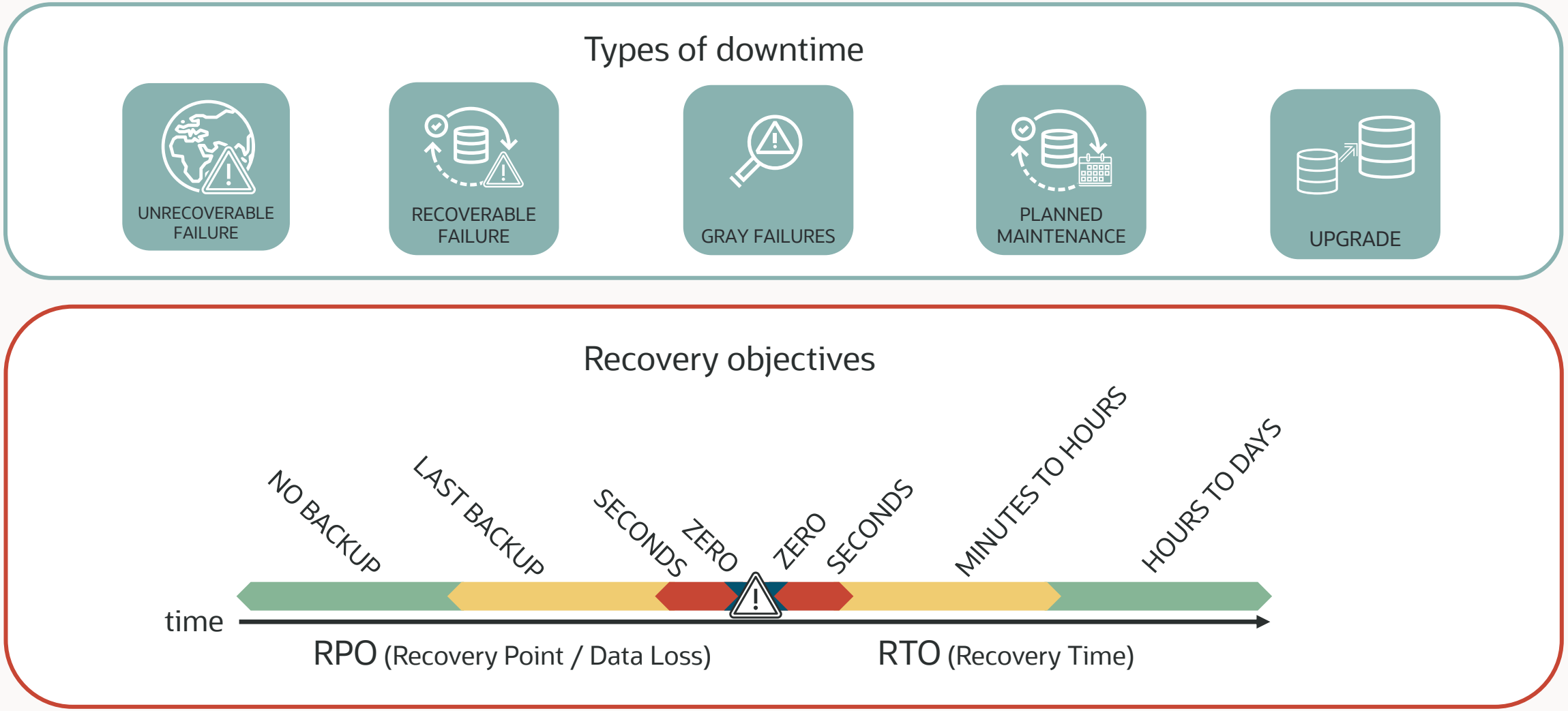
ORACLE

Oracle Cloud Maximum Availability Architecture

October 2026

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

Types of Downtime, Recovery Objectives, and Quality of Service



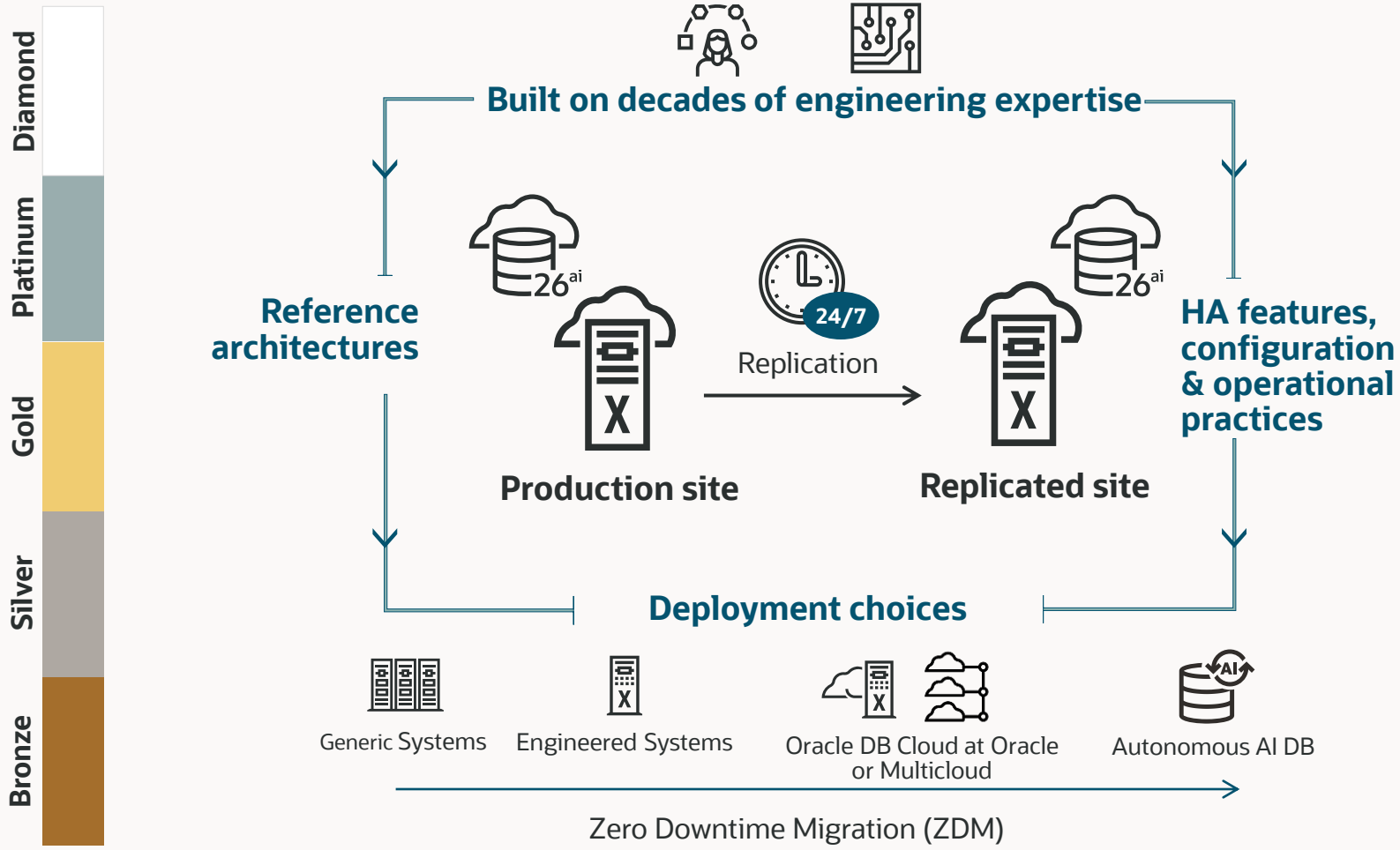
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From Single Instance to 99.9995%

Maximum Availability Reference Architectures

Oracle Maximum Availability Architecture (MAA)

Ultra-resilient availability tiers for all applications



High performance

Resource Management · Exadata · True Cache

Continuous availability

Application Continuity · Online Redefinition · Edition-Based Redefinition

Data protection

Flashback · RMAN · ZDLRA + ZRCV

Active replication and orchestration

Active Data Guard · Full Stack DR · GoldenGate

Scale out & Lifecycle

RAC · Globally Distributed AI Database · FPP · Real Application Testing

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Next-Gen MAA Reference Architectures

High availability tiers for the Oracle AI Database, uniquely engineered for resilience

Bronze:
- Local HA RTO - mins to 1 hr
- Regional DR RTO - hrs to days
- RPO < 15 min

Dev, test, prod

Single Instance, Backup & Restore



Silver:
- Local HA RTO - Secs to mins
- Regional DR RTO - hrs to days
- RPO < 15 min

Prod/departmental

Bronze +

High Availability with RAC or Data Guard



Gold:
- Local HA RTO < 60 secs
- Regional DR RTO < 5 min
- RPO – Zero or near-zero

Business-critical

Silver with RAC +

DB replication with Active Data Guard with automatic failover



Platinum:
- Local HA RTO < 10 secs
- Regional DR RTO < 30 secs
- RPO – Zero or near-zero

Mission-critical

Gold +

Active Data Guard with Oracle AI Database 26ai on Exadata, OR
GoldenGate with Oracle Database 19c on Exadata



Diamond (NEW):
- Local HA RTO < 3 secs
- Regional DR RTO < 3 secs
- RPO – Zero or near-zero

Extreme availability



GoldenGate 26ai replicas, *each running*:

Oracle AI Database 26ai
+ RAC on Exadata
+ (Active) Data Guard

OR
Globally Distributed AI Database with Raft Replication



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Single Instance Protection

Underlying Technologies

SINGLE INSTANCE

- ACID transactions
- Standard protection
- Automatic Restart

ONLINE REORG

- Online table redefinition and partition maintenance
- Less planned downtime

RESOURCE MANAGER

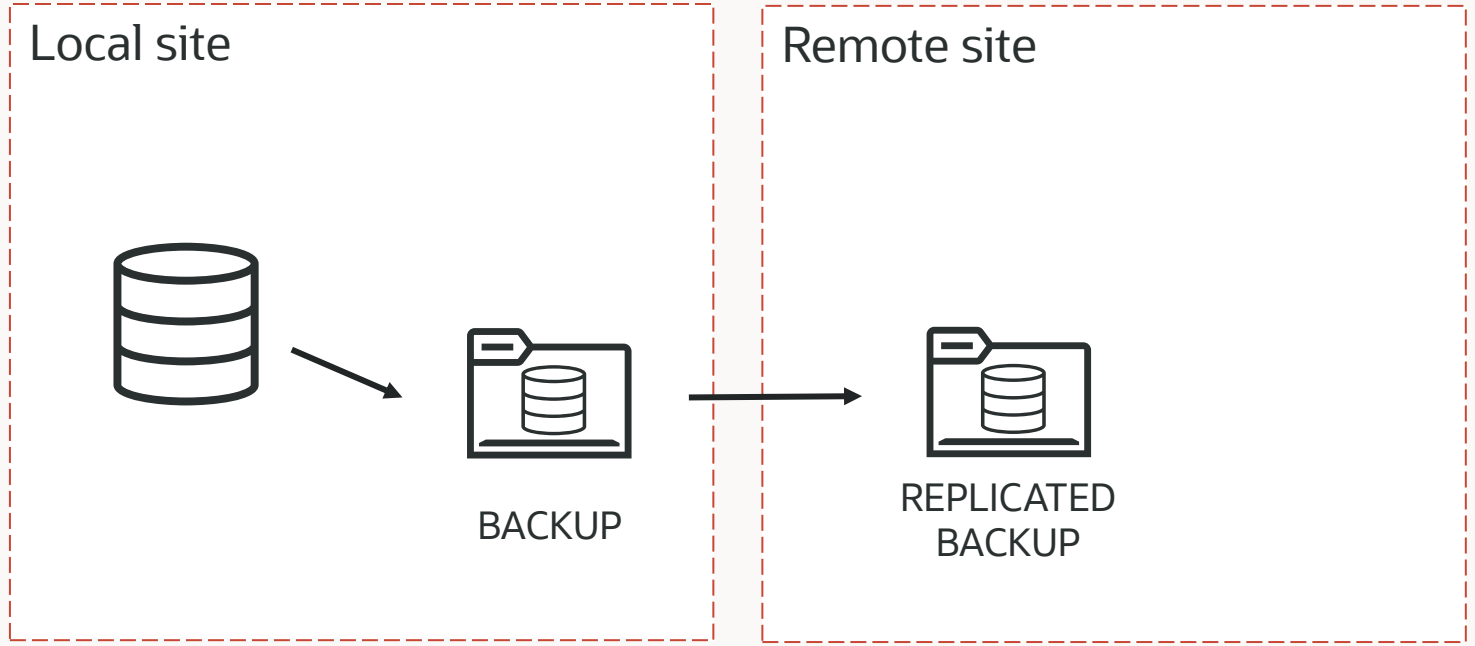
- PDB and CDB isolation
- Protection from noisy neighbors

FLASHBACK

- Protection from wrong transactions

RMAN

- Basic DB protection
- Protection from data loss



Bronze Outage Matrix

PLANNED MAINTENANCE	ZERO	MINS/HOURS
RECOVERABLE FAILURE	ZERO	MINS/HOURS
UNRECOVERABLE FAILURE	LAST BACKUP	HOURS /DAYS (1)
UPGRADE	ZERO	MINS/HOURS

BRONZE

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

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Protection from Recoverable Failures

Underlying Technologies

RAC

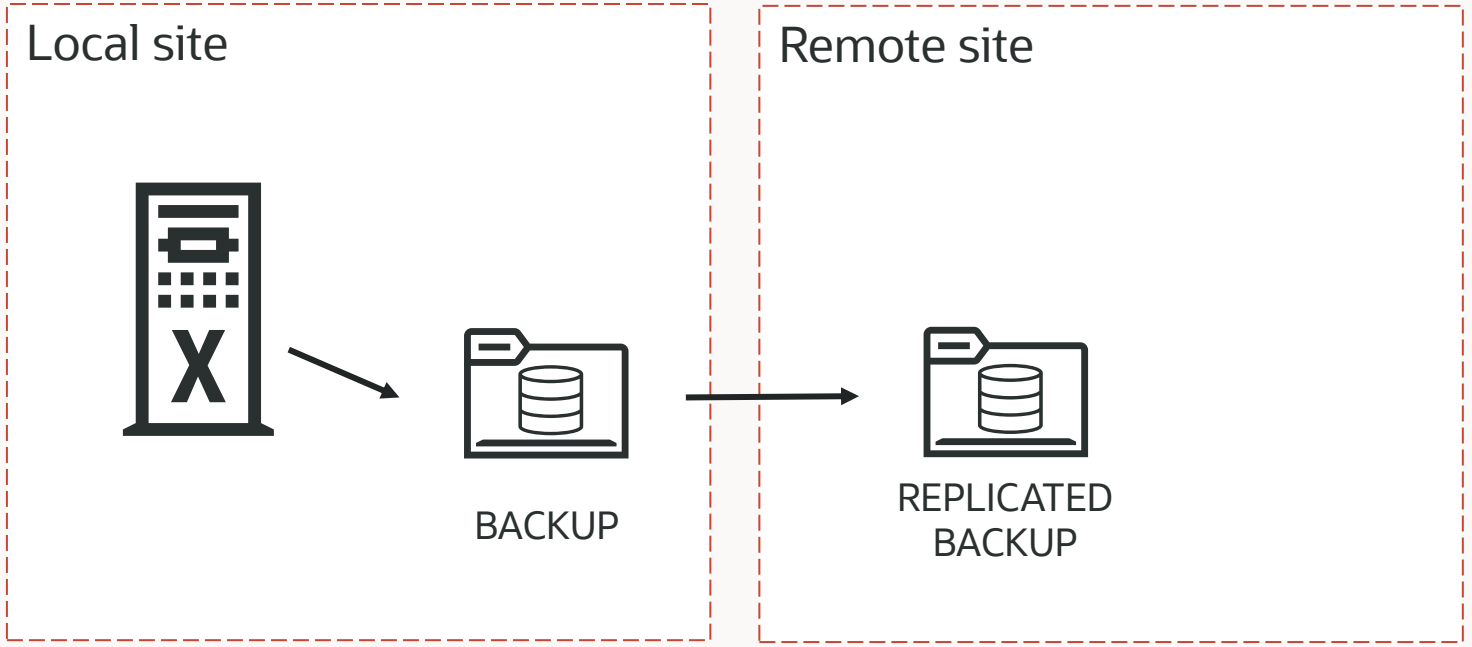
- Node failure protection
- Zero downtime software maintenance
- Elastic changes (CPU, mem, storage) with no downtime

APP CONTINUITY

- (Almost) Transparent unplanned maintenance

ENGINEERED SYSTEMS

- 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	SECS /MINS
UNRECOVERABLE FAILURE	LAST BACKUP	HOURS /DAYS(1)
UPGRADE	ZERO	MINS/HOURS

SILVER

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

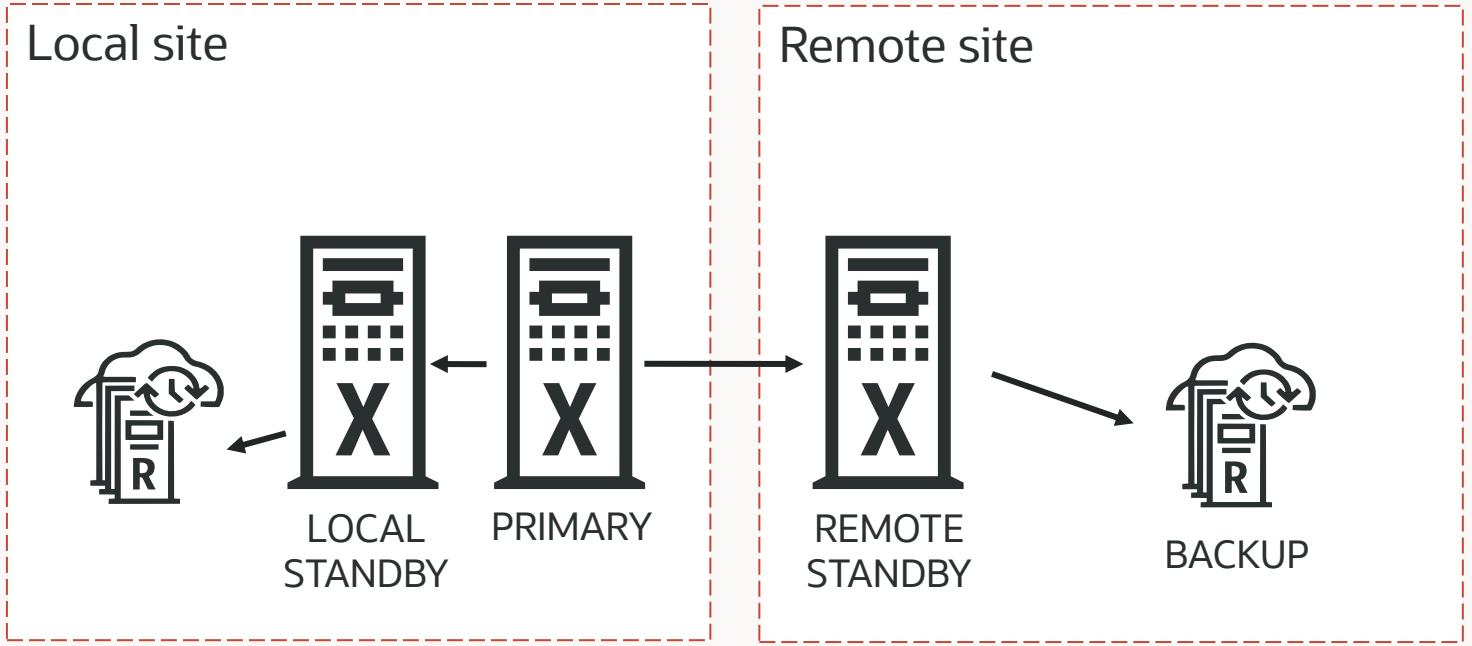
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Protection from Unrecoverable and Site Failures

Underlying Technologies

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	< 1 MIN
UNRECOVERABLE FAILURE	ZERO	< 5 MIN
UPGRADE	ZERO	< 30 Secs

GOLD

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Mission-Critical Availability – Option 1

New In 26ai

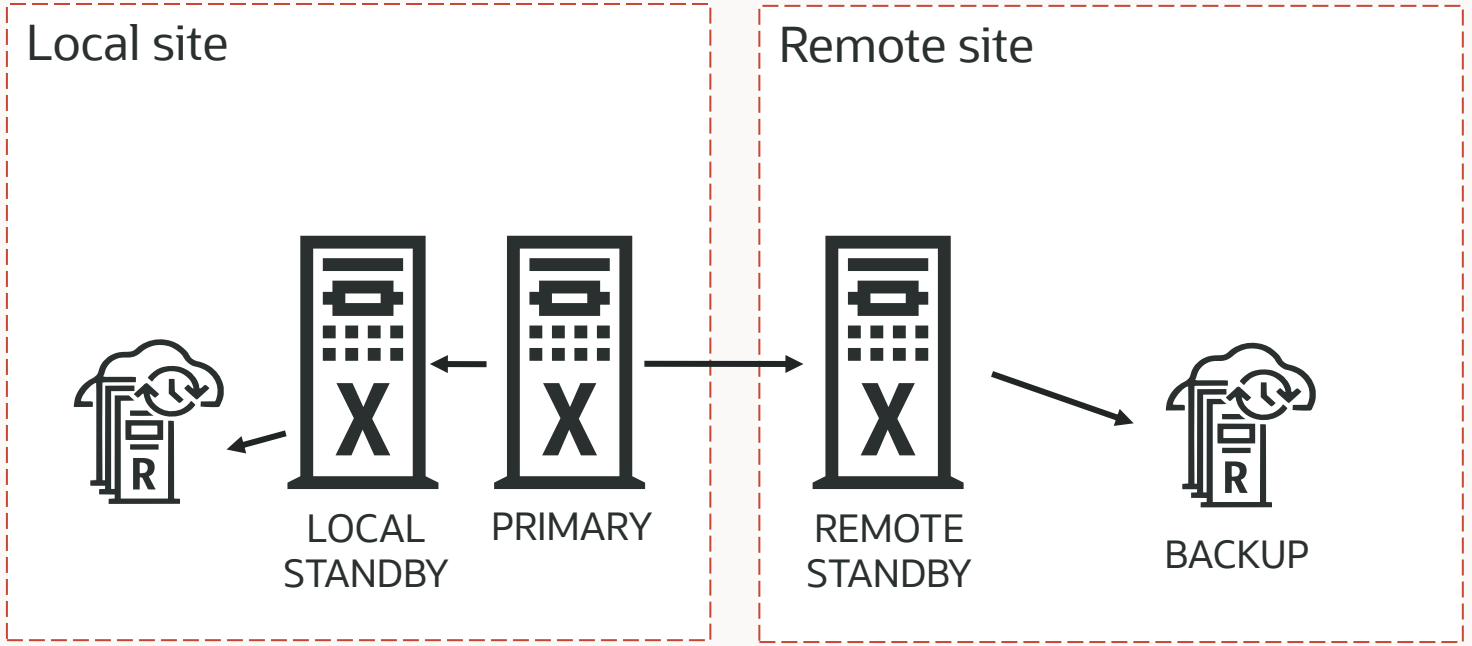
Underlying Technologies

ACTIVE DATA GUARD

- *Oracle AI Database 26ai on Exadata*
- Site failure protection with one or more (recommended) standby databases
- Comprehensive corruption prevention
- Rolling upgrades
- Offload work to standby with read-mostly scale-out

EDITION-BASED REDEFINITION

- Online application upgrades



Platinum Outage Matrix

PLANNED MAINTENANCE	ZERO	ZERO
RECOVERABLE FAILURE	ZERO	< 10 Secs
UNRECOVERABLE FAILURE	ZERO	< 30 Secs
UPGRADE	ZERO	< 30 Secs

PLATINUM

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Mission-Critical Availability – Option 2

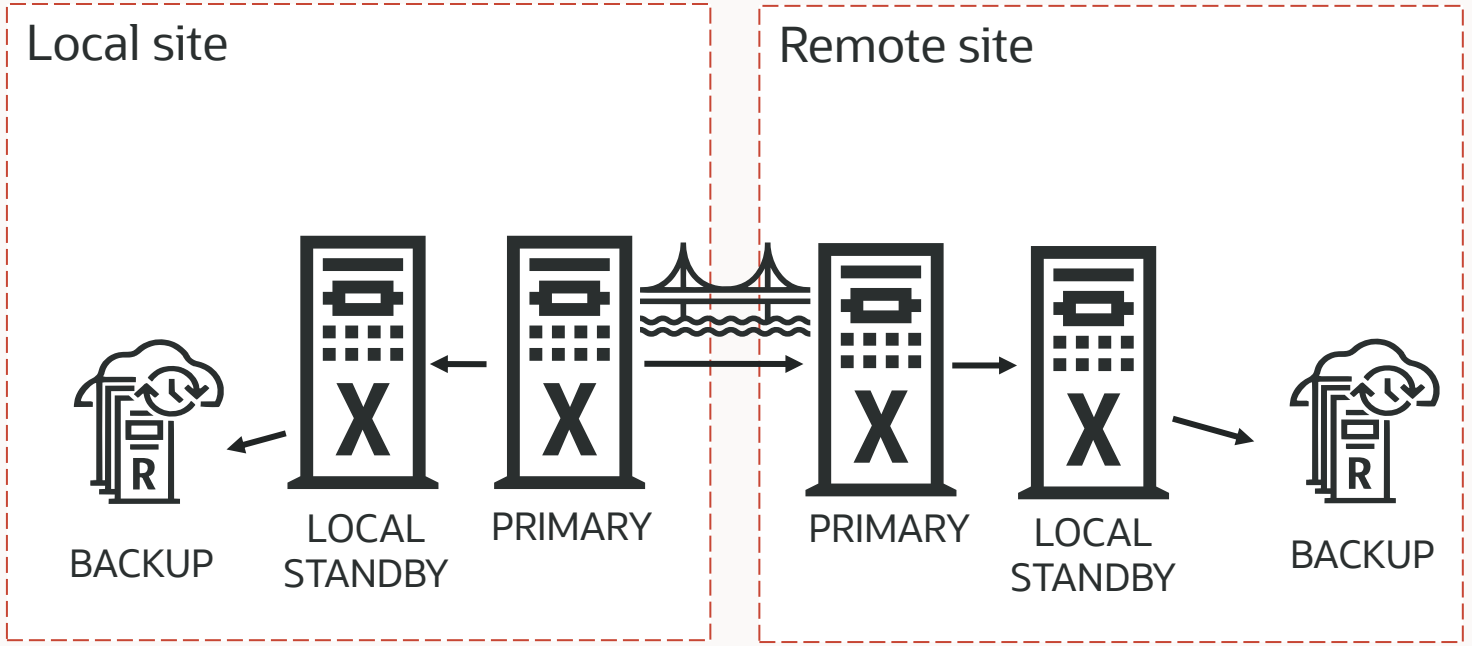
Underlying Technologies

GOLDENGATE

- 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)

EDITION-BASED REDEFINITION

- Online application upgrades



Platinum Outage Matrix

PLANNED MAINTENANCE	ZERO	ZERO
RECOVERABLE FAILURE	ZERO	< 10 secs
UNRECOVERABLE FAILURE	ZERO	< 10 secs
UPGRADE	ZERO	< 2 MIN

PLATINUM

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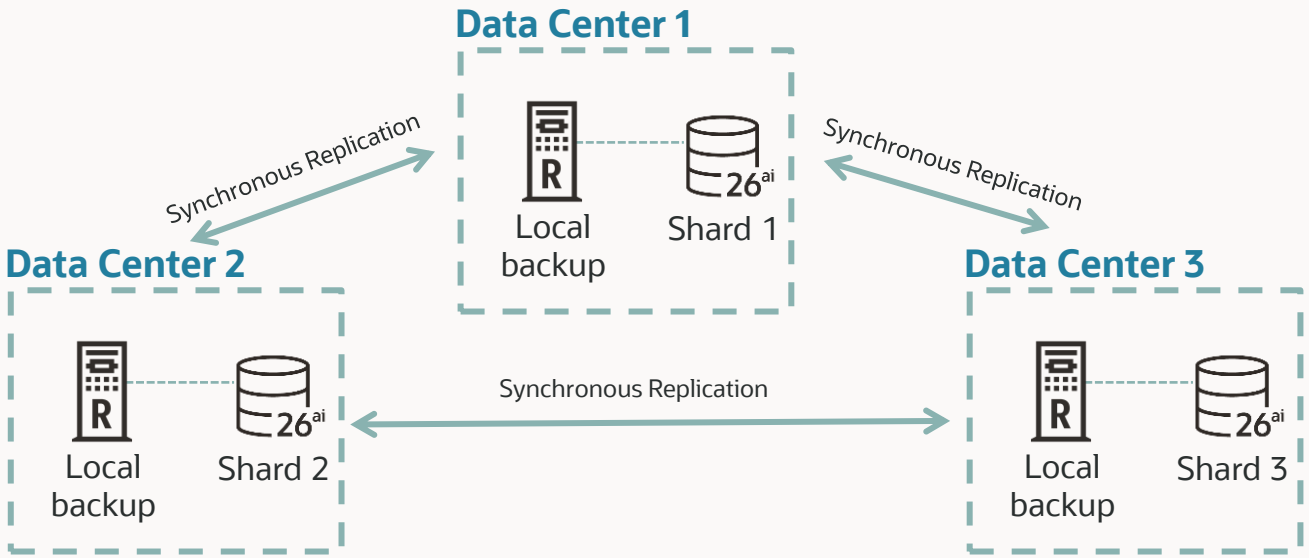
Extreme Availability – Option 1

Underlying Technologies

GDD

- Oracle Globally Distributed AI Database with Raft
  - For applications designed for distributed database architecture
  - Single logical database from an application and management perspective
  - Data is physically distributed across multiple databases in different locations, called shards
  - Data distribution is automatic and transparent to applications
  - Each shard is replicated to ensure survivability

Single Logical Globally Distributed AI Database with Raft Replication



Diamond Outage Matrix

PLANNED MAINTENANCE	ZERO	ZERO
RECOVERABLE FAILURE	ZERO	< 3 secs
UNRECOVERABLE FAILURE	ZERO	< 3 secs
UPGRADE	ZERO	ZERO

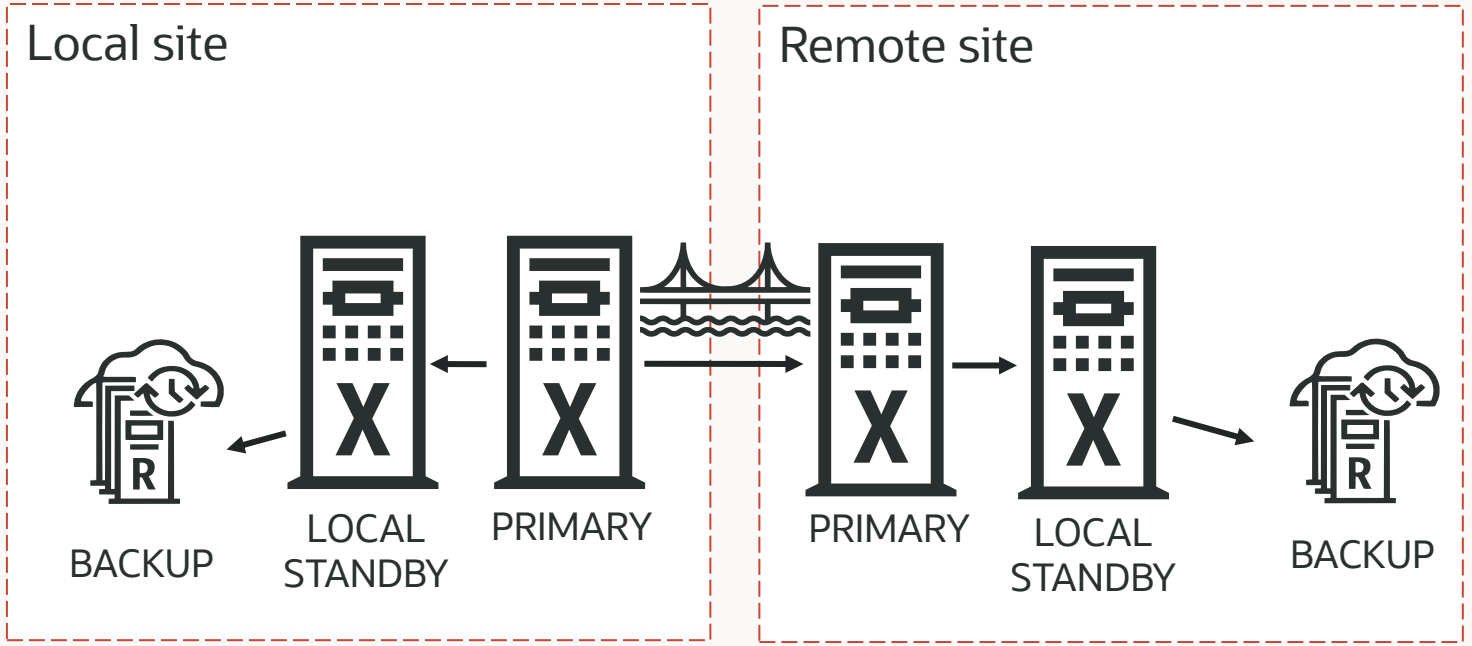
DIAMOND

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Extreme Availability – Option 2

Underlying Technologies

- Oracle GoldenGate 26ai (required)
- Oracle AI Database 26ai (required)
- Oracle Exadata
- 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)



Diamond Outage Matrix

PLANNED MAINTENANCE	ZERO ZERO
RECOVERABLE FAILURE	ZERO < 3 secs
UNRECOVERABLE FAILURE	ZERO < 3 secs
UPGRADE	ZERO ZERO

DIAMOND

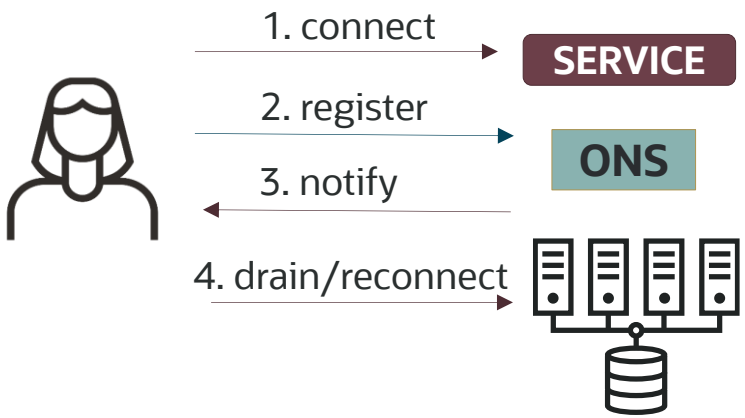
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Required Client-Side Technologies

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

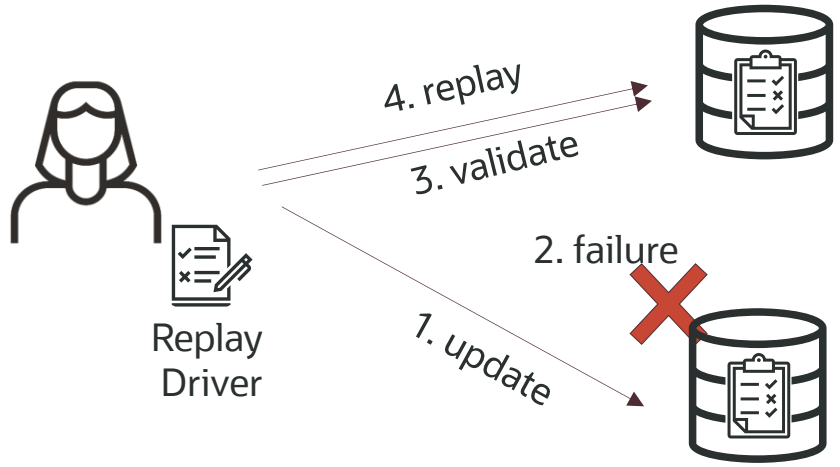
PLANNED MAINTENANCE

Fast Application Notification
(Session Draining)



UNEXPECTED FAILURES

Transparent Application Continuity [1]
(Transaction Replay)



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

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MAA Validated Solutions

MAA Tier	ExaDB-XS	ExaDB-D	ExaDB-C@C	ADB-S	ADB-D
	ExaDB-XS w/ Single Instance DB	ExaDB-D w/ Single Instance DB	ExaDB-C@C w/ Single Instance DB	NA	NA
	ExaDB-XS (Default)	ExaDB-D (Default)	ExaDB-C@C (Default)	ADB-S (Default)	ADB-D (Default)
	ExaDB-XS w/(A)DG	ExaDB-D w/(A)DG	ExaDB-C@C w/(A)DG	ADB-S w/AuDG	ADB-D w/AuDG
	Planned	ExaDB-D w/ADG 26ai or OGG	ExaDB-C@C w/ADG 26ai or OGG	Planned	ADB-D w/AuDG 26ai or OGG
	Planned	ExaDB-D w/ADG & OGG 26ai	Planned	Planned	Planned

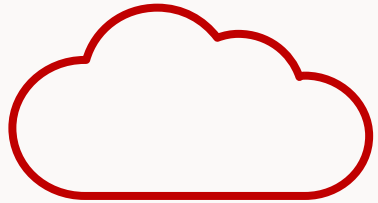
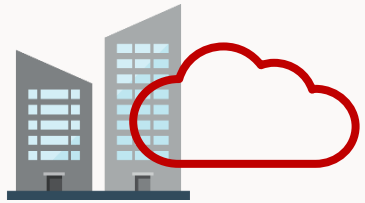
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Oracle Cloud Infrastructure Topology

Maximum Availability Architecture

MAA Best Practices Across Deployment Options

MAA Validations and Recommendations, MAA Anywhere and Everywhere

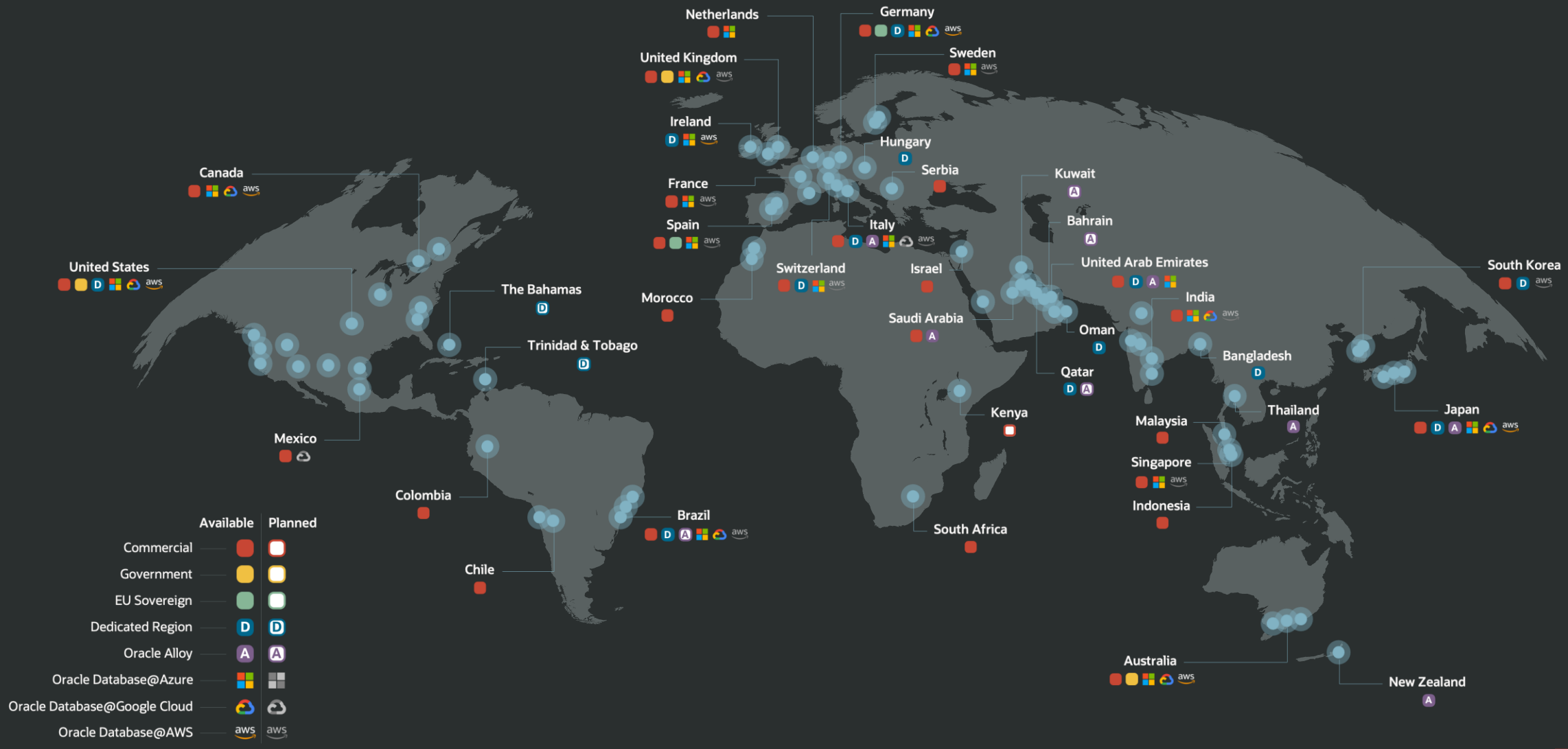
On-premises	Oracle Cloud	Hybrid Cloud	Multicloud
			
[MAA Best Practices - Oracle Database]	[MAA Best Practices for the Oracle Cloud]	[Hybrid Cloud and Multicloud Best Practices]	[MAA Best Practices for Oracle Database@Azure]
			
			[MAA Best Practices for Oracle Database@Google Cloud]
			
			[MAA Best Practices for Oracle Database@AWS]

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Oracle Cloud Infrastructure Global Footprint

200+ live and planned regions[1]

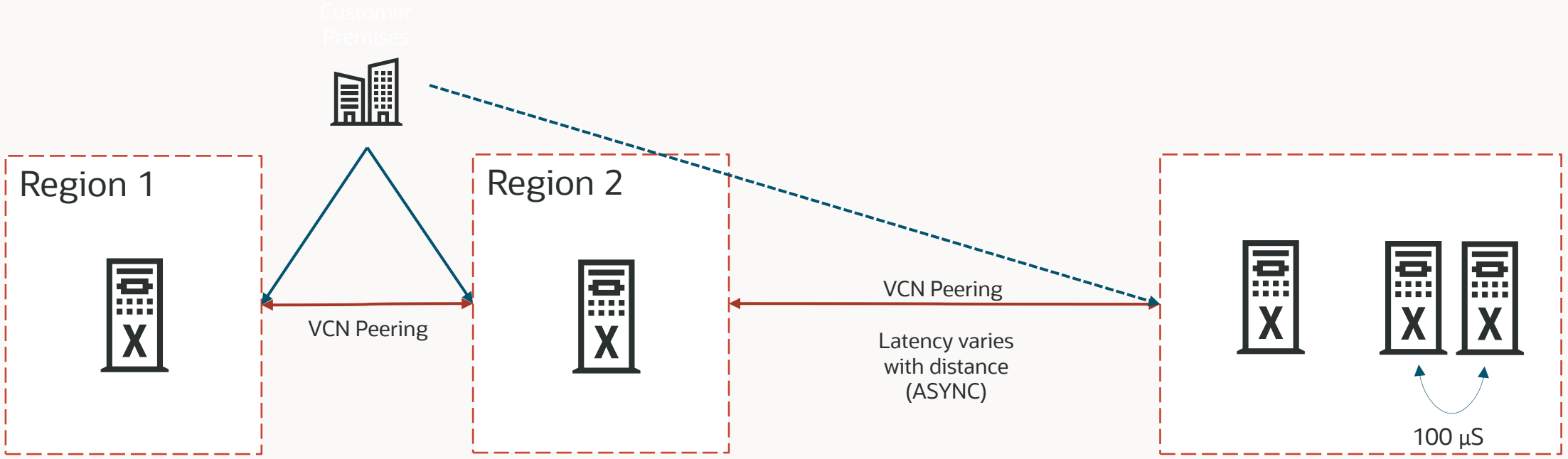
Updated February 25th, 2026



[1] Only publicly announced regions are shown on the map

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Oracle Cloud Infrastructure Topology

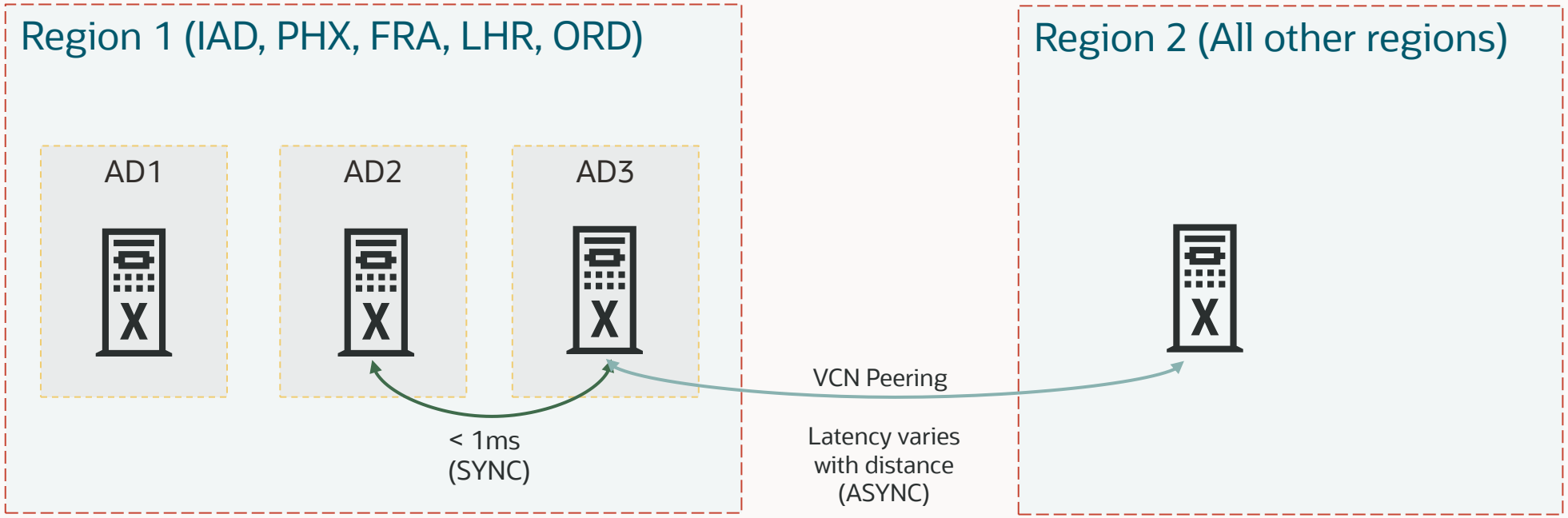


- Regions in the same country or area (e.g. Tokyo & Osaka)
  - Comparable latency from customer premises
  - Suitable for business continuity and disaster recovery
- Regions in different areas (e.g. cross-continent)
  - Suitable for disaster recovery or customer's global premises

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Oracle Cloud Infrastructure Topology

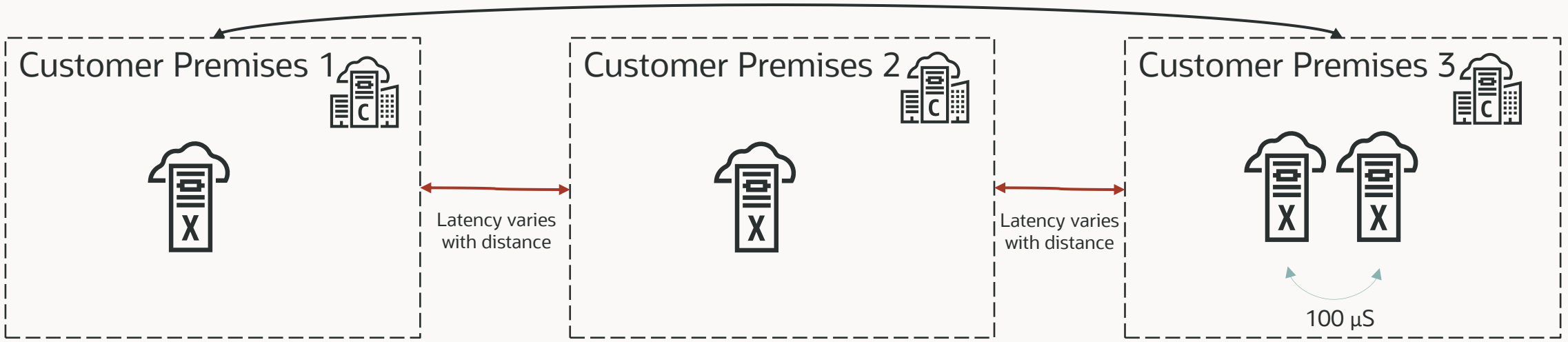
Ashburn, Phoenix, Frankfurt, London and Chicago



- Availability Domains
  - Independent data centers, low latency, allows SYNC Data Guard replication
- Regions
  - Geographical separation

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Oracle Cloud Infrastructure Dedicated Region



Data sovereignty

Regulation, and data privacy requirements

Sensitive/IP data can't leave premises

Security and control

Physical security of infrastructure and data

Single tenant, self-contained environment

Latency

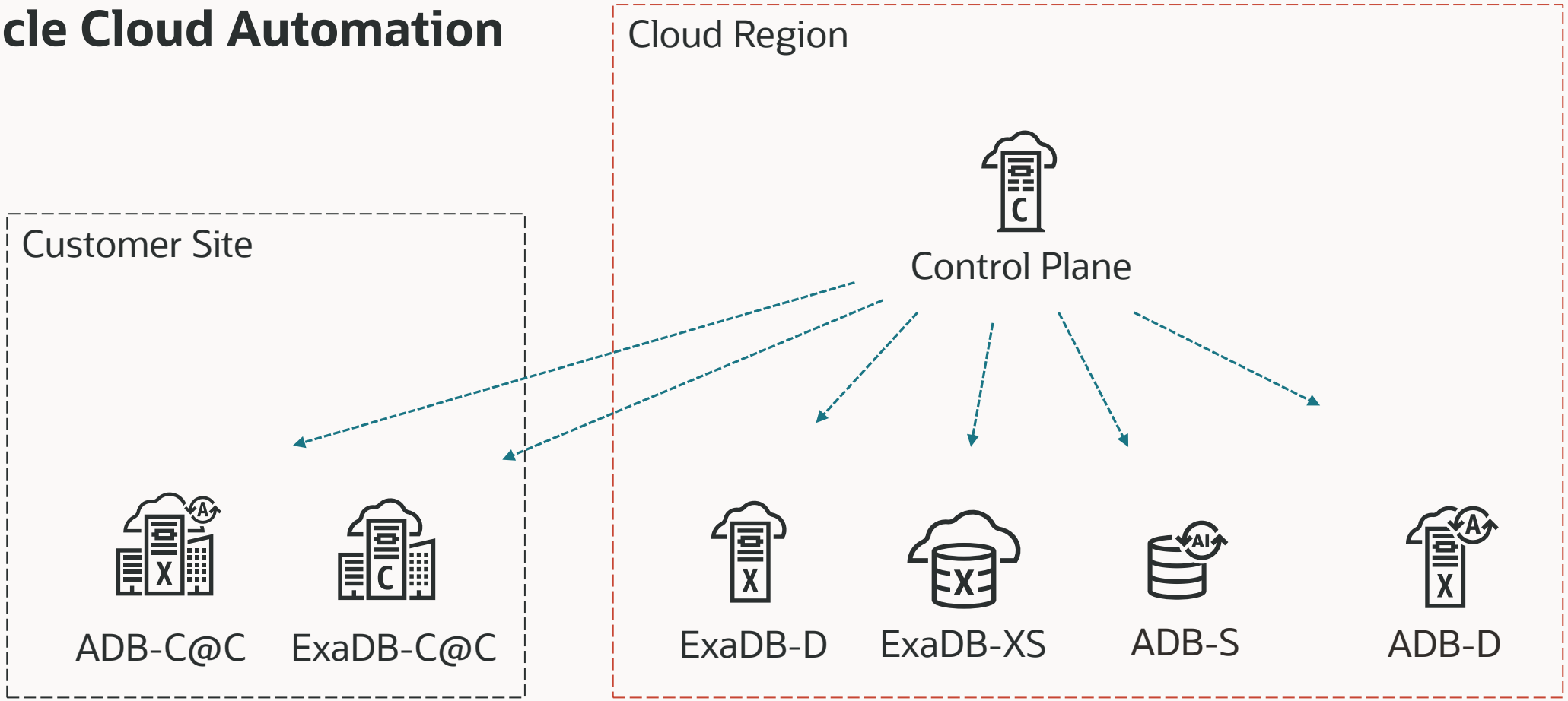
Stringent latency requirements for high volume applications

Legacy applications tied to on-premises operational systems

Same Architecture
Same Billings
Same Operations
Same Security
Same Cloud Services
Same SLAs

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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.

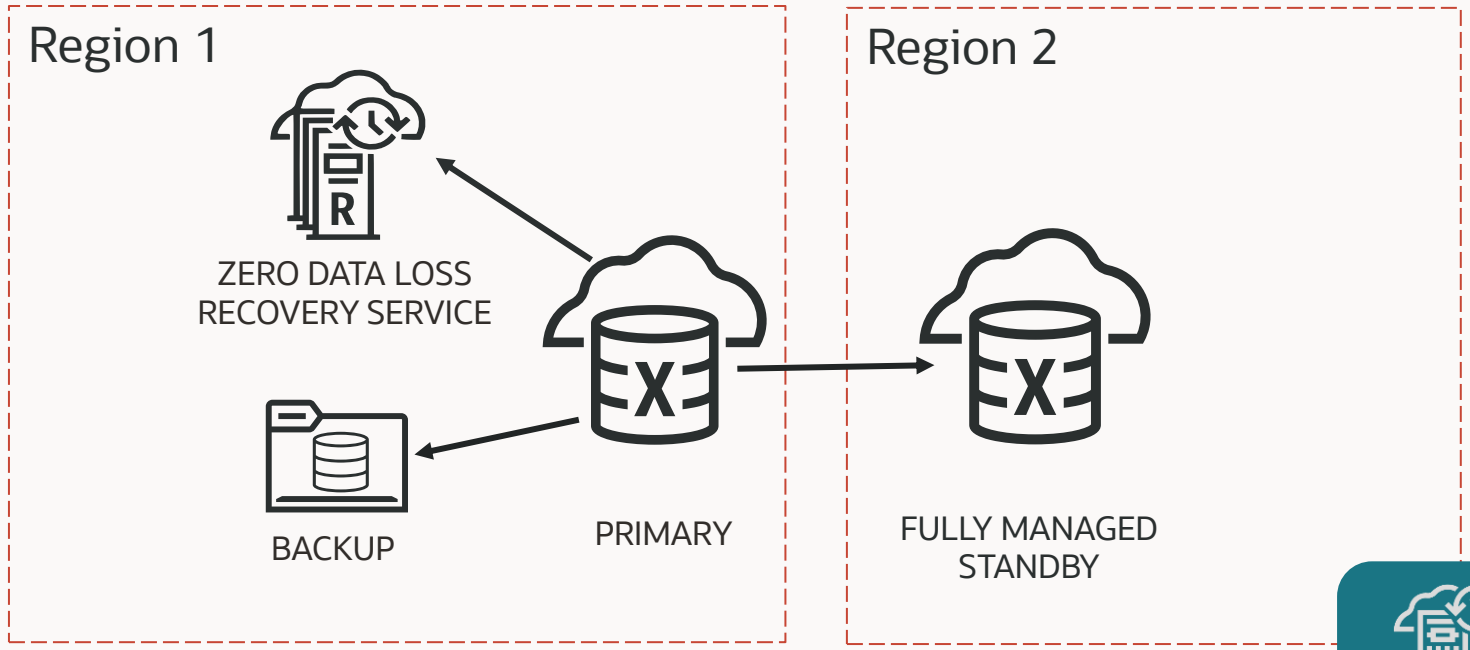
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Oracle Exadata Database Service on Exascale Infrastructure (ExaDB-XS)

Maximum Availability Architecture

Exadata Database Service on Exascale: Protection Out of the Box

AVAILABILITY / AUTOMATION *	
ZRCV	Recovery Service (default) or via automated OCI backups or Dbaascli
RAC	Exadata inherent HA, QoS, and Performance benefits plus *Exadata Fleet Update* for gold image patching
ACTIVE DATA GUARD	Fully automated, customization via console or DBaaS API (Data Guard standby with automatic failover; customizable up to 6 standby databases)
GOLDENGATE	Manual (Capture & Delivery)
MAA LEVEL	SILVER ExaDB-XS + GOLD Data Guard



EXADATA FLEET UPDATE

Integrated Gold MAA Outage Matrix

PLANNED MAINTENANCE	ZERO	Zero
RECOVERABLE FAILURE	ZERO	< 1 min
UNRECOVERABLE FAILURE	ZERO	< 5 min
UPGRADE	ZERO	< 2 MIN

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

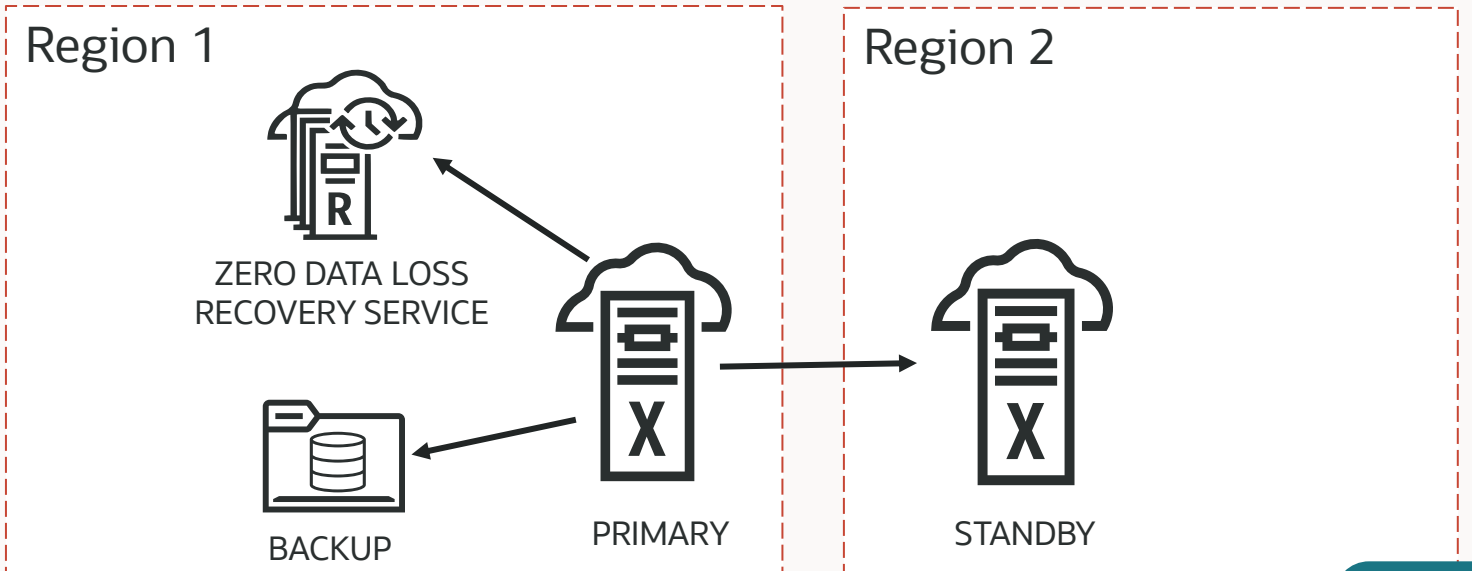
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Oracle Exadata Database Service on Dedicated Infrastructure (ExaDB-D)

Maximum Availability Architecture

Exadata Database Service: Protection Out of the Box

AVAILABILITY / AUTOMATION *	
ZRCV	Recovery Service (default) or via automated OCI backups or Dbaascli
RAC	Exadata inherent HA, QoS, and Performance benefits plus *Exadata Fleet Update* for gold image patching
ACTIVE DATA GUARD	Via console or DBaaS API (Up to 6 Standby DBs in ExaDB-D, cross-region possible, DBMS_ROLLING with cloud API, Snapshot Standby support)
GOLDENGATE	Manual (Capture & Delivery)
MAA LEVEL	SILVER ExaDB-D · GOLD Data Guard · PLATINUM Oracle AI DB · DIAMOND GoldenGate



Integrated Platinum MAA Outage Matrix

PLANNED MAINTENANCE	ZERO	Zero
RECOVERABLE FAILURE	ZERO	< 10 secs
UNRECOVERABLE FAILURE	ZERO	< 30 secs
UPGRADE	ZERO	< 2 MIN

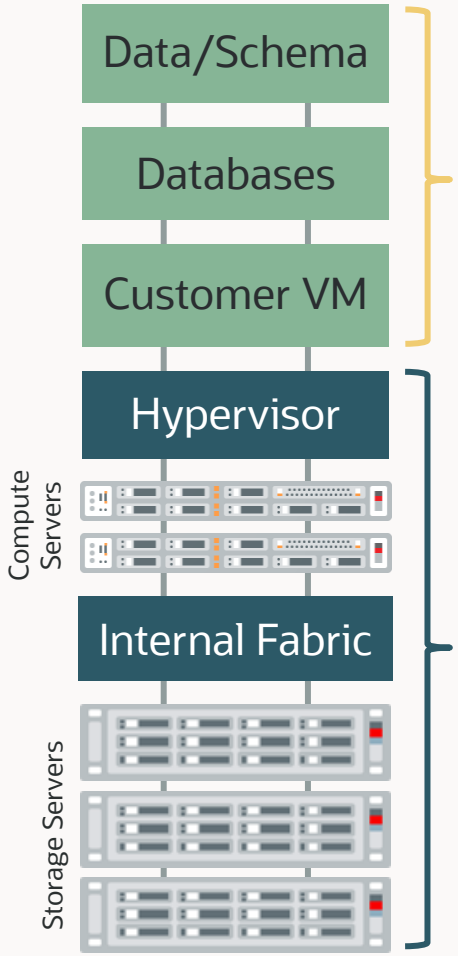
(1) No FSFO, based on time after customer action

EXADATA FLEET UPDATE

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

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Exadata Database Service: Responsibility Overview



Customer owns everything inside database

- Data, schema, encryption keys

Customer subscribes to database services

- Customer manages VMs, GI, and Databases using cloud automation (UI / APIs)
- Automation to create, delete, patch, backup, scale up/down, etc.
- Runs all supported Oracle AI Database versions from 11.2.0.4 to 26ai
- Customer controls access to customer VM

Oracle owns and manages infrastructure

- Database servers/VM hosts, storage servers, fabric network
- Patching, security scans, security updates
- Monitoring and maintenance

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Exadata Database Service: Oracle Managed Backups

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

SCHEDULING	• Done by control plane. Ability to change backup time for full and incremental backups, and the day for full backups • Automatic archivelog backup-every 30 minutes, the frequency can be changed via dbaascli
DESTINATION	• Default is Database Autonomous Recovery Service with optional real-time redo transport for near-zero RPO • ExaDB-D managed backup storage, no direct control by the customer • Long term backup retention is available
REPLICAS	• Backups are highly redundant and can survive a complete storage outage
CREDENTIALS	• Managed by the control plane • Automatic password rotation done by control plane
WALLET	• TDE wallet backed up automatically, but not its password or the autologin Wallet
RESTORE	• Restore CDB and PDB capabilities. • Restore on the same host or a different host within the same or cross-region. • Restore the database using the same or different ORACLE_HOME, via the control plane
FAILOVER	• Backup runs independently and can tolerate node or storage failures
STANDBY	• Backup and restore from the standby are possible (no primary restore from standby backup)

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Exadata Database Service: User-Configured Backups

RMAN backup via dbaascli

SCHEDULING	• No Control Plane (Cloud Console) backup scheduling • Scheduled by customer provided scheduler (DTRS) • Automatic archivelog backup every 30 minutes by default • Ability to change default backup time and L0 backup day
DESTINATION	• Customer-created bucket (fully controlled by the customer, including replication) • No support for archive storage
REPLICAS	• Option to set up cross-region backup replication
CREDENTIALS	• Customer responsible for password rotation
WALLET	• TDE wallet backed up, but not its password or the autologin wallet
RESTORE	• Restore CDB and PDB capabilities
FAILOVER	• Backup runs independently and can tolerate node or storage failures
STANDBY	• Backup and restore from the standby are possible using the object storage as the destination • Snapshot standby support

Not recommended

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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)
  - Ensure recovery window (backup retention period) settings meet SLAs
  - 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

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Exadata Database Service: Real Application Clusters



- Out-of-place update is built-in with the 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/26/haovw/configuring-continuous-availability-applications1.html
- RAC uses 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

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Exadata Database Service: RAC Best Practices



- Create databases only through the cloud control plane or dbaascli 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:
  - https://docs.oracle.com/en/database/oracle/oracle-database/26/haovw/configuring-continuous-availability-applications1.html
- 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

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MULTITENANT

Exadata Database Service: Multitenant via Control Plane

SETUP	• PDB creation or deletion from the cloud console • List PDBs by database • Retrieve PDB connection strings
CLONING	• Create clones or refreshable clones within the same CDB or across CDBs • Thin Cloning for Oracle AI Database 26ai on ExaDB-D *using Exascale* • Data Guard supported for PDB cloning operations
PROTECTION	• PDB creation synced to Data Guard Standby • PDB backup/restore from same CDB. PDB restore to another CDB for BaseDB, ExaDB-XS and ExaDB-D
ADMINISTRATION	• Start and Stop the PDBs from the console on Primary or Standby (ADG)
CONTROL PLANE SYNC	• The PDBs created or dropped out-of-band via dbaascli or SQL are synched periodically

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Exadata Database Service: Multitenant Best Practices

MULTITENANT

- Create pluggable databases only through the cloud control plane or cloud APIs
  - MAA best practices incorporated
  - 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
- 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://docs.oracle.com/en/database/oracle/oracle-database/19/haovw/pdb-switchover-and-failover-multitenant-configuration.html#GUID-92498CB8-C6D1-4DC6-9FD0-3F5B5381C280

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Exadata Database Service: Data Guard via Control Plane

ACTIVE DATA GUARD

SETUP	• 1-click setup from the control plane • Uses Data Guard broker and MAA best practices • Uses optimized Data Guard instantiation with retries and resume capabilities
TOPOLOGY	• Supports Data Guard in the same rack for testing, in the same region, across ADs or across regions • Supports ExaDB-D to ExaDB-D, ExaDB-D to ExaDB-XS (or vice versa), or ExaDB-C@C to ExaDB-C@C
PROTECTION	• Asynchronous configuration by default (protection mode: Maximum Performance) • Synchronous configuration (protection mode: Maximum Availability) • 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 • Multiple standby databases (up to 6) are supported via the console
ROLE CHANGES	• Supports failover and switchover operations • Out-of-band role transition is not recommended except for FSFO. DB role status will be resynchronized in minutes
OPEN MODE	• Choose Active Data Guard (open read-only) for additional data protection and read-only benefits. Alternatively, choose Data Guard (mounted standby); Snapshot Standby available for ExaDB-D/XS/C@C/BaseDB-C@C
PATCHING & UPGRADE	• Control plane patching and offline database upgrade is available. Standby-first patching is available • Exadata Cloud Database 19c Rolling Upgrade With DBMS_ROLLING (Doc ID 2832235.1)

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Exadata Database Service: Manual Data Guard Setup

ACTIVE DATA GUARD

SETUP	• Data Guard instantiation and setup are done by the customer • Create Cloud Database and then manually instantiate standby database using standard MAA Data Guard best practices
TOPOLOGY	• Multiple standby databases (beyond 6), Far Sync, and cascade standby • Hybrid Data Guard configurations • These Data Guard topologies are not recognized in the control plane
PROTECTION	• All data protection modes are possible • Setup fast-start failover and incorporate MAA best practices manually
ROLE CHANGES	• Recommend using DG broker or Enterprise Manager. • Automatic when Data Guard fast-start failover is setup
OPEN MODE	• Managed by the customer
PATCHING & UPGRADE	• Some cloud automation still possible if database is recognized as a cloud database. Redo Apply must be stopped manually. • Customers can manually use standby-first update strategy and DBMS_ROLLING for rolling upgrades

- Not recommended unless for hybrid Data Guard use cases
- Please note that Multitenant PDB operations are not available when Data Guard is configured manually outside of tooling

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Exadata Database Service: Data Guard Best Practices

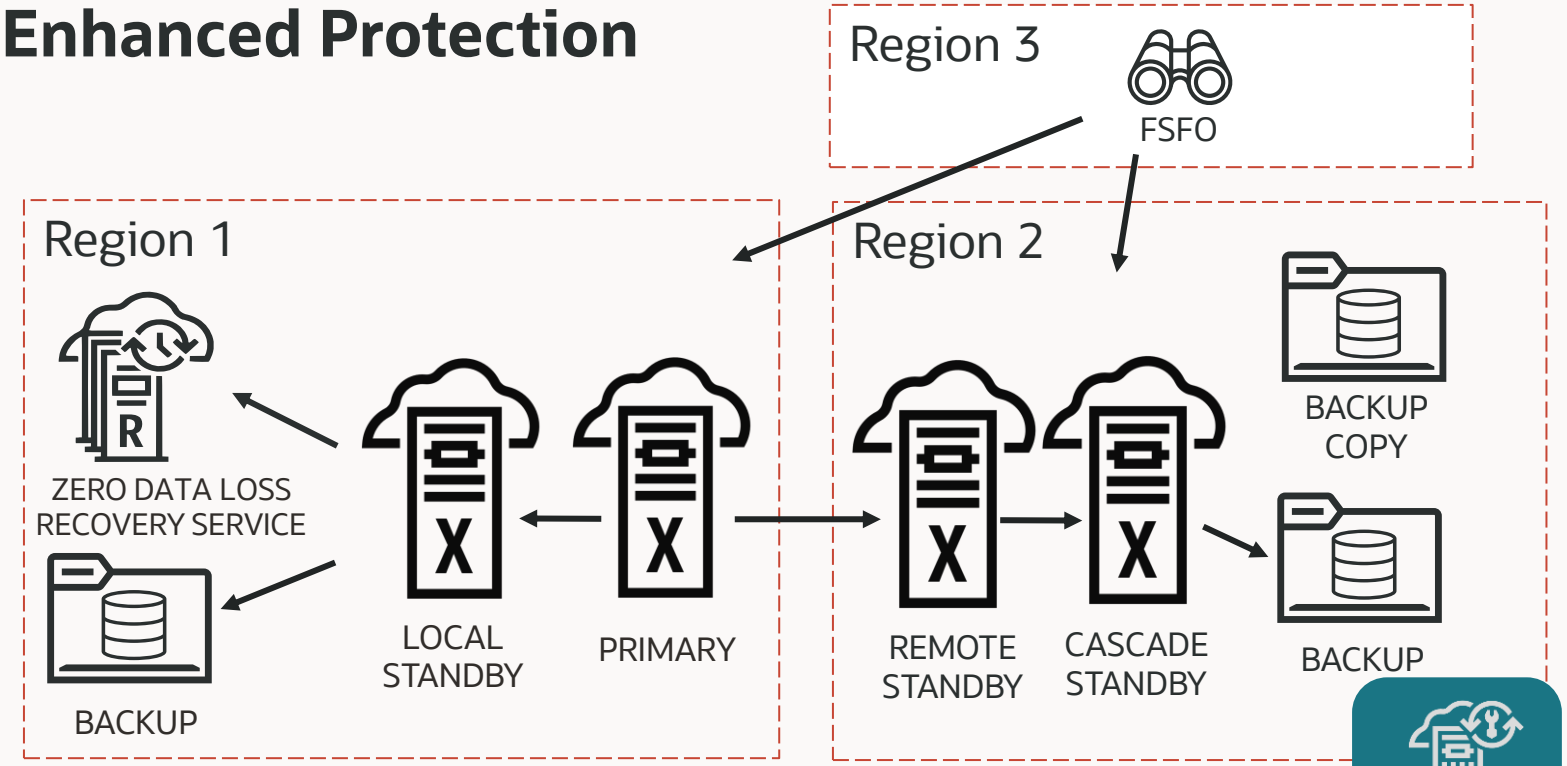


- **Topology**
  - Pick Data Guard topology and protection mode based on SLAs and use cases
  - Use symmetric primary and standby to preserve performance post-role transitions
  - Use VCN connectivity (private network connectivity between primary and standby, rather than the public internet) between 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 Data Guard Broker VALIDATE commands at least monthly

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Exadata Database Service: Enhanced Protection

AVAILABILITY / AUTOMATION *	
RMAN	Multiple backup copies Backup from the standby
RAC	Exadata inherent HA, QoS, and Performance benefits plus *Exadata Fleet Update* for gold image patching
ACTIVE DATA GUARD	Multiple standbys (up to 6 via console) Fast-start Failover (manual); Snapshot Standby support
GOLDENGATE	MAA GoldenGate Hub (capture & delivery) Global Data Services
MAA LEVEL	SILVER ExaDB-D · GOLD Data Guard · PLATINUM Oracle AI DB · DIAMOND GoldenGate



Integrated Platinum MAA Outage Matrix

PLANNED MAINTENANCE	ZERO	Zero
RECOVERABLE FAILURE	ZERO	< 10 secs
UNRECOVERABLE FAILURE	ZERO	< 30 secs
UPGRADE	ZERO	< 2 MIN

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

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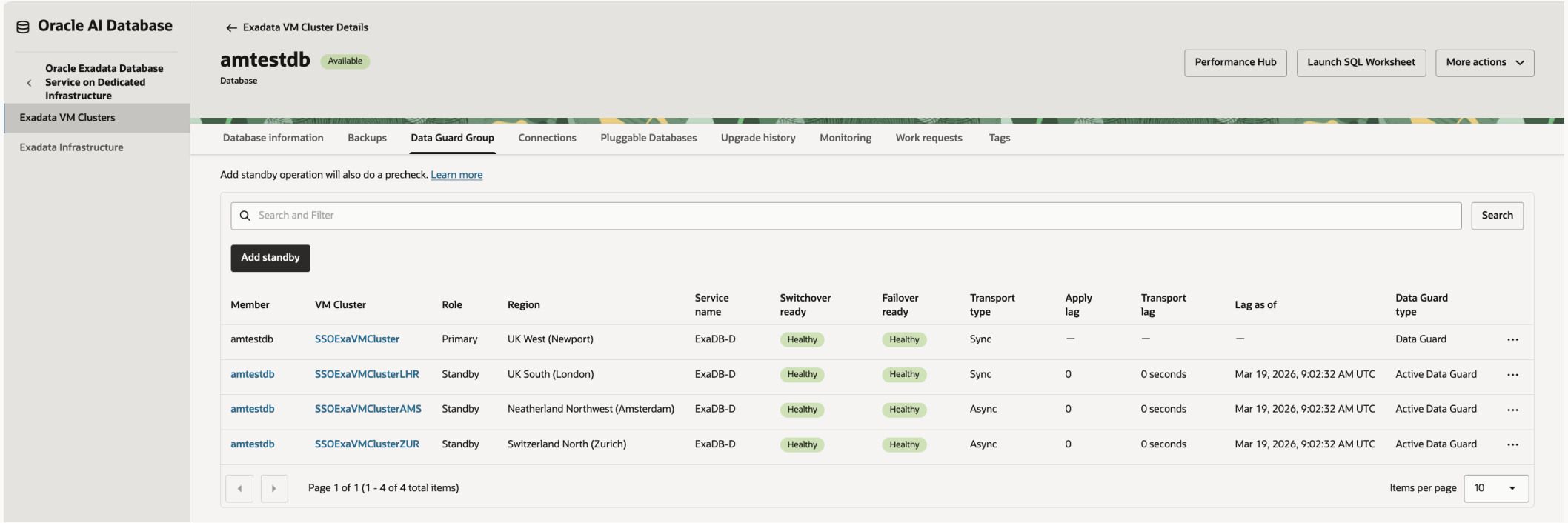
Multiple Standby Databases in Exadata Database Service

Up to 6 standby databases can now be managed by the OCI control plane

ACTIVE DATA GUARD

By taking advantage of multiple standbys in different regions, applications can immediately benefit from improved data protection, increased flexibility and scalability, and better ROI

Using the new Data Guard Group feature, multiple standby databases can be easily deployed and managed via the OCI console feature



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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 Database Cloud https://docs.oracle.com/en/database/oracle/oracle-database/26/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/exabackingup.htm
- GoldenGate and Platinum MAA for Cloud
- MAA Platinum and Oracle GoldenGate Best Practices

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Exadata Database Service: Read More

- (ODyS) Oracle Dynamic Scaling engine - Scale-up and Scale-down automation utility for OCI DB System (ExaCS/ExaC@C) (KM ID 2719916) https://support.oracle.com/support/?anchorId=&kmContentId=2719916
- How to configure OCI-CLI with Instance/Resource Principals (KM ID 2763990) https://support.oracle.com/support/?anchorId=&kmContentId=2763990
- 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/26/haovw/oracle-data-guard-hybrid-cloud-configuration1.html
- (OCI) mv2bucket - Oracle Managed Bucket Content Manager (KM ID 2723911) https://support.oracle.com/support/?anchorId=&kmContentId=2723911

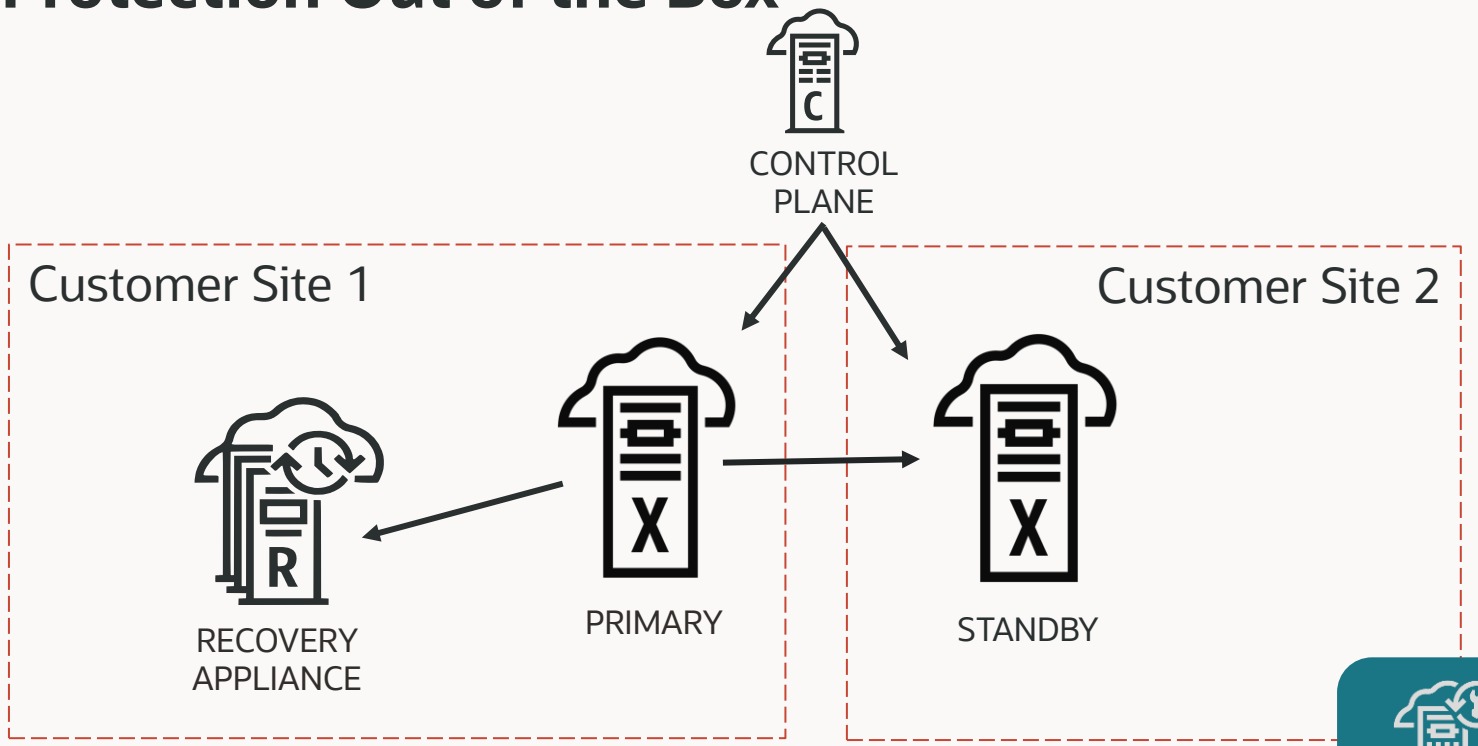
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Oracle Exadata Database Service on Cloud@Customer (ExaDB-C@C)

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 *Exadata Fleet Update* for gold image patching
ACTIVE DATA GUARD	Via console or DBaaS API (Up to 6 Standby DBs, DBMS_ROLLING with cloud APIs only, Snapshot Standby support)
GOLDENGATE	Manual (Capture & Delivery)
MAA LEVEL	SILVER ExaDB-C@C · GOLD Data Guard · PLATINUM Oracle AI DB · DIAMOND GoldenGate



Integrated Platinum MAA Outage Matrix

PLANNED MAINTENANCE	ZERO	Zero
RECOVERABLE FAILURE	ZERO	< 10 secs
UNRECOVERABLE FAILURE	ZERO	< 30 secs
UPGRADE	ZERO	< 2 MIN

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

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

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Exadata Cloud@Customer: Oracle Managed Backups

1-click configuration Automatic RMAN backup

RMAN

SCHEDULING	• Set up as cron job • Automatic 30 minutes archivelog backup via cron job
DESTINATION	• To NFS or ZDLRA • To OCI Object Storage (OSS) or an Oracle-managed bucket
REPLICAS	• 3-way mirrored backup for OCI Object Storage (OSS) - no replication • Customer-defined for NFS and ZDLRA
CREDENTIALS	• Object storage: managed by the control plane • ZDLRA and NFS: Managed by the customer
WALLET	• TDE wallet backed up automatically, but not its password (cloud object storage only) • No requirement for wallet backup if using Oracle Key Vault
RESTORE	• Database restore (from backup, to point-in-time or full) options • Restore PDB capabilities via dbaascli commands
FAILOVER	• Backup initiated on a specific node. It does not run if that node is down.
STANDBY	• Standby Databases can be backed up to NFS or ZDLRA or Object Storage

Please note that manual backups are not recommended and are incompatible with Oracle Managed backup.

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Exadata Cloud@Customer: RMAN Best Practices

RMAN

- 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
- Manual backup is not recommended

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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:
    - Achieving Continuous Availability For Your Applications
      - https://docs.oracle.com/en/database/oracle/oracle-database/26/haovw/oracle-maximum-availability-architecture-oracle-exadata-cloud-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)

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Exadata Cloud@Customer: Multitenant via Control Plane

MULTITENANT

SETUP	• PDB creation or deletion from the cloud console • List PDBs by database • Retrieve PDB connection strings
CLONING	• Create clones within the same CDB or across CDBs within the same AD • Thin Cloning for Oracle AI Database 26ai on ExaDB-C@C *using Exascale*
PROTECTION	• PDB creation synced to Data Guard Standby • Starting with 19c, PDB relocate and relocate + upgrade
ADMINISTRATION	• Start and Stop the PDBs from the console on Primary or Standby (ADG)
CONTROL PLANE SYNC	• The PDBs created or dropped out-of-band via dbaascli or SQL are synched periodically

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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 (KM ID 2809448)

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Exadata Cloud@Customer: Data Guard via Control Plane

ACTIVE DATA GUARD

SETUP	• 1-click setup from the control plane • Uses Data Guard Broker and MAA best practices • Uses optimized Data Guard instantiation
TOPOLOGY	• Supports Data Guard in the same rack for testing, same region, across ADs, or across regions • Multiple standby databases supported (up to 6 via console) • Supports ExaDB-C@C to ExaDB-C@C
PROTECTION	• Asynchronous configuration by default (protection mode: Maximum Performance) • Synchronous configuration (protection mode: Maximum Availability) • Data Guard fast-start failover is a manual setup
ROLE CHANGES	• Supports failover and switchover operations • Out-of-band role transition is not recommended except for FSFO or multiple standby. DB role status will be resynchronized in minutes
OPEN MODE	• Choose Active Data Guard (open read-only) for additional data protection and read-only benefits. Alternatively choose Data Guard (mounted standby)
PATCHING & UPGRADE	• Control plane patching and offline database upgrade is available • Exadata Cloud Database 19c Rolling Upgrade With DBMS_ROLLING

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Exadata Cloud@Customer: Manual Data Guard Setup

ACTIVE DATA GUARD

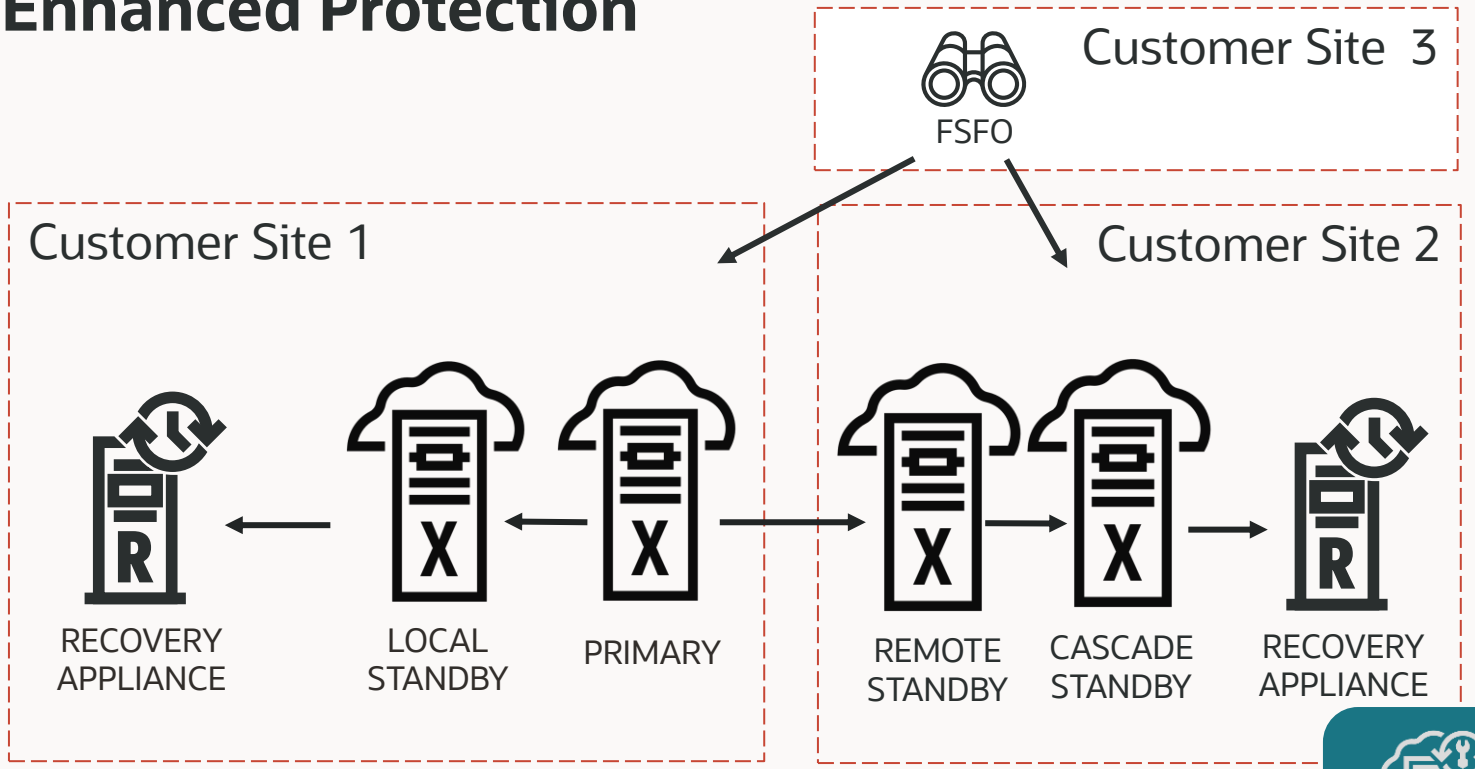
SETUP	• Data Guard instantiation and setup are done by the customer • Create Cloud Database and then manually instantiate a standby database using standard MAA Data Guard best practices
TOPOLOGY	• Multiple standby databases (up to 6 via console) without manual setup, but Far Sync and cascade standby are manual • Hybrid Data Guard and manual configurations are not recognized in the control plane
PROTECTION	• All data protection modes are possible • Setup fast-start failover and incorporate MAA best practices manually
ROLE CHANGES	• Recommend using the Data Guard broker or Enterprise Manager. • Automatic when Data Guard fast-start failover is set up
OPEN MODE	• Managed by the customer
PATCHING & UPGRADE	• Some cloud automation still possible if database is recognized as a cloud database. Redo Apply must be stopped manually. • Customers can manually use standby-first update strategy and DBMS_ROLLING for rolling upgrades

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

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Exadata Cloud@Customer: Enhanced Protection

AVAILABILITY / AUTOMATION *	
RMAN	Backup from the primary and/or standby. Offload backups to the standby.
RAC	Exadata inherent HA, QoS, and Performance benefits plus *Exadata Fleet Update* for gold image patching
ACTIVE DATA GUARD	Multiple standbys (up to 6 via console) Fast-start failover (manual), Snapshot Standby support
GOLDENGATE	Manual (capture & delivery) Global Data Services
MAA LEVEL	SILVER ExaDB-C@C · GOLD Data Guard · PLATINUM Oracle AI DB · DIAMOND GoldenGate



Integrated Platinum MAA Outage Matrix

PLANNED MAINTENANCE	ZERO	Zero
RECOVERABLE FAILURE	ZERO	< 10 secs
UNRECOVERABLE FAILURE	ZERO	< 30 secs
UPGRADE	ZERO	< 2 MIN

EXADATA FLEET UPDATE

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

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Exadata Cloud@Customer MAA: Read More

- Oracle Maximum Availability Architecture in Exadata Cloud Database Systems
  - https://docs.oracle.com/en/database/oracle/oracle-database/26/haovw/oracle-maximum-availability-architecture-oracle-exadata-cloud-systems.html
- Using Oracle Data Guard with Exadata Database Cloud at Customer
  - https://docs.oracle.com/en-us/iaas/exadata/doc/eccusingdataguard.html
- GoldenGate and Platinum/Diamond MAA for Cloud best practices
  - https://docs.oracle.com/en/database/oracle/oracle-database/26/haovw/maa-platinum-and-oracle-goldengate-best-practices.html
- Guidelines When Using ZFS Storage in an Exadata Environment (KM ID 2087231)
  - https://support.oracle.com/support/?anchorId=&kmContentId=2087231
  - Migration of file-based TDE to OKV for Exadata Database Service on Cloud at Customer (KM ID 2823650)
  - https://support.oracle.com/support/?anchorId=&kmContentId=2823650

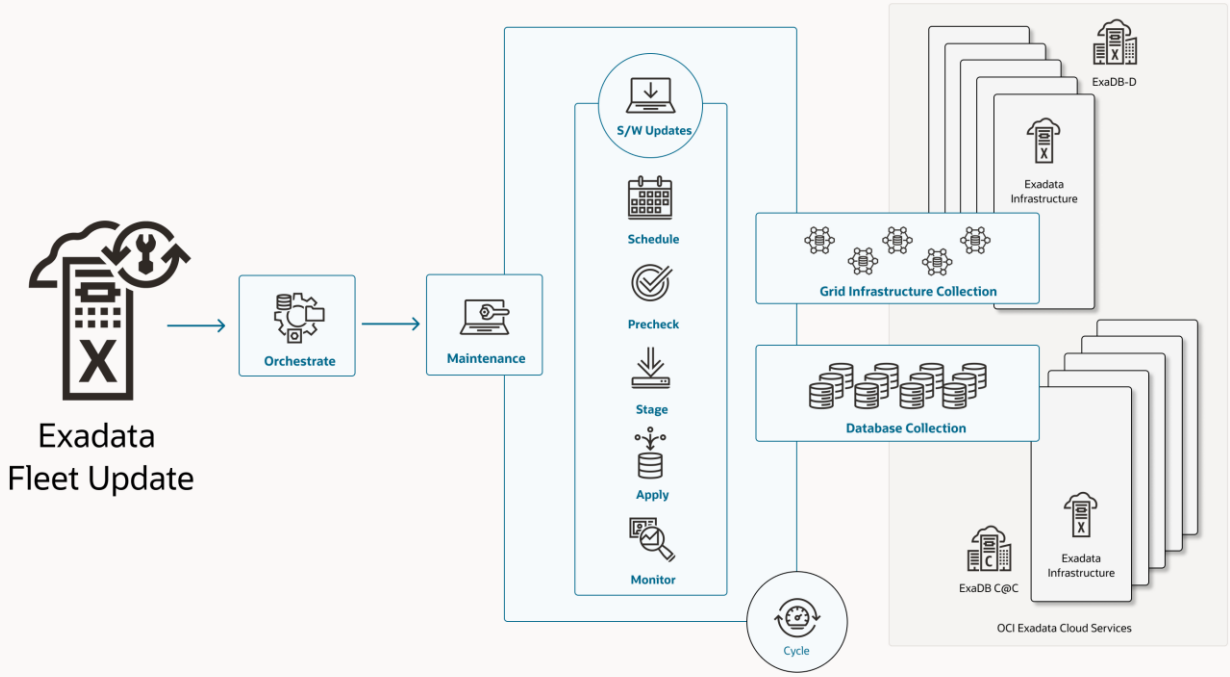
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Exadata Fleet Update

Maximum Availability Architecture

Exadata Fleet Update

- *Orchestrates* maintenance across Exadata Cloud Services fleets
  - ExaDB-D, including multicloud
  - ExaDB-C@C
  - ExaDB-XS
- *Automates* large-scale fleet maintenance operations
- Updates databases and Grid Infrastructure together in a single maintenance schedule
- *Manages fleet operations* by treating target collections as one entity
- *Standardizes* fleet updates using custom gold images applied out-of-place



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Exadata Fleet Update Benefits



- Drastically reduce screen transitions and clicks:
  - For 100 database targets,
    - Using the conventional way needs **800** screen transitions
    - **Exadata Fleet Update** requires only **4** screen transitions
- Fleet-level visibility of patching status, highlighting the failures requiring attention
- Full resume and rollback capability at fleet level
- Advanced rolling options

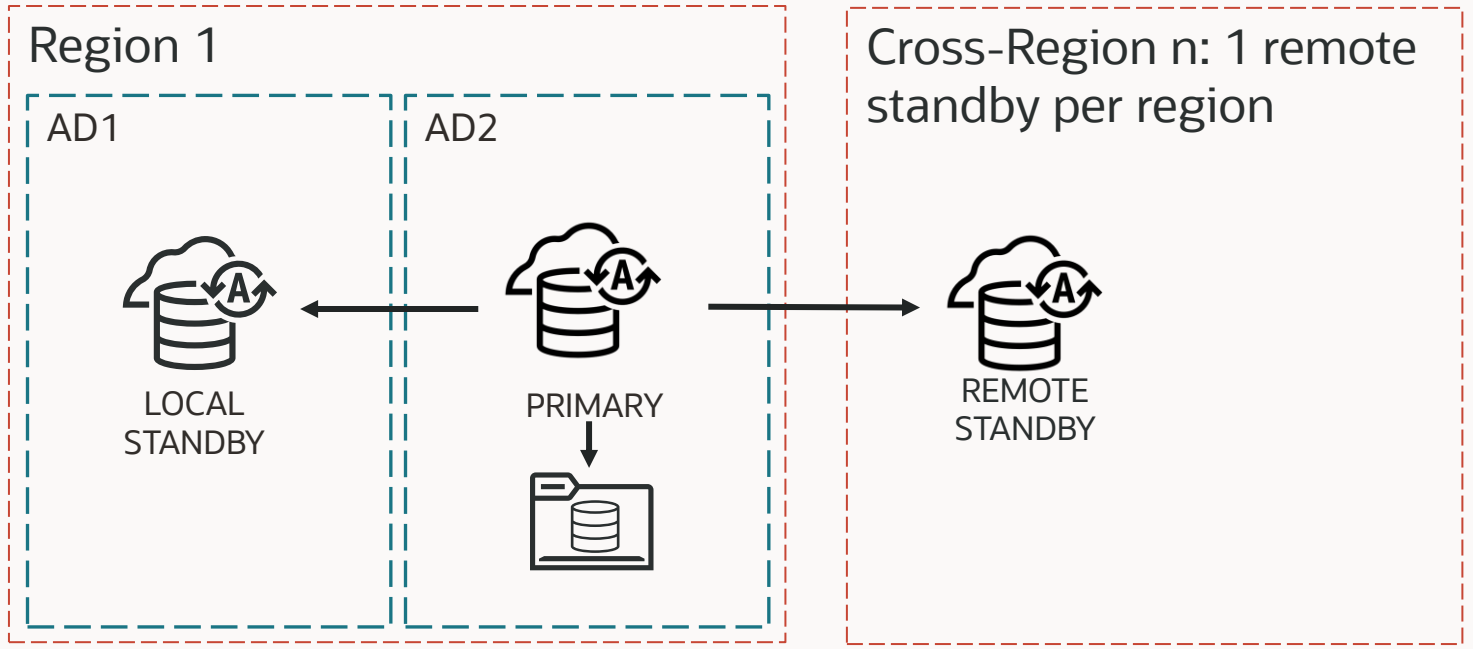
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Oracle Autonomous Database Serverless

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 Minimal data loss is possible with automatic failovers
GOLDENGATE	• Using OGG Hub on OCI Marketplace • Flexible configurations
MAA LEVEL	SILVER: Out of the Box GOLD: + Autonomous Data Guard



Integrated Gold MAA Outage Matrix

PLANNED MAINTENANCE	ZERO	Zero
RECOVERABLE FAILURE	ZERO	< 1 min
UNRECOVERABLE FAILURE	ZERO	< 10 min
UPGRADE	ZERO	< 2 MIN

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

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Autonomous Database Serverless: Automatic Backup

RMAN

SCHEDULING	• Automatically done by the service (60-day full, daily incremental, 5 mins archivelog, some optional retention control)
DESTINATION	• Service-managed bucket, no direct customer access
REPLICAS	• Mirrored and replicated.
CREDENTIALS	• Managed internally • Automatic password rotation
WALLET	• TDE wallet managed and backed up by Oracle
RESTORE	• Restore backup within the retention window
RETENTION	• 60 days of retention and long-term backups are available
STANDBY	• No backup on the standby database

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Autonomous Database Serverless: Real Application Clusters



- Services are automatically created
  - XXX_high, _medium, _low
- 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

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Eliminates Site Downtime

Oracle Autonomous Data Guard

Maintains a real-time remote copy of a production database

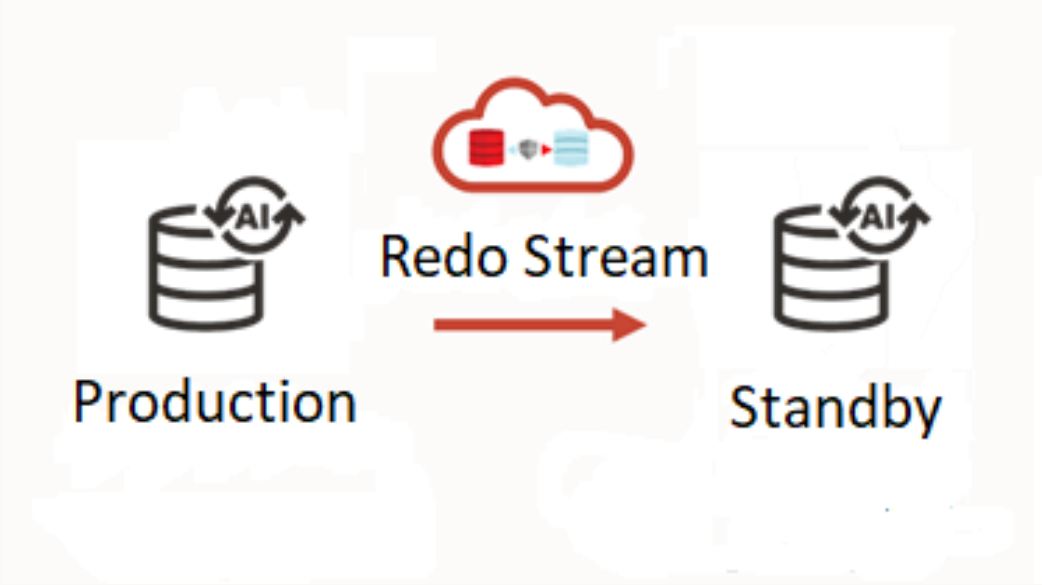
- Protects from physical disasters and network outages
- Can automatically switch from primary to standby replica in the same region

Maintains copy by applying physical changes

- Protects against database corruption
- Validates data consistency as changes are applied

Fully Autonomous – Automates Everything

- Creation, operation, patching, and backup
- Database and Data Guard management



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Autonomous Database Serverless: Autonomous Data Guard

ACTIVE DATA GUARD

SETUP	• 1-click setup from control plane • Via PDB hot clone
TOPOLOGY	• One local standby plus optional cross-region standbys, one per eligible region • Remote region destinations predefined based on lowest latency • From ADB-S to ADB-S
PROTECTION	• Same region standby configuration (MAA validated with local standby: local RPO < 10 seconds, local standby RTO < 131 secs) • Automatic failover available with bounded RPO in the same region • RTO does not include detection time
ROLE CHANGES	• Switchover and failover available through control plane • Connection string only contains regional information. Cross-region needs manual connection string configuration.
OPEN MODE	• No access to standby database • Additional read-only clones can be created and refreshed manually
PATCHING & UPGRADE	• Primary and standby are patched independently • PDB can be relocated to upgraded database

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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

- Continuous Availability - Application Continuous Service for MAA Solutions
  - https://docs.oracle.com/en/database/oracle/oracle-database/26/haovw/autonomous-database-serverless.html#GUID-235442BA-3F2F-4633-BBE9-EACD64F4422F

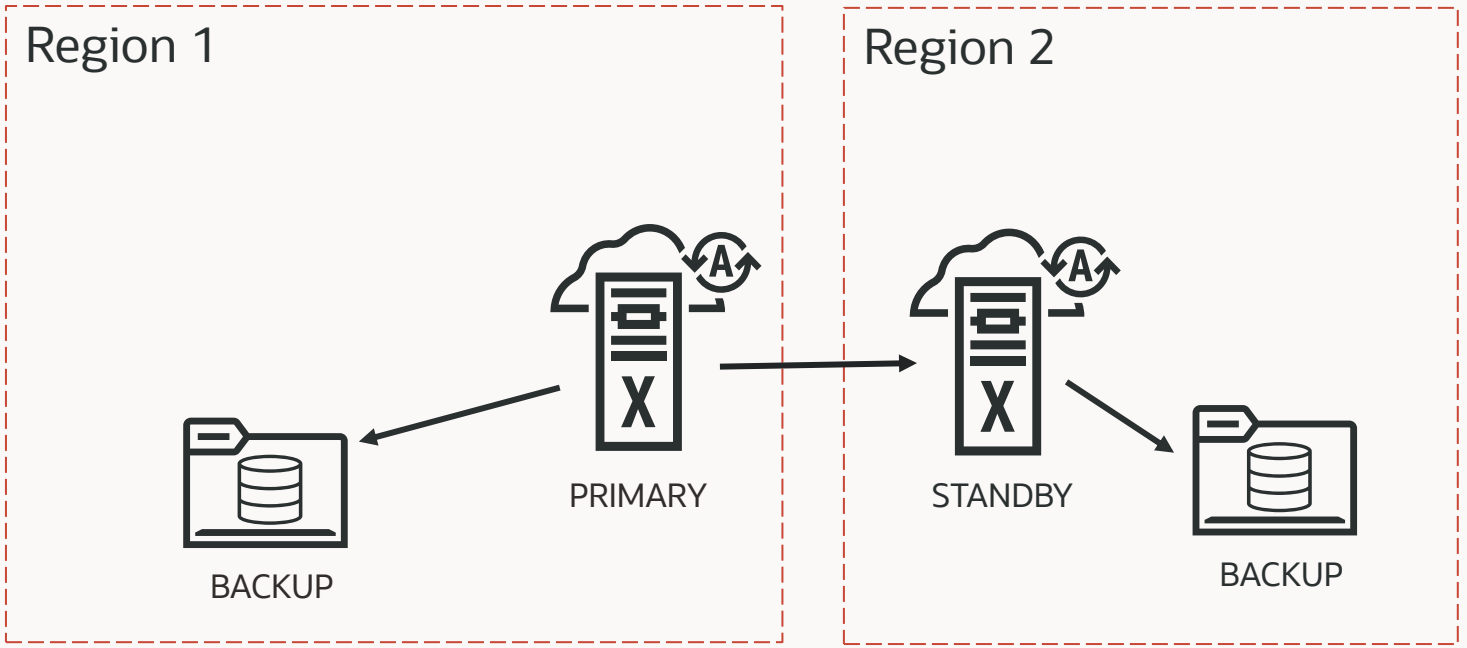
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Oracle Autonomous Database on Dedicated Exadata Infrastructure (ADB-D and ADB-C@C)

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, 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 on OCI Marketplace • Flexible configurations
MAA LEVEL	Ou SILVER Box + GOLD ard + PLATINUM AI DB



Integrated Platinum MAA Outage Matrix

PLANNED MAINTENANCE	ZERO	Zero
RECOVERABLE FAILURE	ZERO	< 10 secs
UNRECOVERABLE FAILURE	ZERO	< 30 secs
UPGRADE	ZERO	< 2 MIN

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

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Autonomous Database – Dedicated: Automatic Backup

RMAN

SCHEDULING	• Automatically done by the service (weekly full, daily incremental, 15 mins archivelog)
DESTINATION	• ADB-D: Service-managed bucket, no direct customer access • ADB-C@C: NFS, ZDLRA (recovery appliance) • For ZDLRA, real-time redo transport is not available yet
REPLICAS	• Object storage, Mirrored backup • ADB-C@C: ZDLRA backup replication available (manual)
CREDENTIALS	• Object storage: managed internally • ZDLRA, NFS: managed by the customer
WALLET	• TDE wallet managed and backed up by Oracle • ADB-D: Oracle Vault (KMS) supported for customer-managed keys • ADB-C@C: Oracle Key Vault supported for customer-managed keys
RESTORE	• Create new ADB from backup is possible. • Duplicate (clone) is supported
RETENTION	• Short-term retention is enabled and configurable • Long-term retention is available
STANDBY	• Automatic backup of standby database

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Autonomous Database – Dedicated: Automatic Backup Best Practices

RMAN

- 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

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Autonomous Database – Dedicated: Real Application Clusters



- RAC uses 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 (<=16) by default only opened on a single node
- Databases with higher ECPU count (>16) are by default opened on two or more nodes
- Container Database has RAC affinity control, opening one node only until all resources are used
- Patching is rolling and scheduled by the customer
- Fast Application Notification (FAN) must be configured

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Autonomous Database – Dedicated: RAC Services



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

[1] Transparent Application Continuity enabled by default

[2] Use DBMS_APP_CONT_ADMIN.ENABLE_TAC to enable TAC for the non TP services

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Autonomous Database – Dedicated: Autonomous Data Guard

ACTIVE DATA GUARD

SETUP	• Setup from control plane on CDB creation or add standby post-CDB creation • A protected CDB can be chosen at ADB creation
TOPOLOGY	• Single primary-standby can be configured within the same region, across ADs, or cross-region • Only possible between same ADB-D type (On-premises to On-premises/OCI to OCI) • MAA practices integrated
PROTECTION	• Max Availability or Max Performance possible at CDB level • Automatic failover (Fast-Start Failover) is available
ROLE CHANGES	• Switchover, Failover and Snapshot Standby at CDB level available through control plane • Connection string is aware of Autonomous Data Guard
OPEN MODE	• Standby database is open read-only (DML redirection not supported) • Standby role listener services available
PATCHING & UPGRADE	• Customer controls when primary and standby are patched • Standby first patching best practices applied automatically • Zero database downtime with RAC rolling for any software or hardware updates

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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/26/haovw/autonomous-database-dedicated-exadata-infrastructure.html

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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 CLOUD Infrastructure	Microsoft Azure	Google Cloud	aws
			
Oracle Database in OCI	**Oracle Database@Azure**	**Oracle Database@GCP**	**Oracle Database@AWS**

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Oracle MAA Platinum for All Oracle AI Database@Hyperscalers

Exadata Database Service on Dedicated Infrastructure

Oracle AI Database@Azure

- ✓ MAA Silver
- ✓ MAA Gold
- ✓ MAA Platinum (Active Data Guard 26ai)

Oracle AI Database@Google Cloud

- ✓ MAA Silver
- ✓ MAA Gold
- ✓ MAA Platinum (Active Data Guard 26ai)

Oracle AI Database@AWS

- ✓ MAA Silver
- ✓ MAA Gold
- ✓ MAA Platinum (Active Data Guard 26ai)









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Oracle MAA Certifications for Oracle Database@Azure

	Exadata Database Service on Dedicated Infrastructure	Exadata Database Service on Exascale Infrastructure	Base Database Service	Autonomous AI Database Dedicated / Serverless
SILVER	✓	✓	N/A***	✓
GOLD	✓	✓	N/A***	✓ *
PLATINUM	✓	Planned	N/A***	✓ **

*** Gold:** ADB-S Gold certification applies to the local standby configuration; cross-region certification is planned.
**** Platinum:** Platinum checks represent the Active Data Guard option on Oracle AI Database 26ai. In the Autonomous column, this applies to ADB-D.
*** Oracle Clusterware and RAC are not available on BaseDB

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Oracle MAA Certifications for Oracle Database@Google Cloud

	 Exadata Database Service on Dedicated Infrastructure	 Exadata Database Service on Exascale Infrastructure	 Base Database Service	 Autonomous AI Database Dedicated / Serverless
 SILVER			N/A***	
 GOLD			N/A***	 *
 PLATINUM		Planned	N/A***	 **

*** Gold:** ADB-S Gold certification applies to the local standby configuration; cross-region certification is planned.
**** Platinum:** Platinum checks represent the Active Data Guard option on Oracle AI Database 26ai. In the Autonomous column, this applies to ADB-D.
*** Oracle Clusterware and RAC are not available on BaseDB

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Oracle MAA Certifications for Oracle Database@AWS

	Exadata Database Service on Dedicated Infrastructure	Exadata Database Service on Exascale Infrastructure	Autonomous AI Database Dedicated / Serverless
SILVER	✓	✓	✓
GOLD	✓	✓	✓ *
PLATINUM	✓	Planned	✓ **

*** Gold:** ADB-S Gold certification applies to the local standby configuration; cross-region certification is planned.
**** Platinum:** Platinum checks represent the Active Data Guard option on Oracle AI Database 26ai. In the Autonomous column, this applies to ADB-D.

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

Example 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 is free
- Up to 6 standby databases via Cloud Tooling
  - Manual setup with optional Fast-Start Failover (FSFO)
- Can support the potential high redo throughput required for enterprise databases

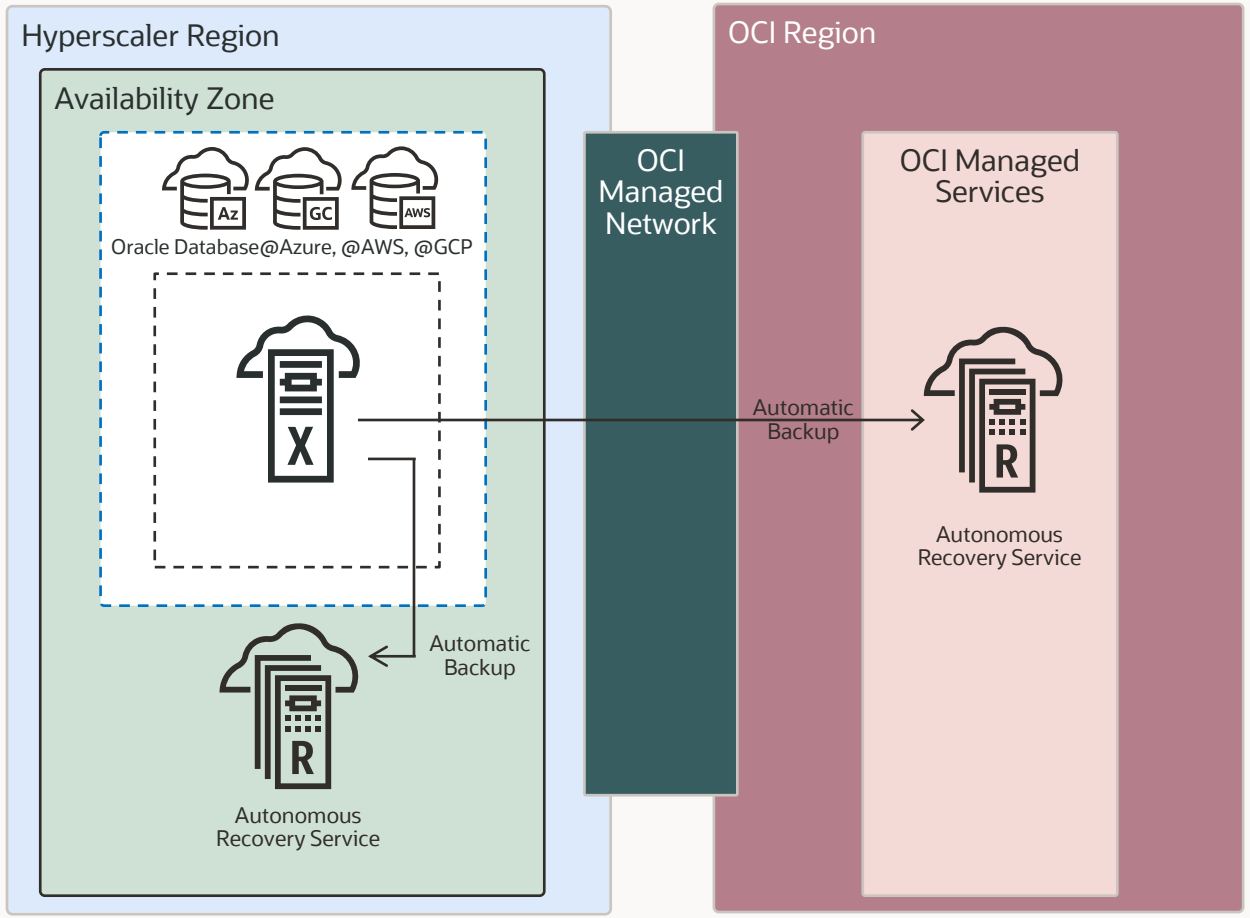
Network Traffic through Azure

- Automated setup via Cloud Tooling
  - VNet peering required
- Microsoft controls the network and ensures reliability
- Chargeback for cross-region traffic
- Up to 6 standby databases via Cloud Tooling
  - Manual setup with optional Fast-Start Failover (FSFO)

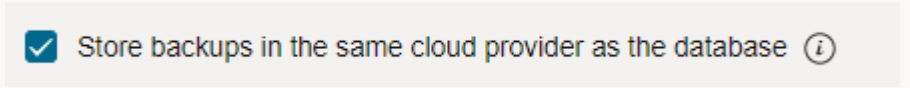
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Exadata Database Service@Hyperscaler: MAA Silver Level

High Availability and Data Protection Built-in by Default



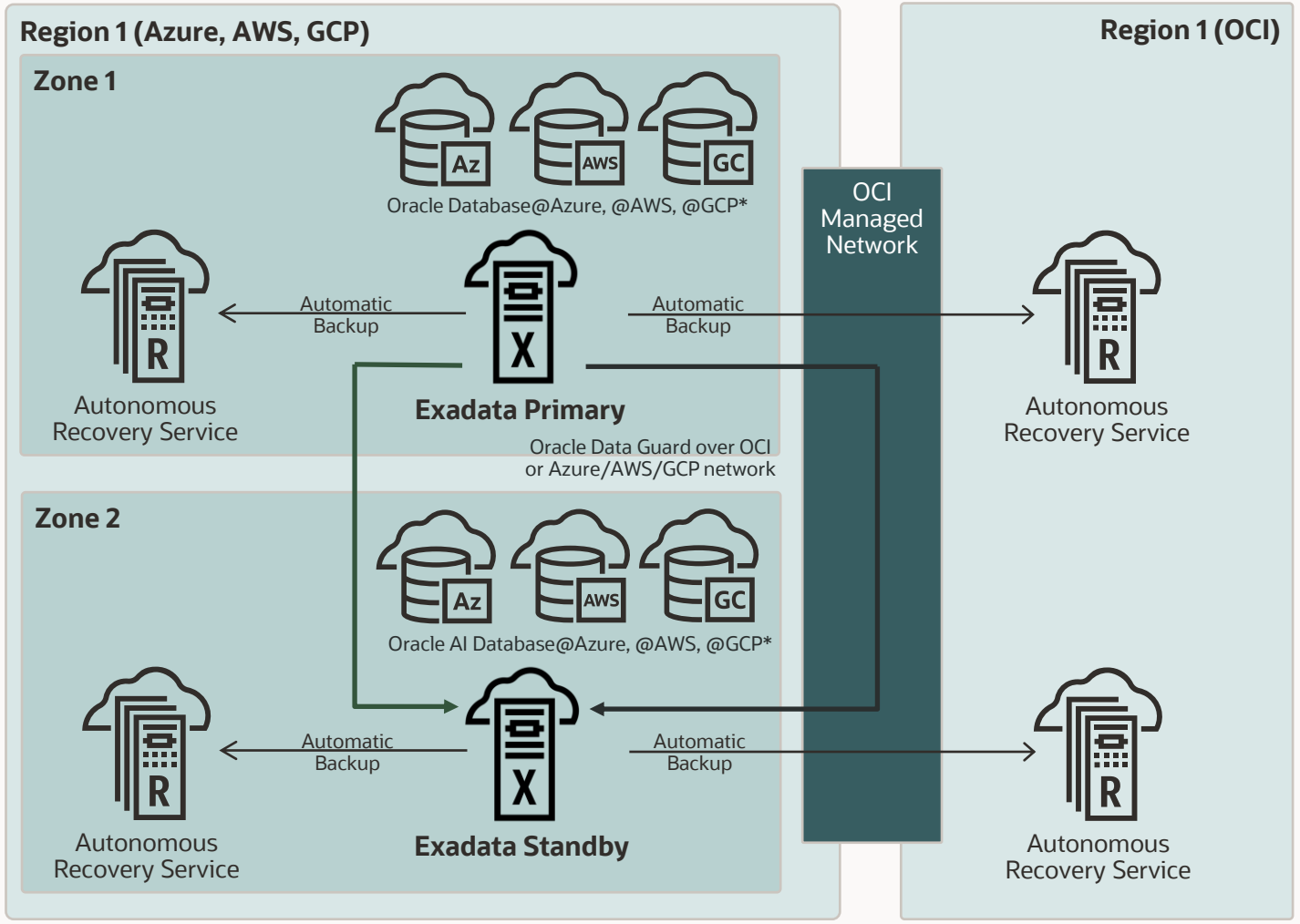
- Oracle Exadata and Oracle RAC
  - ✓ Agility to scale storage, compute, and memory without downtime
  - ✓ Node failure protection
  - ✓ Zero-downtime software maintenance
- Zero Data Loss Autonomous Recovery Service
  - ✓ Available in OCI and in multicloud hyperscaler
  - ✓ One-click to choose the backup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



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Oracle MAA Gold Level Cross-Zone Architecture

Enhancing availability and ensuring zero data loss



MAA Silver Level +

- ✓ Site failure protection
- ✓ Oracle Data Guard's In-Memory replication with zero data loss
- ✓ Minimal performance impact

+ Active Data Guard

- ✓ Comprehensive data corruption prevention
- ✓ Offload read-mostly workloads to the standby
- ✓ Online updates

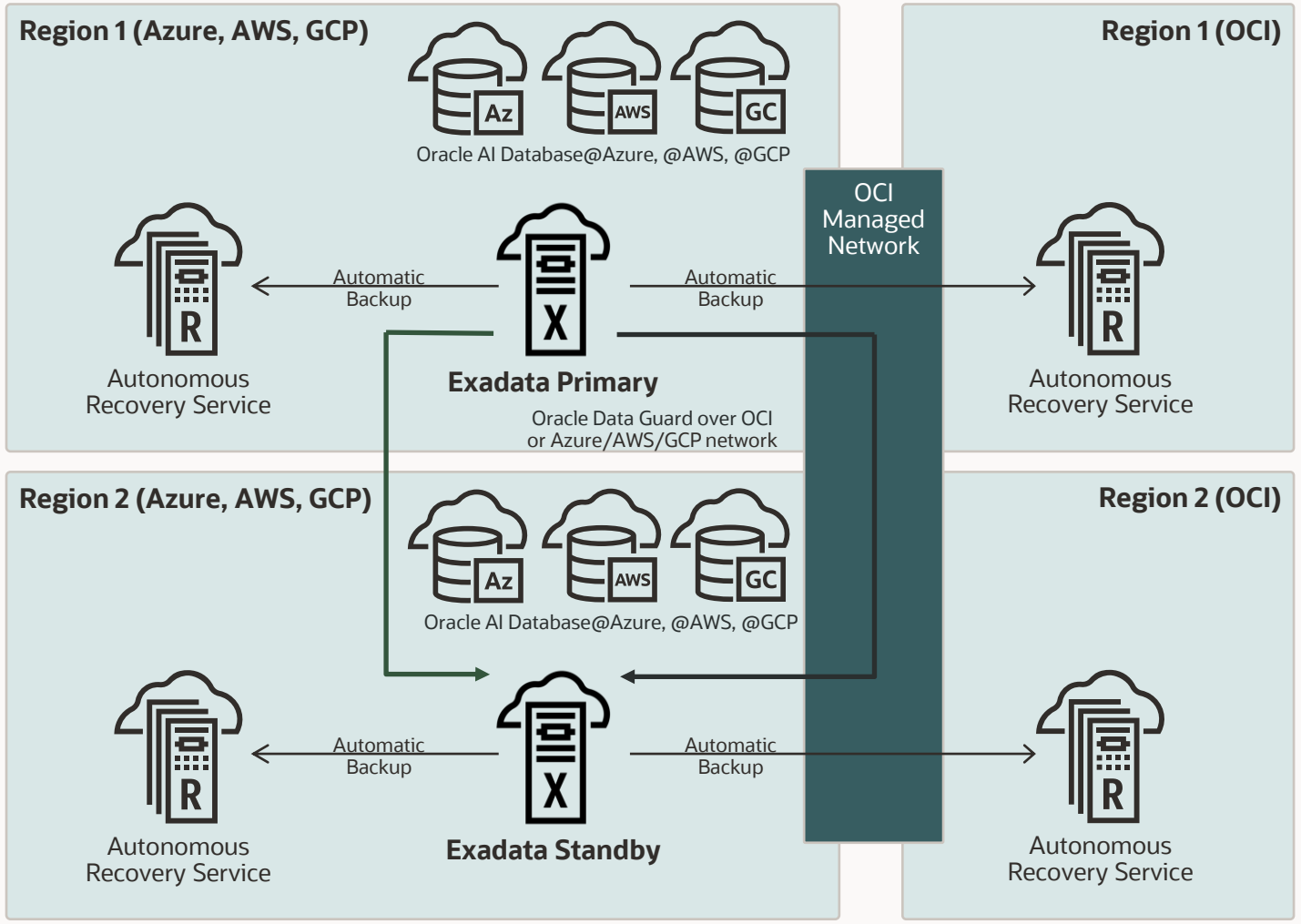
+ Multiple Standbys

- ✓ Read-mostly scale-out

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Oracle MAA Platinum Level Multi-Region Architecture

Safeguarding continuous availability and real-time data protection



PLATINUM

MAA Gold Level +

- ✓ Regional disaster recovery protection
- ✓ Oracle Data Guard's In-Memory replication with (near) zero data loss
- ✓ No performance impact

- + Active Data Guard with Oracle AI Database 26ai

- ✓ Comprehensive data corruption prevention
- ✓ Offload read-mostly workloads to the standby
- ✓ Online updates

- + Multiple Standbys

- ✓ Zero data loss across regions with minimal impact on primary performance
- ✓ Read-mostly scale-out

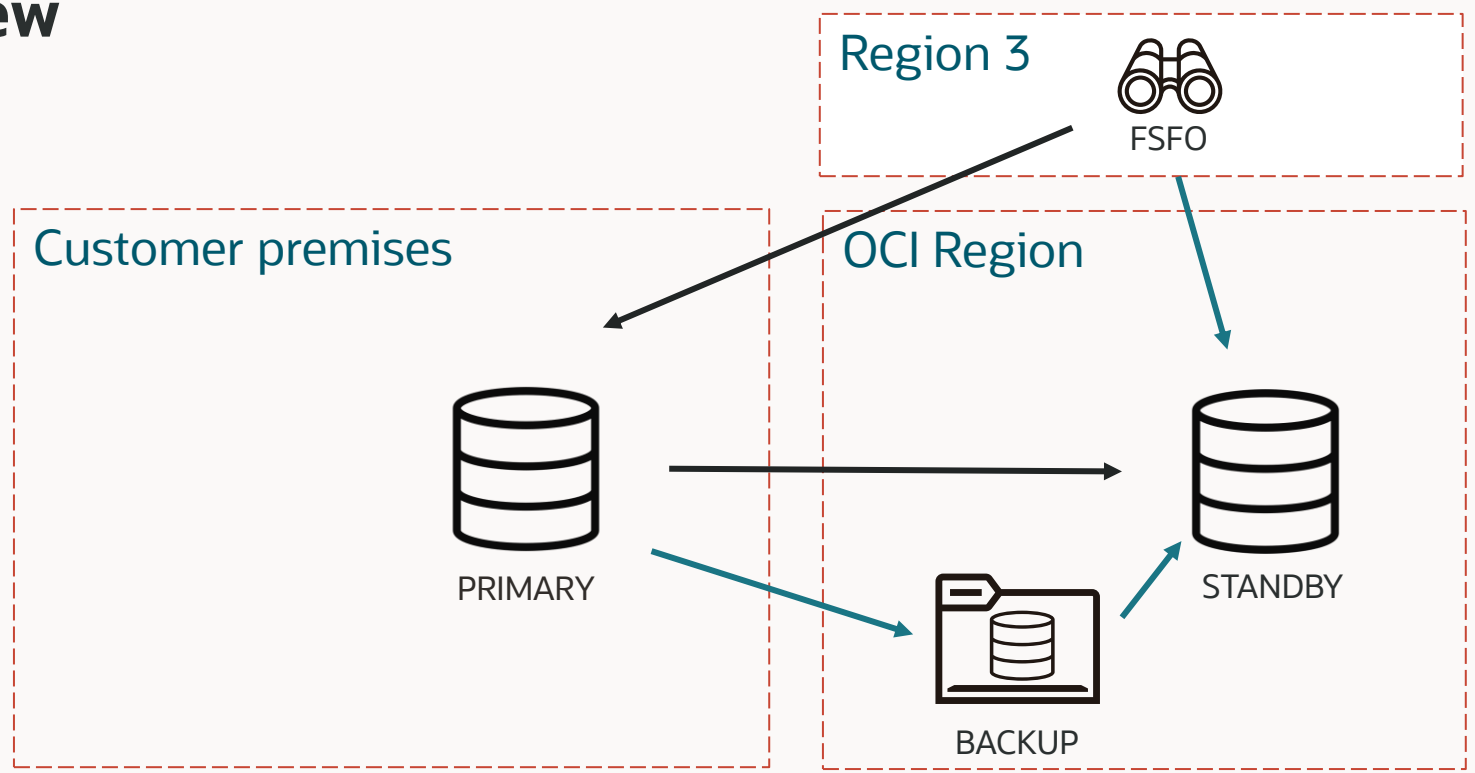
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Hybrid Data Guard

Maximum Availability Architecture

Hybrid Data Guard: Overview

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



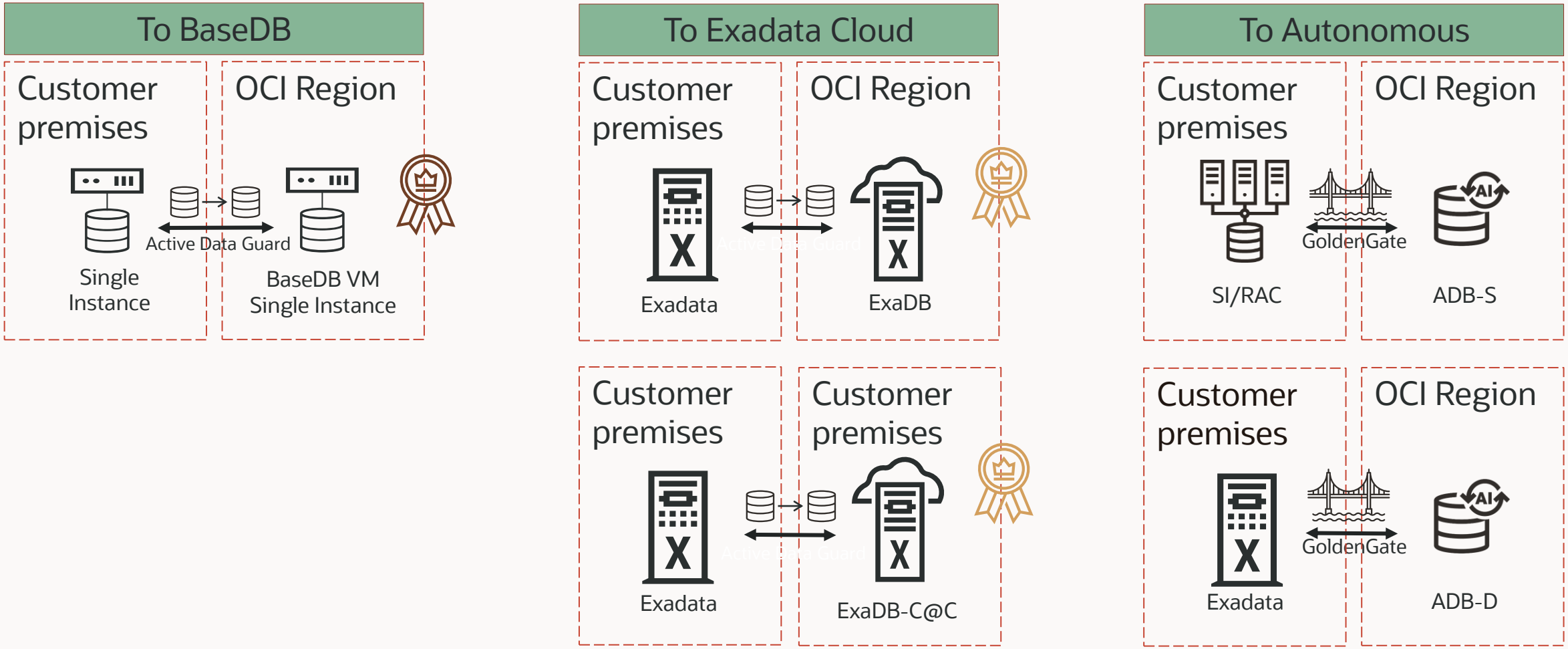
Gold MAA Outage Matrix

PLANNED MAINTENANCE	ZERO	Zero
RECOVERABLE FAILURE	ZERO	< 1 min
UNRECOVERABLE FAILURE	ZERO	<5 min
UPGRADE	ZERO	<30 sec

[1] Customer responsibility

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Hybrid Cloud: Recommended Hybrid Sources and Destinations



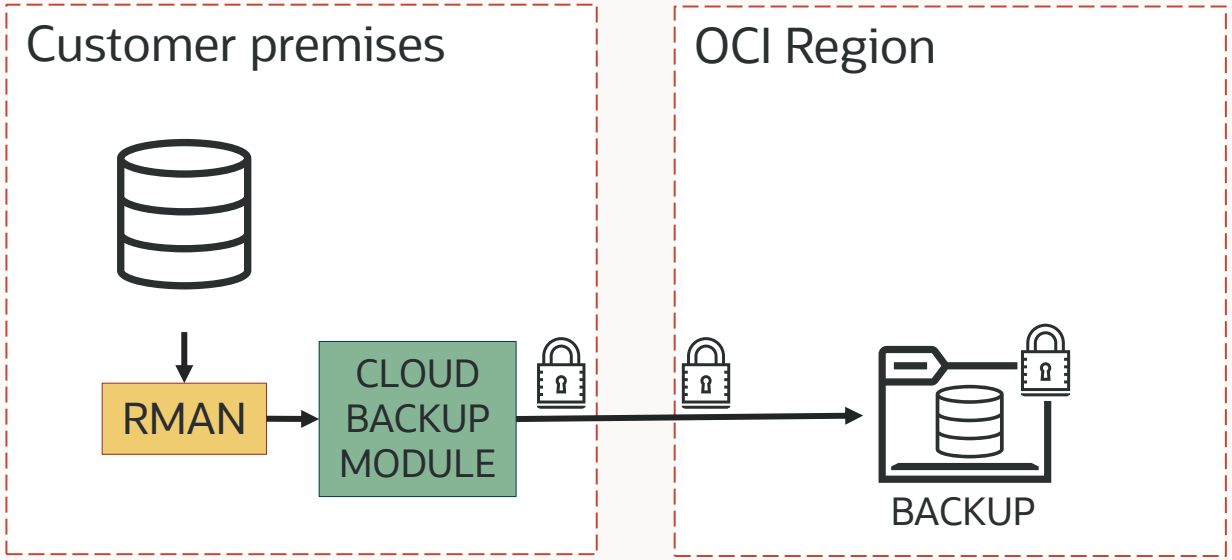
- All Hybrid configurations are achieved manually: no Control Plane automation
- On-premises non-Exadata to ExaDB/ExaDB-C@C is possible, but beware of exclusive features

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Hybrid Cloud: Backup to Oracle Cloud Infrastructure

RMAN

- 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



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Hybrid Cloud: Backup to Oracle Cloud Infrastructure



- Oracle Database Backup Cloud Service Best Practices for on-Premises 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/fastconnectmultipledrgs.htm

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Hybrid Cloud: Data Guard Checklist

ACTIVE DATA GUARD

Network

- Measure peak redo rates and ensure enough bandwidth
  - Assessing and Tuning Network Performance for Data Guard and RMAN (KM ID 2064368)
    - Generally recommended:
      net.ipv4.tcp_rmem=4096 87380 134217728
      net.ipv4.tcp_wmem=4096 16384 134217728
- Communication must be bidirectional
- Use either IPSec VPN or FastConnect (recommended)
  - For FastConnect, use private peering
  - If the internet is used, use SQL*Net encryption

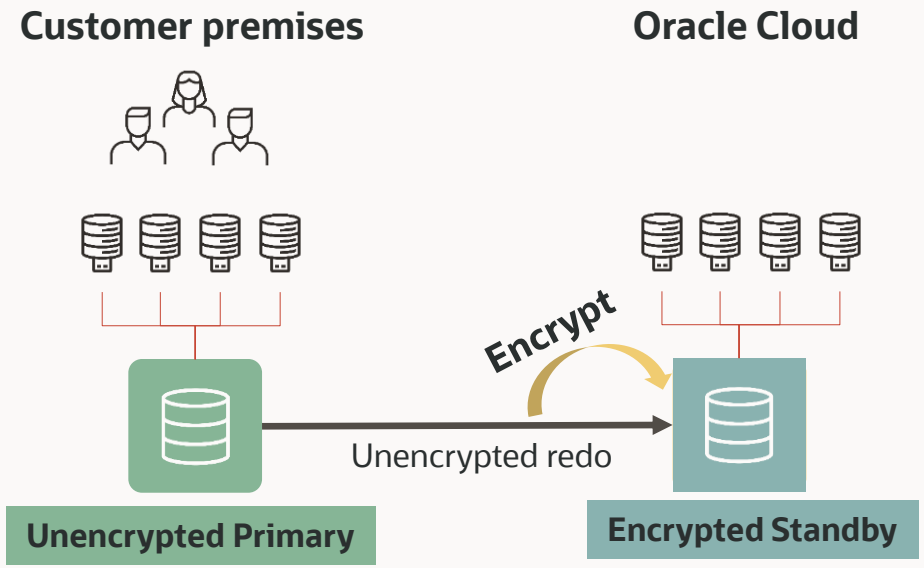
Transparent Data Encryption

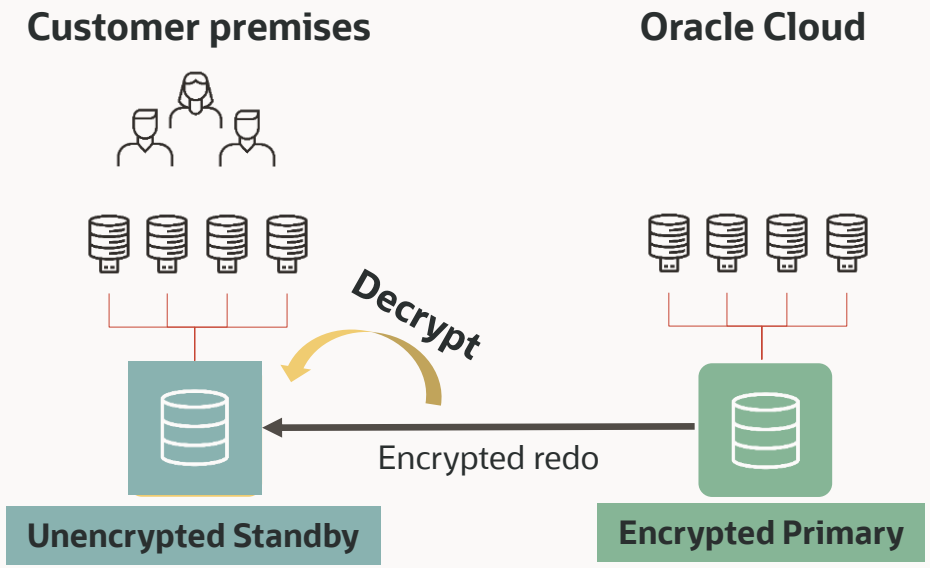
- Recommended: Use TDE on both primary and standby
  - Encrypt primary before migration whenever possible
- Master Note for Transparent Data Encryption (TDE) (KM ID 1228046)
- Oracle Database Tablespace Encryption Behavior in Oracle Cloud (KM ID 2359020)

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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;
```





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Hybrid Cloud: Data Guard High-Level Implementation Steps

ACTIVE DATA GUARD

- Create a Database in the Cloud
  - https://docs.oracle.com/en/database/oracle/oracle-database/26/haovw/oracle-data-guard-hybrid-cloud-configuration1.html
  - Same patch level and one-off patches 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
- Set up 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. ExaDB-C@C, and ExaDB-XS)
- Monitor DG health: Monitoring a Data Guard Configuration (KM ID 2064281)

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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
  2. Patch primary; tooling runs datapatch, changes will be applied to standby
  3. Patches on RAC are rolling by default (no downtime)

- To patch a Data Guard environment non-RAC with minimum downtime:
  1. Patch standby first; tooling will not try to run datapatch
  2. Switchover to standby
  3. Patch the old primary; tooling will not try to run datapatch
  4. Finish patching manually by calling datapatch on primary

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Hybrid Cloud: Data Guard – Read More

- Disaster Recovery using Exadata Cloud
  - On-Premises Primary to Standby in Exadata Database Cloud or Exadata Database Cloud at Customer
  - https://docs.oracle.com/en/database/oracle/oracle-database/26/haovw/oracle-data-guard-hybrid-cloud-configuration1.html
- Best Practices for Corruption Detection, Prevention, and Automatic Repair - in a Data Guard Configuration (KM ID 1302539)
  - https://support.oracle.com/support/?anchorId=&kmContentId=1302539
- Oracle Data Guard Best Practices
  - https://docs.oracle.com/en/database/oracle/oracle-database/26/haovw/oracle-data-guard-best-practices.html

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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

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GoldenGate and Platinum/Diamond MAA

Maximum Availability Architecture

MAA Platinum/Diamond and Cloud GoldenGate Collateral

- MAA Platinum Reference Architecture Overview
- Overview of Oracle GoldenGate Best Practices
- Cloud: Configuring Oracle GoldenGate Hub for MAA Platinum & Diamond
- 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

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Oracle Zero Data Loss Autonomous Recovery Service (ZRCV)

Maximum Availability Architecture

Zero Data Loss Autonomous Recovery Service (ZRCV)

Intelligent data protection for Oracle AI Databases in OCI, Multicloud, & On-premises

Zero Data Loss Recovery

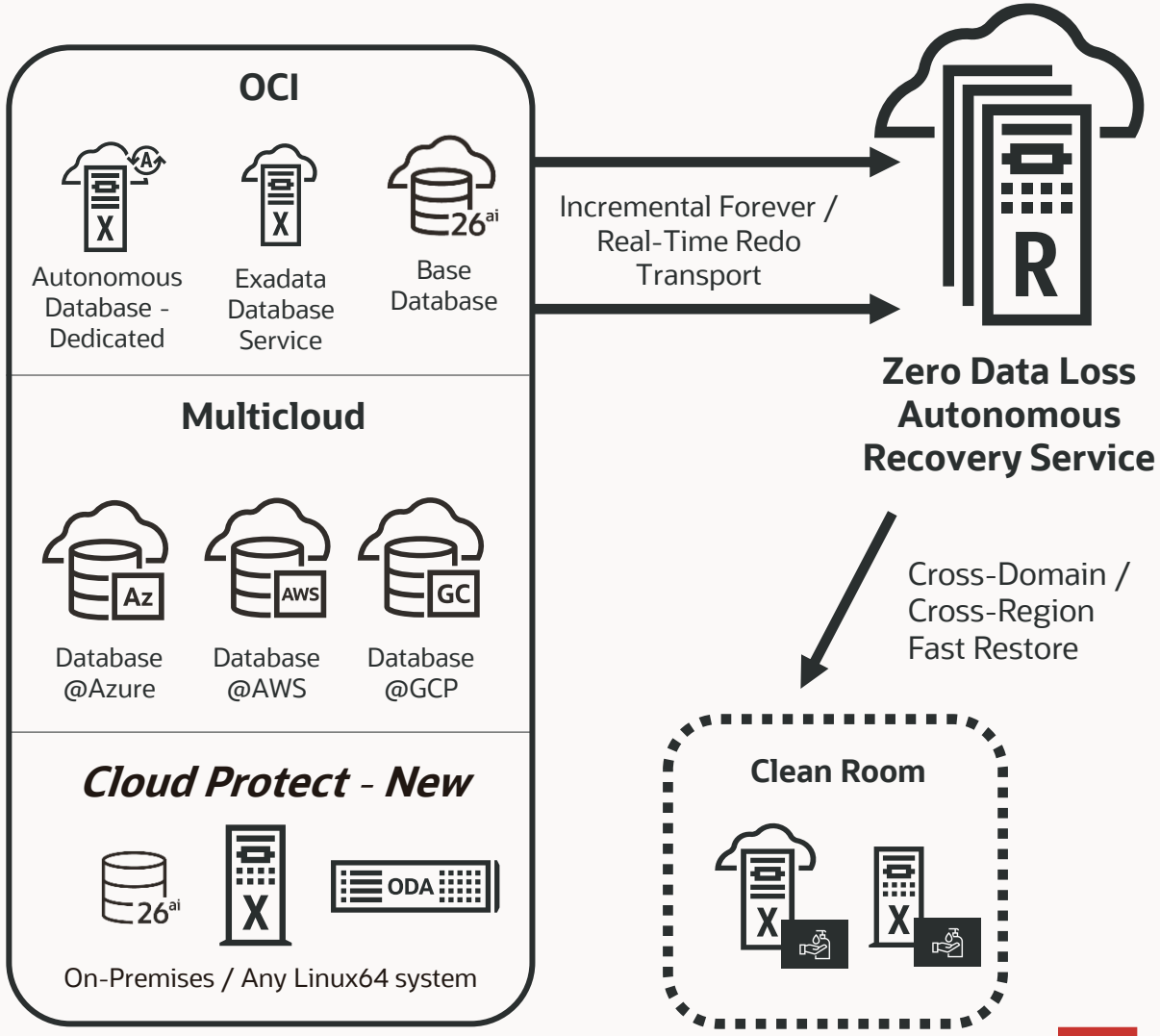
- Real-time transaction protection
- Continuous recovery validation
- Long-term retention support

Fast, Low-Impact Backup and Recovery

- Space-efficient incremental forever
- One-step recovery without needing incremental apply

Database-aware Ransomware Resiliency

- Immutable backups with retention lock
- Separation of duties and granular access control
- Logical air gap between the customer and Oracle Cloud Operations tenancies
- Cross-domain and cross-region clean room support



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OCI Full Stack Disaster Recovery (FSDR)

Maximum Availability Architecture

OCI Full Stack Disaster Recovery

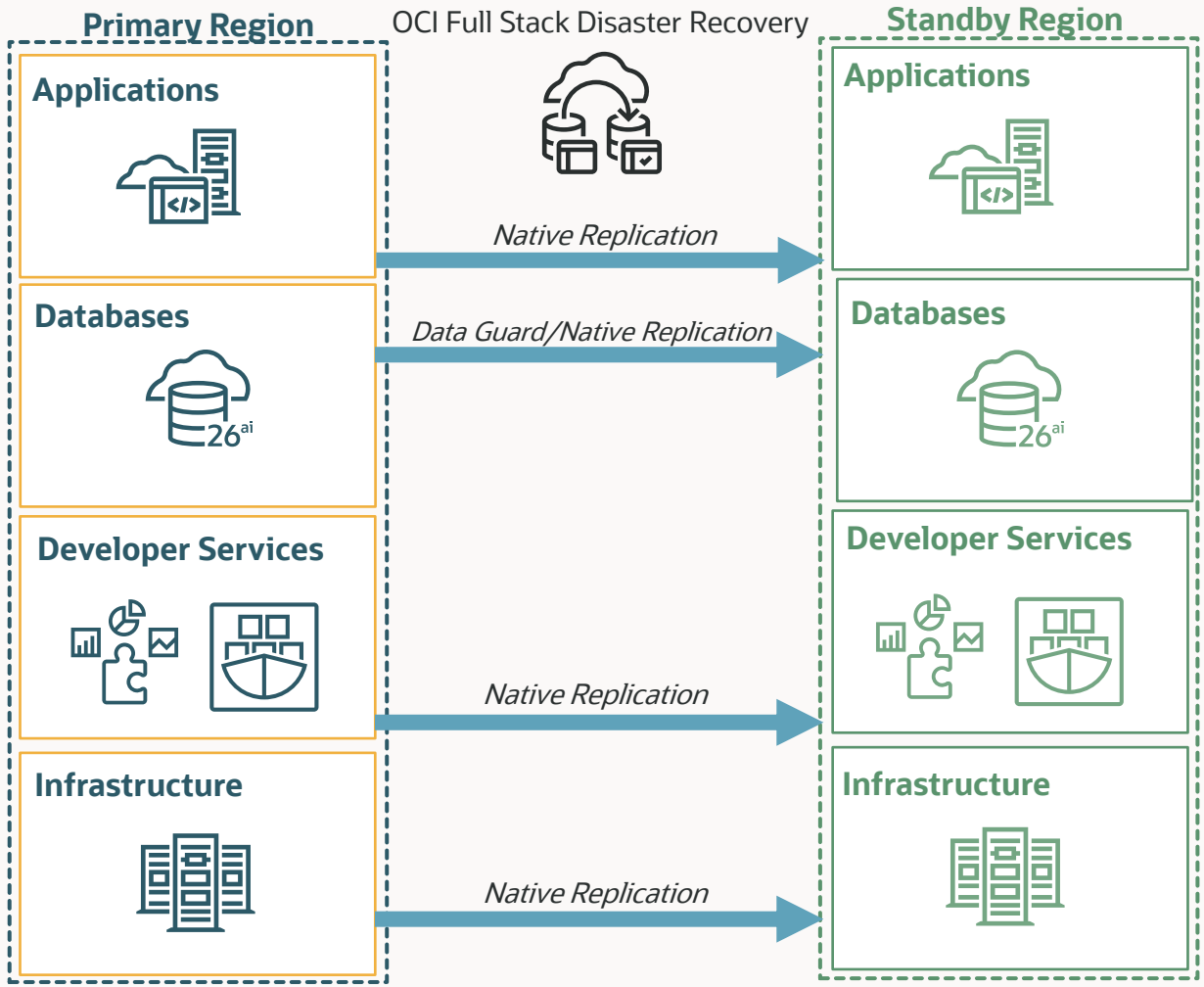
Recovery orchestration across your entire OCI stack — end to end, service by service

Why OCI Full Stack Disaster Recovery?

- Traditional DR tools protect only one layer
- Manual recovery is slow, error-prone, and outdated the moment it's written

What OCI Full Stack Disaster Recovery does

- Orchestrates recovery across your entire stack in the correct dependency order, automatically
- Three modes: Switchover (planned), Failover (outages), DR Drill (zero-impact testing)
- 16+ OCI services covered out-of-the-box, extensible for any custom workload



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Summary and Takeaways

Maximum Availability Architecture

Unique: Consistent Database Experience Across Deployments



Exadata Database Machine
(on-premises)



Exadata Cloud@Customer
(hybrid cloud)

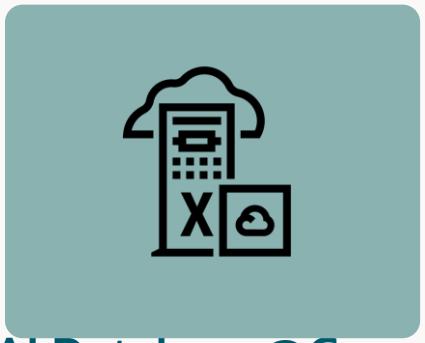


Exadata Cloud Infrastructure
(Oracle public cloud)

Same Oracle Database | 100% compatible | No app changes | Zero downtime migration



Oracle AI Database@Azure
(multicloud)



Oracle AI Database@Google Cloud
(multicloud)



Oracle AI Database@AWS
(multicloud)

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Key Takeaways

Oracle AI Database High Availability and Disaster Recovery technology provides:

- MAA reliability that has evolved over 20 years, deployed by thousands of customers
- Flexible high availability and disaster recovery for the application with no modification
- Zero data loss is an option regardless of distance
- Rolling patching provides zero downtime during the most common planned maintenance operations
- On-demand, reliable, and fully elastic

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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 (KM ID 1302539)
  - https://support.oracle.com/support/?anchorId=&kmContentId=1302539

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