



Oracle OpenWorld 2019

SAN FRANCISCO



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The background features abstract, wavy, horizontal lines in shades of brown, grey, and blue. There are also solid-colored shapes: a red one in the upper right and a teal one in the center. Small orange rectangular dashes are scattered throughout the design.

Maximum Availability Architecture - Best Practices for the Oracle Cloud

Glen Hawkins, Senior Director of Product Management, MAA, Oracle
Brian Spendolini, Senior Principal Product Manager, DB Cloud, Oracle

Program Agenda

- Why MAA in the Cloud?
- Cloud MAA Best Practices
- Migrating Into the Cloud
- Summary
- Q & A

Our Goal in Cloud MAA

- Provides best HA and DR Solutions and Service Levels in the cloud
 - MAA Reference Architectures to meet SLAs
 - Configuration Best Practices for Stability and Reliability
 - MAA Life Cycle Operations integrated with **Cloud APIs and Cloud Console**
 - Evolving and improving with new MAA best practices and capabilities
- Autonomous DB in our Gen 2 Cloud provides a fully managed MAA solution with service SLAs
 - Service Uptime (99.995%) with No Exclusions **for Enterprise Customers**
 - Exadata MAA + Validated Cloud Infrastructure +
 - MAA Cloud Life Cycle Operations +
 - Cloud and Product Enhancements and Fixes

Impact of Database Downtime



\$350K

Average cost of
downtime per hour



\$10M

Average cost of
unplanned data center
outage or disaster



87 hours

Average amount of
downtime per year



91%

Percentage of
companies have
experienced an
unplanned data center
outage in the last 24
months

Source: Gartner, Data Center Knowledge, IT Process Institute, Forrester Research



What Are Your Service Level Agreements and Business Factors?

Impact of Downtime

Cost of downtime

- Business/Market Share
- Application or Database
- Consolidated set of applications or databases



Downtime (RTO)

How much downtime before serious business impact?

- For planned maintenance?
- for Local Failures?
- for Disasters and Corruptions?



Data Loss (RPO)

How much data can I lose before the business suffers irreparable damage?

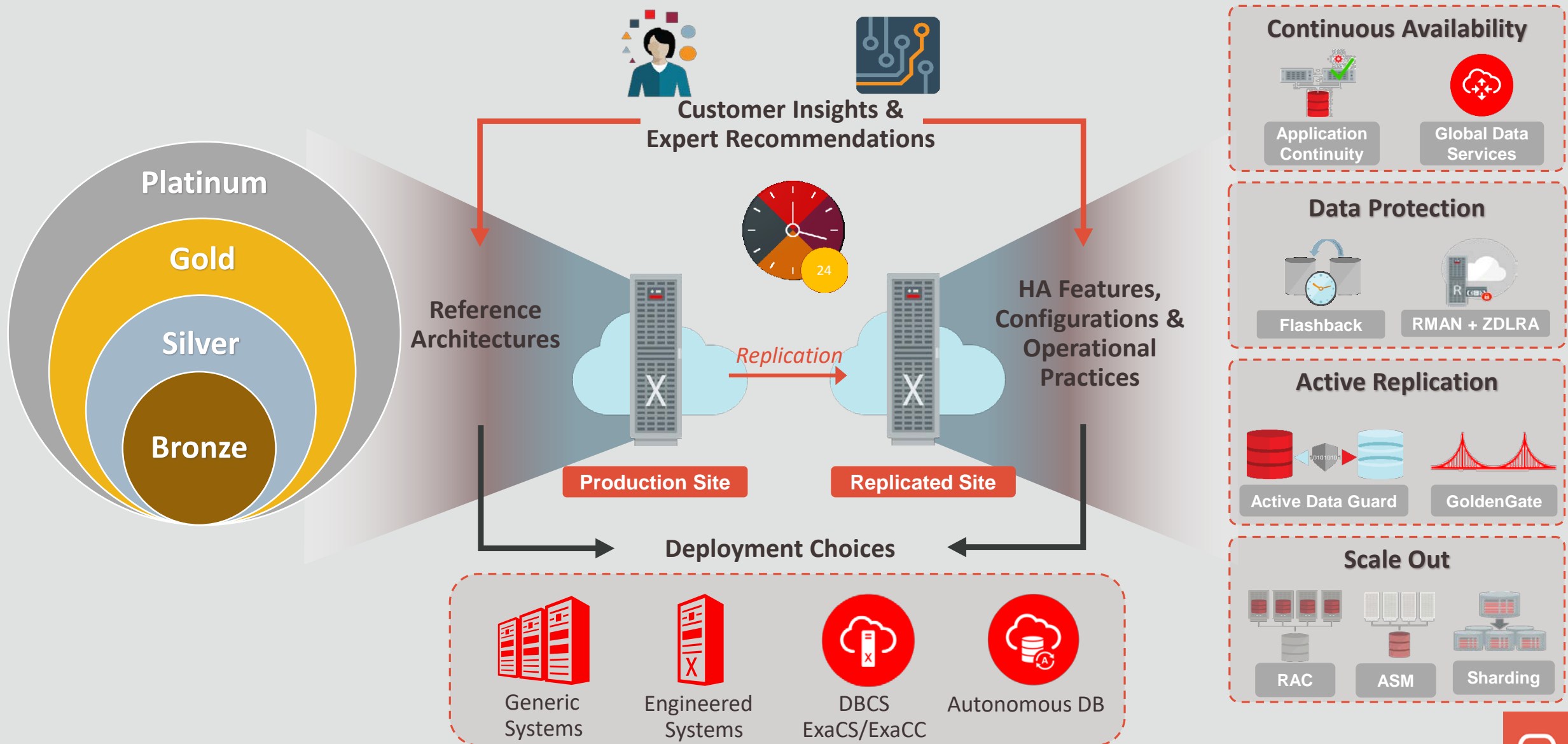


MAA Architecture

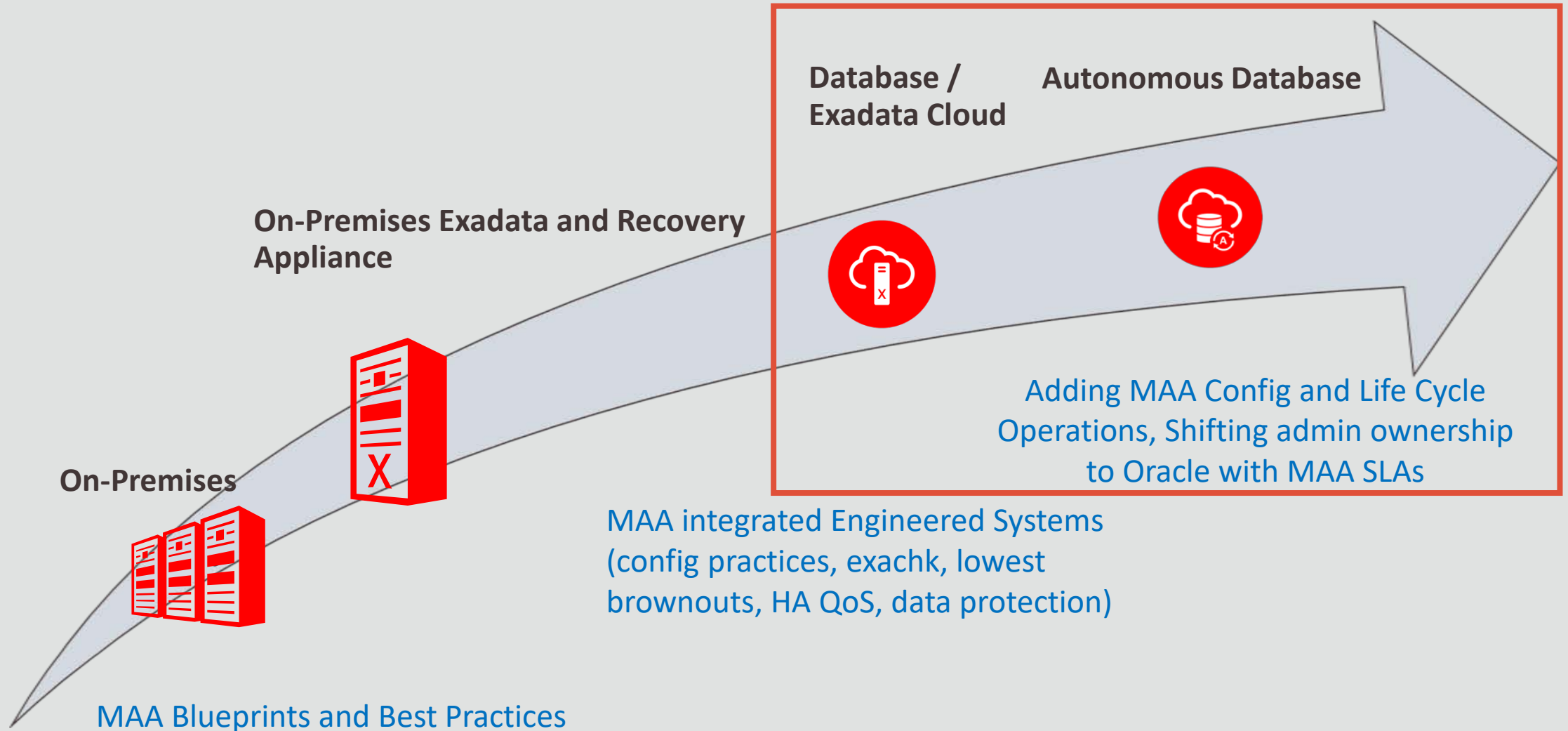
Pick the architecture that fits your needs.

- Any environmental restraints?
- Application needs to be close to the database
- Specific region or location
- Network latency and bandwidth requirements

Oracle Maximum Availability Architecture (MAA)



MAA Evolution: On-Premises to Cloud



Maximum Availability Architecture - Best Practices for the Oracle Cloud

Cloud MAA Best Practices

MAA Reference Architectures for the Cloud

Availability Service Levels



All tiers exist with on-premise and cloud. However, platinum currently must be configured manually while bronze to gold are covered with cloud tool automation

MAA Architecture Building Blocks

What's available where?

Cloud Infrastructure	Backup/Restore Options	RAC	ADG	DB Replication across ADs/Regions
OCI (BM)	Backup to OCI Object Storage (manual/automatic) Automatic backup copies across Availability Domains (ADs)		✓	Across ADs Across Regions via VCN peering
OCI (VM) (with SI or RAC)		✓*	✓	
Exa-OCI (X6/X7,X8)		✓	✓	
ExaCC (X6, X7, X8)	Backup to NFS, Local Object Storage, ZDLRA, Cloud Object Storage	✓	✓	Across ADs and regions where available

*In OCI, RAC VM node are now in separate fault domains. Existing Autonomous DB solutions are in OCI.



Oracle Cloud Infrastructure Region Footprint

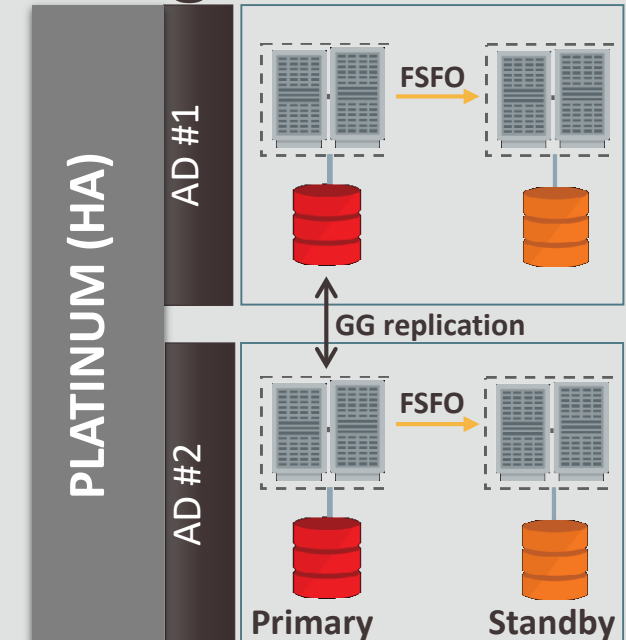
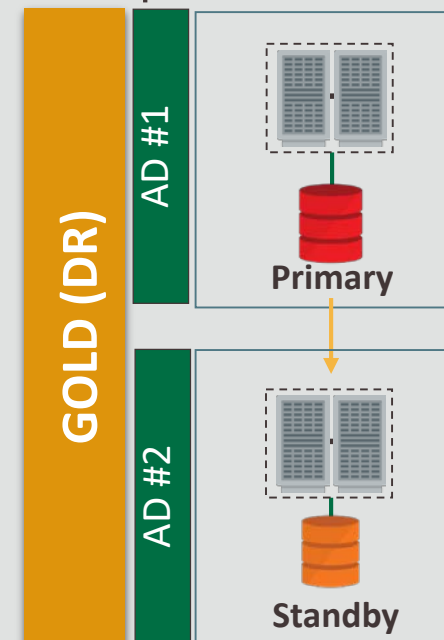
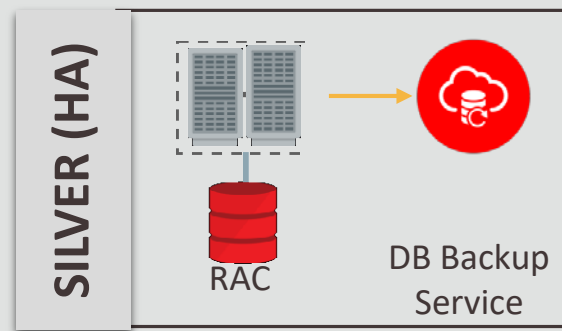
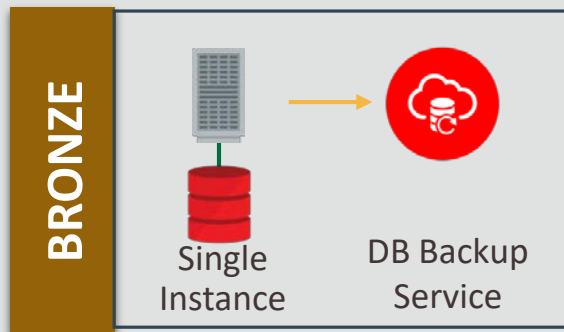


MAA Deployment Automation in the Cloud

MAA Database Deployment Made Easy



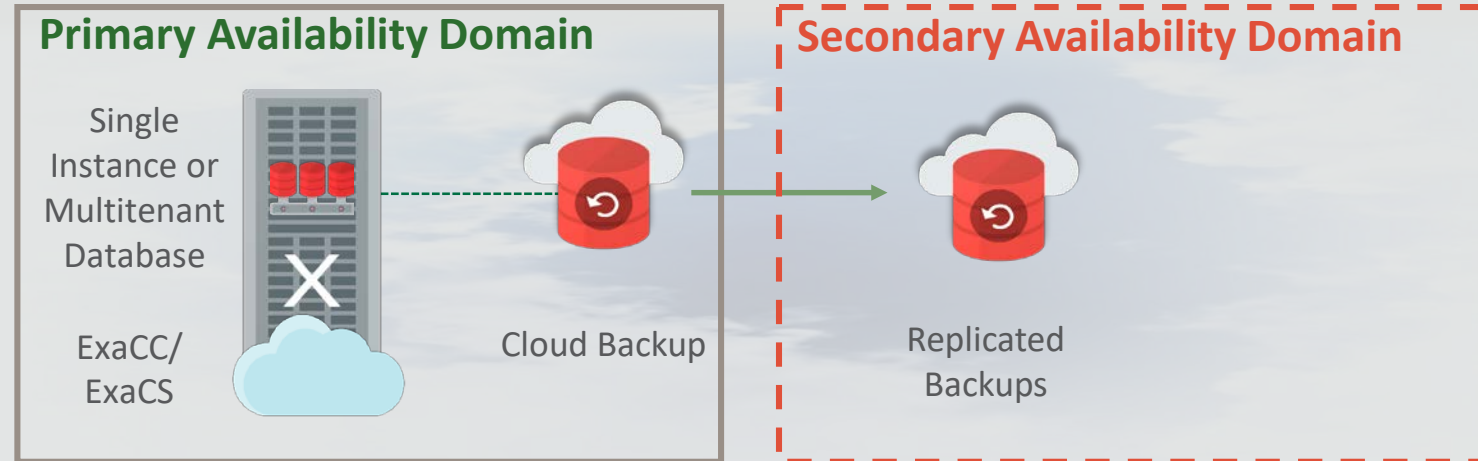
- Simple UI / CLI / REST interfaces being configured for MAA topologies
- Databases are provisioned with MAA parameter configurations
- MAA made easy in the Cloud
 - Oracle Cloud Infrastructure (or)
 - Cloud at Customer



BRONZE

Dev, Test, Prod - Single Instance or Multitenant Database with Backups

- HA infrastructure for storage and network
- Single Instance with Clusterware Restart
- MAA cloud backup/restore
 - Cloud object storage backups with copy across AD for public cloud
 - ZDLRA with incremental forever and near zero RPO for Cloud@Customer
- Multitenant Database/Resource Mgmt with PDB features
- Online Maintenance
- Some corruption protection
- Flashback technologies



Outage Matrix

Unplanned Outage	RTO / RPO*
Recoverable node or instance failure	Minutes to hour ***
Disasters including corruptions and site failures	Hours to days. RPO since last backup or near zero with ZDLRA
Planned Maintenance	
Most common software/hardware updates	Minutes to hour***
Major database upgrade	Minutes to hour

* RPO=0 unless explicitly specified

*** Exadata systems has RAC deployments but Bronze Exadata configuration without RAC can have **highest consolidation density** to reduce costs

SILVER

Critical Prod/Departmental

Bronze +

Real Application Clustering (RAC)
Application Continuity

Primary Availability Domain

RAC or RAC
One Database

ExaCC/
ExaCS



Cloud
Backup

Secondary Availability Domain



Replicated
Backups

Outage Matrix

Unplanned Outage

RTO/RPO*

Recoverable node or instance failure

Seconds

Disasters including corruptions and site failures

Hours to days. RPO since last backup or near zero with ZDLRA

Planned Maintenance

Most common software/hardware updates

Zero

Major database upgrade

Minutes to hour

* RPO=0 unless explicitly specified

GOLD

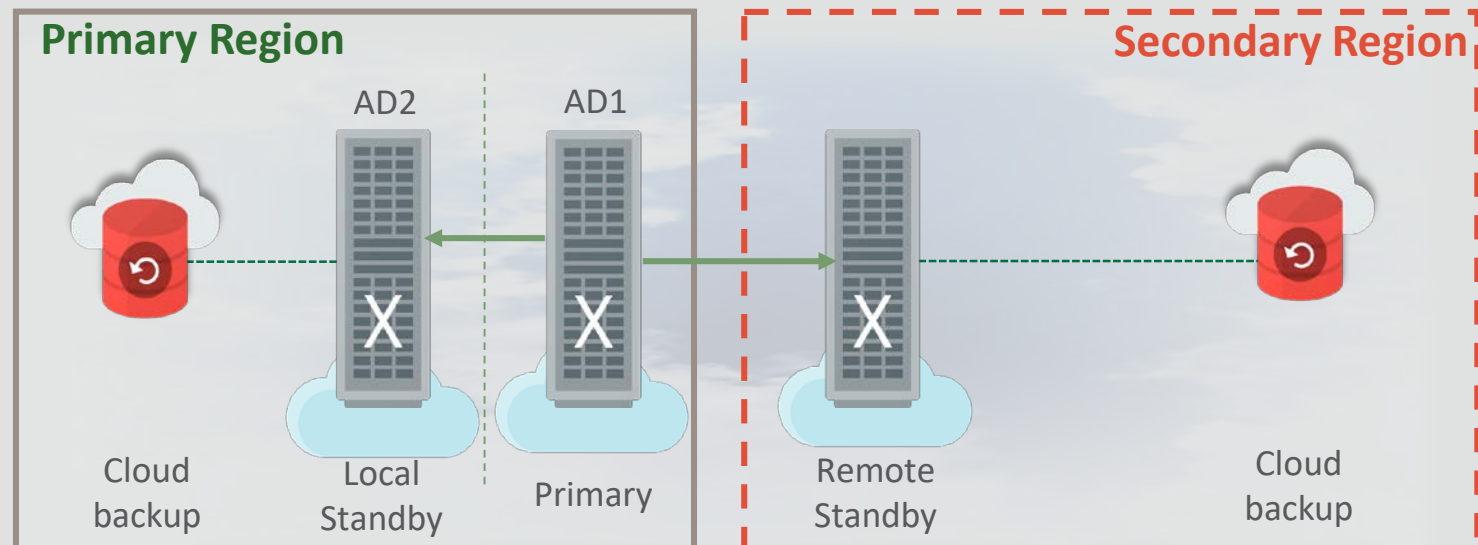
Mission Critical

Silver +

- Active Data Guard
- Comprehensive Data Protection

MAA Architecture:

- Minimum one standby either across AD or region.
- ExaCC/ExaCS primary in one data center(or AD) replicated to a standby ExaCC/ExaCS in another data center
 - Local backups on both sites



Outage Matrix

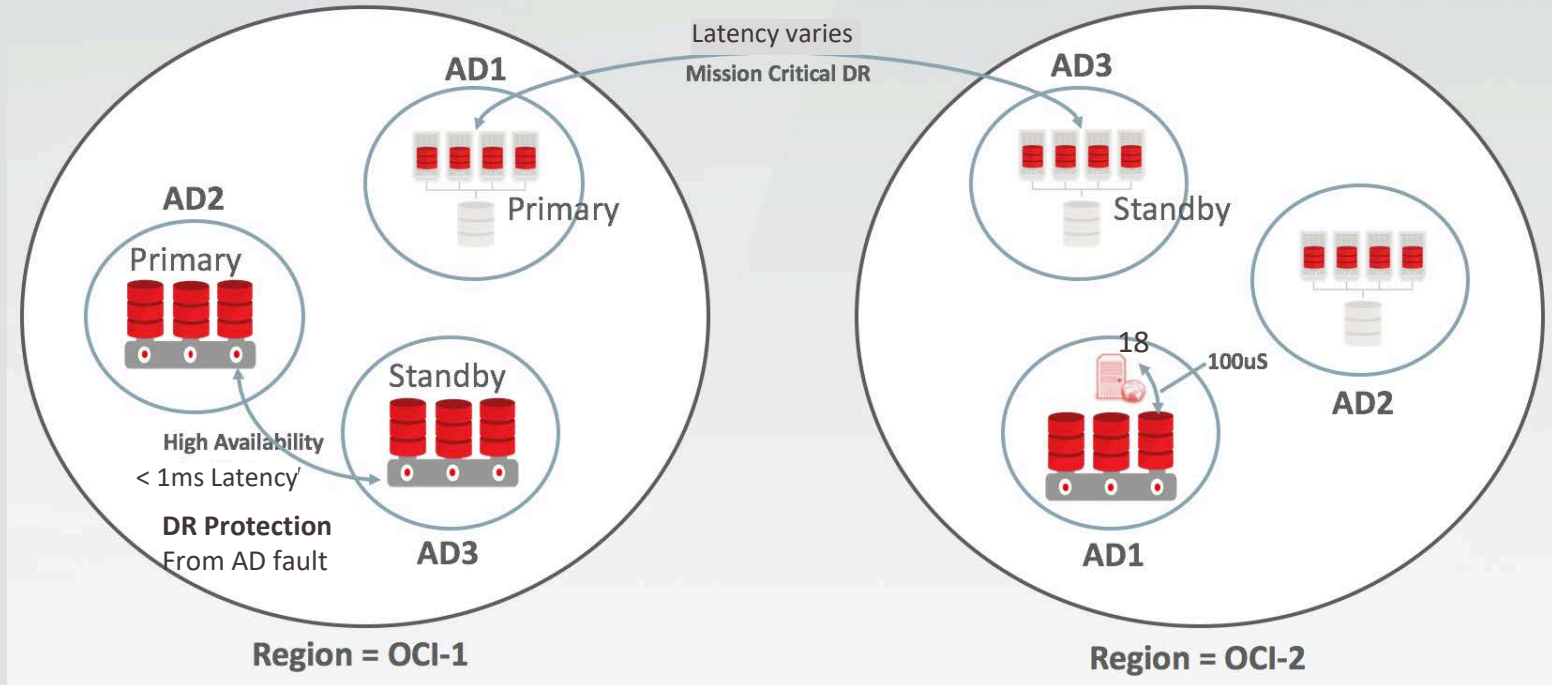
Unplanned Outage	RTO/RPO*
Recoverable node or instance failure	Seconds
Disasters including corruptions and site failures	Seconds. RPO zero or seconds
Planned Maintenance	
Most common software/hardware updates	Zero
Major database upgrade	Seconds

* RPO=0 unless explicitly specified

Oracle Cloud Deployment Model – Gold Tier



- Provides HA, data protection and fast failover for database across ADs
- Data Guard synchronous mode possible due to < 1ms between ADs
- Data Guard Fast Start Failover is manual
- VCN Peering across Regions available today
 - Cannot provision across Regions, so no DR via cloud tooling
 - May want to consider Far Sync instance as well in a different AD with *asynchronous redo* applies to the standby in the secondary region



PLATINUM

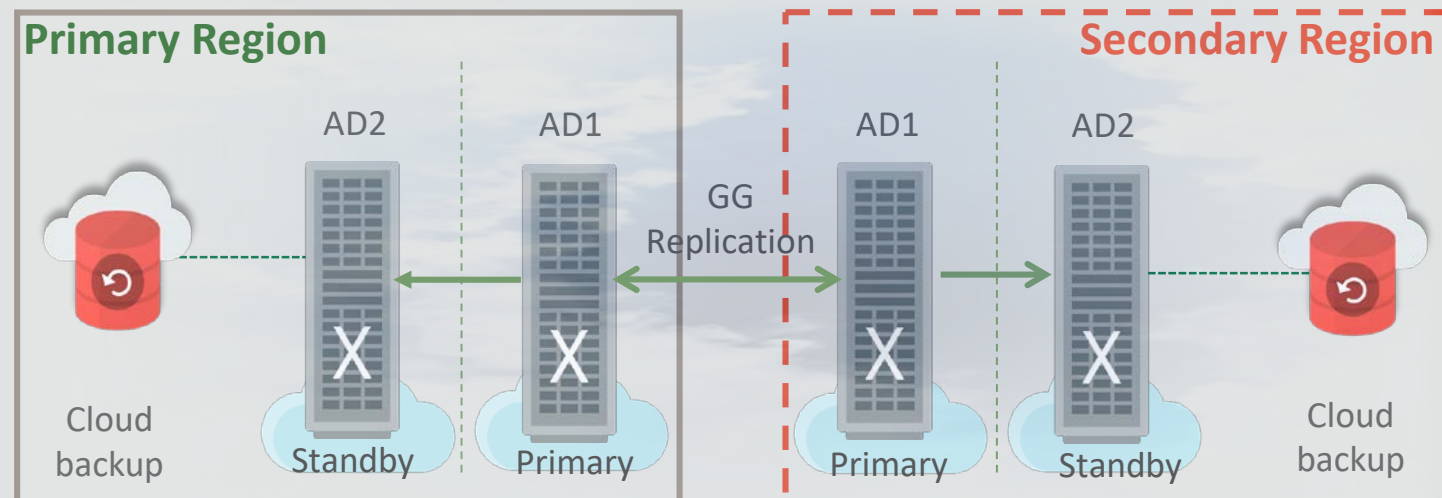
Extreme Critical

Gold +

- GoldenGate Active/Active Replication
- Optional Editions Based Redefinition

MAA Architecture:

- Each GoldenGate “primary” replica protected by Exadata/RAC and Active Data Guard
- ExaCC/ExaCS primary in one data center (or AD) replicated to another primary ExaCC/ExaCS in remote data center (or AD)
- Oracle GG & Editions Based Redefinition for zero downtime application upgrade
- Local/cloud backups on both sites
- To achieve zero downtime, custom failover to available GG replica required



Outage Matrix

Unplanned Outage	RTO/RPO*
Recoverable node or instance failure	Zero
Disasters including corruptions and site failures	Zero**
Planned Maintenance	
Most common software/hardware updates	Zero
Major database upgrade, application upgrade	Zero**

* RPO=0 unless explicitly specified ** application failover is custom



Management & Maintenance

- You control and manage software (in non-autonomous) that directly affects your application
 - Database, Grid Infrastructure, OS
- Oracle manages underlying infrastructure
 - Facilities, servers, storage, storage software, networking, firmware, hypervisor, etc.
- You have administrator privileges for compute VMs and databases so you can configure and run the system as you like
 - Initiate automated database update script when it is convenient
 - Can be run rolling across nodes to avoid database downtime
 - Create backup schedule, initiate on-demand backups

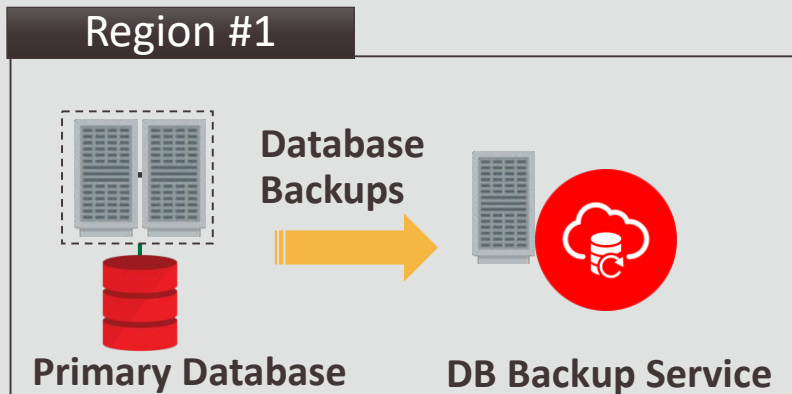


<https://www.oracle.com/technetwork/database/exadata/em-exadata-cloud-3959023.pdf>

Autonomous DB - High Availability Policy



- RAC Database in a single Availability Domain, with redundant storage and networking
 - Nightly Backup that is replicated across ADs
- Protects from the most common sources of downtime such as hardware failures, software crashes, and quarterly software updates
- Service Uptime SLA per Month: **99.95% - less than 22 minutes of downtime per month***
- Suitable for test, development and non-mission critical production databases



* SLA excludes AD or Regional Failures, data corruptions and certain planned maintenance tasks like major upgrades

Autonomous DB - Extreme Availability Policy (Available Soon)



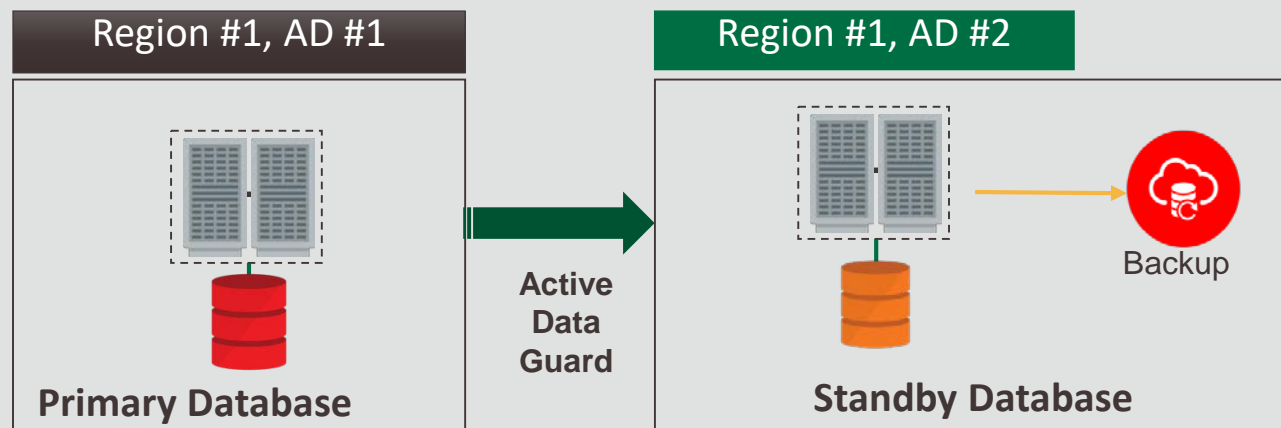
RAC Database, Redundant Networking and Storage, Active Data Guard, and Backup Protection from hardware failures, crashes, corruptions, patches, upgrades, site disasters

Service Uptime SLA per Month: **99.995NRX%** (NRX = No Ridiculous Exclusions)

99.995% Uptime = at most 2m 12s of downtime per month

Goal is for application impact from any one event to be well under 30 seconds

Suitable for Mission Critical production databases



Maximum Availability Architecture - Best Practices for the Oracle Cloud

Migrating to the Cloud

Before Migration: Sizing & Planning

“Avoid Outages and Poor Performance”

Understand your requirements

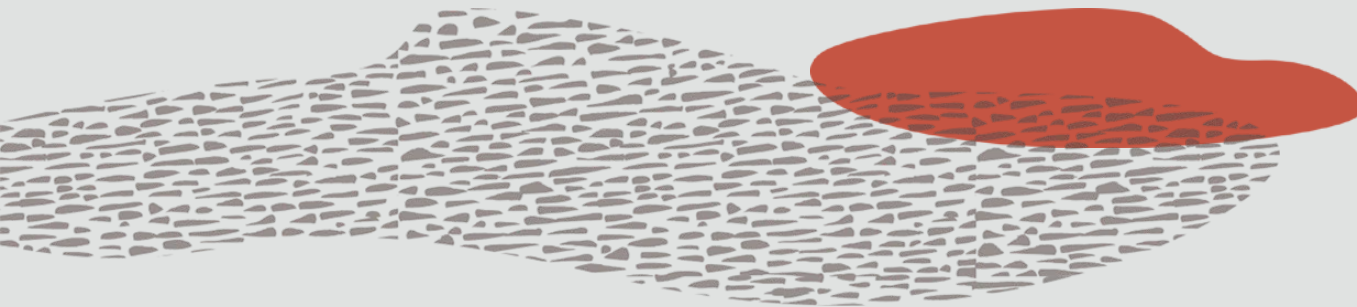
1. Database CPU processing
2. Database Memory*
3. Database Storage capacity*

➤ **Determine all databases to be consolidated based on requirements**

➤ **Pick the correct shape**

➤ **Work with Oracle Sales Consultant**

**No oversubscription of memory and storage*



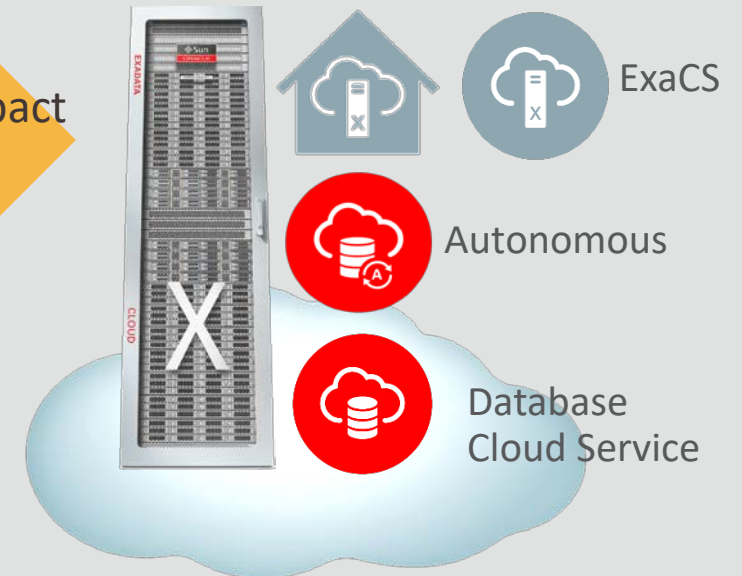
Migration to Cloud

Mixed Platforms
Mixed DB Versions
Non-CDB and PDBs
Non-Encrypted (usually)

Oracle Linux
11.2.0.4 (non-CDB)
12.1.0.2, 12.2.0.1, 18.3.0, 19.3 (CDB)
Encrypted
SI, RAC, Exadata

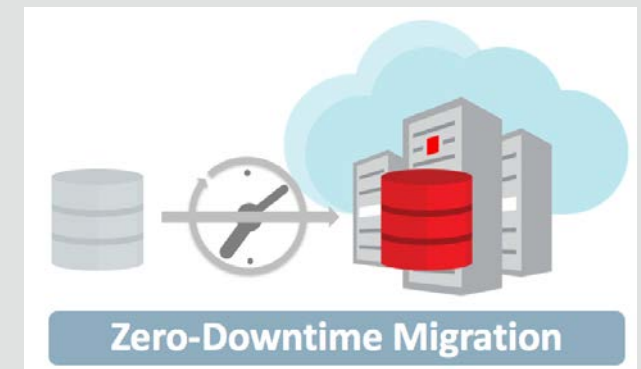
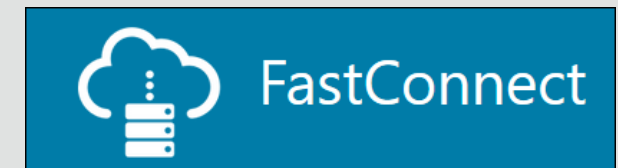
Cloud Migration Service

Simple
Minimal Impact
Near Zero
Downtime



Instantiation Options and Considerations

- Data Transfer Service for Instantiation
 - Data Transfer Disk
 - Data Transfer Appliance
- Migration Connectivity Options
 - FastConnect
 - IPSec VPN and Internet Gateway
- Cloud Migration Tools and Documentation
 - Zero-Downtime Migration (ZDM)
 - <http://oracle.com/goto/MOVE>



Migration Solutions

Physical Migration: Simple. Same Platform. Same DB version. CDB to CDB or non-CDB to non-CDB

	Method	Downtime	Solutions
#1	Backup/Restore with Cloud Object Storage or ZDLRA	Hours to days	ZDM
#2	Data Guard	Less than 5 mins	ZDM and MOS 2386116.1
#3	Data Guard with Transient Logical plus Plugin	Less than 1 hour	MOS 2326901.1

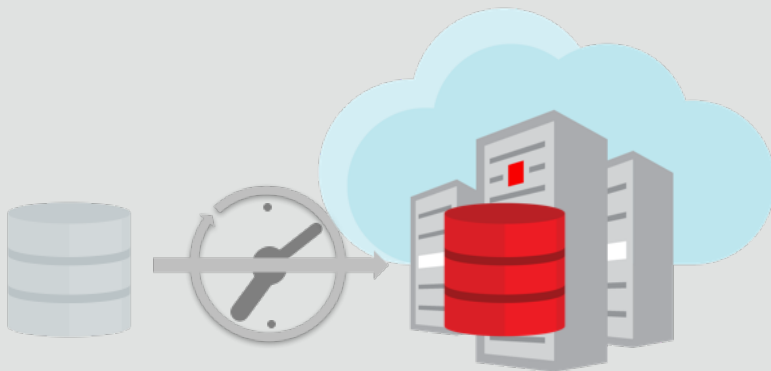
Logical Migration: Flexible. Cross Platform, DB Version, PDB/Schema support. TDE enabled on target.

	Method	Downtime	Solutions
#1	Data Pump	Hours to days	ZDM and cloud API future
#2	Golden Gate	Potentially Zero	MAA paper/ ZDM in the future

Zero Downtime Migration

Simple

Single Button Approach



Zero Downtime Migration

MAA Compliant

Extensive Pre-checks

Extensive Post-checks

Resumable

Rollback enabled

Dry-run option

Fleet Scale

Centralized

Scheduled Operations

Command Deck

Audit Trail

Zero Downtime Migration Platforms

Sources

ORACLE®
Database 11g

ORACLE®
Database 12c

ORACLE®
Database 18c

Targets

ORACLE®
Database 11g

ORACLE®
Database 12c

ORACLE®
Database 18c

Same Version / Platform



Zero Downtime Migration



ORACLE®
Database
Cloud Service
Virtual
Machines



ORACLE®
Database
Cloud Service
Bare
Metal



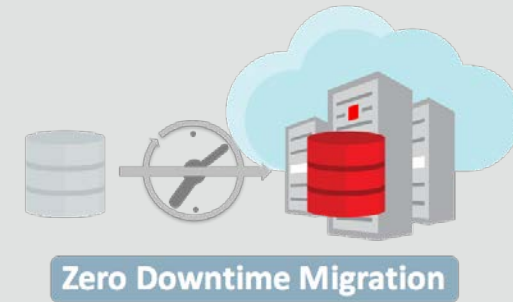
ORACLE®
Database
Cloud Service
Exadata
Cloud Service



ORACLE®
Database
Cloud Service
Exadata
Cloud at Customer

Zero Downtime Migration

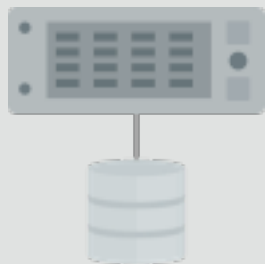
Workflow



Download &
Configure ZDM

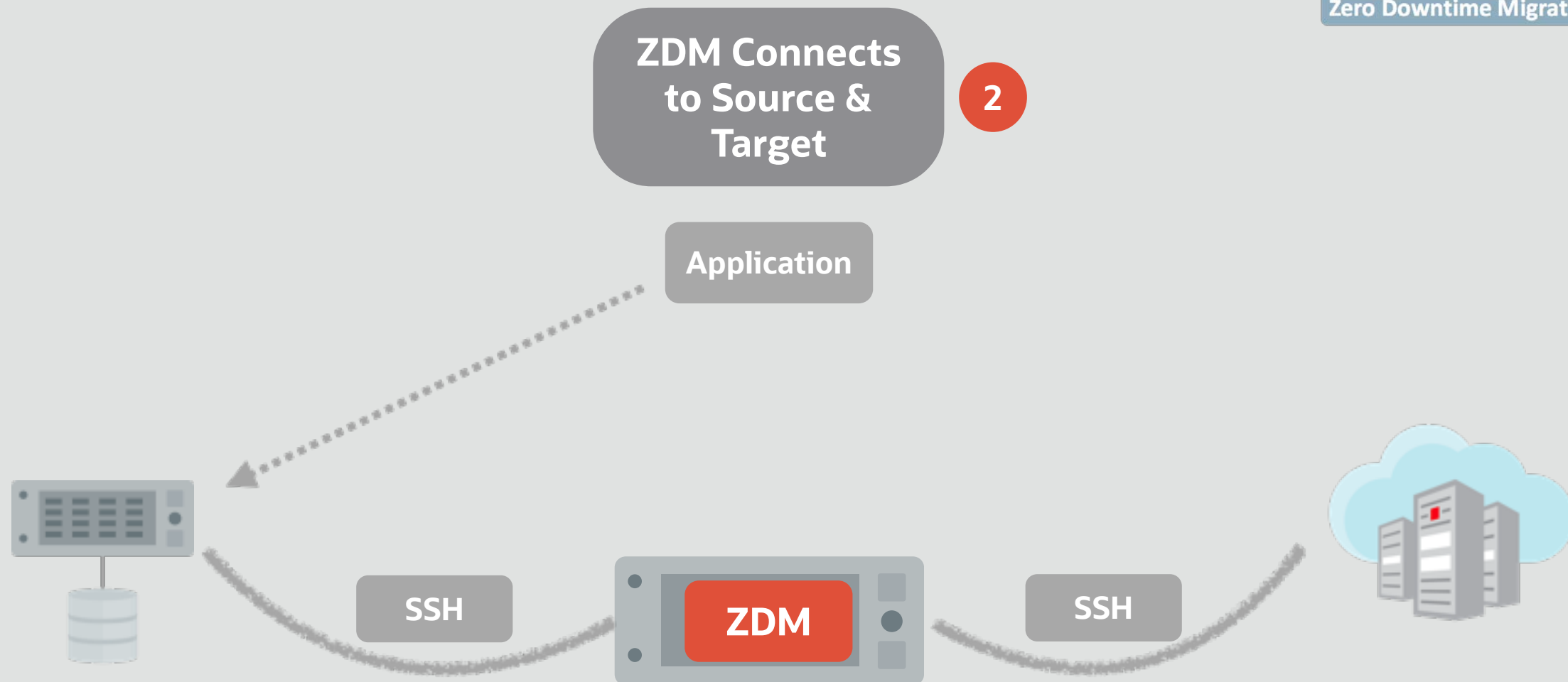
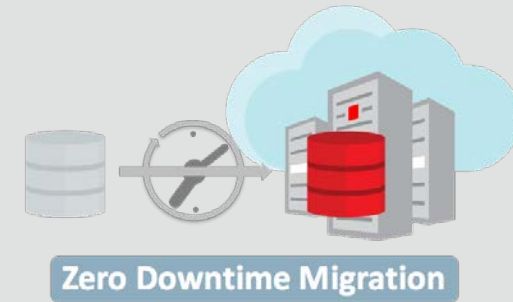
1

Application



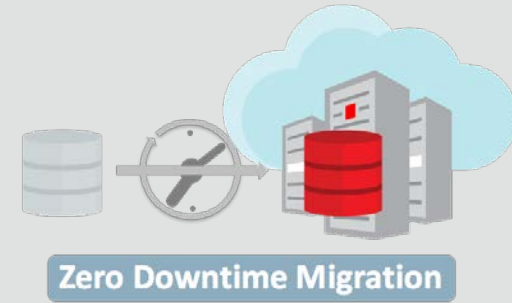
Zero Downtime Migration

Workflow



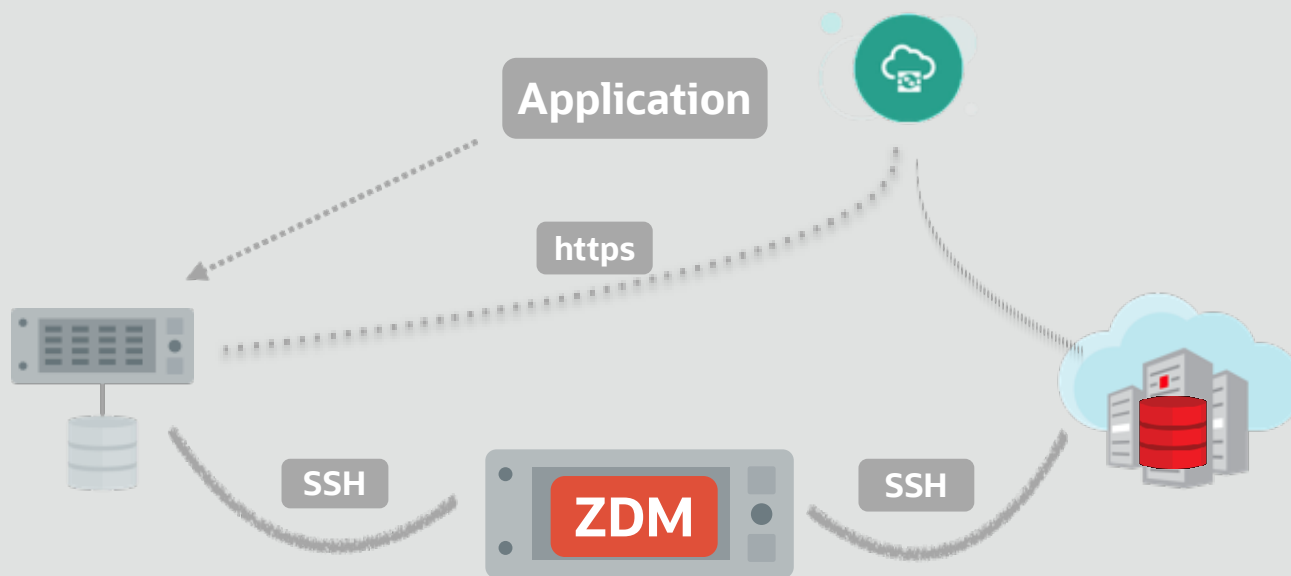
Zero Downtime Migration

Workflow



ZDM
Instantiates
Standby

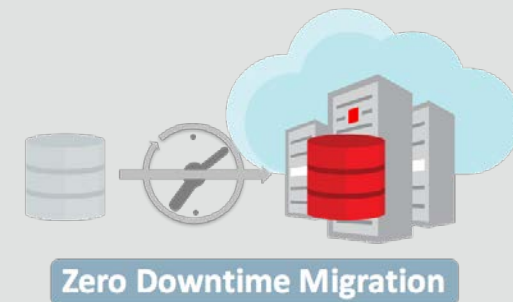
3



- Standby is instantiate with cloud backup and restore

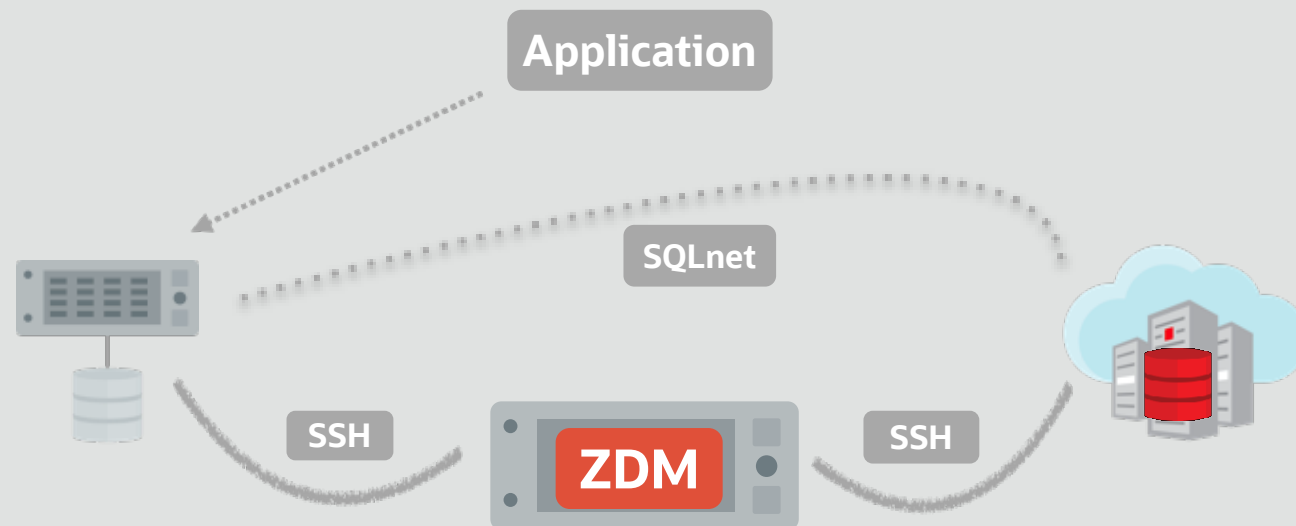
Zero Downtime Migration

Workflow



Hybrid Data
Guard

4

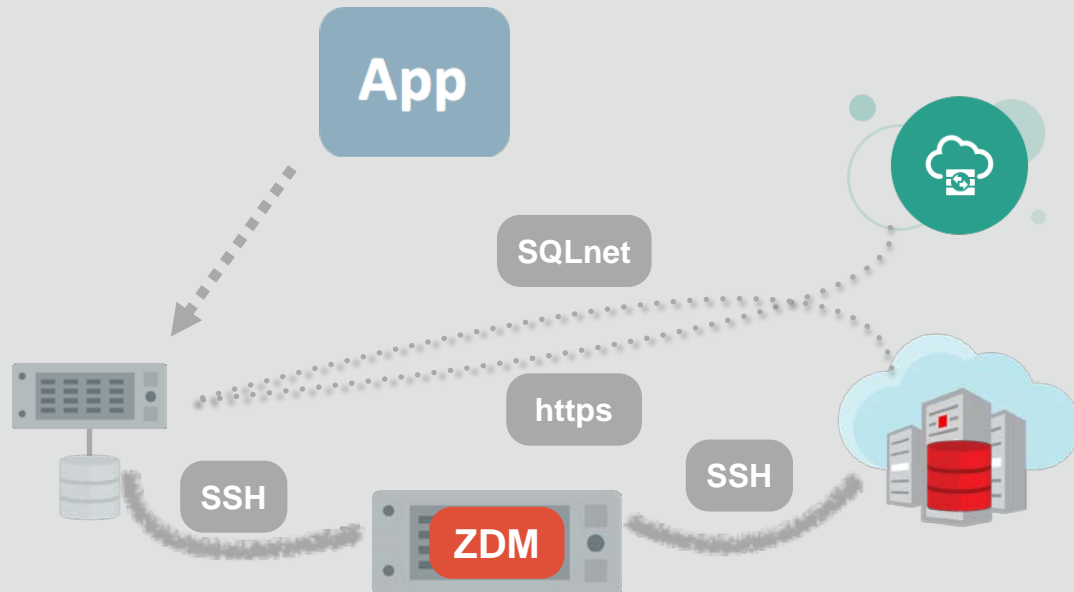


- Data Guard is setup with MAA practices
- Redo Transport and Real Time Apply Starts
- Lag is monitored



Oracle Zero Downtime Migration Steps

An automated Data Guard migration solution



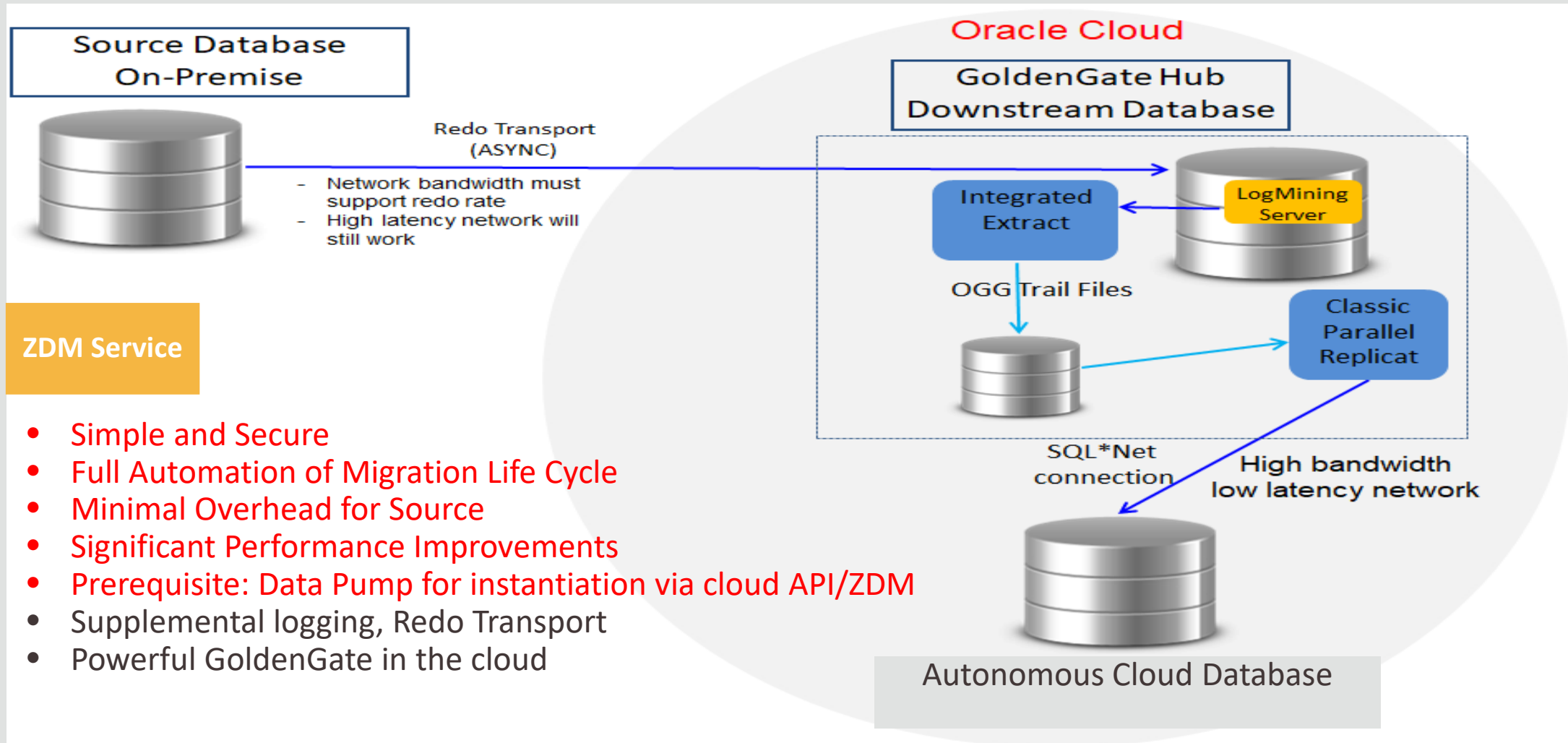
- 1 Download ZDM
- 2 Connects to Source & Target
- 3 Connects to Object Store
- 4 Transfers DB Files
- 5 Instantiates Standby
- 6 Syncs Primary & Standby
- 7 Switches over & Role swaps
- 8 User finalizes at will

Zero Downtime Migration (ZDM) Demo



Zero Downtime Migration

ZDM: GoldenGate Hub for Autonomous Database

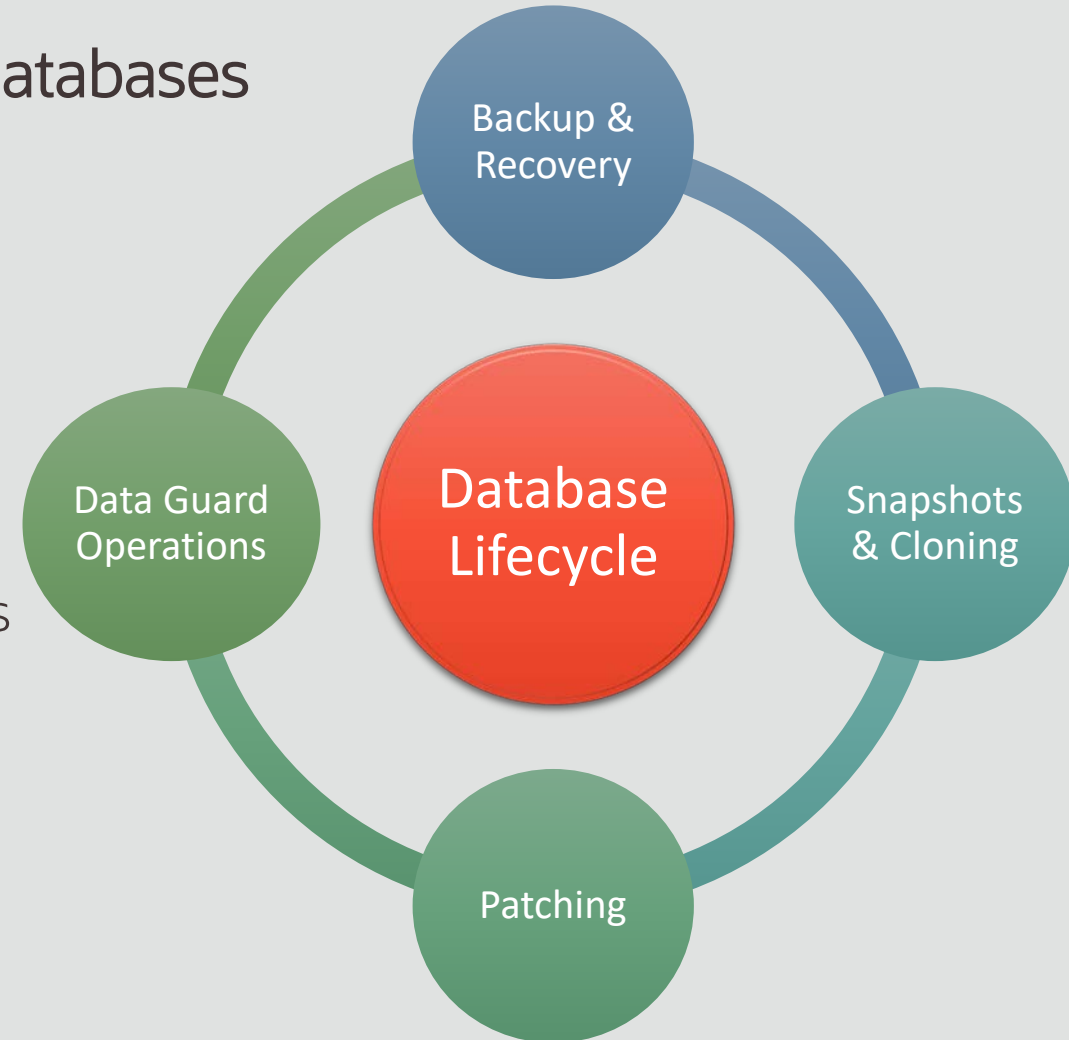


MAA Lifecycle Automation in the Cloud



Easy Lifecycle Management for Cloud Databases

- Migration
- Backup & Recovery
 - Full or Point-in-Time Recovery
 - Instantiate new instances from backups
- Data Guard Operations
 - Failover, Switchover, Reinstatement operations
- Database and Grid Patching
 - Push button deployment



Via UI or REST APIs

Cloud Life Cycle Examples: DBCS Backups

Resources

Backups (4)

Patches (1)

Patch History (1)

Data Guard Associations (0)

Backups

Displaying 4 Backups

Create Backup

Enable Automatic Backup

<div><div>B</div><div>ACTIVE</div></div>	<div>Automatic Backup</div> <div>OCID: ...rj2t5q <a>Show <a>Copy</div> <div>Type: Incremental</div>	<div>Started: Tue, 16 Oct 2018 05:38:37 GMT</div> <div>Ended: Tue, 16 Oct 2018 05:41:43 GMT</div> <div>...</div>
<div><div>B</div><div>ACTIVE</div></div>	<div>Automatic Backup</div> <div>OCID: ...xem4ma <a>Show <a>Copy</div> <div>Type: Incremental</div>	<div>Started: Mon, 15 Oct 2018 05:37:56 GMT</div> <div>Ended: Mon, 15 Oct 2018 05:42:50 GMT</div> <div>...</div>
<div><div>B</div><div>ACTIVE</div></div>	<div>Automatic Backup</div> <div>OCID: ...modwla <a>Show <a>Copy</div> <div>Type: Incremental</div>	<div>Started: Sun, 14 Oct 2018 05:36:59 GMT</div> <div>Ended: Sun, 14 Oct 2018 06:09:26 GMT</div> <div>...</div>
<div><div>B</div><div>ACTIVE</div></div>	<div>OCT14_PROD_BACKUP</div> <div>OCID: ...45ey4a <a>Show <a>Copy</div> <div>Type: Full</div>	<div>Started: Sun, 14 Oct 2018 18:19:30 GMT</div> <div>Ended: Sun, 14 Oct 2018 18:23:10 GMT</div> <div>...</div>

Cloud Life Cycle Examples: Data Guard Setup

Resources

Backups (5)

Patches (2)

Patch History (0)

Data Guard Associations (1)

Data Guard Associations

Displaying 1 Data Guard Associations

Enable Data Guard

DB

AVAILABLE

Peer Database: [CRMCDB](#)

Peer Role: Standby

Peer DB System: [CRMPROD_DR](#)

Launched: Sat, 13 Oct 2018 05:03:03 GMT

Protection Mode: Maximum Performance

Availability Domain: eGJB:US-ASHBURN-AD-3

Apply Lag: 0 seconds

Apply Rate: 5.00 KByte/s

Transport Type: Async

...

Resources

Backups (0)

Patches (2)

Patch History (0)

Data Guard Associations (1)

Data Guard Associations

Displaying 1 Data Guard Associations

Enable Data Guard

DB

AVAILABLE

Primary Database: [CRMCDB](#)

Peer Role: Primary

Peer DB System: [CRMPROD](#)

Launched: Sat, 13 Oct 2018 05:13:34 GMT

Protection Mode: Maximum Performance

Availability Domain: eGJB:US-ASHBURN-AD-1

Apply Lag: 0 seconds

Apply Rate: 5.00 KByte/s

Transport Type: Async

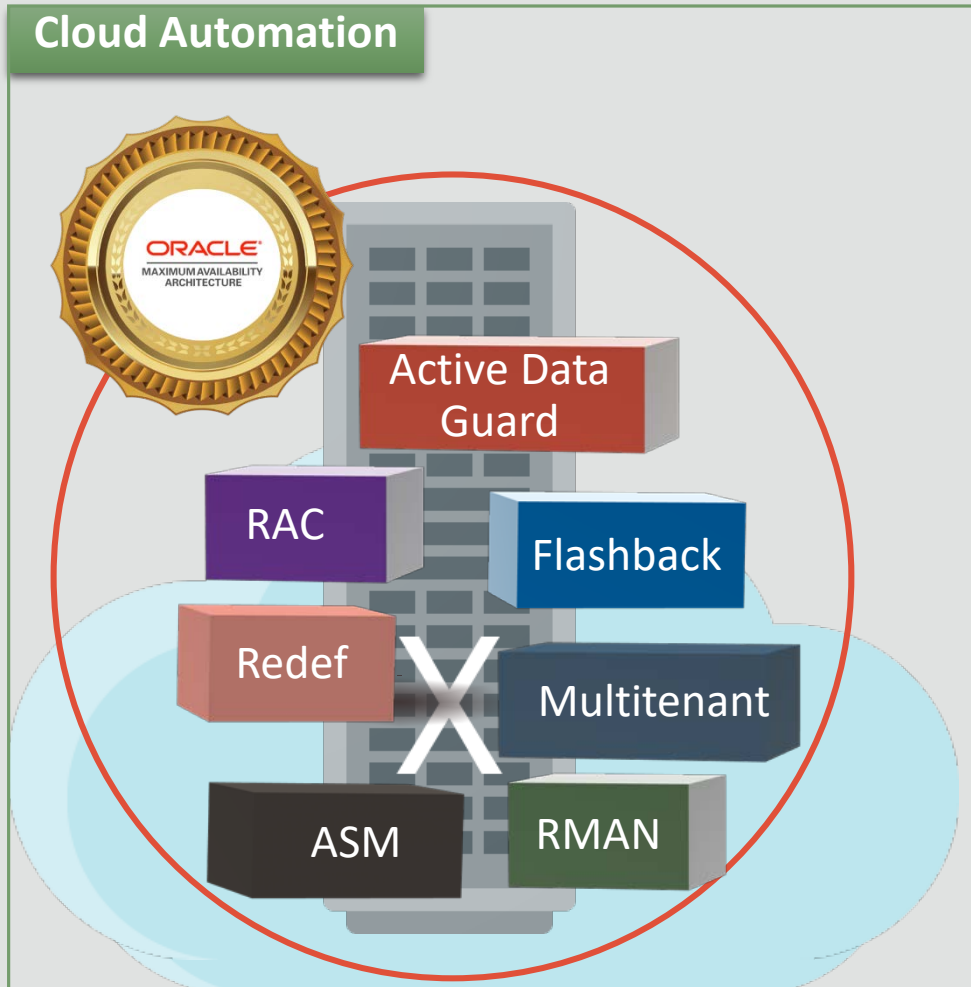
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Maximum Availability Architecture - Best Practices for the Oracle Cloud

Summary

Cloud Uptime Availability Enablers




- **Real Application Clusters** – provides transparent ,near-zero downtime patching, and near-zero downtime for server failover
- **Active Data Guard** - provides DB upgrade in seconds, corruption prevention and auto repair, disaster failover, reporting offload
- **Redefinition** – Online Redefinition provides online changes to table and index definitions
- Other building blocks include **ASM**, **RMAN**, **Flashback**, **Multitenant** etc.
- **Exadata** provides hardware fault-tolerance, fastest detection of faults and sick components, lowest brownout
- **Maximum Availability Architecture** integration provides proven Enterprise Mission Critical Architecture, configuration best practices and life cycle operations
- **Cloud Automation** – complete automation and testing of full stack from database to disks ensures High Availability and prevents configuration and operator issues

What's Ahead



Thursday



- 9:00-9:45** Best Practices for Exadata Cloud Deployments (PRO4864)
Moscone South 215/216
- 1:15-2:00** Maximum Availability Architecture (MAA) Best Practices For Oracle Database 19c (TIP4847) Moscone South 215/216
- 

- 2:15-3:00** Best Practices for the Most Impactful Oracle Database 18c and 19c Features (TIP4855)
Moscone South 215/216

Questions & Answers

- Glen Hawkins, Senior Director of Product Management, MAA, Oracle
- Brian Spendolini, Senior Principal Product Management, DB Cloud, Oracle