

ORACLE

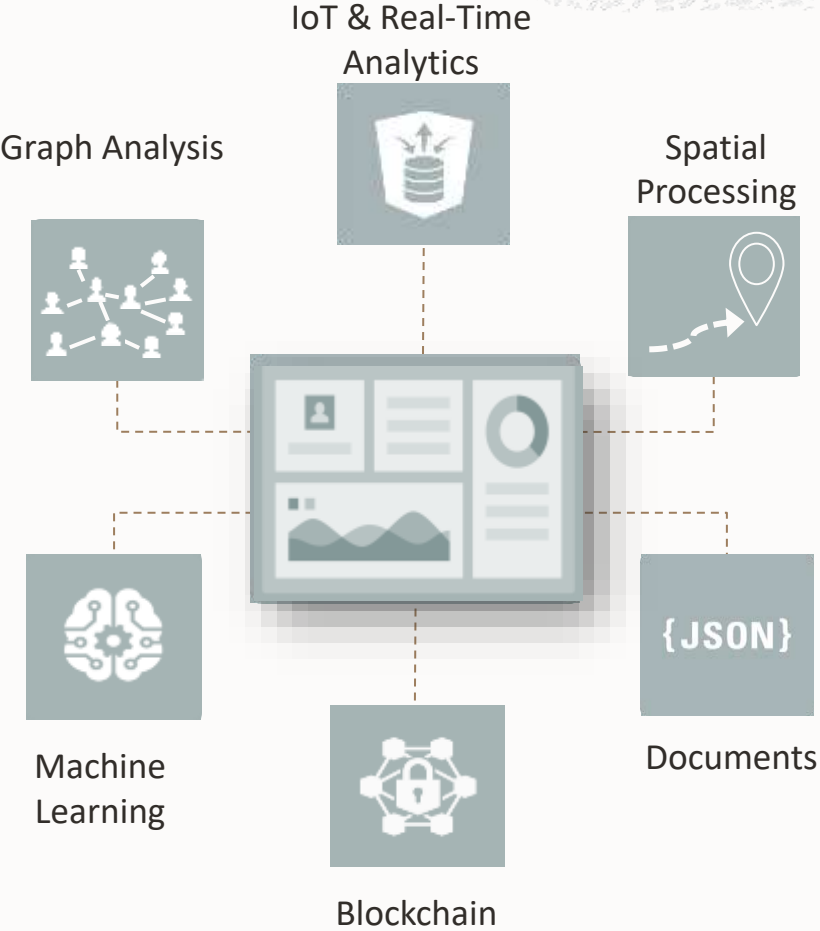
# Oracle Maximum Availability Architecture Take the lead and remain in control

**Ciprian Pustianu**

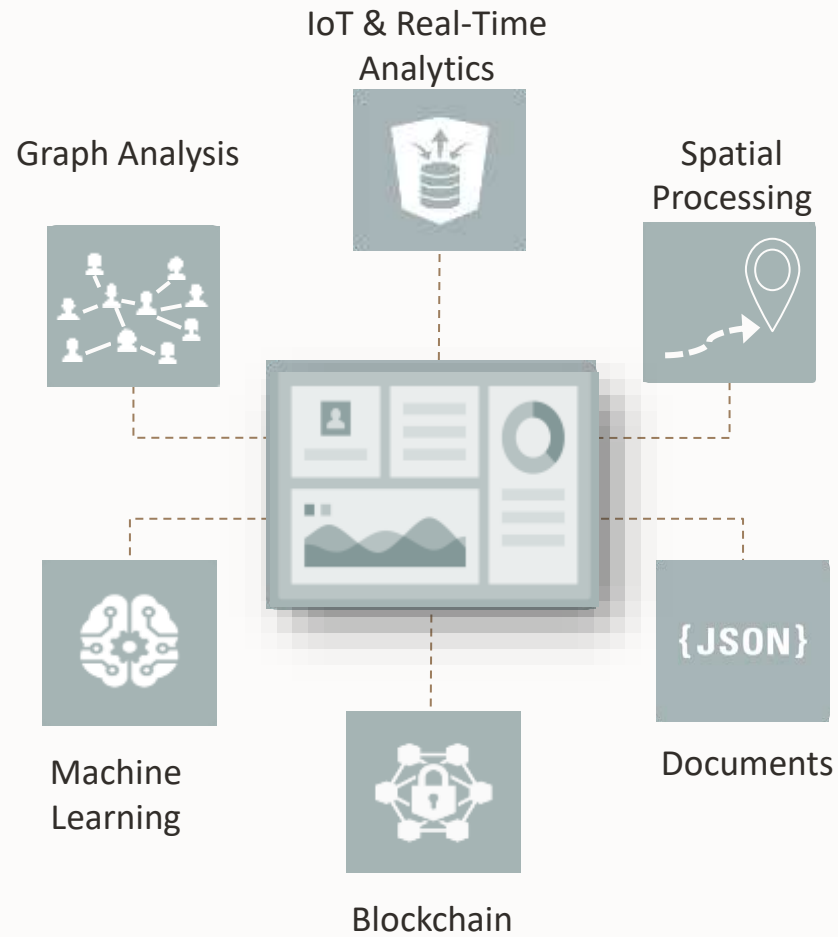
Principal Solution Specialist



# Modern Apps Need To **Generate Value From Data in New Ways**



# Modern Apps Are Built Using New Development Methodologies

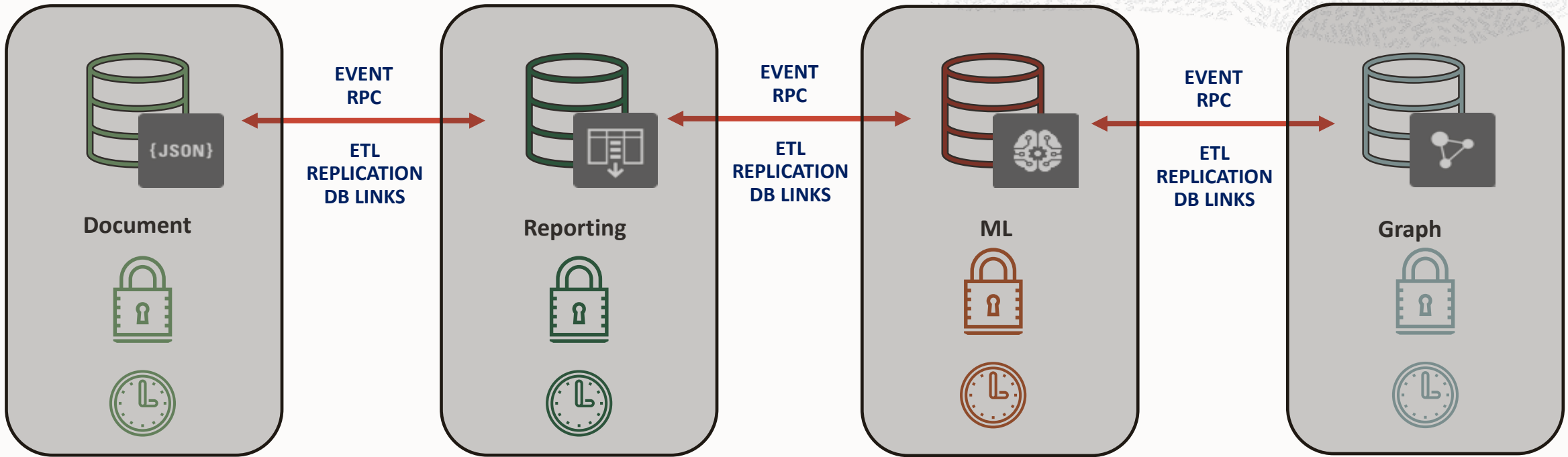


*New data-driven development methodologies or paradigms are available:*

- API Driven Development
- Microservices
- Containers
- CI/CD - Continuous Integration and Development
- Low code development
- Events
- Cloud Native App
- **Single-Purpose**, "best-of-breed" database

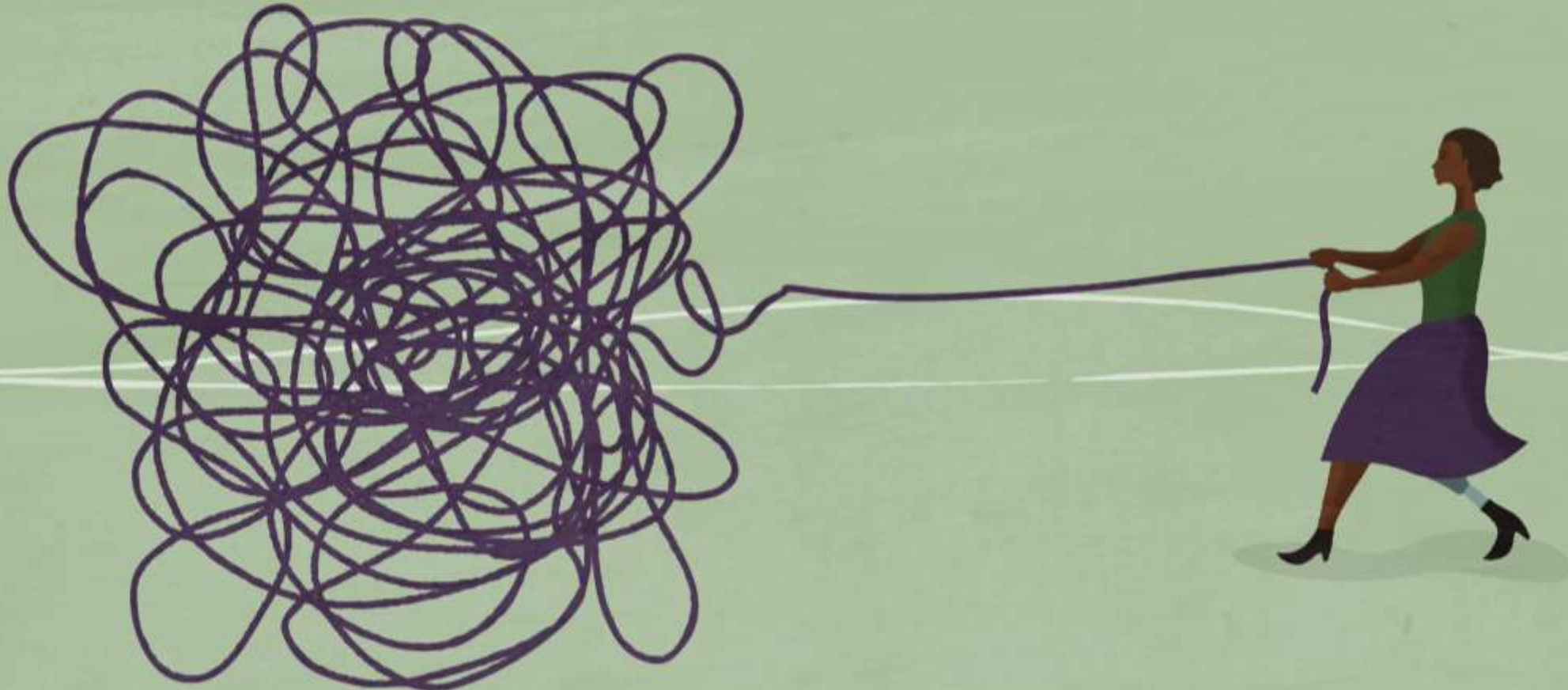


## Modern App Requirements **Lead to an Alternative Approach**

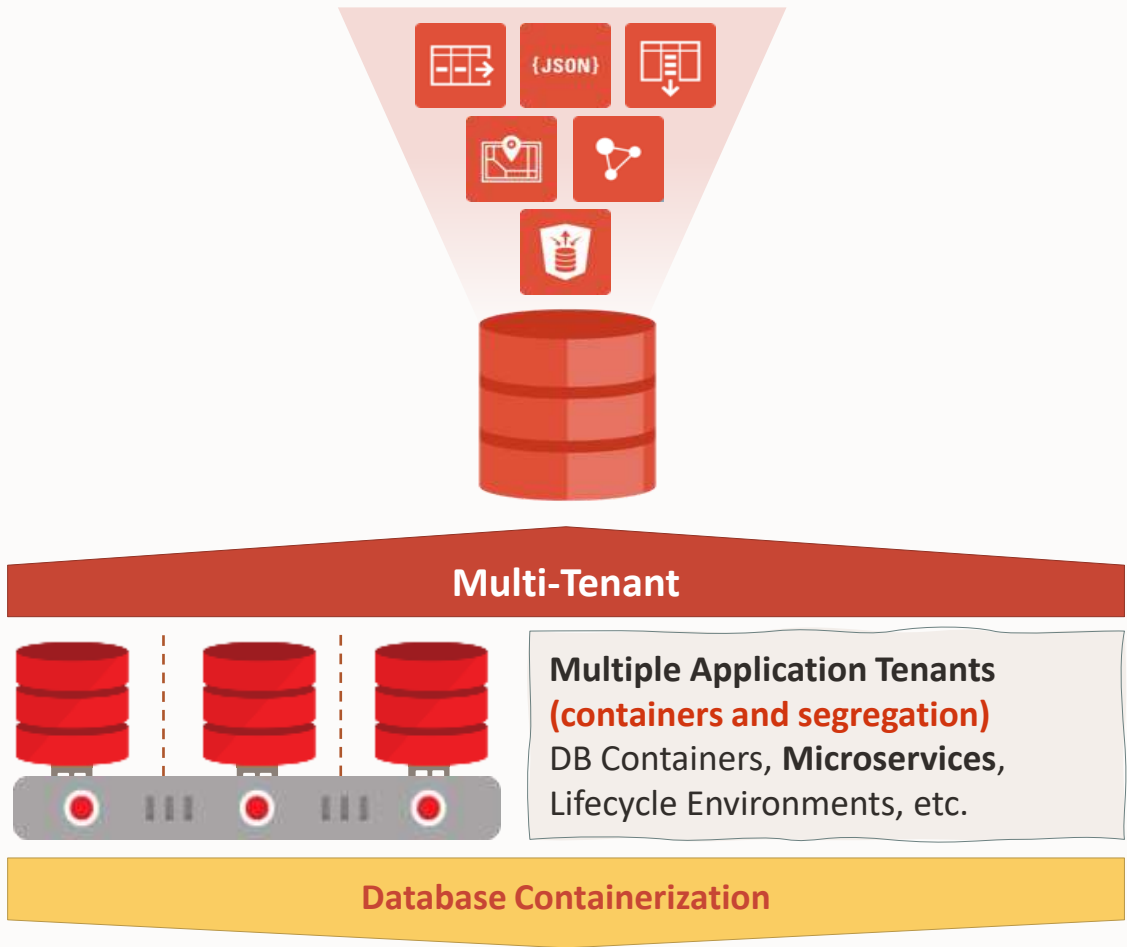


In addition, each of these specialized databases routinely has a **completely different security, high availability, and disaster recovery paradigm** creating operational silos into the architecture usually leading to complex maintenance operations, more downtime, and prolonged recovery in the case of a disaster event

# How Do you Manage This Level of Complexity?



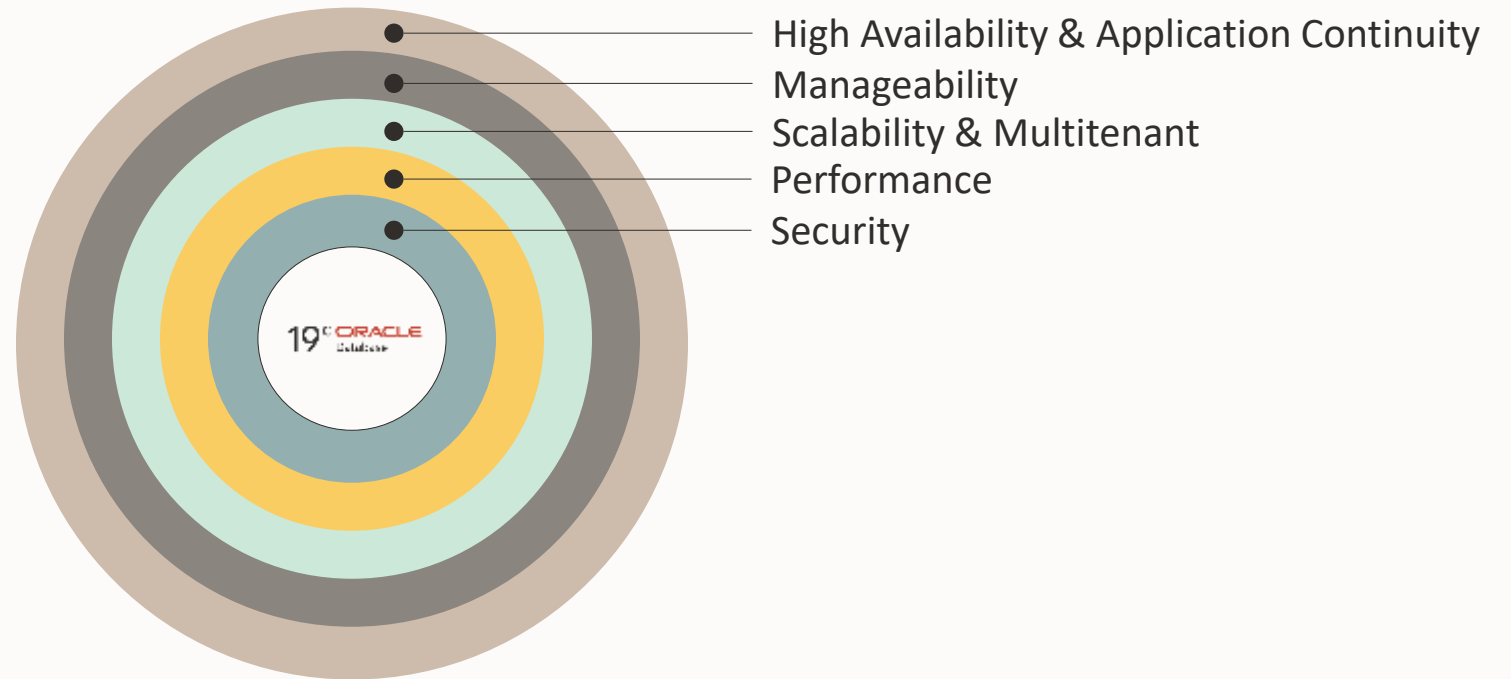
# The Easier Way - Oracle **Converged** Database



- Simplifying new development methodologies with **synergistic data technologies**
- Eliminating data fragmentation with a single **Converged Database** for all data types and uses
- Providing **easy to use declarative implementations** of the new data uses and types in the core database

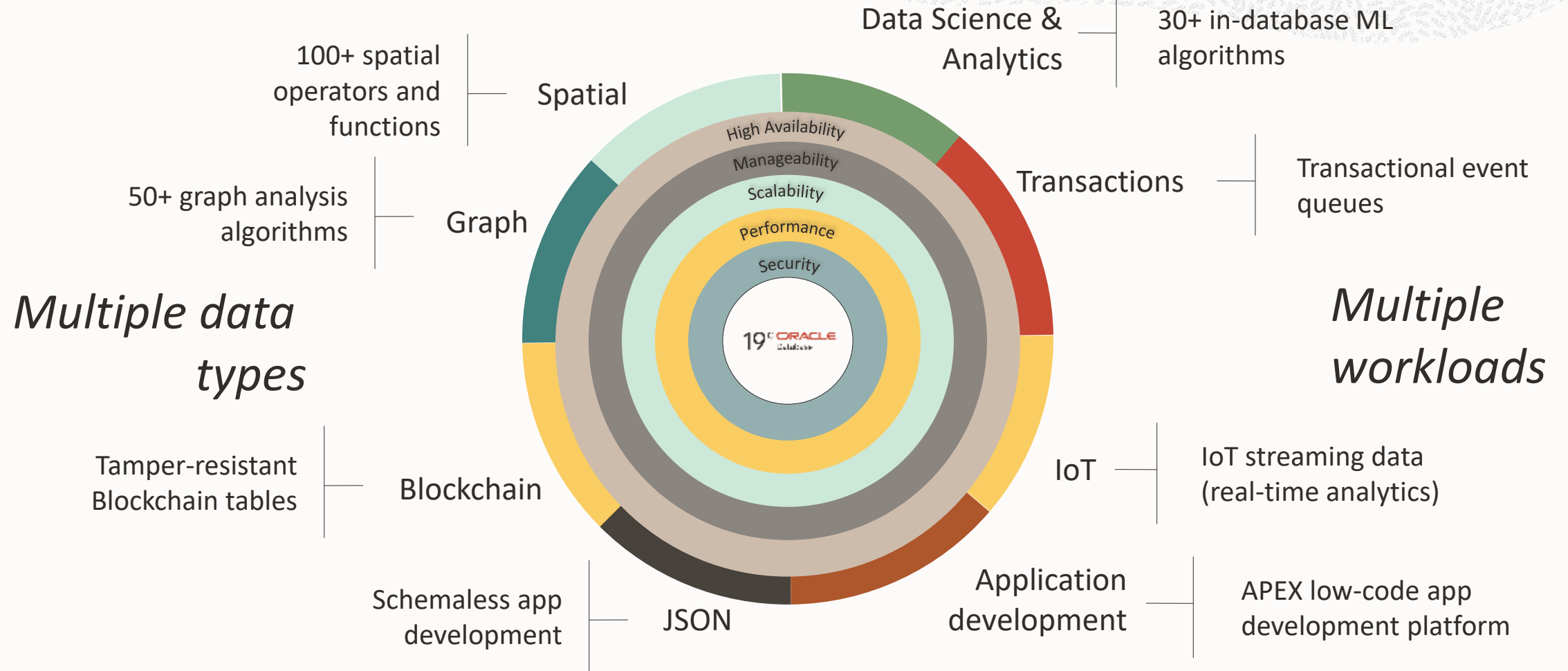


# Oracle Database – core, user-driven capabilities



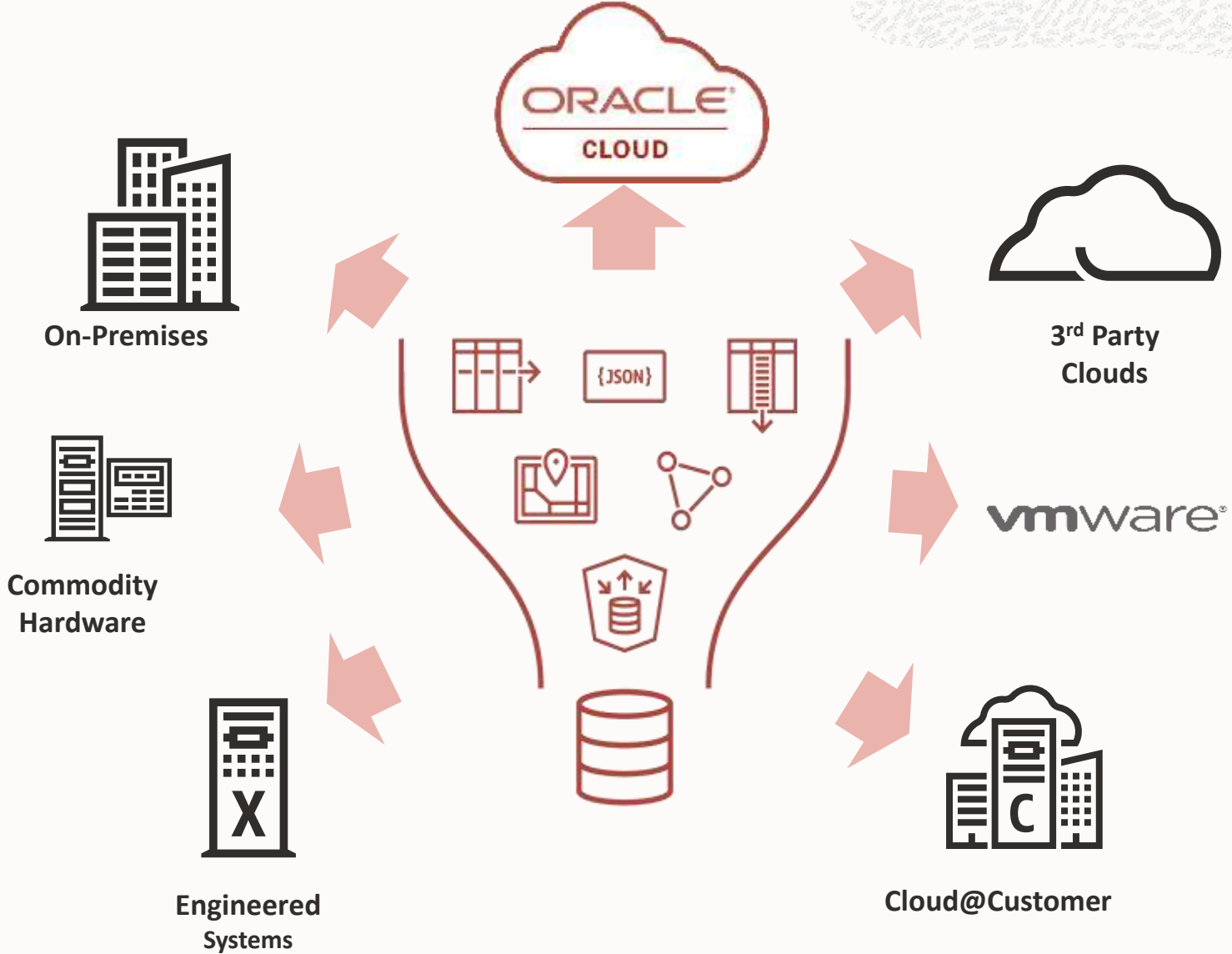


# Oracle Database – converged by design





# Oracle Database, The Converged Database is Available Everywhere




# How Does the Converged Database Ensure High Availability & Business Continuity?



# Types of downtime and recovery objectives


## Types of downtime




PLANNED  
MAINTENANCE



UPGRADE

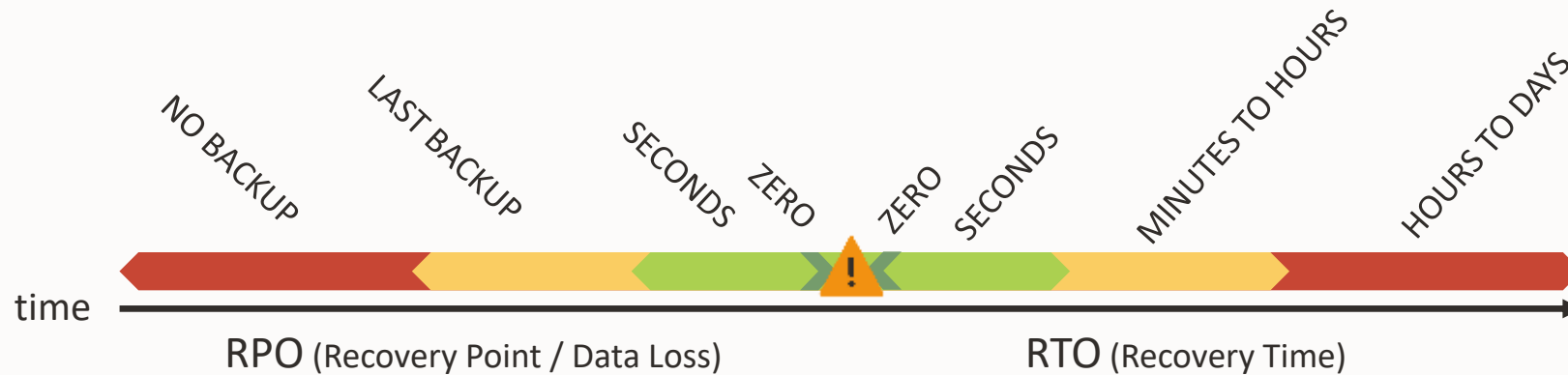


RECOVERABLE  
LOCAL FAILURE



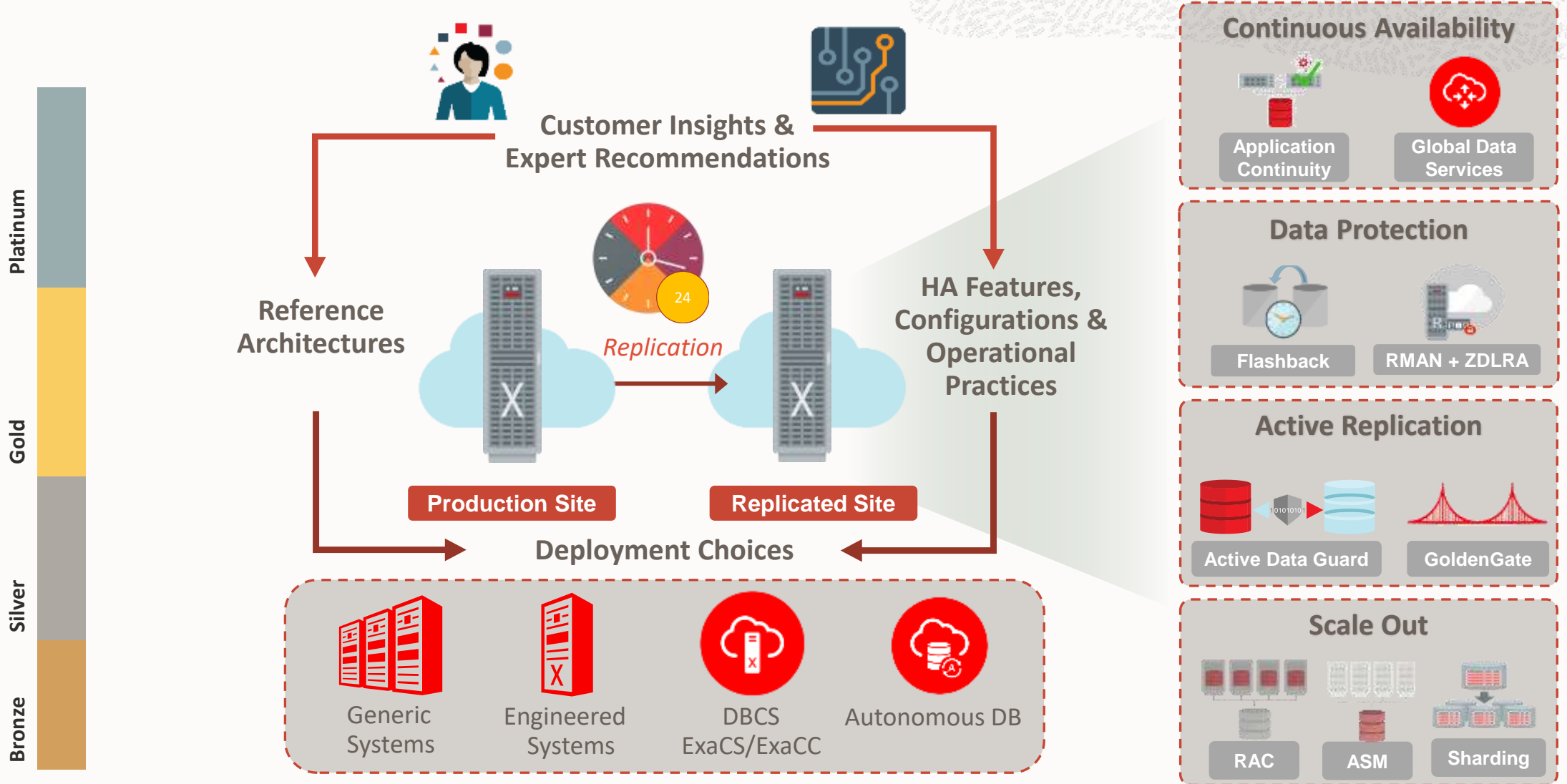
UNRECOVERABLE  
OR SITE FAILURE

## Recovery objectives



# Oracle Maximum Availability Architecture (MAA)





From Single Instance to 99.999% Availability



# MAA reference architectures

## Availability service levels



Bronze	Silver	Gold	Platinum
<b>Dev, test, prod</b>	<b>Prod/departmental</b>	<b>Business critical</b>	<b>Mission critical</b>
	<b>Bronze +</b>	<b>Silver +</b>	<b>Gold +</b>
Single instance DB	Database HA with RAC	DB replication with Active Data Guard	GoldenGate
Restartable	Application continuity		Edition based redefinition
Backup/restore			
			

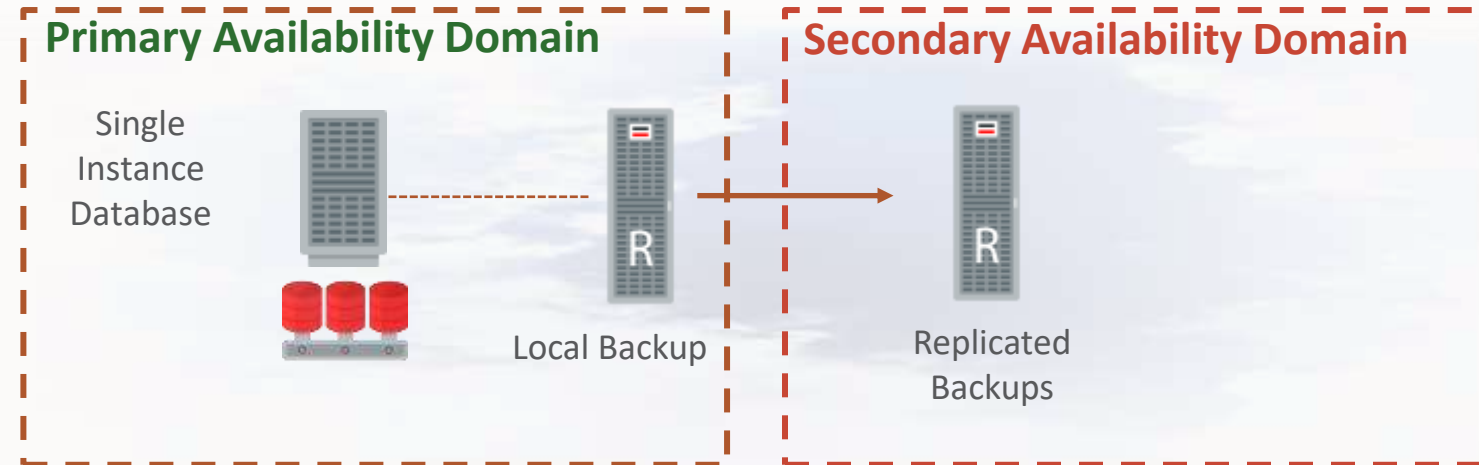
All tiers exist with on-premises and cloud. However, platinum currently must be configured manually while bronze to gold are covered with cloud tool automation for the most part depending on the desired RTO (i.e. FSFO & multiple standby databases still must be manually configured for example)



# BRONZE

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

- Single Instance with Clusterware Restart
- Advanced backup/restore with RMAN
  - Optional ZDLRA with incremental forever and near zero RPO
- Storage redundancy and validation with ASM
- Multitenant Database/Resource Management with PDB features
- Online Maintenance
- Some corruption protection
- Flashback technologies



## Outage Matrix

Unplanned Outage	RTO / RPO Service Level Objectives (f1)
Recoverable node or instance failure	Minutes to hour (f2)
Disasters: corruptions and site failures	Hours to days. RPO since last backup or near zero with ZDLRA
Planned Maintenance	
Software/hardware updates	Minutes to hour (f2)
Major database upgrade	Minutes to hour

f1 : RPO=0 unless explicitly specified

f2 : Exadata systems has RAC but Bronze Exadata configuration with Single Instance database running with Oracle Clusterware has **highest consolidation density** to reduce costs



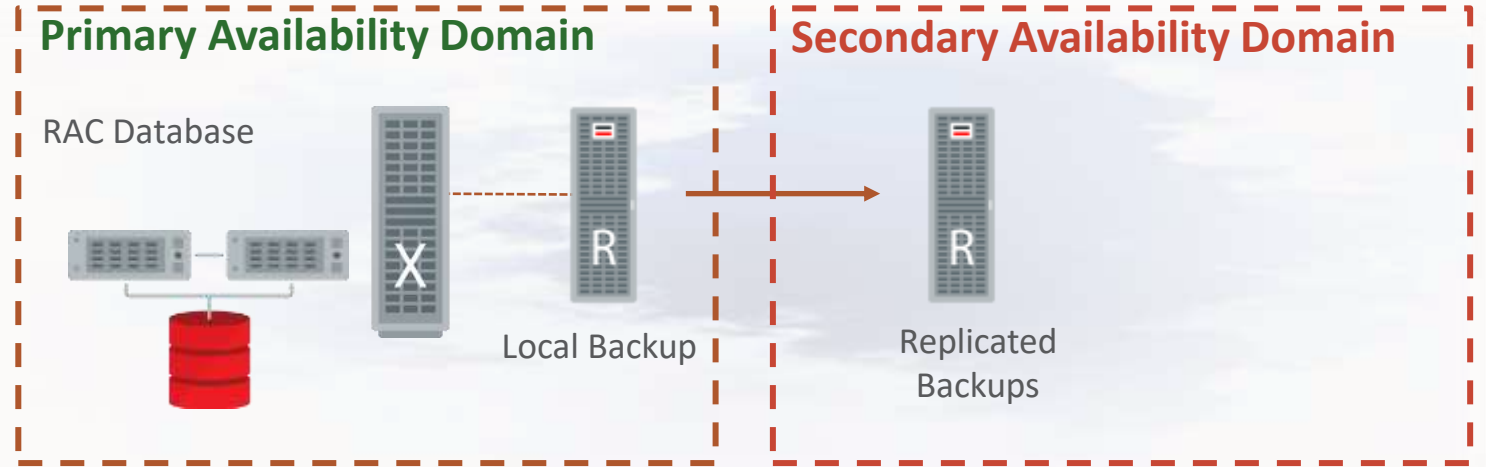


# SILVER

Prod/Departmental

Bronze +

- Real Application Clustering (RAC)
- Application Continuity



## Outage Matrix

Unplanned Outage	RTO/RPO Service Level Objectives(f1)
Recoverable node or instance failure	<b>Single digit seconds</b> (f2)
Disasters: corruptions and site failures	Hours to days. RPO since last backup or near zero with ZDLRA
Planned Maintenance	
Software/Hardware updates	<b>Zero</b> (f2)
Major database upgrade	Minutes to hour

f1: RPO=0 unless explicitly specified

f2: To achieve zero downtime or lowest impact, apply application checklist best practices; Batch jobs should be deferred outside planned maintenance window.

## Checklist found in MAA OTN

<https://www.oracle.com/technetwork/database/clustering/checklist-ac-6676160.pdf>





# GOLD

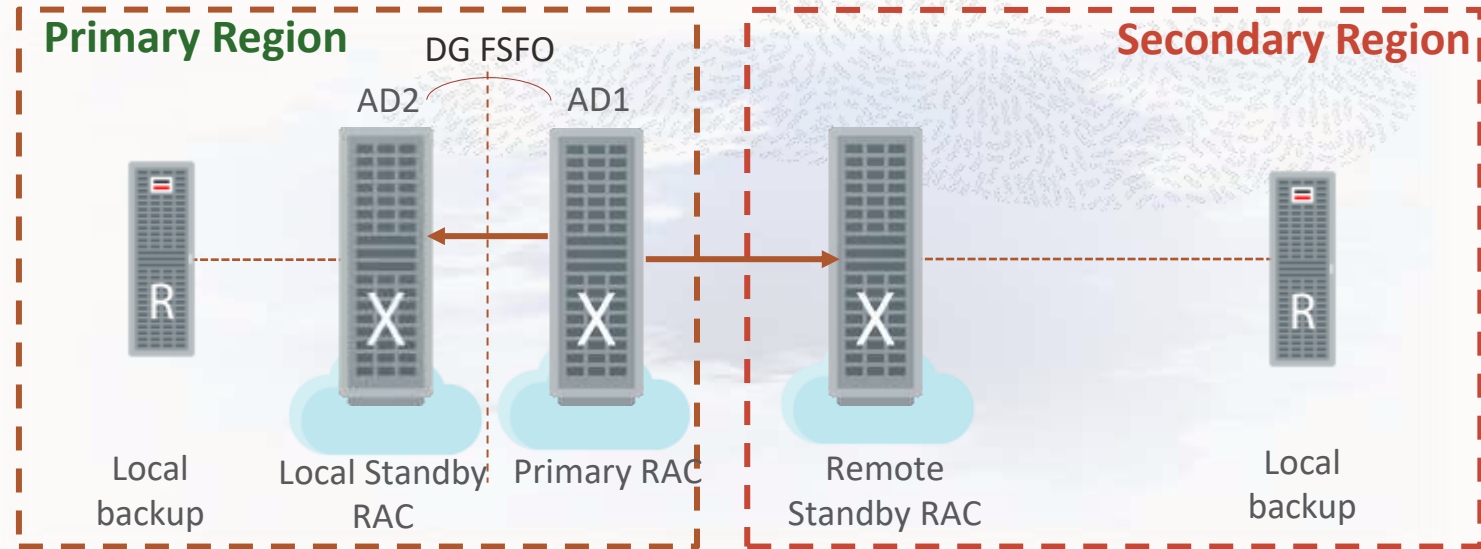
## Mission Critical

### Silver +

- Active Data Guard
  - Comprehensive Data Protection

### MAA Architecture:

- At least one standby required across AD or region.
- Primary in one data center(or AD) replicated to a Standby in another data center
- Active Data Guard Fast-Start Failover (FSFO)
- Local backups on both primary and standby



## Outage Matrix

Unplanned Outage	RTO/RPO Service Level Objectives (f1)
Recoverable node or instance failure	Single digit seconds (f2)
Disasters: corruptions and site failures	<b>Seconds to 2 minutes. RPO zero or seconds</b>
Planned Maintenance	
Software/Hardware updates	Zero (f2)
Major database upgrade	<b>Less than 30 seconds</b>

f1: RPO=0 unless explicitly specified

f2: To achieve zero downtime or lowest impact, apply application checklist best practices; Batch jobs should be deferred outside planned maintenance window.



# PLATINUM

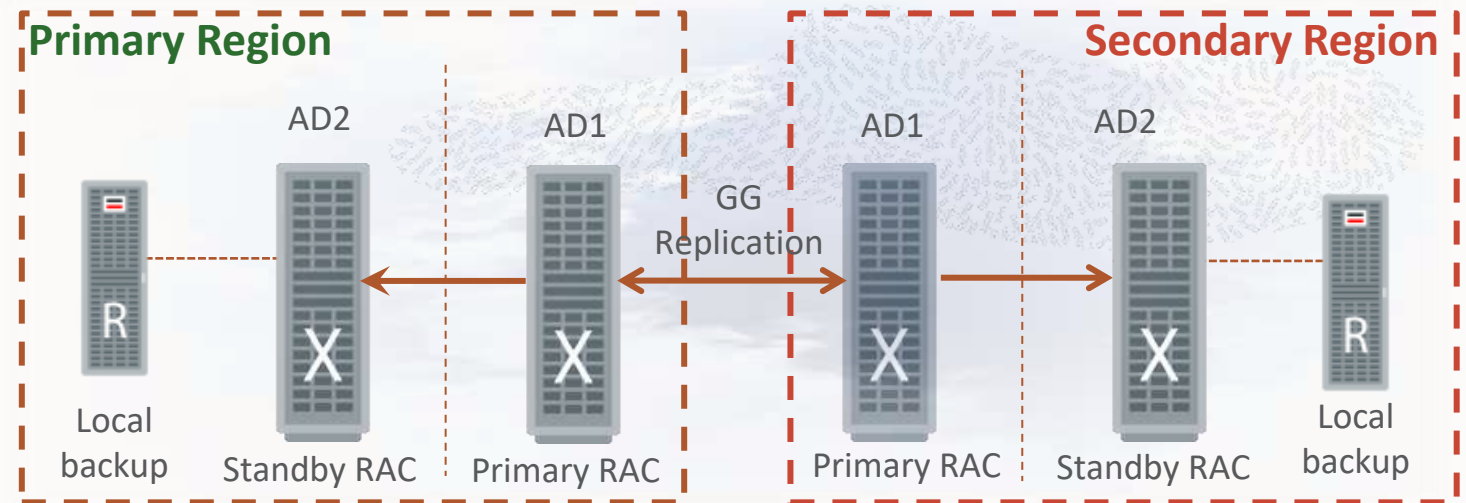
## Extreme Critical

### Gold +

- GoldenGate Active/Active Replication
- Optional Sharding & Editions Based Redefinition

### MAA Architecture:

- Each GoldenGate “primary” replica protected by Exadata, RAC and Active Data Guard
- Primary in one data center (or AD) replicated to another Primary in remote data center (or AD)
- Oracle GG & Editions Based Redefinition for zero downtime application upgrade
- Sharding for scalability and fault isolation
- Local backups on both sites
- Achieve zero downtime through custom failover to GG replica



## Outage Matrix

Unplanned Outage	RTO/RPO Service Level Objectives (f1)
Recoverable node or instance failure	<b>Zero or single digit seconds (f2/f3)</b>
Disasters including corruptions and site failures	<b>Zero (f3)</b>
Planned Maintenance	
Most common software/hardware updates	Zero (f2)
Major database upgrade, <b>application upgrade</b>	<b>Zero (f3)</b>

f1: RPO=0 unless explicitly specified

f2: To achieve zero downtime or lowest impact, apply application checklist best practices

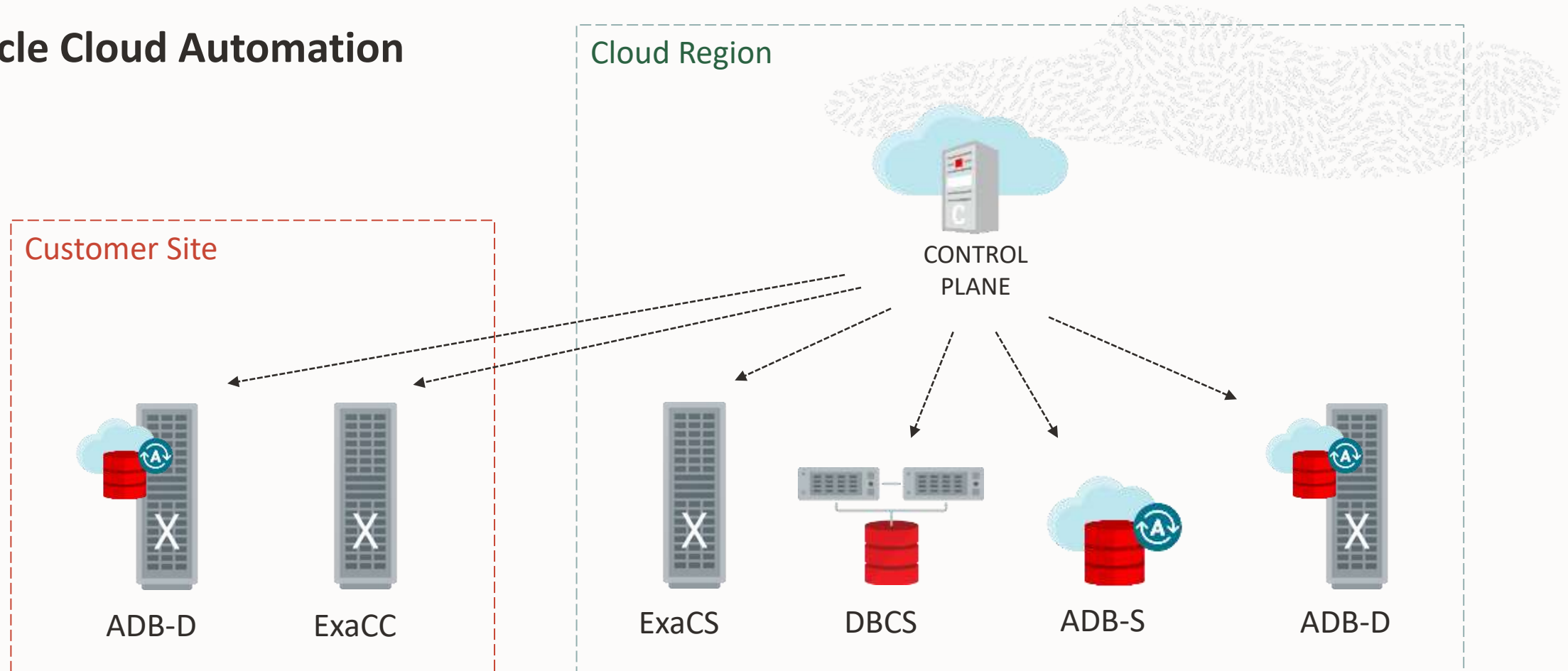
f3: Application failover is custom or with Global Data Services



# Oracle Cloud Infrastructure Topology

Maximum Availability Architecture

# 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.




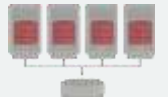




# Exadata Cloud Services (ExaCS)

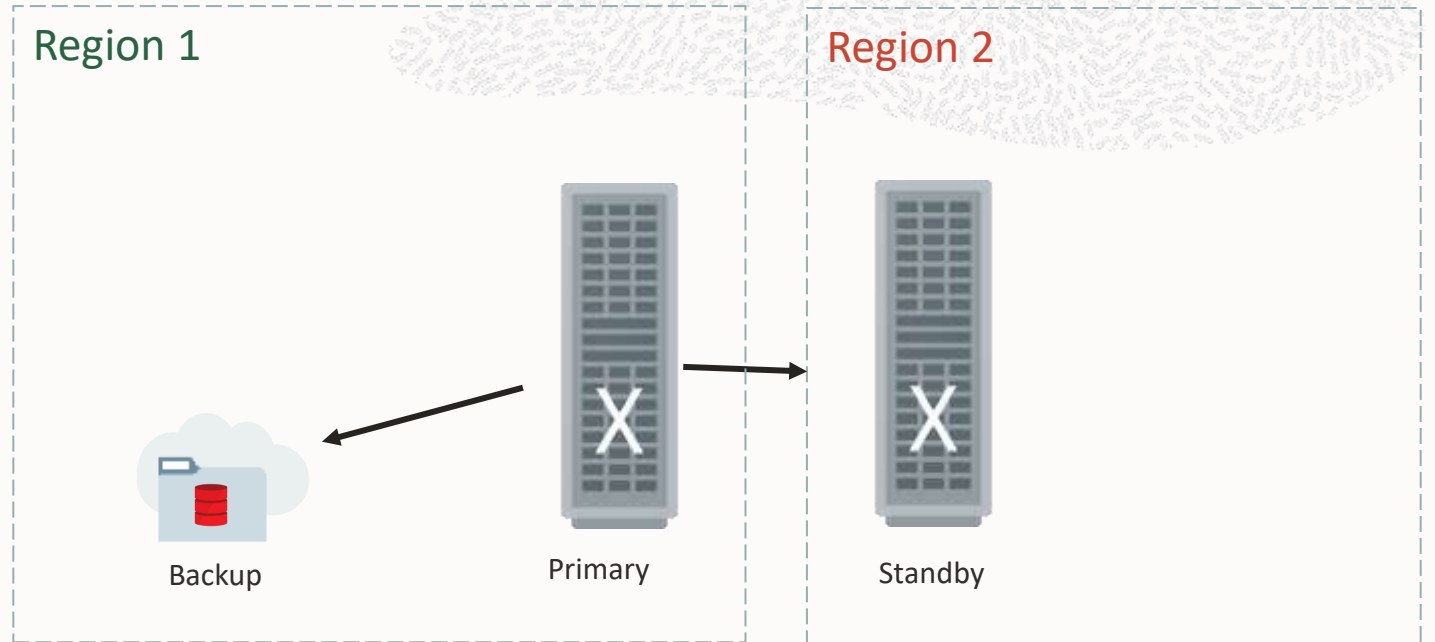
Maximum Availability Architecture











# Exadata Cloud Services: protection out of the box

## AVAILABILITY / AUTOMATION \*

✓	 RMAN	1 copy to 3-way mirrored object storage via <a href="#">automated OCI backups</a> or <a href="#">bkup api</a>
✓	 RAC	Exadata inherent HA, QoS and Performance benefits
✓	 ACTIVE DATA GUARD	<a href="#">Via console or DBaaS API</a> (Single Standby only, ExaCS only, cross-region possible, no DBMS_ROLLING OOTB)
✓	 GOLDEN GATE	Manual (Capture & Delivery)
	MAA LEVEL	Out of the Box + Data Guard  



### OOTB + ADG Outage Matrix

	PLANNED MAINTENANCE	Zero  Zero
	UPGRADE	Zero  Hours
	RECOVERABLE FAILURE	Zero  Secs
	UNRECOVERABLE FAILURE	Secs  Minutes <sup>1</sup>





<sup>1</sup> No FSFO, based on time after customer action

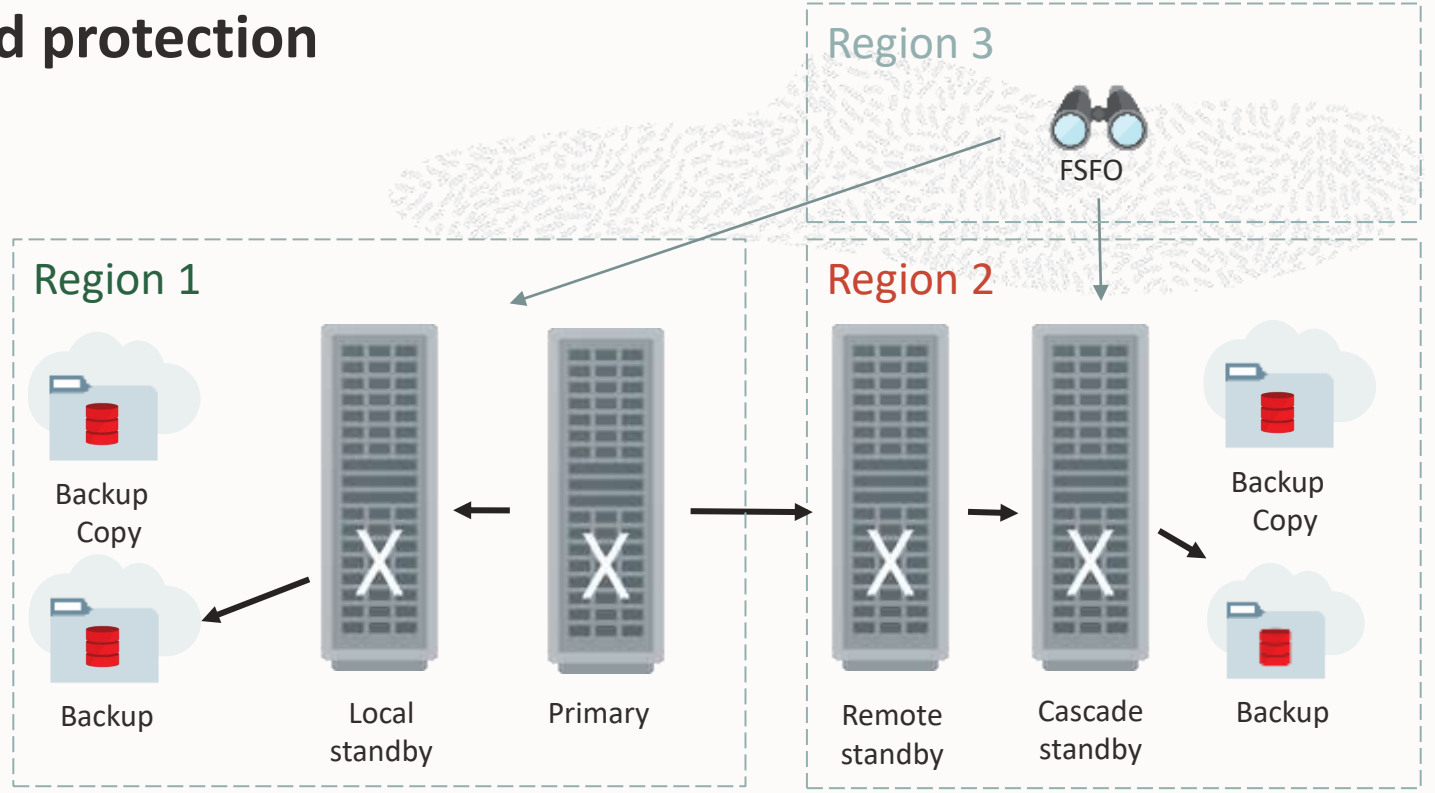
- \* Legend:
- ✓ Out of the box
  - ✓ Automated via control plane
  - ✓ Manual setup
  - ✗ Not available/possible











# Exadata Cloud Services: enhanced protection

## AVAILABILITY / AUTOMATION \*

✓	 RMAN	Multiple backup copies Backup from the standby
✓	 RAC	Custom application services
✓	 ACTIVE DATA GUARD	Multiple standbys Fast-start failover
✓	 GOLDEN GATE	Manual (capture & delivery) Global Data Service
	MAA LEVEL	<div style="display: flex; align-items: center; gap: 10px;"> <div style="border: 1px solid gray; padding: 2px;">SILVER</div> <div style="border: 1px solid gray; padding: 2px; background-color: gold;">GOLD</div> <div style="border: 1px solid gray; padding: 2px; background-color: silver;">PLATINUM</div> </div>



### Gold Outage Matrix

	PLANNED MAINTENANCE	Zero  Zero
	UPGRADE	Zero  Secs
	RECOVERABLE FAILURE	Zero  Secs
	UNRECOVERABLE FAILURE	Zero  Secs

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






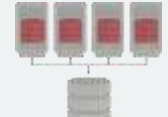



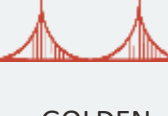




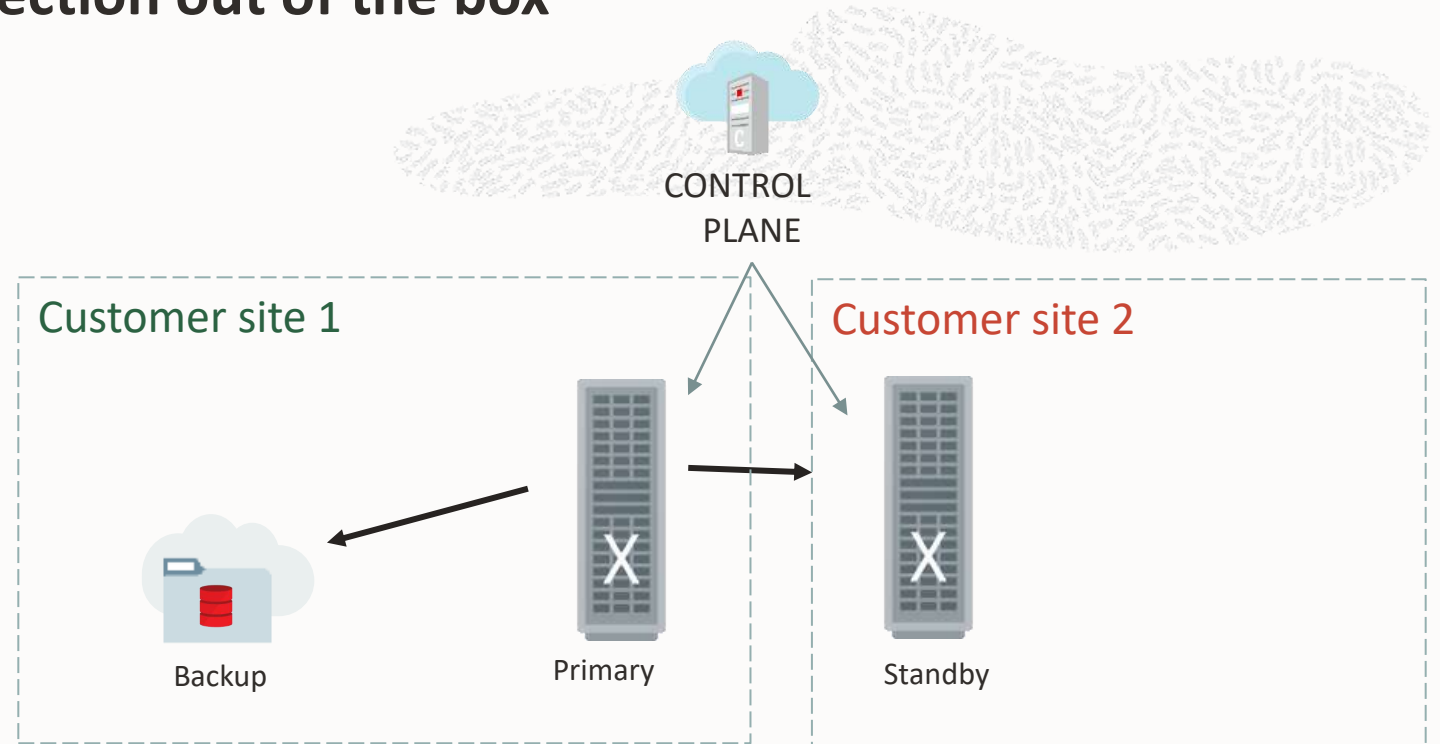
# Exadata Cloud @ Customer

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
 	ACTIVE DATA GUARD	<a href="#">Via console or DBaaS API</a> (single standby only, no DBMS_ROLLING OOTB, same control plane)
 	GOLDEN GATE	Manual (capture & delivery)
MAA LEVEL	Out of the box + Data Guard	 



### OOTB + ADG Outage Matrix

	PLANNED MAINTENANCE	Zero  Zero
	UPGRADE	Zero  Hours
	RECOVERABLE FAILURE	Zero  Secs
	UNRECOVERABLE FAILURE	Secs  Minutes <sup>1</sup>





<sup>1</sup> No FSFO, based on time after customer action

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

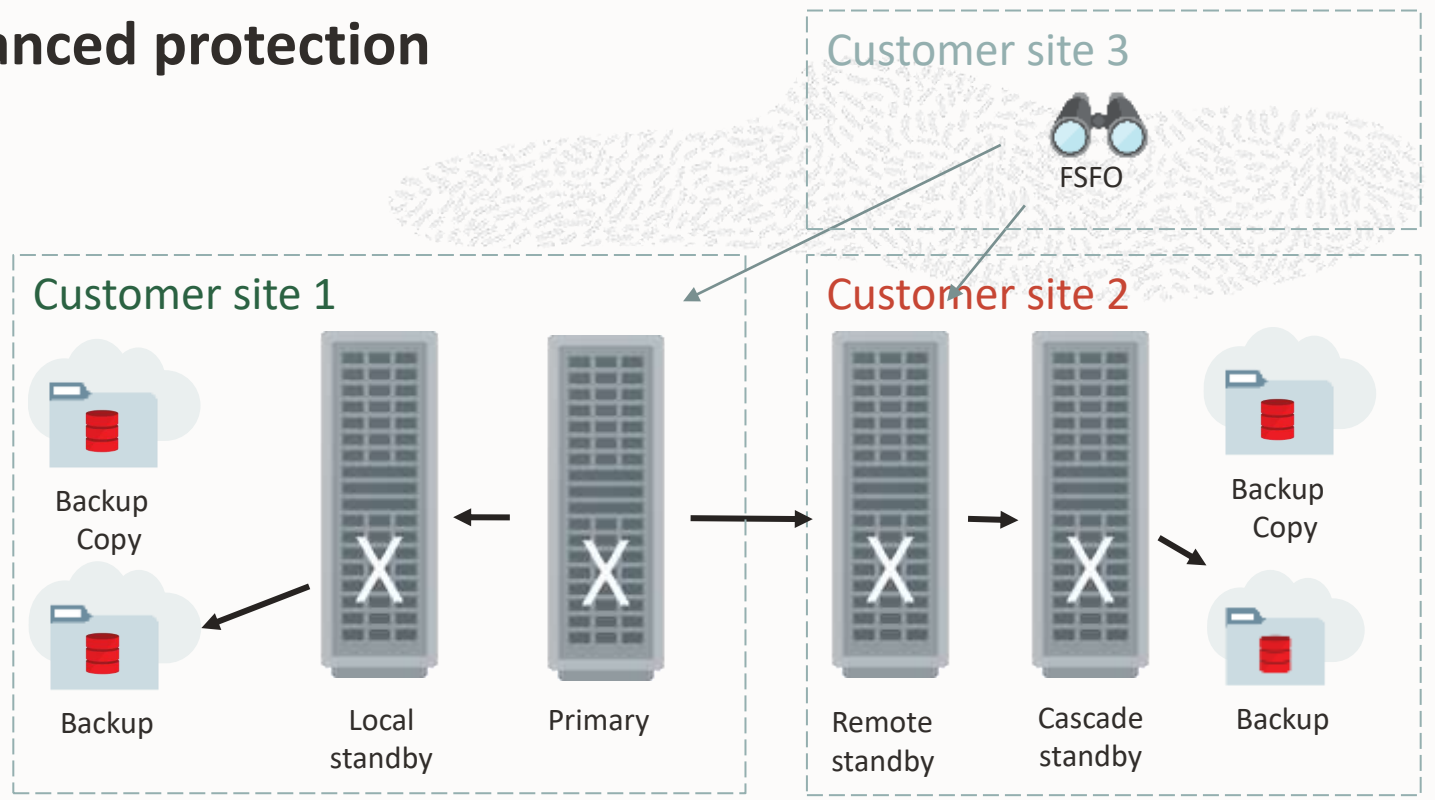


# Exadata Cloud @ Customer: enhanced protection





## AVAILABILITY / AUTOMATION \*

✓	 RMAN	Backup from the primary or/and standby. Offload backups to the standby.
✓	 RAC	Custom application services
✓	 ACTIVE DATA GUARD	Multiple standbys Fast-start failover
✓	 GOLDEN GATE	Manual (capture & delivery)
	MAA LEVEL	Out of the box + Data Guard + GoldenGate

SILVER  
GOLD  
PLATINUM



### Gold Outage Matrix

	PLANNED MAINTENANCE	Zero	! Zero
	UPGRADE	Zero	! Secs
	RECOVERABLE FAILURE	Zero	! Secs
	UNRECOVERABLE FAILURE	Zero	! Secs

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


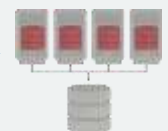




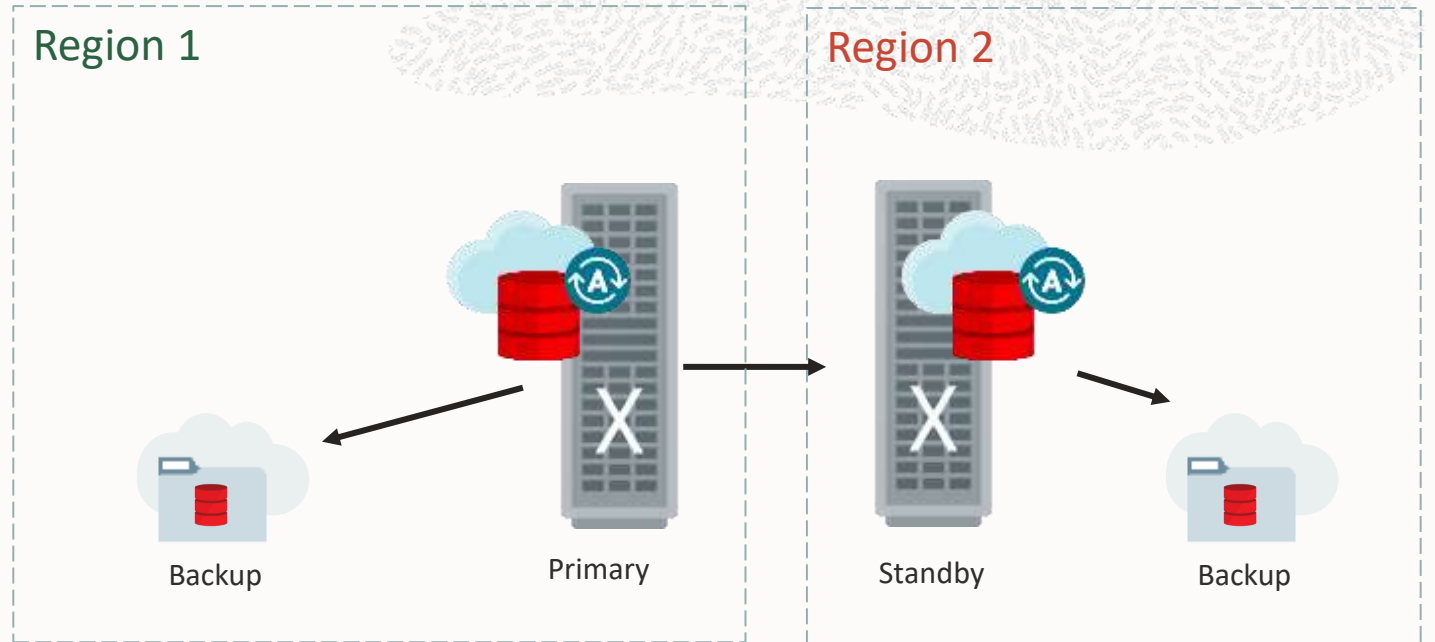
# Autonomous Database

Maximum Availability Architecture





# Autonomous Database - Dedicated: protection out of the box

## AVAILABILITY / AUTOMATION \*

✓	 RMAN	1 copy to 3-way mirrored object storage via automated OCI backups ExaCC: also ZDLRA, NFS, local
✓	 RAC	Exadata inherent HA, QoS and Performance benefits Services out of the box
✓	 AUTONOMOUS DATA GUARD	1 SB ADB-D only, cross-region possible ADB on ExaCC: same control plane only, ADB ExaCC only
✓	 GOLDEN GATE	Manual (Capture & delivery)
	MAA LEVEL	Out of the box + AuDG + GoldenGate



### Gold Outage Matrix

	PLANNED MAINTENANCE	Zero	! Zero
	UPGRADE	Zero	! Minutes
	RECOVERABLE FAILURE	Zero	! Secs
	UNRECOVERABLE FAILURE	Secs	! Minutes <sup>1</sup>

<sup>1</sup> No FSFO, based on time after customer action

\*

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


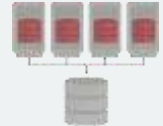









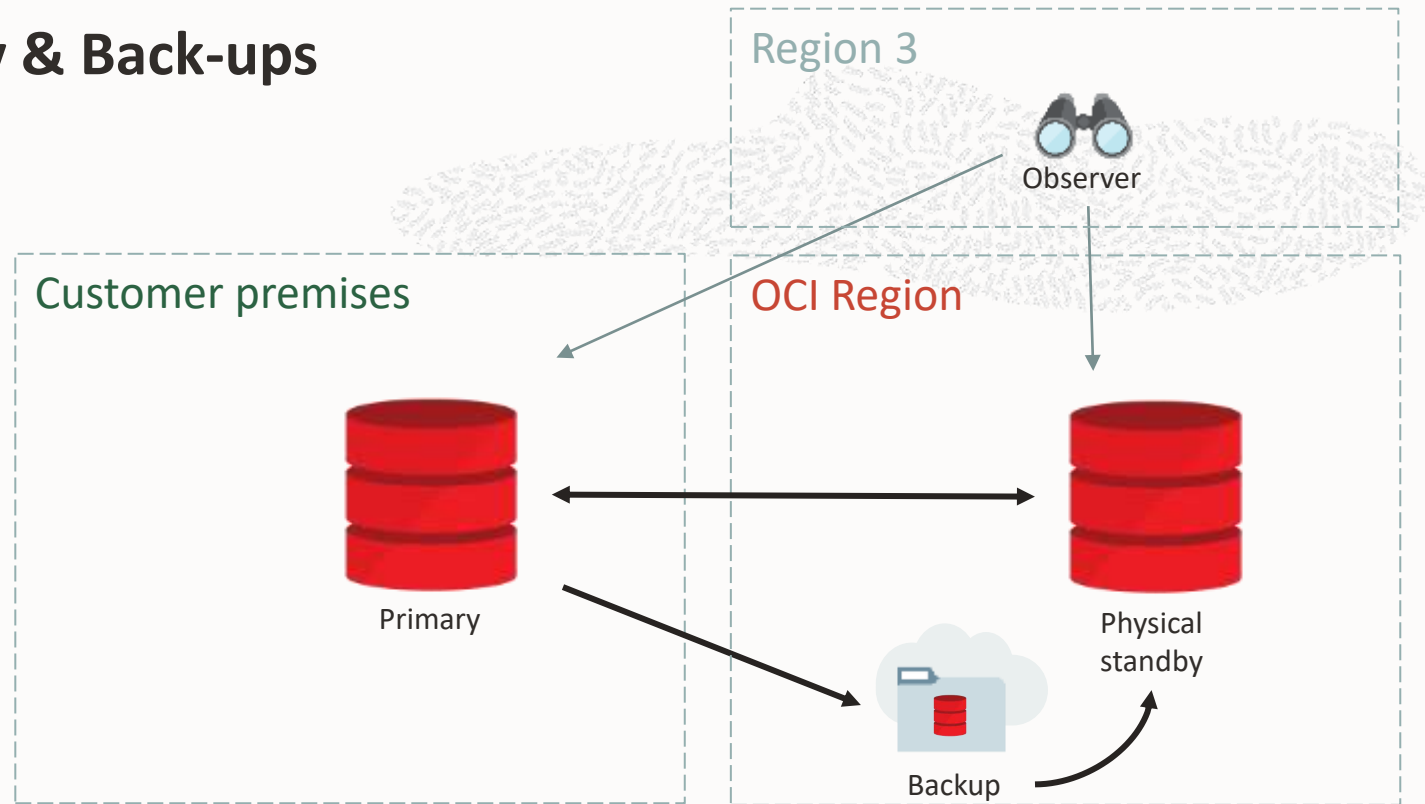
# What about hybrid deployment?









Maximum Availability Architecture

# Hybrid Cloud – Disaster Recovery & Back-ups

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



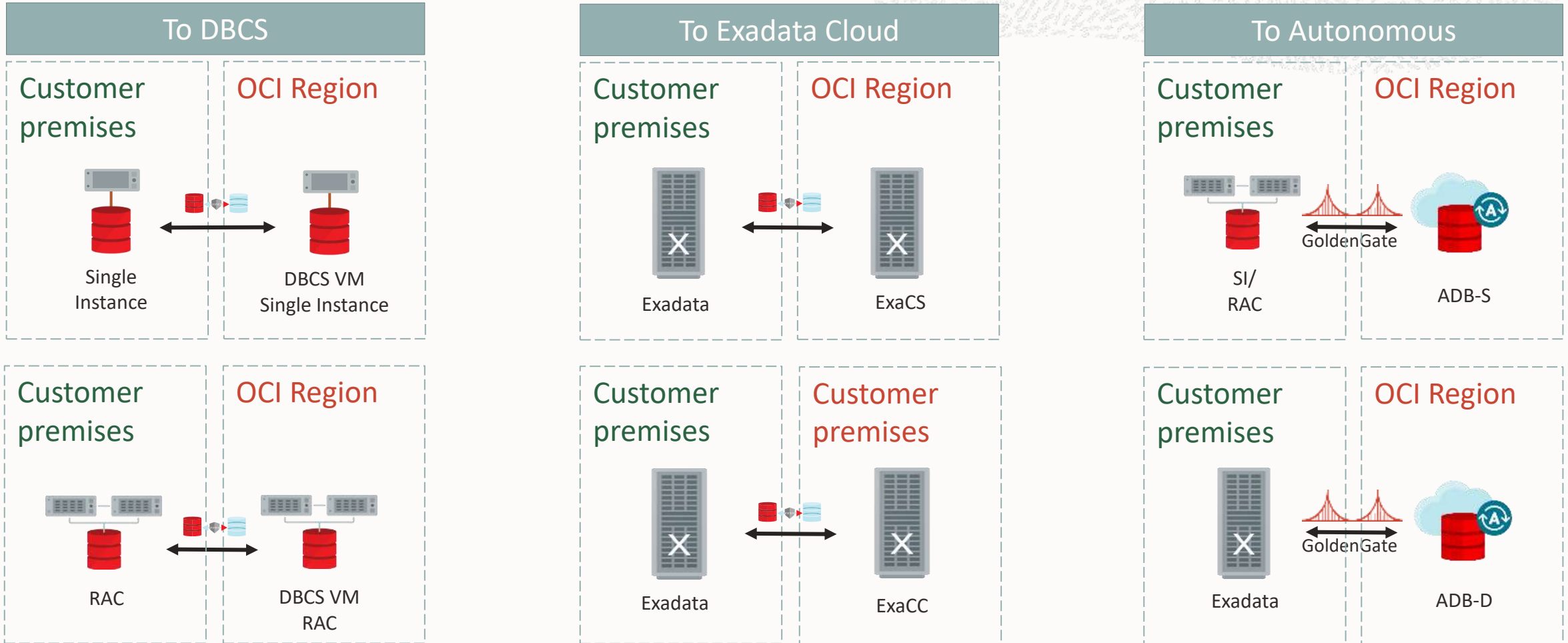
Gold Outage Matrix <sup>2</sup>		
	PLANNED MAINTENANCE	Zero  Zero
	UPGRADE	Zero  Secs
	RECOVERABLE FAILURE	Zero  Secs
	UNRECOVERABLE FAILURE	Zero  Secs

<sup>1</sup> Customer responsibility  
<sup>2</sup> Best case scenario (FSFO + SYNC or FAR SYNC)





# Hybrid Cloud: Sources and Destinations



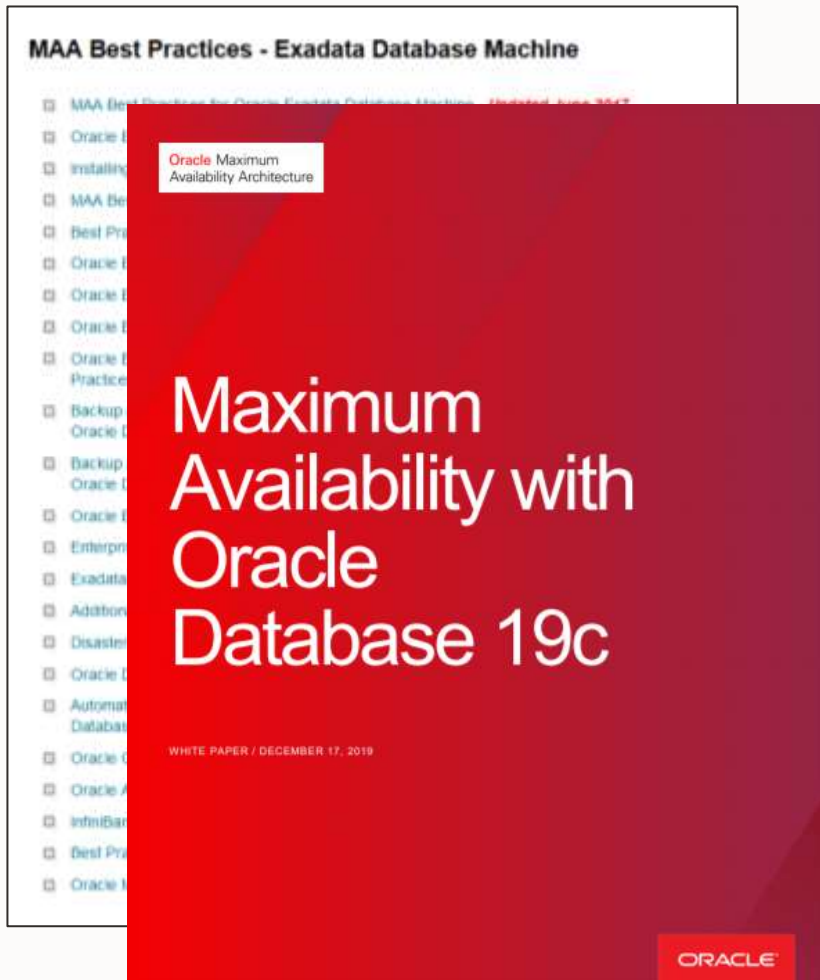
- All Hybrid configurations are achieved manually: no Control Plane automation
- On-premises non-Exadata to ExaCC/ExaCS is possible but beware of exclusive features



# How does the MAA team ensure Oracle Database availability, performance and scalability?



# MAA & Chaos Engineering – Breaking things to ensure your peace of mind



<https://www.oracle.com/goto/maa>

***Chaos Engineering** is the art form of experimenting (i.e. proactively breaking things) on a system in order to build confidence in a system's resilience to withstand turbulent events in production*

*In today's digital age, this may include but is not limited to:*

- Network, server & storage failures
- Human errors & data corruption
- Data corruption
- Power failures or site failure (i.e. *Godzilla attack or hurricane*)
- Application, database & server software updates
- Data reorganization or changes
- Application changes and optimizations

# Summary

1

Oracle makes it simple to build Data Driven Apps by providing **Synergistic Data Technologies** for each modern Development Methodologies

2

One **Converged Database** for all data types and model engineered so they all work together enables **Cross Data Synergy**

3

One Converged Database **greatly simplifies development, operations and overall architecture including high availability, disaster recovery and security.**





It's now time for Q&A

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