DTRS)</li> <li>Automatic archivelog backup every 30 minutes by default</li> <li>Ability to change default backup time and LO backup day</li> </ul>
 <p>DESTINATION</p>	<ul style="list-style-type: none"> <li>Customer-created bucket (fully controlled by the customer, including replication)</li> <li>Autonomous Recovery Service is an option as well</li> <li>No support for archive storage</li> </ul>
 <p>REPLICAS</p>	<ul style="list-style-type: none"> <li>Option to set up cross-region backup replication</li> </ul>
 <p>CREDENTIALS</p>	<ul style="list-style-type: none"> <li>Customer responsible for password rotation</li> </ul>
 <p>WALLET</p>	<ul style="list-style-type: none"> <li>TDE wallet backed up, but not its password or the autologin wallet</li> </ul>
 <p>RESTORE</p>	<ul style="list-style-type: none"> <li>Restore CDB and PDB capabilities</li> </ul>
 <p>FAILOVER</p>	<ul style="list-style-type: none"> <li>Backup runs independently and can tolerate node or storage failures</li> </ul>
 <p>STANDBY</p>	<ul style="list-style-type: none"> <li>Backup and restore from the standby are possible using the object storage as destination</li> </ul>

Not recommended

# Exadata Database Service: manual RMAN backups

Direct RMAN backup with customer downloaded and configured backup module

 SCHEDULING	<ul style="list-style-type: none"> <li>Database and archivelog backups must be scheduled by the customer</li> </ul>
 DESTINATION	<ul style="list-style-type: none"> <li>Use latest Cloud backup module with native API support to access all capabilities (replication, archive storage, ...) of OCI object storage</li> </ul>
 REPLICAS	<ul style="list-style-type: none"> <li>Possible to set up backup replication</li> <li>RMAN catalog possible</li> </ul>
 CREDENTIALS	<ul style="list-style-type: none"> <li>Bucket credentials must be fully managed by customer</li> </ul>
 WALLET	<ul style="list-style-type: none"> <li>TDE wallet backup is customer responsibility</li> </ul>
 RESTORE	<ul style="list-style-type: none"> <li>Restore CDB and PDB capabilities. From anywhere the backups are accessible (across ADs, across regions, on-premises)</li> </ul>
 FAILOVER	<ul style="list-style-type: none"> <li>Customer must configure where the backup executes</li> </ul>
 STANDBY	<ul style="list-style-type: none"> <li>Possible to backup standby databases or offload backups to the standby</li> </ul>

Not recommended and incompatible with Oracle Managed and User Configured backup options.

# Exadata Database Service: RMAN Best Practices

Use Control Plane Oracle Managed backups with OSS, ZRCV, or NFS (C@C) – highly recommended

- Use Database Autonomous Recovery Service (ZRCV)
  - DB19.16/21.7 without real-time transport or DB19.18/21.8 with real-time transport
- Ensure recovery window (backup retention period) settings meet SLAs
- If using OSS, the ability to offload backup to standby
- Increase RMAN parallelism for higher performance via dbaascli, trading off higher CPU processing

User-configured backup options via dbaascli - not recommended

- Use only when customer-created buckets or when backup replication is required
- [Refer to Disaster Recovery Using Cross-Region Backups](#)

Use manual RMAN backup solution for these exceptions - incompatible

- Not compatible with the above options, so no cloud automation
- Not cloud-supported





# Exadata Database Service: Real Application Clusters






- Out-of-place update is built-in with control plane move command
- Software update orchestrates drain, service relocation and instance restart
  - For application drain attributes, refer to [Achieving Continuous Availability For Your Applications](https://docs.oracle.com/en/database/oracle/oracle-database/21/haovw/oracle-maximum-availability-architecture-exadata-cloud-database-systems.html#GUID-E9DF9482-A414-45E0-A5F4-29F6056E364F) <https://docs.oracle.com/en/database/oracle/oracle-database/21/haovw/oracle-maximum-availability-architecture-exadata-cloud-database-systems.html#GUID-E9DF9482-A414-45E0-A5F4-29F6056E364F>
- RAC uses 192.168.128.0/20 on IB and 100.64.0.0/10 on RoCE for interconnect
- Additional virtual IP addresses can be added via the Cloud console
  - Clusterware VIP still needs to be added manually via either srvctl, crsctl, or appvipcfg
- Change of SCAN listener port possible during VM creation (range 1024-8999)
- Changing local listener port is not supported, but additional ports can be added



# Exadata Database Service: RAC best practices

- Create databases only through cloud control plane or dbaascli to include configuration best practices
- Update software using cloud automation. DB software is out-of-place update.
- Create a separate application service managed by Oracle Clusterware and follow [Achieving Continuous Availability For Your Applications](https://docs.oracle.com/en/database/oracle/oracle-database/21/haovw/oracle-maximum-availability-architecture-exadata-cloud-database-systems.html#GUID-E9DF9482-A414-45E0-A5F4-29F6056E364F)  
<https://docs.oracle.com/en/database/oracle/oracle-database/21/haovw/oracle-maximum-availability-architecture-exadata-cloud-database-systems.html#GUID-E9DF9482-A414-45E0-A5F4-29F6056E364F>
- Run exachk monthly and address alerts
- For “Single Instance”, consider PDB singletons or use a single VM cluster node
- Adjust hugepages as you add or resize databases (set use\_large\_pages=ONLY)
- Avoid DB and system customizations

# Exadata Database Service: Multitenant via Control Plane

 SETUP	<ul style="list-style-type: none"><li>• PDB creation or deletion from the cloud console</li><li>• List PDBs by database</li><li>• Retrieve PDB connection strings</li></ul>
 CLONING	<ul style="list-style-type: none"><li>• Create clones or refreshable clones within the same CDB or across CDBs</li><li>• Data Guard supported for PDB cloning operations</li></ul>
 PROTECTION	<ul style="list-style-type: none"><li>• PDB creation synced to Data Guard Standby</li><li>• PDB backup/restore from same CDB. PDB restore to another CDB for BaseDB and ExaDB-D (C@C later)</li></ul>
 ADMINISTRATION	<ul style="list-style-type: none"><li>• Start and Stop the PDBs from the console on Primary or Standby (ADG)</li></ul>
 CONTROL PLANE SYNC	<ul style="list-style-type: none"><li>• The PDBs created or dropped out-of-band via dbaascli or SQL are synced periodically</li></ul>









# Exadata Database Service: Multitenant Best Practices







- Create pluggable databases only through cloud control plane or cloud APIs
  - MAA best practices incorporated
  - PDBs created via cloud APIs/SQL will sync with control plane shortly after creation completes
  - PDBs created with deferred recovery will not appear in the console on the standby
- For Data Guard-enabled CDBs, add temporary files to the standby PDB when creating new PDBs
- Do not use PDB save state or triggers to manage services or PDB startup. It may lead to service downtime during Data Guard role transitions.
- Manual PDB switchover and failover functionality in 19c:
  - [PDB Switchover and Failover in a Multitenant Configuration \(oracle.com\)](https://www.oracle.com/technetwork/database/cloud-managed/19c-pluggable-databases-multitenant-configuration-2814911.pdf)



# Exadata Database Service: Data Guard via Control Plane

 <p>SETUP</p>	<ul style="list-style-type: none"> <li>• 1-click setup from control plane</li> <li>• Uses Data Guard broker and MAA best practices</li> <li>• Uses optimized Data Guard instantiation with retries and resume capabilities</li> </ul>
 <p>TOPOLOGY</p>	<ul style="list-style-type: none"> <li>• Supports Data Guard in same rack for testing, same region, across ADs or across regions</li> <li>• Supports ExaDB-D to ExaDB-D or BaseDB to BaseDB or ExaDB-C@C to ExaDB-C@C</li> </ul>
 <p>PROTECTION</p>	<ul style="list-style-type: none"> <li>• Asynchronous configuration by default (protection level MAX PERFORMANCE)</li> <li>• Synchronous configuration (protection level MAX AVAILABILITY)</li> <li>• OCI Vault, File-based TDE wallet, or Oracle key vault managed keys are supported. Data Guard fast-start failover (FSFO) and Far Sync require manual setup</li> <li>• Multiple standby databases (up to 6) are supported via console</li> </ul>
 <p>ROLE CHANGES</p>	<ul style="list-style-type: none"> <li>• Supports failover and switchover operations</li> <li>• Out-of-band role transition is not recommended except for FSFO or multiple standby. DB role status will be resynchronized in minutes</li> </ul>
 <p>OPEN MODE</p>	<ul style="list-style-type: none"> <li>• Choose Active Data Guard (open read-only) for additional data protection and read-only benefits. Alternatively, choose Data Guard (mounted standby); Snapshot Standby requires manual command</li> </ul>
 <p>PATCHING &amp; UPGRADE</p>	<ul style="list-style-type: none"> <li>• Control plane patching and offline database upgrade is available. Standby-first patching is available</li> <li>• Exadata Cloud Database 19c Rolling Upgrade With DBMS_ROLLING (Doc ID 2832235.1)</li> </ul>

# Exadata Database Service: Manual Data Guard Setup

 <p>SETUP</p>	<ul style="list-style-type: none"> <li>• Data Guard instantiation and setup are done by the customer</li> <li>• Create Cloud Database and then manually instantiate standby database using standard MAA Data Guard best practices</li> </ul>
 <p>TOPOLOGY</p>	<ul style="list-style-type: none"> <li>• Multiple standby databases (beyond 6), far sync, and cascade standby</li> <li>• Hybrid Data Guard configurations</li> <li>• These Data Guard topologies are not recognized in the control plane</li> </ul>
 <p>PROTECTION</p>	<ul style="list-style-type: none"> <li>• All data protection modes are possible</li> <li>• Setup fast-start failover and incorporate MAA best practices manually</li> </ul>
 <p>ROLE CHANGES</p>	<ul style="list-style-type: none"> <li>• Recommend using DG broker or Enterprise Manager.</li> <li>• Automatic when Data Guard fast-start failover is setup</li> </ul>
 <p>OPEN MODE</p>	<ul style="list-style-type: none"> <li>• Managed by the customer</li> </ul>
 <p>PATCHING &amp; UPGRADE</p>	<ul style="list-style-type: none"> <li>• Some cloud automation still possible if database is recognized as a cloud database. Redo Apply must be stopped manually.</li> <li>• Customers can manually use standby-first update strategy and DBMS_ROLLING for rolling upgrades</li> </ul>

Not recommended unless for multiple standby or hybrid Data Guard use cases

# Exadata Database Service: Data Guard Best Practices

- Topology
  - Pick Data Guard topology and protection mode based on SLAs and use cases
  - Use symmetric primary and standby to preserve performance post-role transitions
  - Use VCN connectivity (not public cloud) between primary and standby
- Operations
  - Create a Data Guard association or group through the control plane
    - Pre-create the target Oracle Home with the same version
    - It's recommended to use Custom Database Software Images for source and target
  - MAA and Data Guard configuration best practices incorporated
  - Keep the primary and standby Oracle Home software as much the same as possible
  - Periodically test and validate end-to-end DR
  - Issue DG Broker VALIDATE commands at least monthly

# Exadata Database Service: Enhanced Protection

## AVAILABILITY / AUTOMATION \*



Multiple backup copies  
Backup from the standby



Exadata inherent HA, QoS, and Performance benefits plus *Exadata Fleet Update* for gold image patching



Multiple standbys (up to 6 via console)  
Fast-start failover

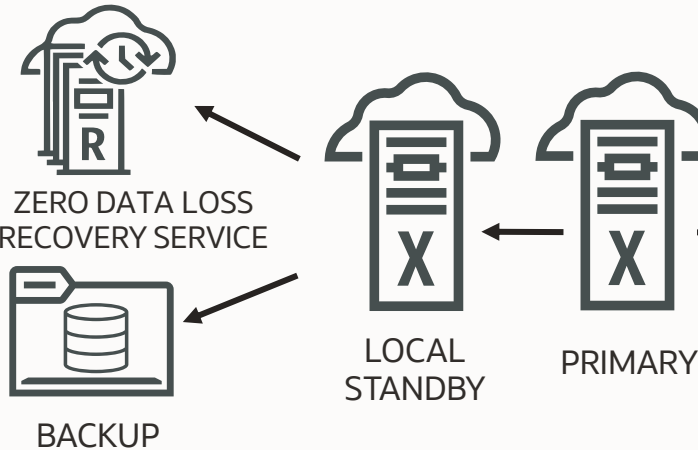


MAA GoldenGate Hub  
(capture & delivery)  
Global Data Service



MAA LEVEL  
SILVER GOLD PLATINUM  
ExaDB-D + Data Guard + GoldenGate

### Region 1

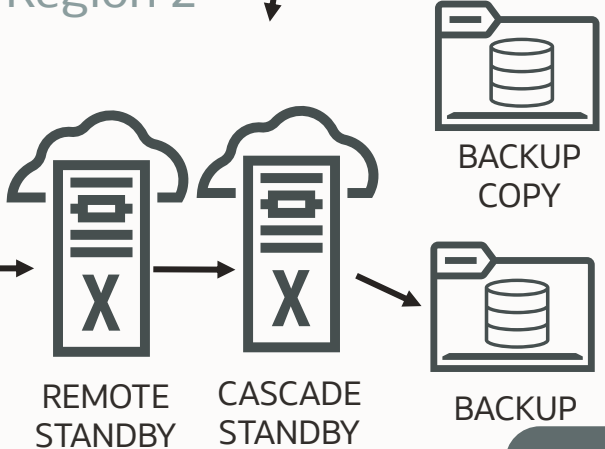


### Region 3



FSFO

### Region 2



## Gold Outage Matrix

	PLANNED MAINTENANCE	ZERO  ZERO
	RECOVERABLE FAILURE	ZERO  SECONDS
	UNRECOVERABLE FAILURE	ZERO  SECONDS
	UPGRADE	ZERO  SECONDS

\*

- Out of the box
- Automated via control plane
- Manual setup
- Not available/possible



EXADATA FLEET UPDATE





## Exadata Database Service: Read more

- Oracle Maximum Availability Architecture in Exadata Cloud Database Systems
  - Oracle Maximum Availability Architecture Benefits
  - Expected Impact with Unplanned Outages
  - Expected Impact with Planned Maintenance
  - Achieving Continuous Availability For Your Applications
  - Oracle Maximum Availability Architecture Reference Architectures in the Exadata Cloud  
<https://docs.oracle.com/en/database/oracle/oracle-database/19/haovw/oracle-maximum-availability-architecture-oracle-exadata-cloud-systems.html>
- ExaDB-D Database Backup and Restore with Object Storage Performance Observations  
<https://www.oracle.com/a/tech/docs/exacs-oci-backup-restore--oss-performance.pdf>
- Managing Exadata Database Backups  
<https://docs.oracle.com/en-us/iaas/Content/Database/Tasks/exabackup.htm>
- GoldenGate and Platinum MAA for Cloud
- [MAA Platinum and Oracle GoldenGate Best Practices](#)

## Exadata Database Service: Read more

- (ODyS) Oracle Dynamic Scaling engine - Scale-up and Scale-down automation utility for OCI DB System (ExaCS/ExaC@C) (Doc ID 2719916.1)  
<https://support.oracle.com/epmos/faces/DocumentDisplay?id=2719916.1>
- How to configure OCI-CLI with Instance/Resource Principals (Doc ID 2763990.1)  
<https://support.oracle.com/epmos/faces/DocumentDisplay?id=2763990.1>
- Use Oracle Data Guard with Exadata Cloud Infrastructure  
<https://docs.cloud.oracle.com/en-us/iaas/Content/Database/Tasks/exausingdataguard.htm>
- Disaster Recovery using Exadata Cloud (On-Premises Primary to Standby in Exadata Database Service or Gen 2 Exadata Database Service Cloud@Customer)  
<https://docs.oracle.com/en/database/oracle/oracle-database/19/haovw/oracle-data-guard-hybrid-cloud-configuration1.html>
- (OCI) mv2bucket - Oracle Managed Bucket Content Manager (Doc ID 2723911.1)  
<https://support.oracle.com/epmos/faces/DocumentDisplay?id=2723911.1>







# Oracle Exadata Database Service on Cloud@Customer (ExaDB-C@C)

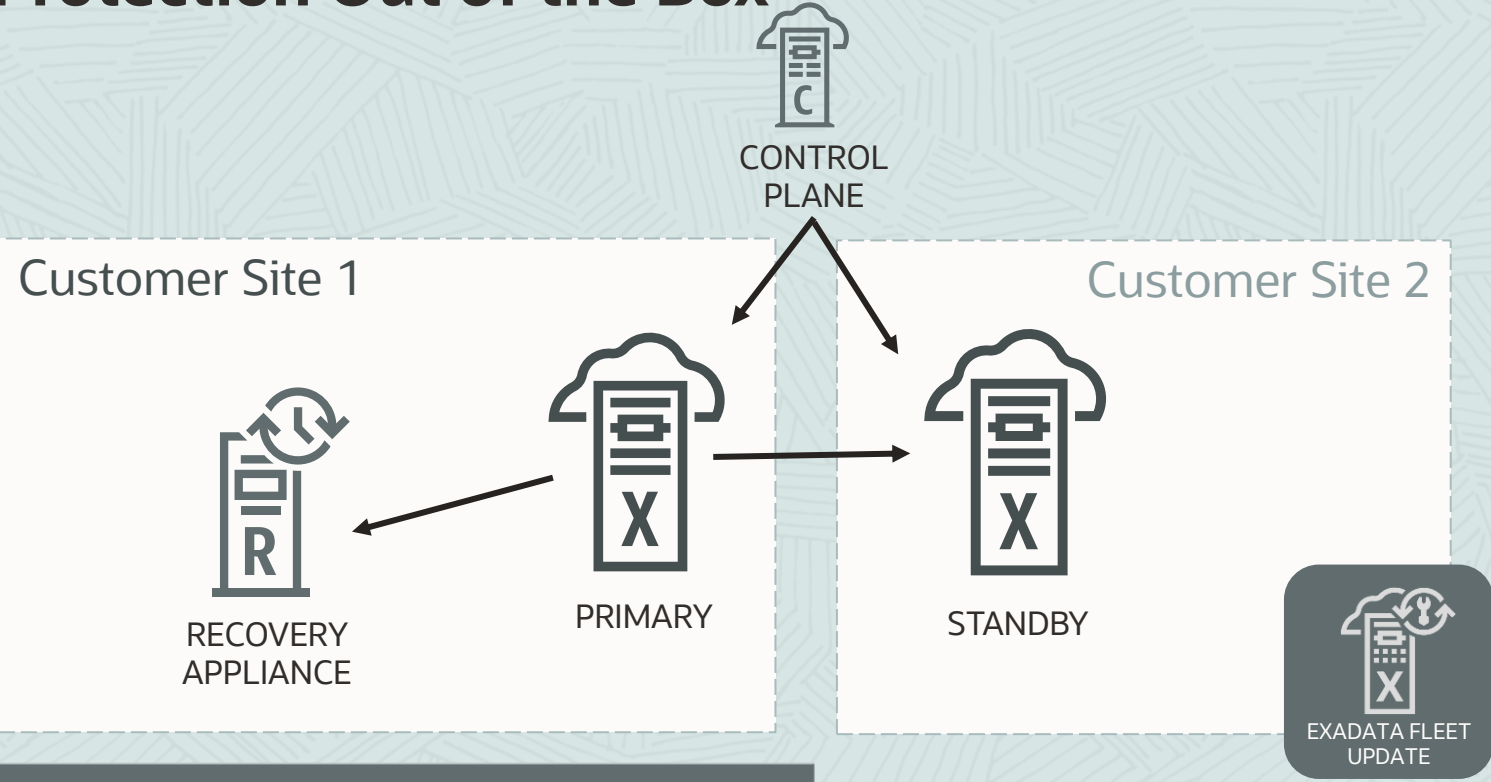
---

Maximum Availability Architecture









# Exadata Cloud@Customer: Protection Out of the Box

## AVAILABILITY / AUTOMATION \*





 RMAN	Customer-defined, to NFS, local object storage, ZDLRA or cloud object storage
 RAC	Exadata inherent HA, QoS, and Performance benefits plus <i>Exadata Fleet Update</i> for gold image patching
 ACTIVE DATA GUARD	<u><a href="#">Via console or DBaaS API</a></u> (Up to 6 Standby DBs , DBMS_ROLLING with cloud APIs only)
 GOLDENGATE	Manual (Capture & Delivery)
MAA LEVEL	<div> SILVER Out of the Box</div> <div> GOLD + Data Guard</div>



## Outage Matrix

	PLANNED MAINTENANCE	ZERO		ZERO
	RECOVERABLE FAILURE	ZERO		SECONDS
	UNRECOVERABLE FAILURE <sup>(1)</sup>	SECONDS		MINUTES (1)
	UPGRADE	ZERO		SECONDS









(1) No FSFO, based on time after customer action

- \*
-  Out of the box
  -  Automated via control plane
  -  Manual setup
  -  Not available/possible











# Exadata Cloud@Customer: Oracle Managed Backup

## 1-click configuration Automatic RMAN backup

 SCHEDULING	<ul style="list-style-type: none"> <li>Set up as cron job</li> <li>Automatic 30 minutes archivelog backup via cron job</li> </ul>
 DESTINATION	<ul style="list-style-type: none"> <li>To NFS or ZDLRA</li> <li>To cloud object storage or Oracle-managed bucket</li> </ul>
 REPLICAS	<ul style="list-style-type: none"> <li>3-ways mirrored backup for cloud object storage (no replication)</li> <li>Customer-defined for NFS and ZDLRA</li> </ul>
 CREDENTIALS	<ul style="list-style-type: none"> <li>Object storage: managed by the control plane</li> <li>ZDLRA and NFS: Managed by the customer</li> </ul>
 WALLET	<ul style="list-style-type: none"> <li>TDE wallet backed up automatically, but not its password (cloud object storage only)</li> <li>No requirement for wallet backup if using Oracle Key Vault</li> </ul>
 RESTORE	<ul style="list-style-type: none"> <li>Database restore (from backup, to point-in-time or full) options</li> <li>Restore PDB capabilities via dbaascli commands</li> </ul>
 FAILOVER	<ul style="list-style-type: none"> <li>Backup initiated on a specific node. It does not run if that node is down.</li> </ul>
 STANDBY	<ul style="list-style-type: none"> <li>No backup of standby database</li> </ul>

# Exadata Cloud@Customer: manual RMAN backups

Direct RMAN backup with customer configured backup module

 SCHEDULING	<ul style="list-style-type: none"><li>Database and archivelog backups must be scheduled by the customer</li></ul>
 DESTINATION	<ul style="list-style-type: none"><li>Any destination possible via RMAN</li><li>Use latest Cloud backup module with native API support to access all capabilities (replication, archive storage, ...) of OCI object storage</li></ul>
 REPLICAS	<ul style="list-style-type: none"><li>Depends on destination capabilities</li></ul>
 CREDENTIALS	<ul style="list-style-type: none"><li>Credentials fully managed by customer</li></ul>
 WALLET	<ul style="list-style-type: none"><li>TDE wallet backup is customer responsibility</li><li>Check backup destination compatibility when using Oracle Key Vault</li></ul>
 RESTORE	<ul style="list-style-type: none"><li>Restore CDB and PDB capabilities. From anywhere the backups are accessible (across ADs, across regions, on-premises)</li></ul>
 FAILOVER	<ul style="list-style-type: none"><li>Customer must configure where the backup executes</li></ul>
 STANDBY	<ul style="list-style-type: none"><li>Possible to backup standby databases</li></ul>

Not recommended and incompatible to Oracle Managed backup.

# Exadata Cloud@Customer: RMAN best practices

- Use control plane automatic backup for database backup/restore in ExaDB-C@C
- Use ZDLRA for lowest RPO, incremental forever and additional backup/restore benefits
- If NFS is used as backup destination, configure DNFS. Tuning is responsibility of the customer
- Increase parallelism for higher performance trading off higher CPU processing
- Ensure backup window is optimum for application cycles
- Choose the backup retention depending on your requirements
  - Object storage, NFS: 7, 15, 30, 45 or 60 days. Standalone backups for longer retention
  - ZDLRA: controlled by the recovery appliance protection policy
- Use OCI Object storage and archive storage for long term backup retention








# Exadata Cloud@Customer: RAC best practices

- Create databases only through cloud control plane or dbaascli to include configuration best practices
- Update software using cloud automation. DB software is out-of-place update.
  - Cloud orchestrates service drain, service relocation and instance restart transparently
- Create a separate application service managed by Oracle Clusterware and follow:  
<https://docs.oracle.com/en/database/oracle/oracle-database/21/haovw/oracle-maximum-availability-architecture-exadata-cloud-database-systems.html#GUID-E9DF9482-A414-45E0-A5F4-29F6056E364F>
- Avoid DB and system customizations
- Run exachk monthly and address alerts
- Adjust hugepages as you add or resize databases (set use\_large\_pages=ONLY)
- Change of SCAN listener port possible during creation (range 1024-8999)









# Exadata Cloud@Customer: Multitenant via control plane

 SETUP	<ul style="list-style-type: none"><li>• PDB creation or deletion from the cloud console</li><li>• List PDBs by database</li><li>• Retrieve PDB connection strings</li></ul>
 CLONING	<ul style="list-style-type: none"><li>• Create clones within the same CDB or across CDBs within same AD</li></ul>
 PROTECTION	<ul style="list-style-type: none"><li>• PDB creation synced to Data Guard Standby</li><li>• Starting with 19c, PDB relocate and relocate + upgrade</li></ul>
 ADMINISTRATION	<ul style="list-style-type: none"><li>• Start and Stop the PDBs from the console on Primary or Standby (ADG)</li></ul>
 CONTROL PLANE SYNC	<ul style="list-style-type: none"><li>• The PDBs created or dropped out-of-band via dbaascli or SQL are synced periodically</li></ul>







# Exadata Cloud@Customer: Multitenant best practices

- Create pluggable databases only through cloud control plane or cloud APIs to include configuration best practices
  - PDBs created via cloud APIs/SQL will sync with the control plane shortly after creation completes
  - PDBs created with deferred recovery will not appear in the console on the standby
- Always use either the connection strings provided by the console or custom application services to connect to a PDB
- For Data Guard-enabled CDBs, add temporary files to the standby PDB when creating new PDBs
- Perform per PDB backup/restore via dbaascli utility  
Exadata Cloud Service: Pluggable Database Backup and Restore (Doc ID 2809448.1)

# Exadata Cloud@Customer: Data Guard via control plane

 <p>SETUP</p>	<ul style="list-style-type: none"> <li>• 1-click setup from control plane</li> <li>• Uses Data Guard broker and MAA best practices</li> <li>• Uses optimized Data Guard instantiation</li> </ul>
 <p>TOPOLOGY</p>	<ul style="list-style-type: none"> <li>• Supports Data Guard in the same rack for testing, same region, across ADs, or across regions</li> <li>• Multiple standby databases supported (up to 6 via console)</li> <li>• Supports ExaDB-C@C to ExaDB-C@C</li> </ul>
 <p>PROTECTION</p>	<ul style="list-style-type: none"> <li>• Asynchronous configuration by default (protection level MAX PERFORMANCE)</li> <li>• Synchronous configuration (protection level MAX AVAILABILITY)</li> <li>• Data Guard fast-start failover is a manual setup</li> </ul>
 <p>ROLE CHANGES</p>	<ul style="list-style-type: none"> <li>• Supports failover and switchover operations</li> <li>• Out-of-band role transition is not recommended except for FSFO or multiple standby. DB role status will be resynchronized in minutes</li> </ul>
 <p>OPEN MODE</p>	<ul style="list-style-type: none"> <li>• Choose Active Data Guard (open read-only) for additional data protection and read-only benefits. Alternatively choose Data Guard (mounted standby)</li> </ul>
 <p>PATCHING &amp; UPGRADE</p>	<ul style="list-style-type: none"> <li>• Control plane patching and offline database upgrade is available</li> <li>• Exadata Cloud Database 19c Rolling Upgrade With DBMS_ROLLING (Doc ID 2832235.1)</li> </ul>




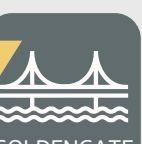
# Exadata Cloud@Customer: manual Data Guard setup

 <p>SETUP</p>	<ul style="list-style-type: none"> <li>• Data Guard instantiation and setup are done by the customer</li> <li>• Create Cloud Database and then manually instantiate standby database using standard MAA Data Guard best practices</li> </ul>
 <p>TOPOLOGY</p>	<ul style="list-style-type: none"> <li>• Multiple standby databases (up to 6 via console), far sync (manual) and cascade standby (manual)</li> <li>• Hybrid Data Guard configurations</li> <li>• These Data Guard topologies are not recognized in the control plane</li> </ul>
 <p>PROTECTION</p>	<ul style="list-style-type: none"> <li>• All data protection modes are possible</li> <li>• Setup fast-start failover and incorporate MAA best practices manually</li> </ul>
 <p>ROLE CHANGES</p>	<ul style="list-style-type: none"> <li>• Recommend using DG broker or Enterprise Manager.</li> <li>• Automatic when Data Guard fast-start failover is setup</li> </ul>
 <p>OPEN MODE</p>	<ul style="list-style-type: none"> <li>• Managed by the customer</li> </ul>
 <p>PATCHING &amp; UPGRADE</p>	<ul style="list-style-type: none"> <li>• Some cloud automation still possible if database is recognized as a cloud database. Redo Apply must be stopped manually.</li> <li>• Customers can manually use standby-first update strategy and DBMS_ROLLING for rolling upgrades</li> </ul>

Not recommended unless for multiple standby or hybrid Data Guard use cases

# Exadata Cloud@Customer: Enhanced Protection

## AVAILABILITY / AUTOMATION \*

-  Backup from the primary or/and standby. Offload backups to the standby.
-  Exadata inherent HA, QoS, and Performance benefits plus *Exadata Fleet Update* for gold image patching
-  Multiple standbys (up to 6 via console) Fast-start failover
-  Manual (capture & delivery) Global Data Service

MAA LEVEL

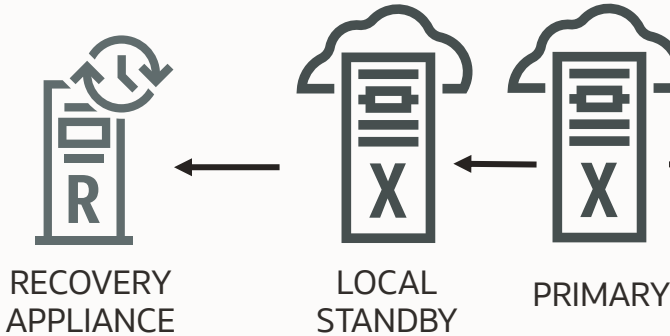
 SILVER

 GOLD

 PLATINUM

ExaDB-C@C + Data Guard + GoldenGate

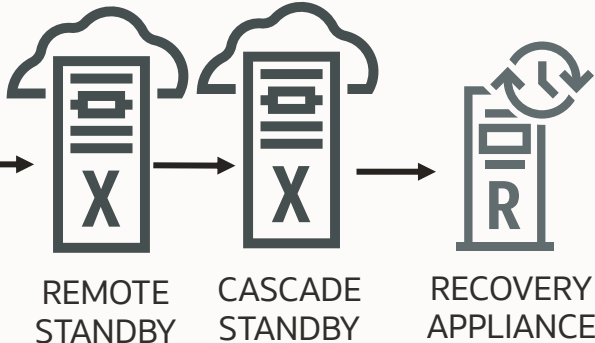
### Customer Site 1











### Customer Site 3







### Customer Site 2



## Gold Outage Matrix

	PLANNED MAINTENANCE	ZERO  ZERO
	RECOVERABLE FAILURE	ZERO  SECONDS
	UNRECOVERABLE FAILURE	ZERO  SECONDS
	UPGRADE	ZERO  SECONDS

- \*
-  Out of the box
  -  Automated via control plane
  -  Manual setup
  -  Not available/possible





## Exadata Cloud@Customer MAA: Read more

- Oracle Maximum Availability Architecture in Exadata Cloud Database Systems
  - <https://docs.oracle.com/en/database/oracle/oracle-database/19/haovw/oracle-maximum-availability-architecture-oracle-exadata-cloud-systems.html>
- Using Oracle Data Guard with Exadata Cloud at Customer
  - <https://docs.oracle.com/en-us/iaas/exadata/doc/eccusingdataguard.html>
- GoldenGate and Platinum MAA for Cloud
  - [MAA Platinum and Oracle GoldenGate Best Practices](#)
- Guidelines When Using ZFS Storage in an Exadata Environment (2087231.1)
  - <https://support.oracle.com/epmos/faces/DocumentDisplay?id=2087231.1>
- Migration of file-based TDE to OKV for Exadata Database Service on Cloud at Customer Gen2 (Doc ID 2823650.1)
  - <https://support.oracle.com/epmos/faces/DocumentDisplay?id=2823650.1>

# Exadata Fleet Update



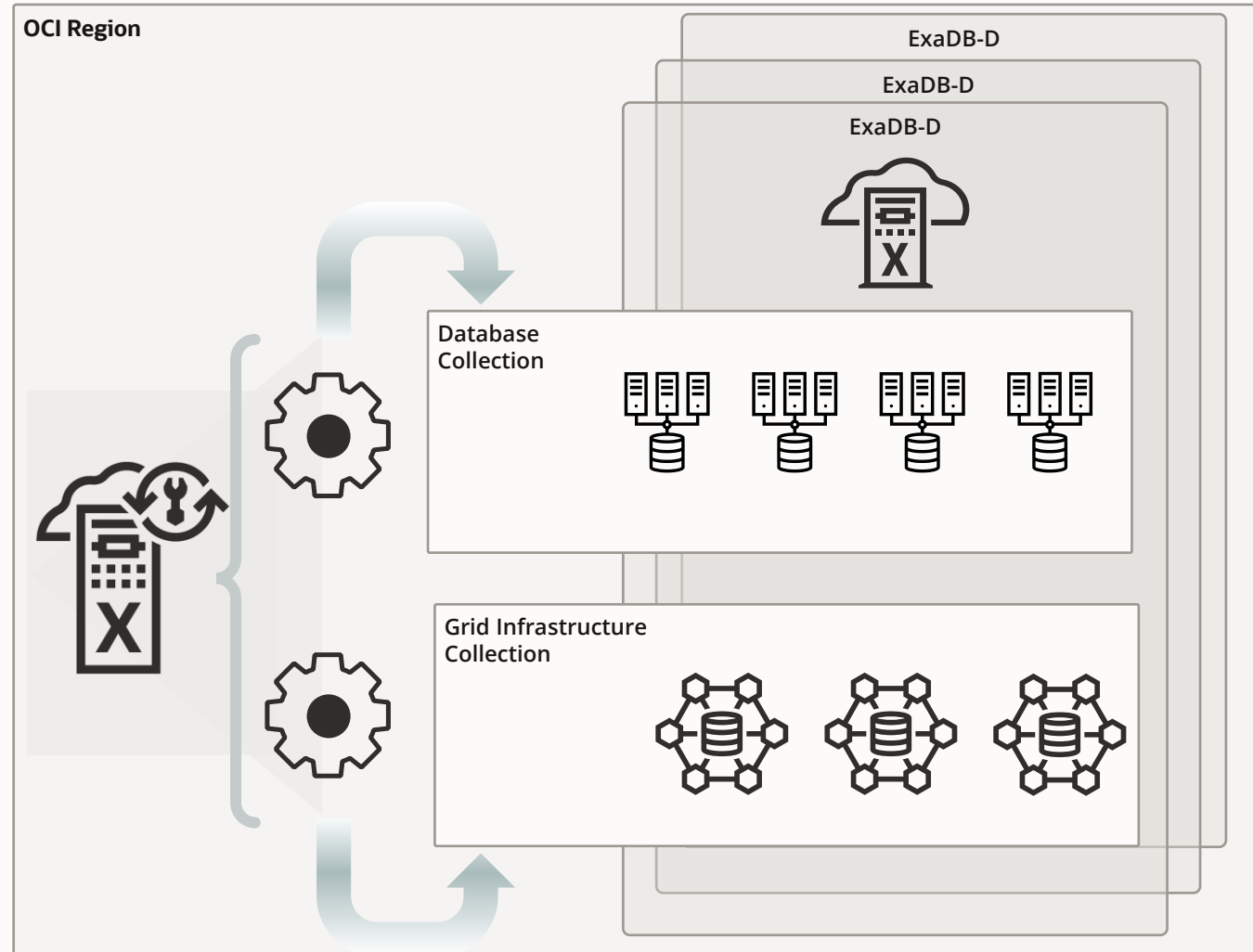
Maximum Availability Architecture

# Exadata Fleet Update

Streamlines Database and Grid Infrastructure updates for large-scale deployments

- Group multiple Oracle Databases and Oracle Grid Infrastructures into collections to allow patching in a single operation and maintenance schedule
- Offers various capabilities such as rolling and non-rolling, session draining, scheduling of pre-check, staging, and patch operations
- Automates fleet-wide patching, gold image standardization, reduces manual intervention
- Reduces patching time and complexity using standard out-of-place patching mechanism and Oracle-provided or customized database software images
- Available for ExaDB-D and ExaDB-C@C deployments

Ref. <https://blogs.oracle.com/maa/post/announcing-exadata-fleet-update>



# Oracle Base Database Service – Virtual Machines (BaseDB)







—  
Maximum Availability Architecture

# Base Database Service VM: basic information

- BaseDB uses standard Intel or AMD Compute with block storage
  - Block storage is triple-mirrored automatically
  - Either on LVM or ASM (Grid Infrastructure)
    - ASM uses external redundancy
- VMs are automatically restarted on failure
- VMs are automatically relocated to a different hypervisor on HW failure
- RAC uses different fault domains per node
- Support for «VM reboot» migrations



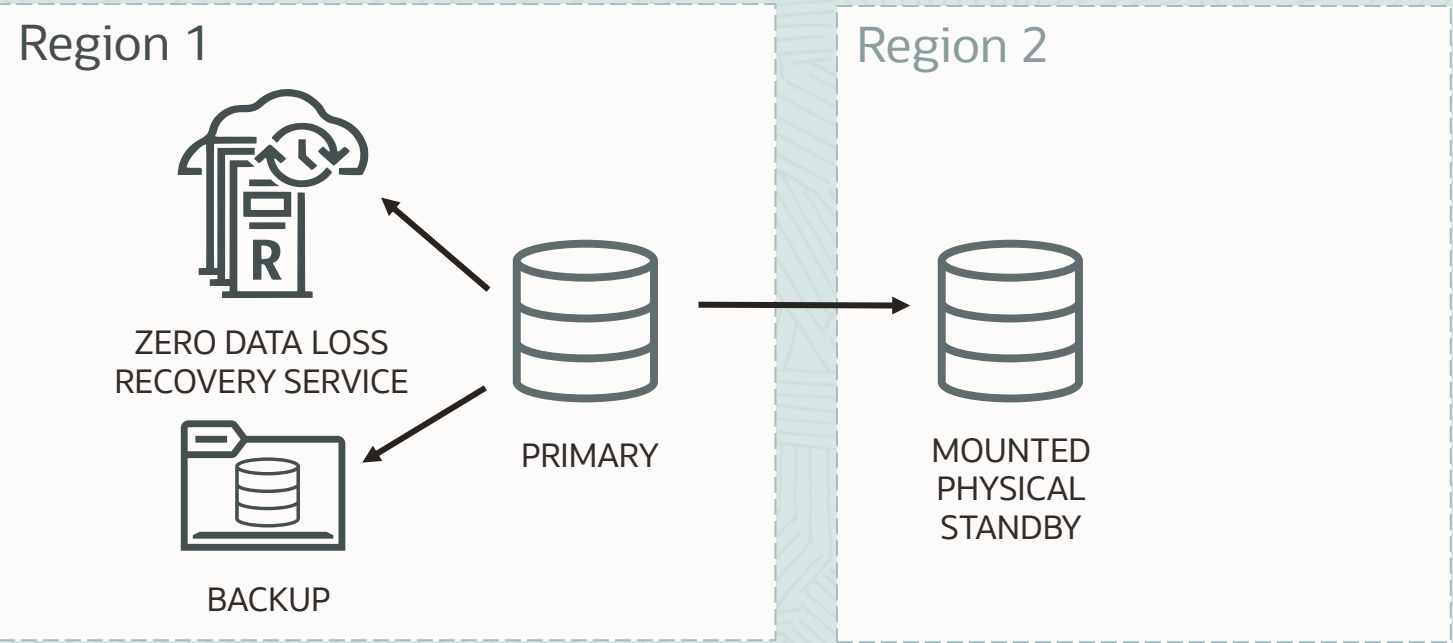
# Base Database Service VM: software editions









		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	✗	✗	✗	✓	✓







# Base Database Service VM 1-Node: Protection Out of the Box

AVAILABILITY / AUTOMATION *	
	Recovery Service or via 1 copy to 3-way mirrored object storage via <a href="#">automated OCI backups</a>
	It requires 2 nodes EE Extreme Performance
	<a href="#">Via console or DBaaS API</a> (one standby to BaseDB)
	Manual (Capture & Delivery)
MAA LEVEL	 Out of the Box



Outage Matrix		
	PLANNED MAINTENANCE	ZERO  MINS/HOURS
	RECOVERABLE FAILURE <sup>1</sup>	SECONDS  MINUTES
	UNRECOVERABLE FAILURE <sup>1</sup>	SECONDS  MINS/HOURS
	UPGRADE	ZERO  MINS/HOURS

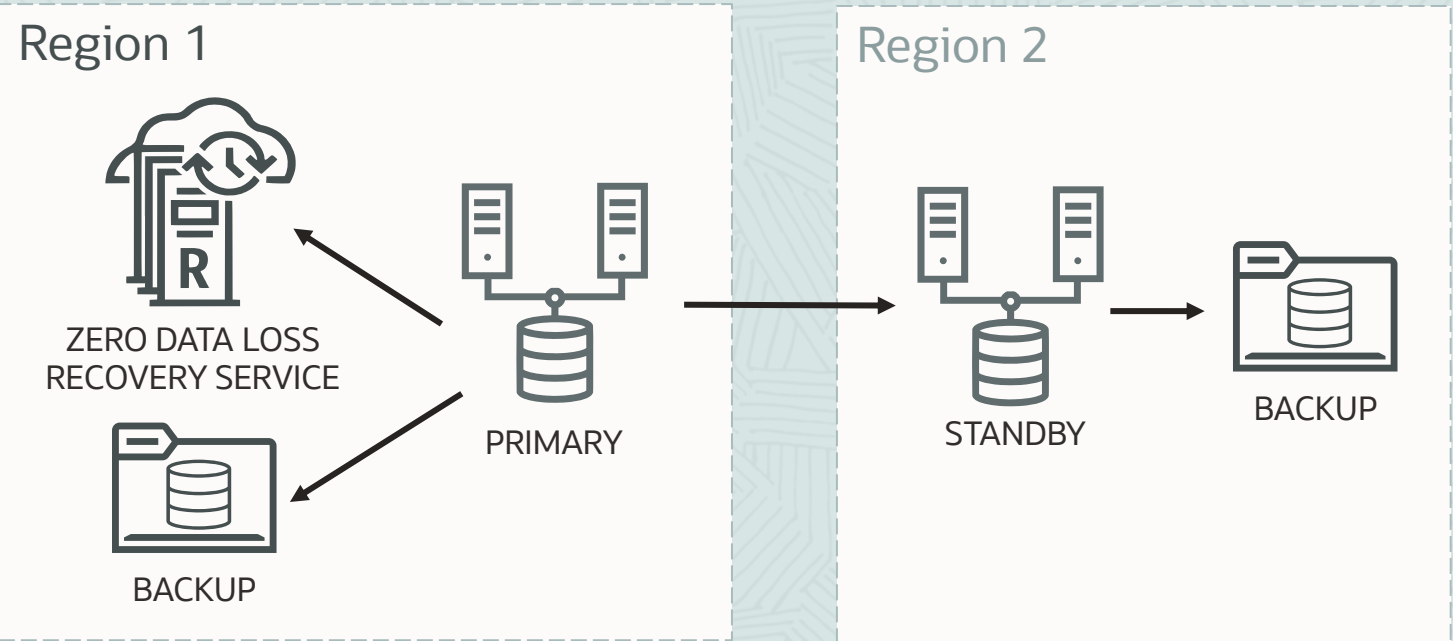
	Out of the box
	Automated via control plane
	Manual setup
	Not available/possible









(1) RPO can be seconds with Autonomous Recovery Service (ZRCV)







# Base Database Service VM RAC: Protection Out of the Box

AVAILABILITY / AUTOMATION *		
	Recovery Service or via 1 copy to 3-way mirrored object storage through <a href="#">automated OCI backups</a>	
	It requires 2 nodes EE Extreme Performance	
	<a href="#">Via console or DBaaS API</a> (one standby to BaseDB)	
	Manual (Capture & Delivery)	
MAA LEVEL	 SILVER Out of the Box	 GOLD + Data Guard



Outage Matrix		
	PLANNED MAINTENANCE	ZERO  ZERO
	RECOVERABLE FAILURE <sup>(1)</sup>	ZERO  SECONDS
	UNRECOVERABLE FAILURE <sup>(1)</sup>	SECONDS  MINUTES (1)
	UPGRADE	ZERO  MINS/HOURS

(1) No FSFO, based on time after customer action









- \*
-  Out of the box
  -  Automated via control plane
  -  Manual setup
  -  Not available/possible

(1) RPO can be seconds with Autonomous Recovery Service (ZRCV)











# Base Database Service VM: Oracle Managed Backup

1-click configuration automatic RMAN backup

 SCHEDULING	<ul style="list-style-type: none"> <li>• Done by control plane. Ability to change backup time for full and incremental backups, and the day for full backups</li> <li>• Automatic hourly archivelog backup via BaseDB agent</li> </ul>
 DESTINATION	<ul style="list-style-type: none"> <li>• Default is Database Autonomous Recovery Service with optional real time redo transport for near zero RPO</li> <li>• Long term backup retention is available with alternative managed backup service: Object Storage Service (OSS)</li> </ul>
 REPLICAS	<ul style="list-style-type: none"> <li>• Back-ups are highly redundant and can survive a complete storage outage</li> <li>• No support for archive storage</li> </ul>
 CREDENTIALS	<ul style="list-style-type: none"> <li>• Managed by the control plane</li> <li>• Automatic password rotation done by control plane</li> </ul>
 WALLET	<ul style="list-style-type: none"> <li>• TDE wallet backed up automatically, but not its password or the autologin wallet</li> <li>• Separated manual backup recommended</li> </ul>
 RESTORE	<ul style="list-style-type: none"> <li>• Restore on same host or different host within same region or across region.</li> <li>• No duplicate on the same host (only 1 CDB supported per DB system)</li> </ul>
 FAILOVER	<ul style="list-style-type: none"> <li>• Backup runs independently and can tolerate node or storage failures</li> </ul>
 STANDBY	<ul style="list-style-type: none"> <li>• Backup of standby database with Object Storage Service</li> </ul>

# Base Database Service VM: User Configured Backup









## RMAN backup via dbcli

 SCHEDULING	<ul style="list-style-type: none"><li>• Scheduled by BaseDB scheduler</li><li>• Automatic hourly archivelog backup</li></ul>
 DESTINATION	<ul style="list-style-type: none"><li>• Customer bucket (fully controlled by the customer)</li><li>• No support for archive storage</li></ul>
 REPLICAS	<ul style="list-style-type: none"><li>• Possible to set up backup replication</li></ul>
 CREDENTIALS	<ul style="list-style-type: none"><li>• Customer responsible for password rotation</li></ul>
 WALLET	<ul style="list-style-type: none"><li>• TDE wallet backup is customer responsibility</li></ul>
 RESTORE	<ul style="list-style-type: none"><li>• No duplicate on the same host (only 1 CDB supported per DB system)</li></ul>
 FAILOVER	<ul style="list-style-type: none"><li>• Backup runs independently of node availability (only for RAC)</li></ul>
 STANDBY	<ul style="list-style-type: none"><li>• Standby backup is also an option using DBCLI</li></ul>



# Base Database Service VM: manual RMAN backups

Direct RMAN backup with customer downloaded and configured backup module

 SCHEDULING	<ul style="list-style-type: none"><li>Database and archivelog backups must be scheduled by the customer</li></ul>
 DESTINATION	<ul style="list-style-type: none"><li>Use latest Cloud backup module with native API support to access all capabilities (replication, archive storage, ...) of OCI object storage</li></ul>
 REPLICAS	<ul style="list-style-type: none"><li>Possible to set up backup replication</li><li>RMAN catalog possible</li></ul>
 CREDENTIALS	<ul style="list-style-type: none"><li>Bucket credentials must be fully managed by customer</li></ul>
 WALLET	<ul style="list-style-type: none"><li>TDE wallet backup is customer responsibility</li></ul>
 RESTORE	<ul style="list-style-type: none"><li>From anywhere the backups are accessible (across ADs, across regions, on-premises)</li></ul>
 FAILOVER	<ul style="list-style-type: none"><li>Customer must configure where the backup executes</li></ul>
 STANDBY	<ul style="list-style-type: none"><li>Possible to backup standby databases or offload backups to the standby</li></ul>

Not recommended and incompatible to Oracle Managed and User Configured backup options.

# Base Database Service VM: RMAN best practices

- Use Control Plane **Oracle Managed** backups with OSS or ZRCV– highly recommended
  - Use Database Autonomous Recovery Service (ZRCV)
    - DB19.16/21.7 without real-time transport or DB19.18/21.8 with real-time transport
- The performance of the RMAN backup is defined by the network.
  - Depending on VM shape (network bandwidth is correlated to the number of CPUs)
- The number of backup channels depends on the VM shape and should be adapted manually
- Additional separated manual backup of TDE wallet recommended
- Backup retention can be set to 7, 15, 30, or 60 days
- Use standalone backups (full) through the control plane for long-term backups with longer retention requirements
  - Automatic backups are deleted by default 72 hours after the instance is terminated
  - Standalone backups will stay until deleted manually



# Base Database Service VM: Real Application Clusters







- Software update orchestrates drain, service relocation and instance restart
- RAC uses 192.168.16.0/24 for interconnect
- Additional IP addresses can be added
- Changing listener port is not supported, but additional ports can be added



# Base Database Service VM: RAC best practices







- Create databases only through cloud control plane or cloud APIs to include configuration best practices
- Update software using cloud automation. DB software is an out-of-place update.
- Create a separate application service managed by Oracle Clusterware and follow application failover best practices to achieve zero application downtime
- For “Single Instance”, consider PDB singletons.
- Avoid DB and system customizations

# Base Database Service VM: Data Guard via control plane

 <p>SETUP</p>	<ul style="list-style-type: none"> <li>• 1-click setup from control plane</li> <li>• Uses Data Guard broker</li> <li>• Only via DUPLICATE FROM ACTIVE DATABASE</li> </ul>
 <p>TOPOLOGY</p>	<ul style="list-style-type: none"> <li>• Possible only between BaseDB</li> <li>• Not supported between RAC and single instance</li> <li>• Data Guard Far sync, cascade redo transport or multiple standby databases are manual setups</li> </ul>
 <p>PROTECTION</p>	<ul style="list-style-type: none"> <li>• Asynchronous configuration by default (protection level MAX PERFORMANCE)</li> <li>• Synchronous configuration (protection level MAX AVAILABILITY)</li> <li>• Data Guard fast-start failover is a manual setup</li> </ul>
 <p>ROLE CHANGES</p>	<ul style="list-style-type: none"> <li>• Out-of-band role transition is not recommended</li> </ul>
 <p>OPEN MODE</p>	<ul style="list-style-type: none"> <li>• It depends on Database software edition. On EE-EP, change is possible between Data Guard (mounted) or Active Data Guard (open read-only)</li> </ul>
 <p>PATCHING &amp; UPGRADE</p>	<ul style="list-style-type: none"> <li>• No guided patching of databases but control plane understands the role and does not apply datapatch on a standby</li> <li>• No support for rolling upgrade</li> </ul>



# Base Database Service VM : manual Data Guard setup

 SETUP	<ul style="list-style-type: none"><li>• Data Guard instantiation and setup are done by the customer</li><li>• Create Cloud Database and then manually instantiate standby database using standard MAA Data Guard best practices</li></ul>
 TOPOLOGY	<ul style="list-style-type: none"><li>• Multiple standby databases, far sync and cascade standby are available</li><li>• Hybrid Data Guard configurations</li><li>• Data Guard topology is not recognized in the control plane</li></ul>
 PROTECTION	<ul style="list-style-type: none"><li>• All data protection modes are possible</li><li>• Setup Fast-start failover and incorporate MAA practices</li></ul>
 ROLE CHANGES	<ul style="list-style-type: none"><li>• Recommend using DG broker or Enterprise Manager.</li><li>• Automatic when Data Guard fast-start failover is setup</li></ul>
 OPEN MODE	<ul style="list-style-type: none"><li>• Managed by the customer</li></ul>
 PATCHING & UPGRADE	<ul style="list-style-type: none"><li>• Some Database cloud automation still possible</li><li>• Customers can manually use standby-first approach and DBMS_ROLLING for rolling upgrades</li></ul>


Not recommended unless for multiple standby or hybrid Data Guard use cases

# Base Database Service VM: 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)
- Verify that `db_block_checking` is set to TYPICAL (this may vary depending on version and shape)
- Custom DB software images are recommended
- Only use VCN connectivity and not public network
- Put FSFO observer with the applications or in a 3<sup>rd</sup> region


# Base Database Service VM: Enhanced Protection

## AVAILABILITY / AUTOMATION \*

 Recovery Service or via multiple backup copies with optional backup from the standby

 Custom application services

 Multiple standbys  
Fast-start failover

 Manual (capture & delivery)  
Global Data Service

MAA  
LEVEL



BaseDB

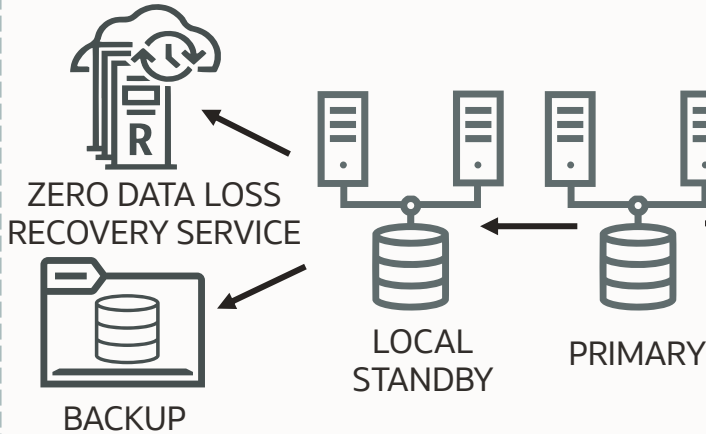


+ Data Guard



+ GoldenGate

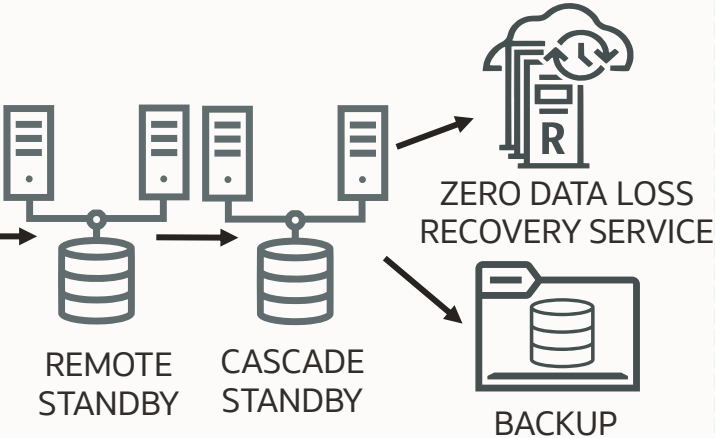
## Region 1











## Region 3







## Region 2



## Gold Outage Matrix

	PLANNED MAINTENANCE	ZERO  ZERO
	RECOVERABLE FAILURE	ZERO  SECONDS
	UNRECOVERABLE FAILURE <sup>1</sup>	ZERO  SECONDS
	UPGRADE	ZERO  SECONDS

\*

-  Out of the box
-  Automated via control plane
-  Manual setup
-  Not available/possible

## Base Database Service VM: read more

- Backing Up a Database to Oracle Cloud Infrastructure Object Storage
  - <https://docs.oracle.com/en-us/iaas/Content/Database/Tasks/backingupOS.htm>
- Using Oracle Data Guard
  - <https://docs.oracle.com/en-us/iaas/Content/Database/Tasks/usingdataguard.htm>
- How to configure oci-cli with Instance/Resource Principals (Doc ID 2763990.1)
  - <https://support.oracle.com/epmos/faces/DocumentDisplay?id=2763990.1>
- (OCI) mv2bucket - Oracle Managed Bucket Content Manager (Doc ID 2723911.1)
  - <https://support.oracle.com/epmos/faces/DocumentDisplay?id=2723711.1>

# Oracle Autonomous Database Serverless

---

Maximum Availability Architecture

# Autonomous Database Serverless: Protection Out-of-the-box

## AVAILABILITY / AUTOMATION \*



RMAN

Primary and cross-region backups  
Backups are redundant  
Retention is 60 days  
Long term backup retention available



RAC

Exadata inherent HA, QoS and  
Performance benefits  
Services out of the box



ACTIVE  
DATA GUARD

Multiple Standby databases supported:  
1 local and up to one additional remote  
per region  
Bounded minimal data loss is possible  
for manual and automatic failovers



GOLDENGATE

- Using OGG Hub or OCI OGG
- Flexible configurations



MAA  
LEVEL



SILVER



GOLD

Out of the Box + Autonomous Data Guard

## Region 1

AD1



LOCAL  
STANDBY

AD2



PRIMARY



BACKUP

## Cross-Region n: 1 remote standby per region



REMOTE  
STANDBY



BACKUP

## Gold Outage Matrix



PLANNED  
MAINTENANCE

ZERO  ZERO



RECOVERABLE  
FAILURE

ZERO  SECONDS



UNRECOVERABLE  
FAILURE

SECONDS  MINUTES



UPGRADE

ZERO  MINUTES

\*



Out of the box



Automated via control plane











Manual setup



Not available/possible



# Autonomous Database Serverless: Automatic backup







 SCHEDULING	<ul style="list-style-type: none"><li>Automatically done by the service (60-day full, daily incremental, 5 mins archivelog, some optional retention control)</li></ul>
 DESTINATION	<ul style="list-style-type: none"><li>Service-managed bucket, no direct customer access</li></ul>
 REPLICAS	<ul style="list-style-type: none"><li>Mirrored and replicated.</li></ul>
 CREDENTIALS	<ul style="list-style-type: none"><li>Managed internally</li><li>Automatic password rotation</li></ul>
 WALLET	<ul style="list-style-type: none"><li>TDE wallet managed and backed up by Oracle</li></ul>
 RESTORE	<ul style="list-style-type: none"><li>Restore backup within the retention window</li></ul>
 RETENTION	<ul style="list-style-type: none"><li>60 days of retention and long-term backups are available</li></ul>
 STANDBY	<ul style="list-style-type: none"><li>No backup on the standby database</li></ul>



# Autonomous Database Serverless: Real Application Clusters

- Services are automatically created
  - ATP and ADW: \_high, \_medium, \_low
  - ATP only: \_tp, \_tpurgent
- Client access only via TLS or mTLS
- Application Continuity can be enabled and configured via DBMS\_CLOUD\_ADMIN package
- No configuration requirement for Fast Application Notification
  - FAN events are handled by the Connection Manager (CMAN)
- Patching is rolling and announced in the user interface (No database downtime . Zero application downtime for short transactions, long transactions might have an impact)

# Autonomous Database Serverless: Autonomous Data Guard

 SETUP	<ul style="list-style-type: none"><li>• 1-click setup from control plane</li><li>• Via PDB hot clone</li></ul>
 TOPOLOGY	<ul style="list-style-type: none"><li>• Option to configure 1 or 2 standby databases within the same region as the primary or cross-region</li><li>• Remote region destinations predefined based on lowest latency</li><li>• From ADB-S to ADB-S</li></ul>
 PROTECTION	<ul style="list-style-type: none"><li>• Same region standby configuration (MAA validated with local standby: local RPO &lt; 10 seconds, local standby RTO &lt; 131 secs)</li><li>• Automatic failover available with bounded RPO in the same region</li><li>• RTO does not include detection time</li></ul>
 ROLE CHANGES	<ul style="list-style-type: none"><li>• Switchover and failover available through control plane</li><li>• Connection string only contains regional information. Cross-region needs manual connection string configuration.</li></ul>
 OPEN MODE	<ul style="list-style-type: none"><li>• No access to standby database</li><li>• Additional read-only clones can be created and refreshed manually</li></ul>
 PATCHING & UPGRADE	<ul style="list-style-type: none"><li>• Primary and standby are patched independently</li><li>• PDB can be relocated to upgraded database</li></ul>

## Autonomous Database Serverless: read more

- Oracle Maximum Availability Architecture and Autonomous Database Cloud
  - [https://docs.oracle.com/en-us/iaas/Content/Database/Concepts/maxavailarch.htm#MAA\\_auto](https://docs.oracle.com/en-us/iaas/Content/Database/Concepts/maxavailarch.htm#MAA_auto)
- Continuous Availability - Application Continuous Service for MAA Solutions
  - <https://docs.oracle.com/en/database/oracle/oracle-database/19/haovw/configuring-continuous-availability-applicationsconfiguring-continuous-availability-applicati.html>



# Oracle Autonomous Database on Dedicated Exadata Infrastructure (ADB-D and ADB-C@C)



---

Maximum Availability Architecture

# Autonomous Database - Dedicated: Protection Out-of-the-box

## AVAILABILITY / AUTOMATION \*

-  **RMAN**
  - Manage or Cancel Backups
  - Primary/Standby backup/restore available and long-term retention
  - CDB or PDB backup/restore
-  **RAC**

Exadata inherent HA, QoS, and Performance benefits, Agility, and Expansion (CPU, memory, disk storage, DB node, Storage Cell, DB Node (or new Clusters))
-  **ACTIVE DATA GUARD**
  - 1 standby, local or remote
  - Automatic failover option (FSFO)
  - Max Availability or Max Performance
-  **GOLDENGATE**
  - Using OGG Hub or OCI OGG
  - Flexible configurations

MAA LEVEL



ADB-D

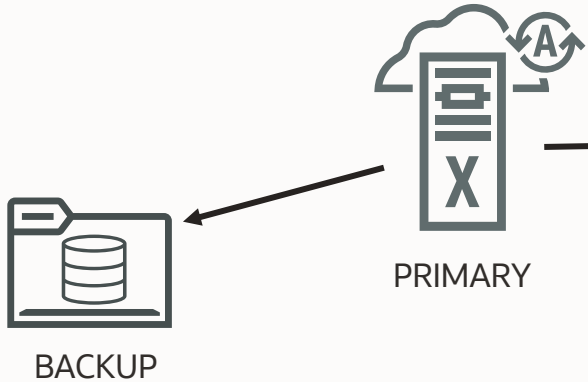


+ Data Guard

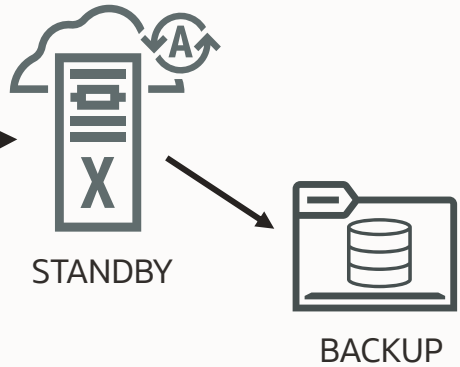


(with OGG)









## Region 1







## Region 2



## Gold Outage Matrix








	PLANNED MAINTENANCE	ZERO		ZERO
	RECOVERABLE FAILURE	ZERO		SECONDS
	UNRECOVERABLE FAILURE	SECONDS		SECONDS
	UPGRADE	ZERO		MINUTES

\*

-  Out of the box
-  Automated via control plane
-  Manual setup
-  Not available/possible



# Autonomous Database - Dedicated: automatic backup

 SCHEDULING	<ul style="list-style-type: none"> <li>Automatically done by the service (weekly full, daily incremental, 15 mins archive log)</li> </ul>
 DESTINATION	<ul style="list-style-type: none"> <li>ADB-D: Service-managed bucket, no direct customer access</li> <li>ADB-C@C: NFS, ZDLRA (recovery appliance) or local (for</li> <li>For ZDLRA, real-time redo transport is not available yet</li> </ul>
 REPLICAS	<ul style="list-style-type: none"> <li>Object storage, Mirrored backup</li> <li>ADB-C@C: ZDLRA backup replication available (manual)</li> </ul>
 CREDENTIALS	<ul style="list-style-type: none"> <li>Object storage: managed internally</li> <li>ZDLRA, NFS: managed by the customer</li> </ul>
 WALLET	<ul style="list-style-type: none"> <li>TDE wallet managed and backed up by Oracle</li> <li>ADB-D: Oracle Vault (KMS) supported for customer-managed keys</li> <li>ADB-C@C: Oracle Key Vault supported for customer-managed keys</li> </ul>
 RESTORE	<ul style="list-style-type: none"> <li>Create new ADB from backup is possible.</li> <li>Duplicate (clone) is supported</li> </ul>
RETENTION	<ul style="list-style-type: none"> <li>Short-term retention is enabled and configurable</li> <li>Long-term retention is available</li> </ul>
 STANDBY	<ul style="list-style-type: none"> <li>Automatic backup of standby database</li> </ul>

# Autonomous Database - Dedicated: automatic backup best practices

- Backup retention
  - Object storage or NFS up to 95 days
  - Long-term backup: between 90 days and 10 years (ADB-C@C: NFS only)
  - ZDLRA: controlled by the recovery appliance protection policy
  - Local: 7 days (ADB-C@C Only)
- On-demand PDB backup:
  - Used for fast PITR only
  - Follows backup retention
  - Can be used to create a new database



# Autonomous Database - Dedicated: Real Application Clusters

- RAC uses 192.168.128.0/20 on IB and 100.64.0.0/10 on RoCE for interconnect
- Client network configured on customer's subnet. The only available connection is SCAN
- Client connection via TCP or TLS
- Databases with lower ECPU count ( $\leq 16$ ) by default only opened on a single node
- Databases with higher ECPU count ( $> 16$ ) by default opened on two or more nodes
- Container Database has RAC split control, open at OCPU count different than default 16
- Container Database has RAC affinity control, opening one node only until all resources used
- Patching is rolling and scheduled by the customer
- Fast Application Notification must be configured



# Autonomous Database – Dedicated: RAC services







High priority OLTP <sup>1</sup>	tpurgent	tpurgent_tls	tpurgent_ro	tpurgent_ro_tls
Typical OLTP <sup>1</sup>	tp	tp_tls	tp_ro	tp_ro_tls
High priority Reporting <sup>2</sup>	high	high_tls	high_ro	high_ro_tls
Typical Reporting <sup>2</sup>	medium	medium_tls	medium_ro	medium_ro_tls
Low priority Reporting <sup>2</sup>	low	low_tls	low_ro	low_ro_tls

<sup>1</sup> Transparent Application Continuity enabled by default

<sup>2</sup> Use DBMS\_APP\_CONT\_ADMIN.ENABLE\_TAC to enable TAC for the non TP services



# Autonomous Database - Dedicated: Autonomous Data Guard

 SETUP	<ul style="list-style-type: none"><li>• Setup from control plane on CDB creation or add standby post-CDB creation</li><li>• A protected CDB can be chosen at ADB creation</li></ul>
 TOPOLOGY	<ul style="list-style-type: none"><li>• Single primary-standby can be configured within the same region, across ADs, or cross-region</li><li>• Only possible between same ADB-D type (On-premises to On-premises/OCI to OCI)</li><li>• MAA practices integrated</li></ul>
 PROTECTION	<ul style="list-style-type: none"><li>• Max Availability or Max Performance possible at CDB level</li><li>• Automatic failover (Fast-Start Failover) is available</li></ul>
 ROLE CHANGES	<ul style="list-style-type: none"><li>• Switchover, Failover and Snapshot Standby at CDB level available through control plane</li><li>• Connection string is aware of Autonomous Data Guard</li></ul>
 OPEN MODE	<ul style="list-style-type: none"><li>• Standby database is open read-only (DML redirection not supported)</li><li>• Standby role listener services available</li></ul>
 PATCHING & UPGRADE	<ul style="list-style-type: none"><li>• Customer controls when primary and standby are patched</li><li>• Standby first patching best practices applied automatically</li><li>• Zero database downtime with RAC rolling for any software or hardware updates</li></ul>

## Autonomous Database - Dedicated: Read more

Oracle Maximum Availability Architecture and Autonomous Database Cloud

- Autonomous Database with Default High Availability Option
- Autonomous Database with Autonomous Data Guard Option
- Maintaining Application Uptime

<https://docs.oracle.com/en/database/oracle/oracle-database/19/haovw/oracle-maximum-availability-architecture-and-oracle-autonomous-database.html>



# Multicloud











Maximum Availability Architecture

# Oracle Database on Exadata in Multicloud

Deploy full-featured Oracle Databases on Exadata located within hyperscale cloud data centers

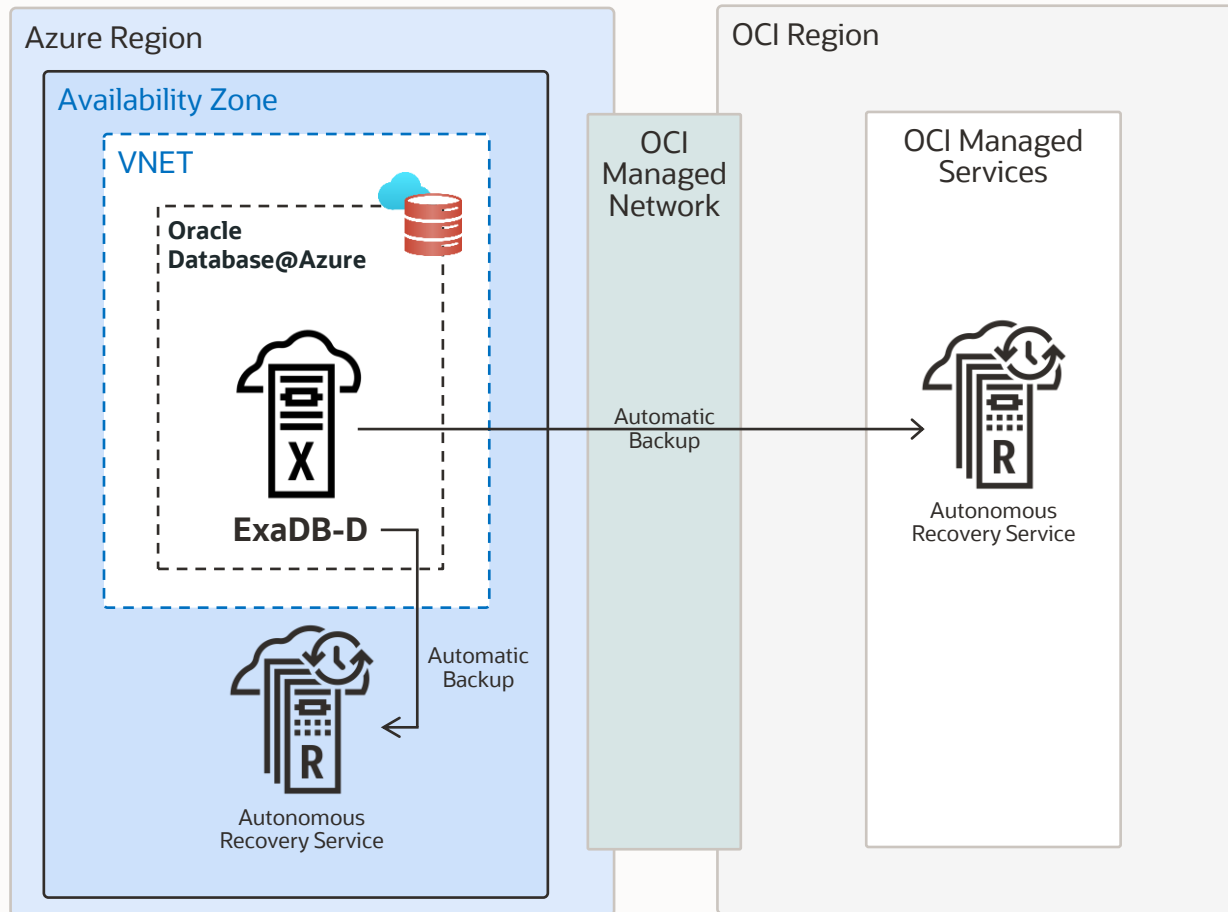
- Co-located apps and databases deliver superior performance
- Integrated cloud console, APIs, and monitoring with joint support enhances customer experience
- Full Oracle Database functionality and compatibility accelerates cloud migration and IT modernization

			
			
Oracle Database in OCI	Oracle Database@Azure	Oracle Database@GCP	Oracle Database@AWS



# Oracle Database@Azure MAA Silver Level

## High Availability and Data Protection Built-in by Default

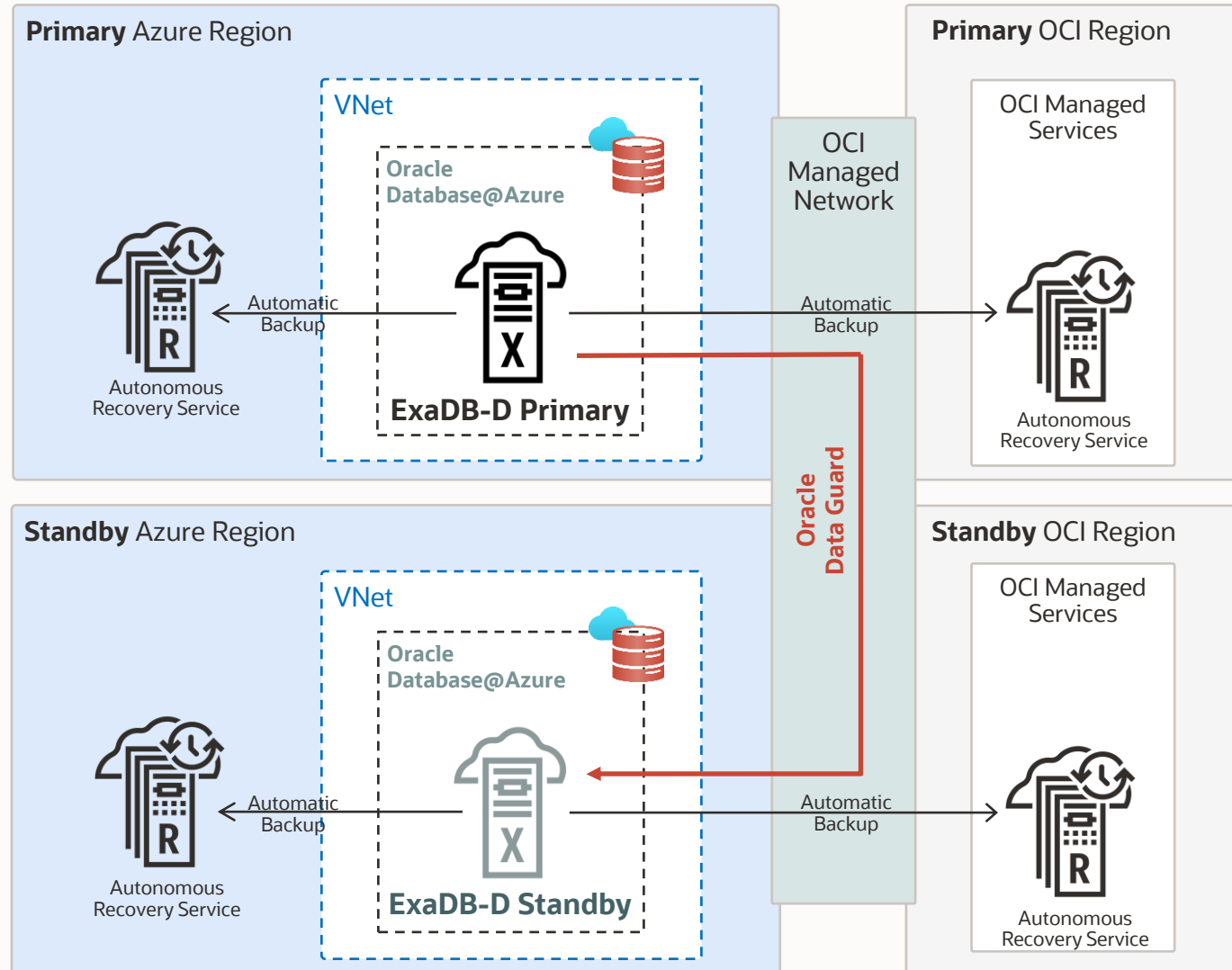


- ✓ Oracle Exadata and Oracle RAC
  - ✓ Agility to scale storage, compute, and memory without downtime
  - ✓ Node failure protection
  - ✓ Zero downtime software maintenance
- ✓ Zero Data Loss Autonomous Recovery Service
  - ✓ Available in OCI and in Azure
  - ✓ One click to choose backup destination

☒ Store backups in the same cloud provider as the database ⓘ
- ✓ Alternatively, backup to OCI Object Storage

# Oracle Database@Azure MAA Gold Level | Cross-regions

Mission-Critical Deployments with Disaster Recovery



MAA Silver Level +

- ✓ Fully Automated Oracle (Active) Data Guard setup
- ✓ **Regional disaster recovery protection**
- ✓ Comprehensive data corruption prevention
- ✓ Defense from ransomware attacks
- ✓ Online upgrades and migrations
- ✓ Offload backup and workload to standby with read-mostly scale-out

# Oracle Data Guard for ExaDB-D on Oracle Database@Azure

## Cross-region deployment options

### Network Traffic through OCI (recommended)

- Automated setup via Cloud Tooling
  - VCN peering required
- Oracle controls the network and ensures reliability
- First 10TB/month cross-region traffic for free
- One standby database via Cloud Tooling
  - Multiple standbys via manual setup with optional Fast-Start Failover (FSFO)
- Can support the potential high redo throughput required for enterprise databases

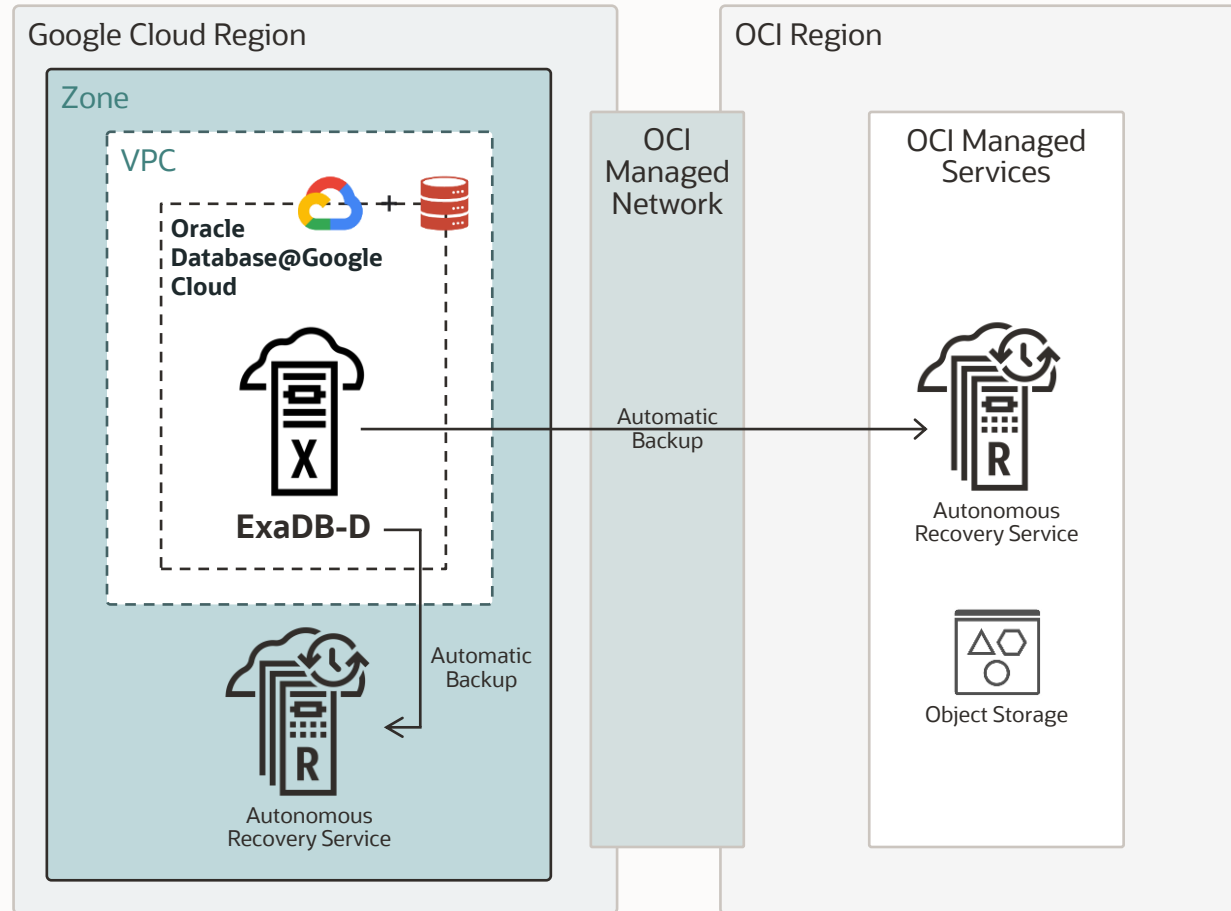
### Network Traffic through Azure

- Automated setup via Cloud Tooling
  - VNet peering required
- Microsoft controls the network and ensures reliability
- Chargeback for cross-region traffic
- One standby database via Cloud Tooling
  - Multiple standbys via manual setup with optional Fast-Start Failover (FSFO)



# Oracle Database@Google Cloud MAA Silver Level

High Availability and Data Protection Built-in by Default



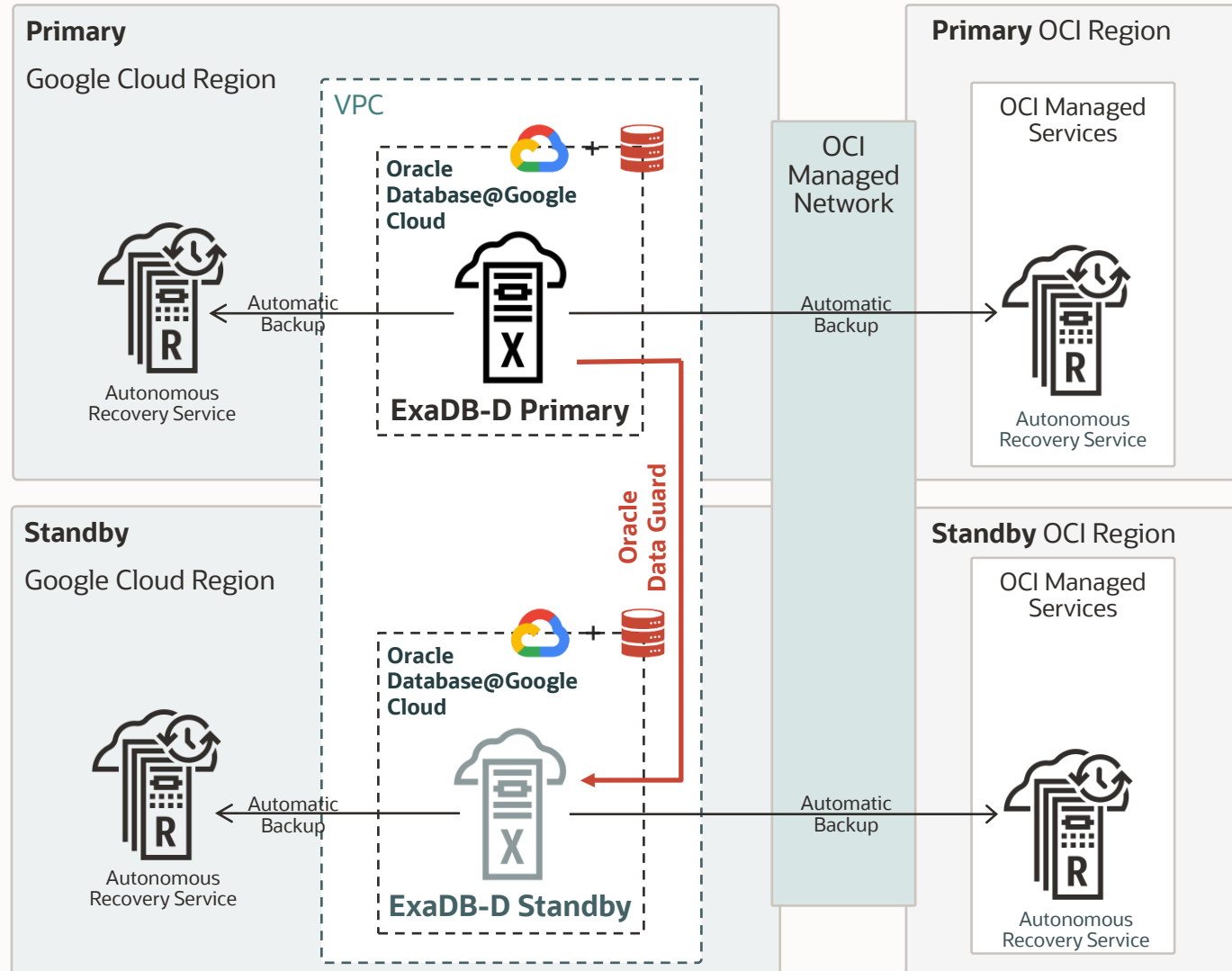
- ✓ Oracle Exadata and Oracle RAC
  - ✓ Agility to scale storage, compute, and memory without downtime
  - ✓ Node failure protection
  - ✓ Zero downtime software maintenance
- ✓ Zero Data Loss Autonomous Recovery Service
  - ✓ Available in OCI and in GCP
  - ✓ One click to choose backup destination

☒ Store backups in the same cloud provider as the database ⓘ
- ✓ Alternatively, backup to OCI Object Storage



# Oracle Database@Google Cloud MAA Gold Level | Cross-regions

## Mission-Critical Deployments with Disaster Recovery



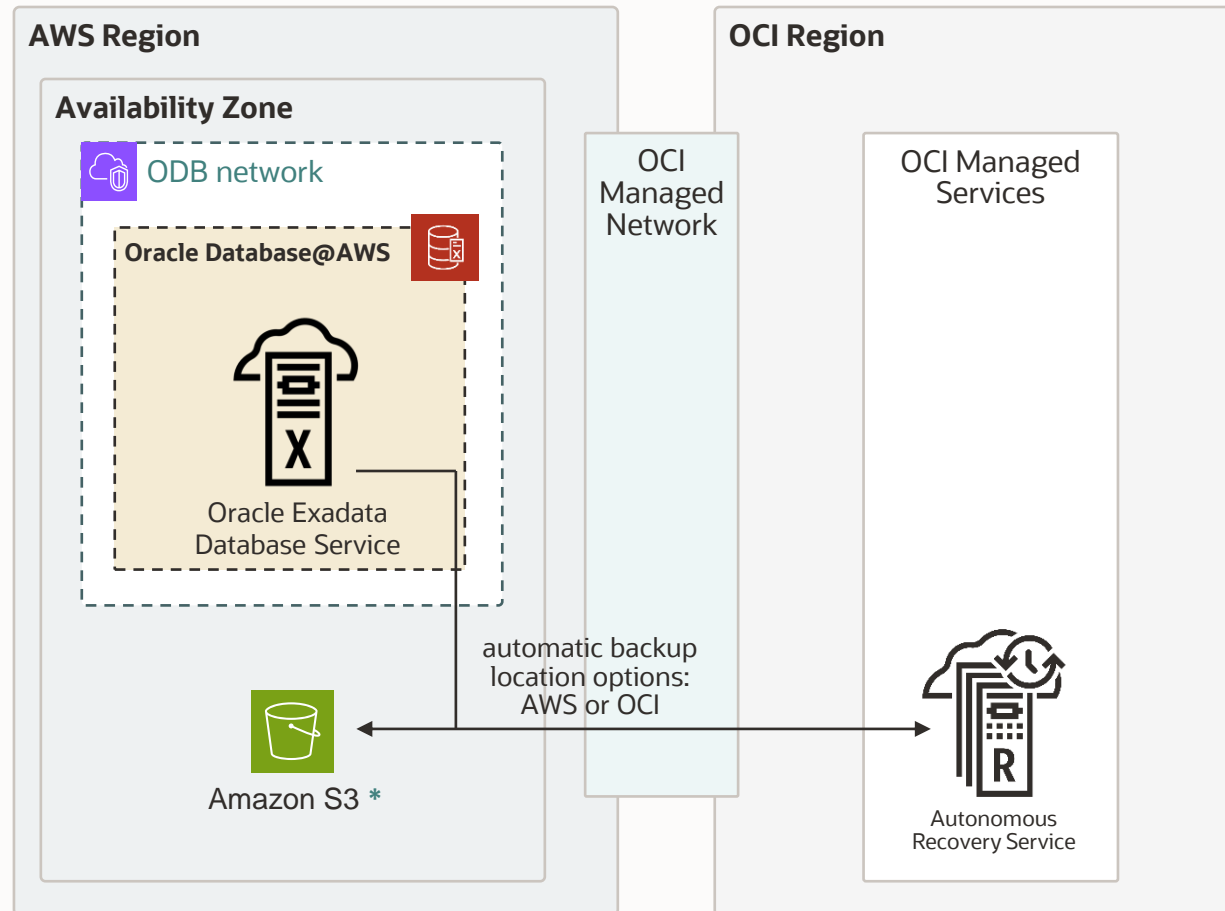
### MAA Silver Level +

- ✓ Fully Automated Oracle (Active) Data Guard setup
- ✓ **Regional disaster recovery protection**
- ✓ Comprehensive data corruption prevention
- ✓ Defense from ransomware attacks
- ✓ Online upgrades and migrations
- ✓ Offload backup and workload to standby with read-mostly scale-out



# Exadata Database Service@AWS MAA Silver Level

High Availability and Data Protection Built-in by Default



## Oracle Exadata and Oracle RAC

- ✓ Agility to scale storage, compute, and memory without downtime
- ✓ Node failure protection
- ✓ Zero downtime software maintenance

## Zero Data Loss Autonomous Recovery Service

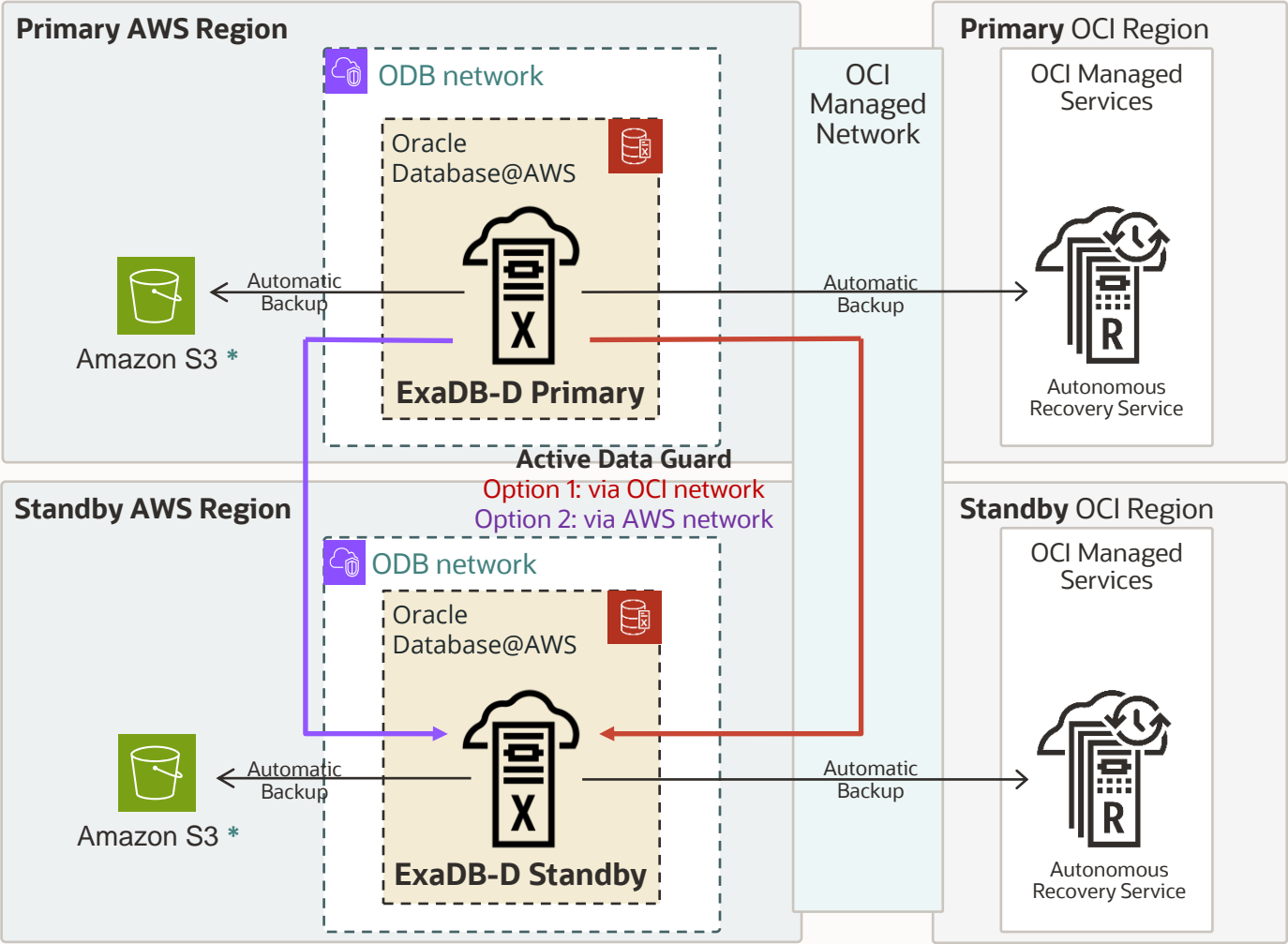
- ✓ Available in OCI and in AWS
- ✓ One click to choose backup destination

☒ Store backups in the same cloud provider as the database ⓘ



# Exadata Database Service@AWS | MAA Gold Level - Cross-region

## Mission-Critical Deployments with Disaster Recovery



- MAA Silver Level +  
Fully Automated Oracle Active Data Guard setup
- ✓ **Regional disaster recovery protection**
  - ✓ Comprehensive data corruption prevention
  - ✓ Defense from ransomware attacks
  - ✓ Online upgrades and migrations
  - ✓ Offload backup and workload to standby with read-mostly scale-out
  - ✓ Network traffic through OCI network (recommended) or AWS Network






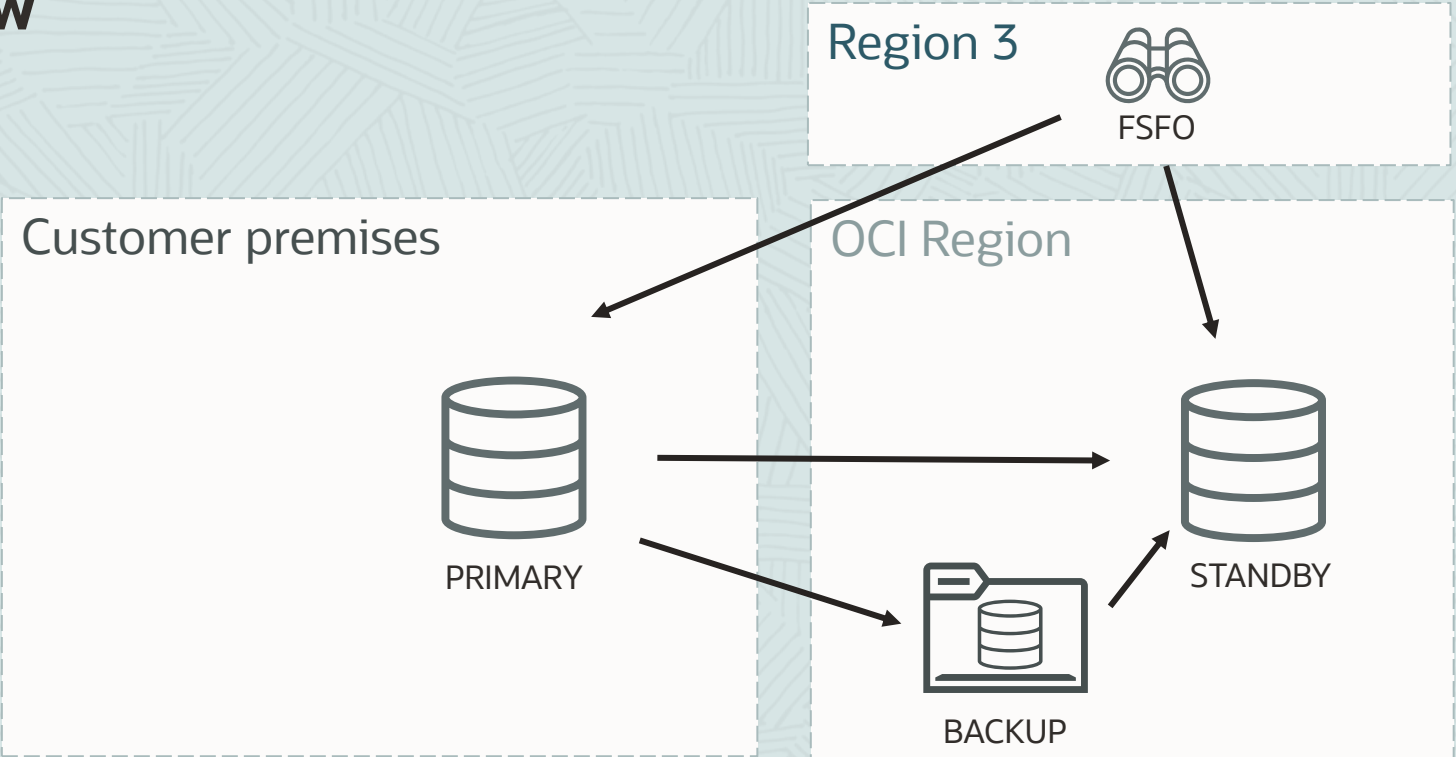
# Hybrid Data Guard









---

Maximum Availability Architecture

# Hybrid Data Guard: overview

AVAILABILITY / AUTOMATION <sup>(1)</sup>	
 RMAN	Backup to the cloud
 RAC	Customer-specific
 ACTIVE DATA GUARD	Instantiate & operate Data Guard configuration
 GOLDENGATE	Manual (capture & delivery)
MAA LEVEL	<div> SILVER</div> <div> GOLD</div> <div> PLATINUM</div> <div>Customer responsibility.</div>



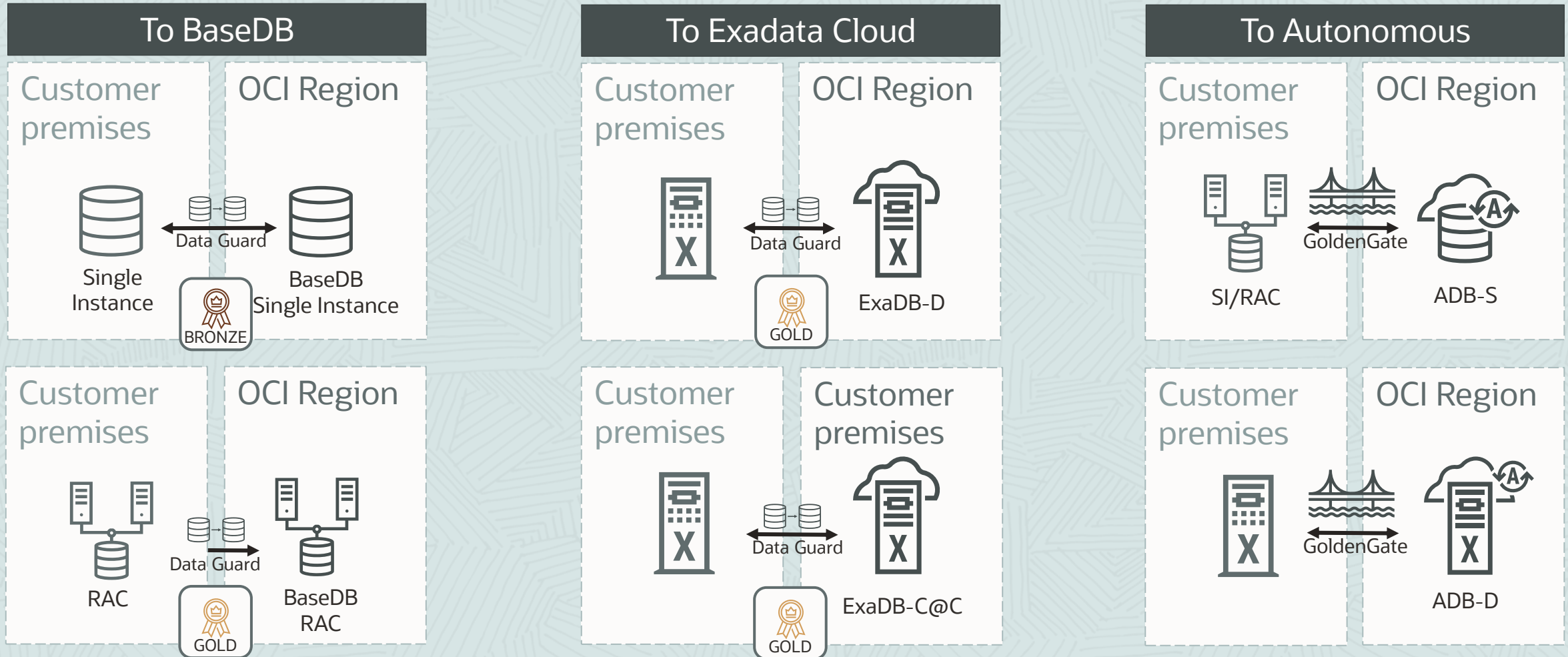
Gold Outage Matrix <sup>(2)</sup>		
	PLANNED MAINTENANCE	ZERO  ZERO
	RECOVERABLE FAILURE	ZERO  SECONDS
	UNRECOVERABLE FAILURE	ZERO  SECONDS
	UPGRADE	ZERO  SECONDS

(1) Customer responsibility  
(2) Best case scenario (FSFO + SYNC or FAR SYNC)





# Hybrid Cloud: recommended hybrid sources/destinations

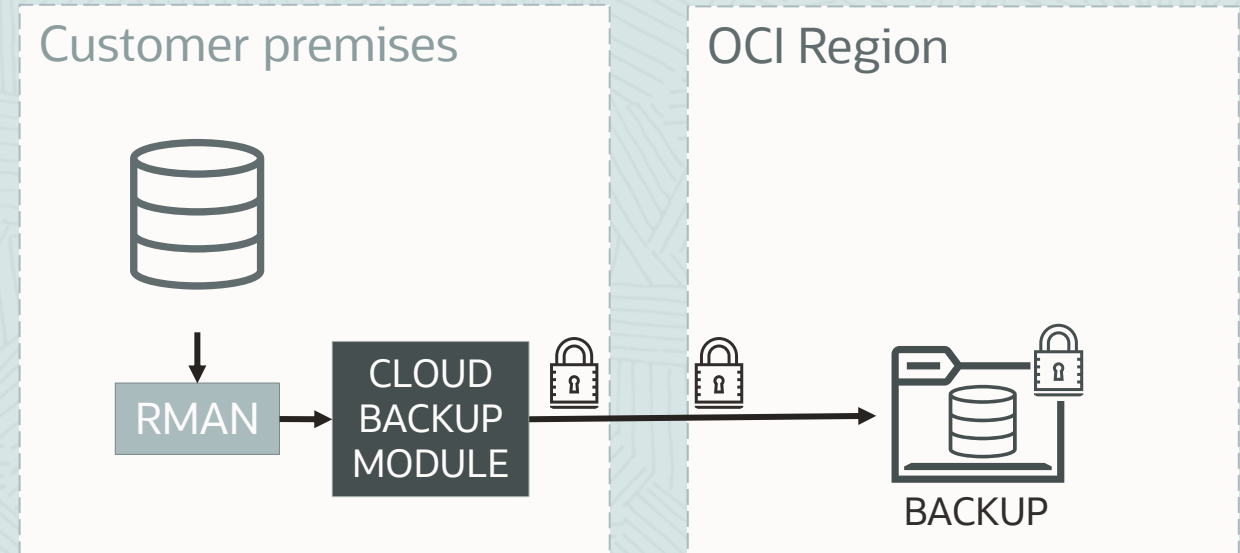


- All Hybrid configurations are achieved manually: no Control Plane automation
- On-premises non-Exadata to ExaDB-C@C/ExaDB-D is possible but beware of exclusive features



# Hybrid Cloud: backup to Oracle Cloud Infrastructure






- Cost effective, scalable cloud storage for database backups
- End-to-end enterprise-grade data encryption, compression and protection
- Key based authentication
- Supports multiple compartments
- Object lifecycle policies for archiving
- Multipart upload
- Geo-replication, 3-way protection in the cloud
- RMAN driven backup & recovery
- Support for Immutable Backup



# Hybrid Cloud: backup to Oracle Cloud Infrastructure

- Oracle Database Backup Cloud Service Best Practices for On-Premise Database Backup & Recovery  
<https://www.oracle.com/technetwork/database/features/availability/twp-oracledatabasebackupservice-2183633.pdf>
- Use Fast Connect with public peering  
<https://docs.oracle.com/en-us/iaas/Content/Network/Concepts/fastconnectmultipliedrgs.htm>

# Hybrid Cloud: Data Guard destination matrix

		On-premises DB	BaseDB	BaseDB RAC	ExaDB-C@C	ExaDB-D
	OS	Linux Windows <sup>1</sup>	Linux	Linux	Linux	Linux
	VERSION	All supported versions	Same as source	Same as source	Same as source	Same as source
	RELEASE UPDATE	Stay within last 3 RUs	Same as source or Standby first. Use Custom DB Image	Same as source or Standby first. Use Custom DB Image	Same as source or Standby first. Use Custom DB Image	Same as source or Standby first. Use Custom DB Image
	ARCHITECTURE	Same as destination	CDB	CDB	CDB or non-CDB	CDB or non-CDB
	EDITION	DG: EE	DG: EE, EE-HP	EE-EP	Included in ExaDB-C@C	Included in ExaDB-D
		ADG: +ADG option	ADG: EE-EP			

<sup>1</sup> Data Guard Support for Heterogeneous Primary and Physical Standbys in Same Data Guard Configuration (Doc ID 413484.1)



# Hybrid Cloud: Data Guard checklist

## Network

- Measure peak redo rates and ensure enough bandwidth
  - Assessing and Tuning Network Performance for Data Guard and RMAN (Doc ID 2064368.1)
    - Generally recommended:  
net.ipv4.tcp\_rmem=4096 87380 134217728  
net.ipv4.tcp\_wmem=4096 16384 134217728
- Communication must be bi-directional
- Use either IPSec VPN or FastConnect (recommended)
  - For FastConnect use private peering
  - If the internet is used, use SQL\*Net encryption

## Transparent Data Encryption

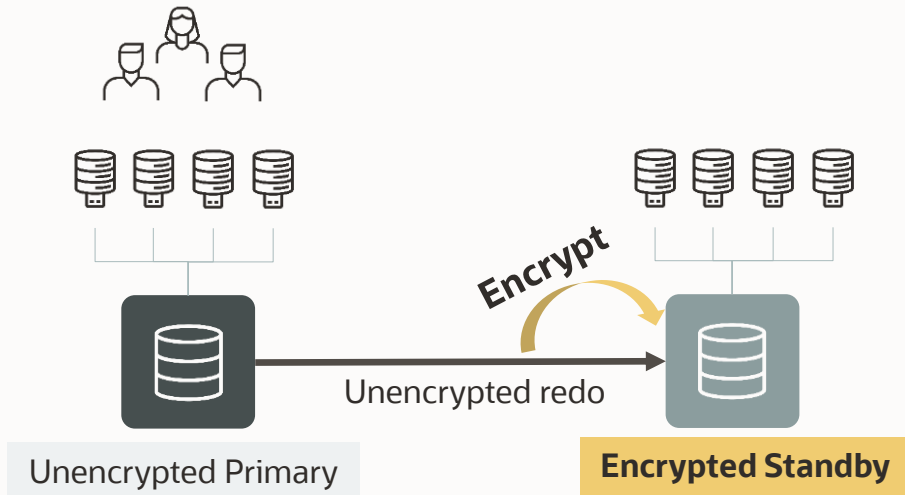
- Recommended: Use TDE on both primary and standby
  - Encrypt primary prior to migration whenever possible
- Master Note for Transparent Data Encryption (TDE) (Doc ID 1228046.1)
- Oracle Database Tablespace Encryption Behavior in Oracle Cloud (Doc ID 2359020.1)

# Transparent Data Encryption in hybrid deployments

```
-- On-premises init.ora or spfile:
TABLESPACE_ENCRYPTION = DECRYPT_ONLY;
-- OCI init.ora or spfile:
TABLESPACE_ENCRYPTION = AUTO_ENABLE;
```

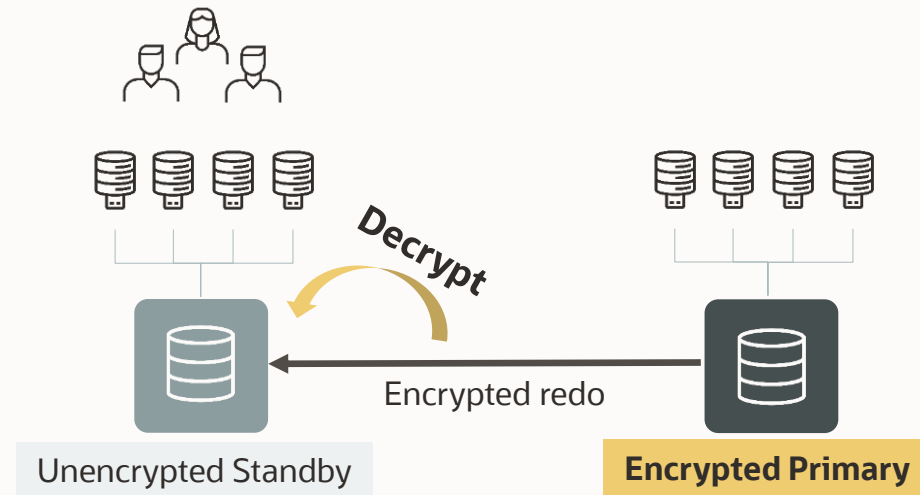
## Customer premises

## Oracle Cloud



## Customer premises

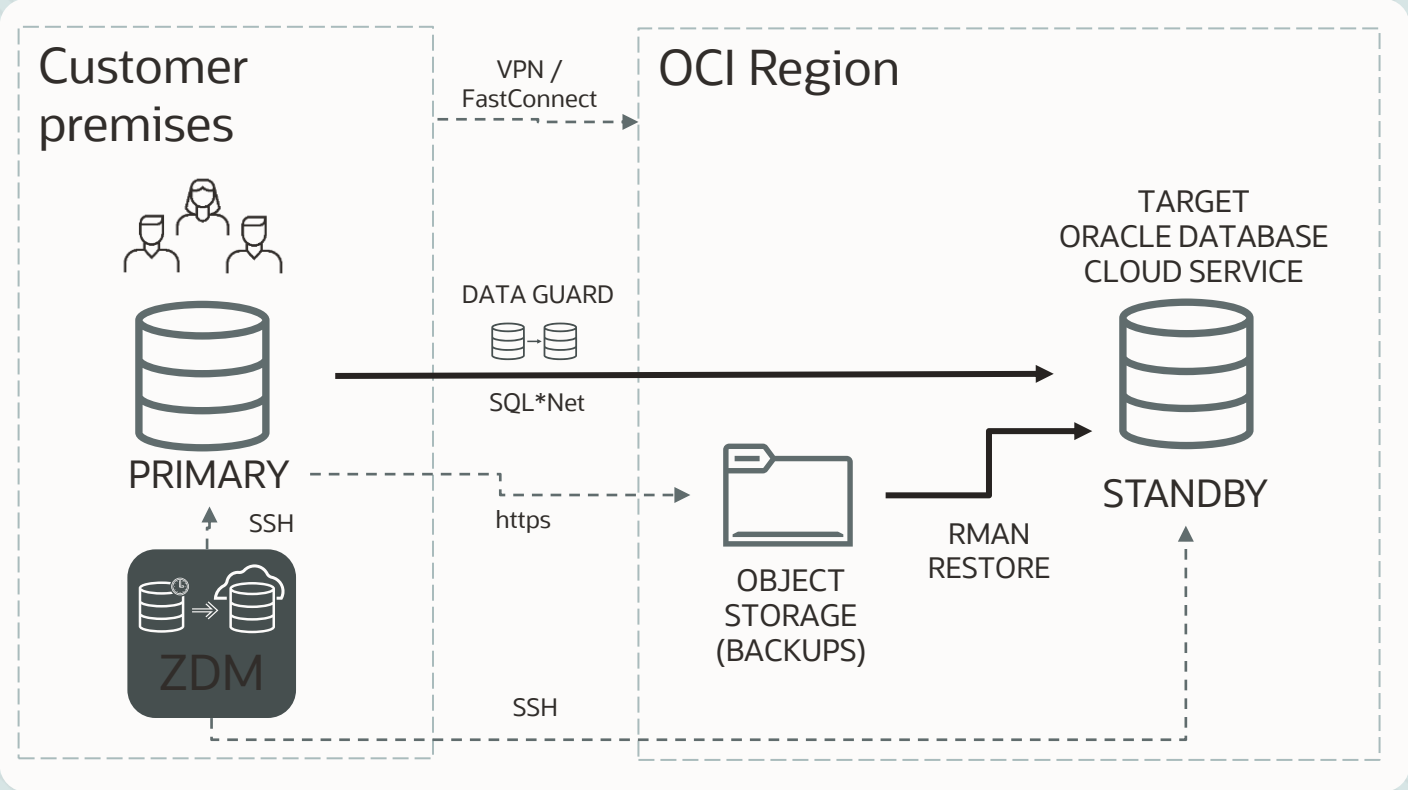
## Oracle Cloud



# Hybrid Cloud: automatic setup with ZDM



ZDM PHASES	
1	Download & Configure ZDM
2	ZDM Starts Database Migration
3	ZDM Orchestrates Transfer of Backup Files
4	ZDM Instantiates a Standby DB
5	ZDM Synchronizes Primary & Standby
6	ZDM Switches Over & Swaps Roles
7	ZDM Finalizes the Migration Process
8	ZDM Finalizes the Migration



<https://oracle.com/goto/zdm>





# Hybrid Cloud: Data Guard high-level implementation steps

- Create a Database in the Cloud
  - Same patch level +one-offs as a source via Custom DB Software Images
  - Same db\_name (db\_unique\_name defined by the cloud)
- Delete the DB with the drop command (not using cloud tooling)
- Copy passwordfile
- Prepare the new init file (avoid copying parameters from on-premises)
- Copy/create TDE wallet
- Setup SQL\*Net communication
- Instantiate standby database (RESTORE FROM SERVICE/DUPLICATE)
- Configure broker and enable configuration
- Validate Switchover, Snapshot Standby, **Client failover**
- Monitor MAA score (ORAchk for BaseDB, Exachk for ExaDB-D)
- Monitor DG health: **Monitoring a Data Guard Configuration (Doc ID 2064281.1)**

# Patching for hybrid Data Guard in OCI

- The control plane does not support automatic patching of primary and standby
- Cloud tooling understands the role of the database
- To patch a Data Guard environment (Cloud control plane setup or manual):
  1. Patch standby first, tooling will not try to run datapatch, it will succeed
  2. Patch primary, tooling runs datapatch, changes will be applied to standby
  3. Patches on RAC are always rolling (no downtime)
- To patch a Data Guard environment non-RAC with minimum downtime:
  1. Patch standby first, tooling will not try to run datapatch, it will succeed
  2. Switchover to standby
  3. Patch old primary, tooling will not try to run datapatch, it will succeed
  4. Finish patching manually by calling datapatch manually on primary

## Hybrid Cloud: Data Guard - read more

- Hybrid Data Guard to Oracle Cloud Infrastructure Production Database on Premises and Disaster Recovery with BaseDB BM or VM shapes in Oracle Cloud Infrastructure  
<https://www.oracle.com/docs/tech/database/hybrid-dg-to-oci.pdf>
- Disaster Recovery using Exadata Cloud  
On-Premises Primary to Standby in Exadata Cloud Service or Gen 2 Exadata Cloud at Customer  
<https://docs.oracle.com/en/database/oracle/oracle-database/19/haovw/oracle-data-guard-hybrid-cloud-configuration1.html>
- Best Practices for Corruption Detection, Prevention, and Automatic Repair - in a Data Guard Configuration (Doc ID 1302539.1)  
<https://support.oracle.com/epmos/faces/DocumentDisplay?id=1302539.1>
- Oracle Data Guard Best Practices  
<https://docs.oracle.com/en/database/oracle/oracle-database/19/haovw/oracle-data-guard-best-practices.html>



# Hybrid Cloud: GoldenGate

- Migration to the Oracle Cloud with an Oracle GoldenGate Hub Configuration  
<https://www.oracle.com/a/tech/docs/maa-database-migration-to-oci-with-a-goldengate-hub.pdf>

# GoldenGate and Platinum MAA

—  
Maximum Availability Architecture

# MAA Platinum and Cloud GoldenGate Collateral

- [MAA Platinum Reference Architecture Overview](#)
- [Overview of Oracle GoldenGate Best Practices](#)
- [Cloud-Specific GoldenGate Papers](#)
  - [Cloud: Configuring Oracle GoldenGate Hub for MAA Platinum](#)
  - [Cloud: Oracle GoldenGate Microservices Architecture on Oracle Exadata Database Service Configuration Best Practices](#)
  - [Cloud MAA Platinum: Oracle GoldenGate Microservices Architecture Integrated with Active Data Guard](#)
- [Managing Planned and Unplanned Outages for Oracle GoldenGate Hub](#)
- [Troubleshooting Oracle GoldenGate](#)



# Oracle Zero Data Loss Autonomous Recovery Service (ZRCV)

---

Maximum Availability Architecture

# Zero Data Loss Autonomous Recovery Service

Gives the near zero RPO for ExaDB-D and BaseDB

## Ransomware resiliency

- Fast, zero data loss recovery with optimized backups
- Automated and mandatory encryption to help prevent data theft
- Safeguards backups with enforced policy-level database retention lock

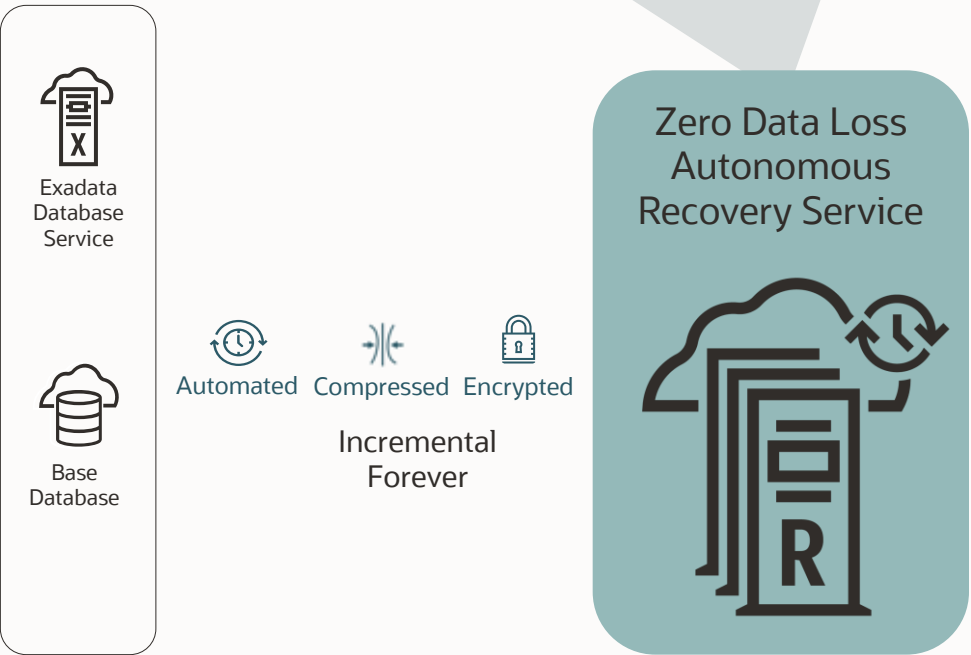
## Operational efficiency

- No more weekly full backups – eliminates production database overhead
- Shorter backup windows with incremental forever strategy
- Zero-impact database recovery validation for every backup

## Cloud simplicity

- Quickly configure database protection at scale with zero data loss
- Control costs with database-specific backup consumption metrics
- Gain deep data protection insights with a granular recovery health dashboard

Health	Source Database	Real-Time Data Protection	Data Loss Exposure	Current Recovery Window
Protected	<a href="#">FINANCE</a>	Enabled	0 seconds	7 d 5 h 54 m
Protected	<a href="#">HR</a>	Disabled	11 m 7 s	15 d 3 h 19 m



Encryption keys are owned by and managed with the database

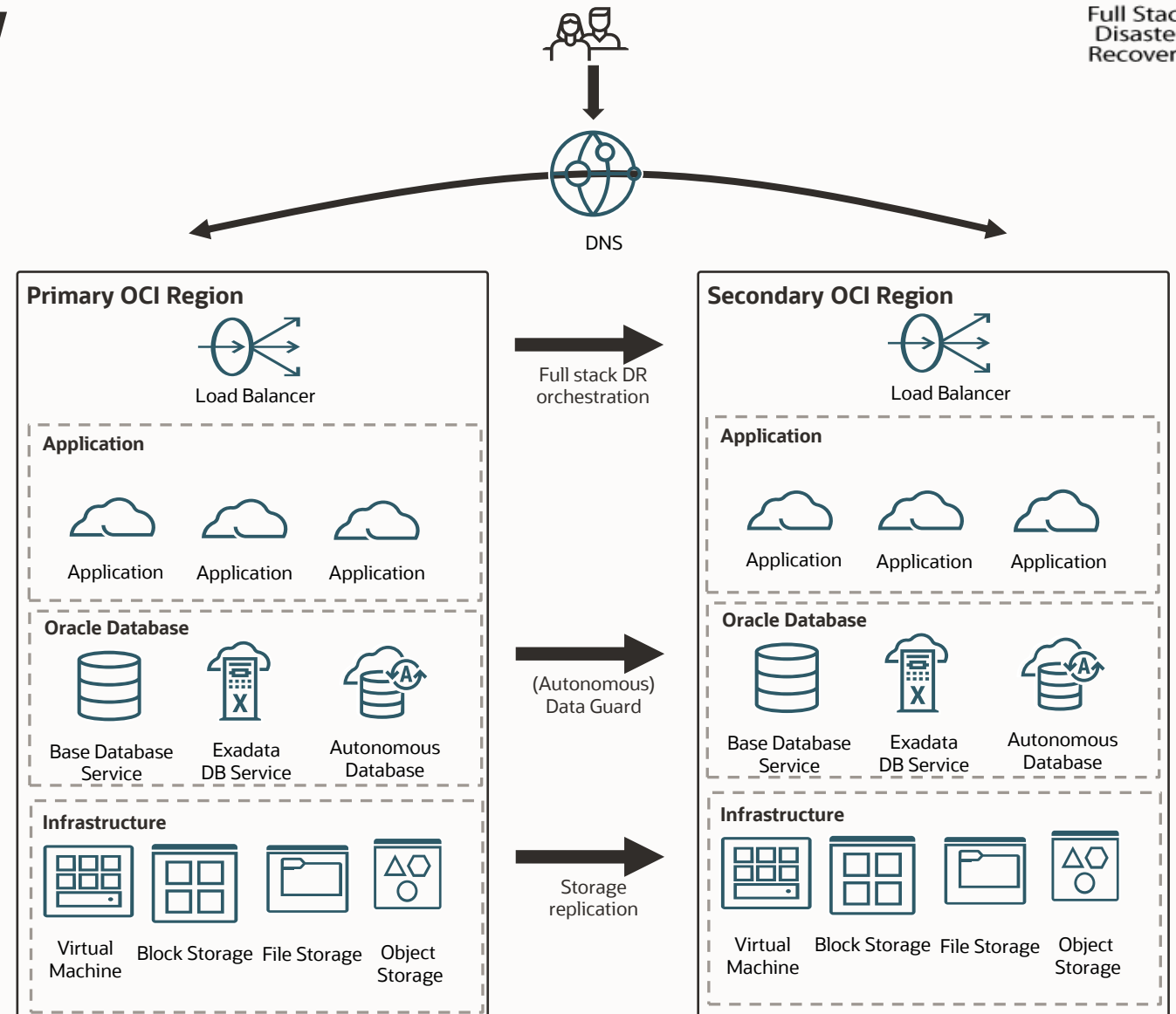


# OCI Full Stack Disaster Recovery (FSDR)

—  
Maximum Availability Architecture

# OCI Full Stack Disaster Recovery

- Fully managed disaster recovery (DR) service in Oracle Cloud
- DR for the entire application stack
  - Orchestrated single-click DR for infrastructure, applications & databases
- Automated discovery
  - Automates finding interdependent resources and creating and customizing DR plans
- Unified management
  - Validated and monitored execution of DR plans through an integrated UI / API



# Additional Information

---

Maximum Availability Architecture



# Cloud MAA configuration

	RMAN			RAC	DATA GUARD			
	Auto Backup	Backup Replicas	Standby Backup	App Services	Auto DG Config	Auto Failover	Cross Region	Auto Patching
ExaDB-D	✓	✓	✓	✓	✓	✓	✓	✓
ExaDB-C@C	✓	✓	✓	✓	✓	✓	✓	✓
BaseDB RAC	✓	✓	✓	✓	✓	✓	✓	✓
ADB-S	✓	✓	✓	✓	✓	✓	✓	✓
ADB-D	✓	✓	✓	✓	✓	✓	✓	✓



Out of the box



Automated via control plane



Manual setup



Not yet available





## Additional Information: read more

- MAA Best Practices for the Oracle Cloud
- <https://www.oracle.com/database/technologies/high-availability/oracle-cloud-maa.html>
- MAA Best Practices - Oracle Database
- <https://www.oracle.com/database/technologies/high-availability/oracle-database-maa-best-practices.html>
- MAA Best Practices - Exadata Database Machine
- <https://www.oracle.com/database/technologies/high-availability/exadata-maa-best-practices.html>
- Best Practices for Corruption Detection, Prevention, and Automatic Repair - in a Data Guard Configuration (Doc ID 1302539.1)
- <https://support.oracle.com/epmos/faces/DocumentDisplay?id=1302539.1>

ORACLE

Our mission is to help people see  
data in new ways, discover insights,  
unlock endless possibilities.

