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Integrity

Ethics

Compliance

Innovation

Teamwork

Mutual  
Respect

Customer  
Satisfaction

Fairness

Quality

Communication

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# Standby Databases & Oracle Data Guard



**Alexandre Fagundes**

LAD Partner Enablement  
August, 2022

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# Today's topics

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**Standby Databases**

**Data Guard**

- Concepts
- Types & Benefits

**MAA**

- Concepts
- Administration interfaces
- Requirements Considerations

Maximum Availability  
Architecture



# Standby Database

**A standby database is a transactionally consistent copy of an Oracle production database that is initially created from a backup copy of the primary database.**

3 types:

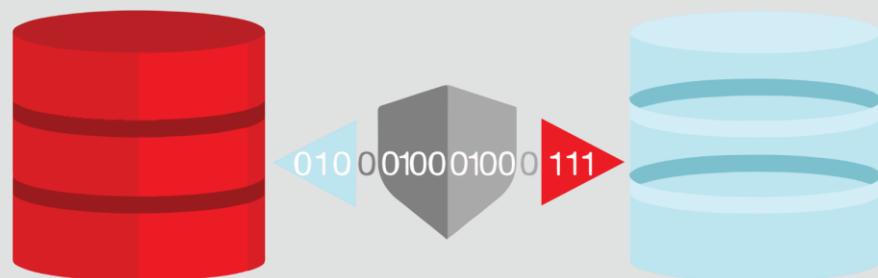
- Physical standby database
- Logical standby database
- Snapshot standby database.

Only Physical or a Logical standby database can assume the role of the primary database



# Physical Standby

**A physical standby database is an exact, block-for-block copy of a primary database.**



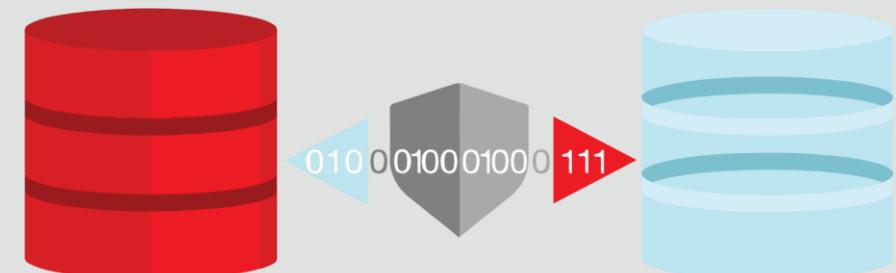
With Oracle Active Data Guard option, Redo Apply can be active while the physical standby database is open

- Maintained as an exact copy through a process called Redo Apply
- A physical standby database can be opened for read-only access and used to offload queries

# Physical Standby: Main Benefits

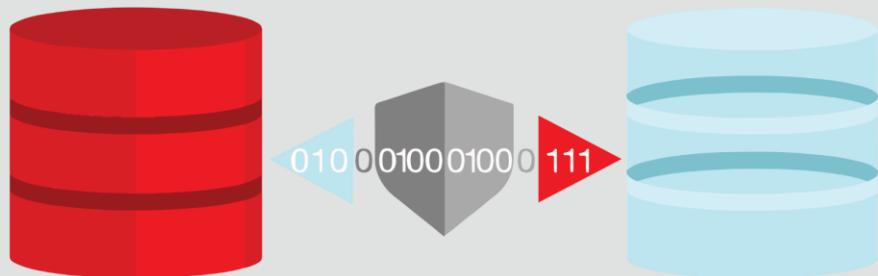
- Disaster recovery and high availability
- Data protection
- Reduction in primary database workload

Oracle Recovery Manager (RMAN) can use a physical standby database to offload backups from a primary database, saving valuable CPU and I/O cycles.



# Logical Standby

**A logical standby database is initially created as an identical copy of the primary database, but it later can be altered to have a different structure.**



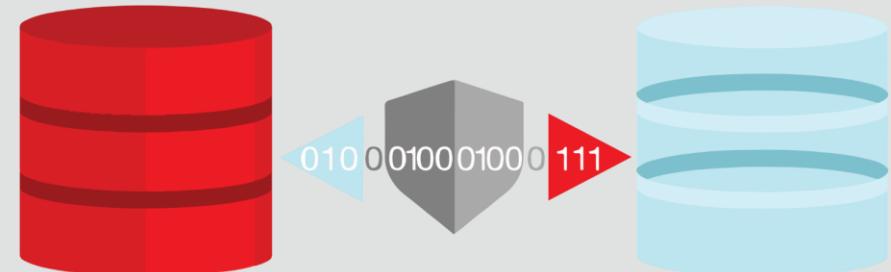
The logical standby database is updated by executing SQL statements.

- Logical Standby enables database maintenance in rolling fashion with almost no downtime.
- It has some restrictions on data types, types of tables, and types of DDL and DML operations.

# Logical Standby: Main Benefits

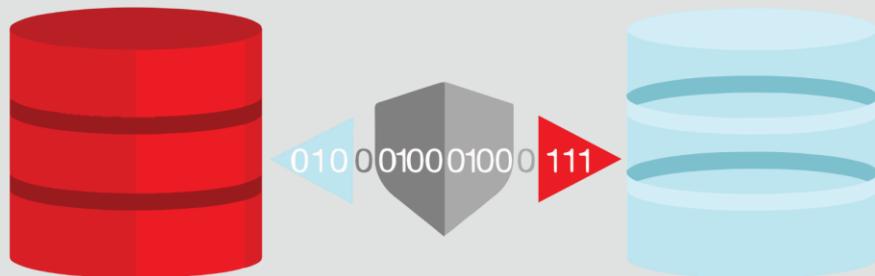
- Minimizing downtime on software upgrades
- Support for reporting and business decisions requirements

A logical standby can be upgraded to the new release and then switched over to become the active primary



# Snapshot Standby

**A snapshot standby database is a fully updatable standby database.**



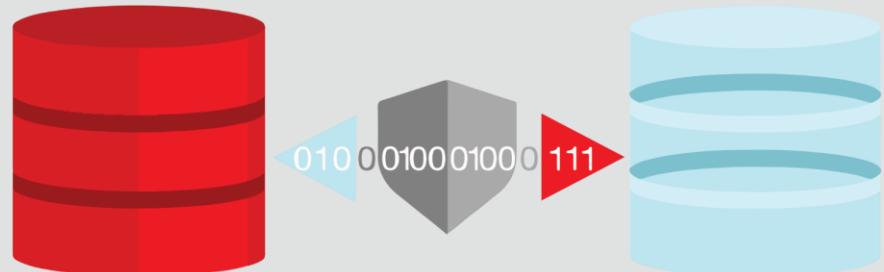
The redo data received by a snapshot standby database is not applied until the snapshot standby is converted back into a physical standby database

- A snapshot standby database receives and archives redo data from a primary database.
- Unlike a physical or logical standby database, a snapshot standby database does not apply the redo data that it receives

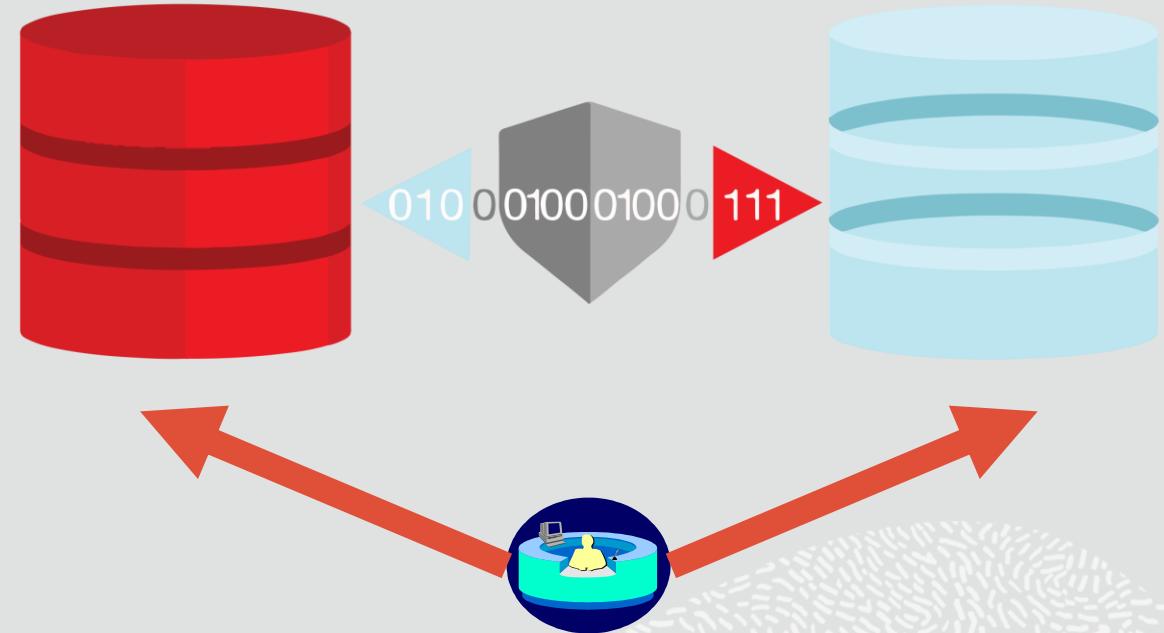
# Snapshot Standby: Main Benefits

- Best used in scenarios that require a temporary, updatable snapshot of a physical standby database
- Support for reporting and decision making

The time needed to recover from a primary database failure is directly proportional to the amount of redo data that needs to be applied in the snapshot DB



# Oracle Data Guard



# Data Guard

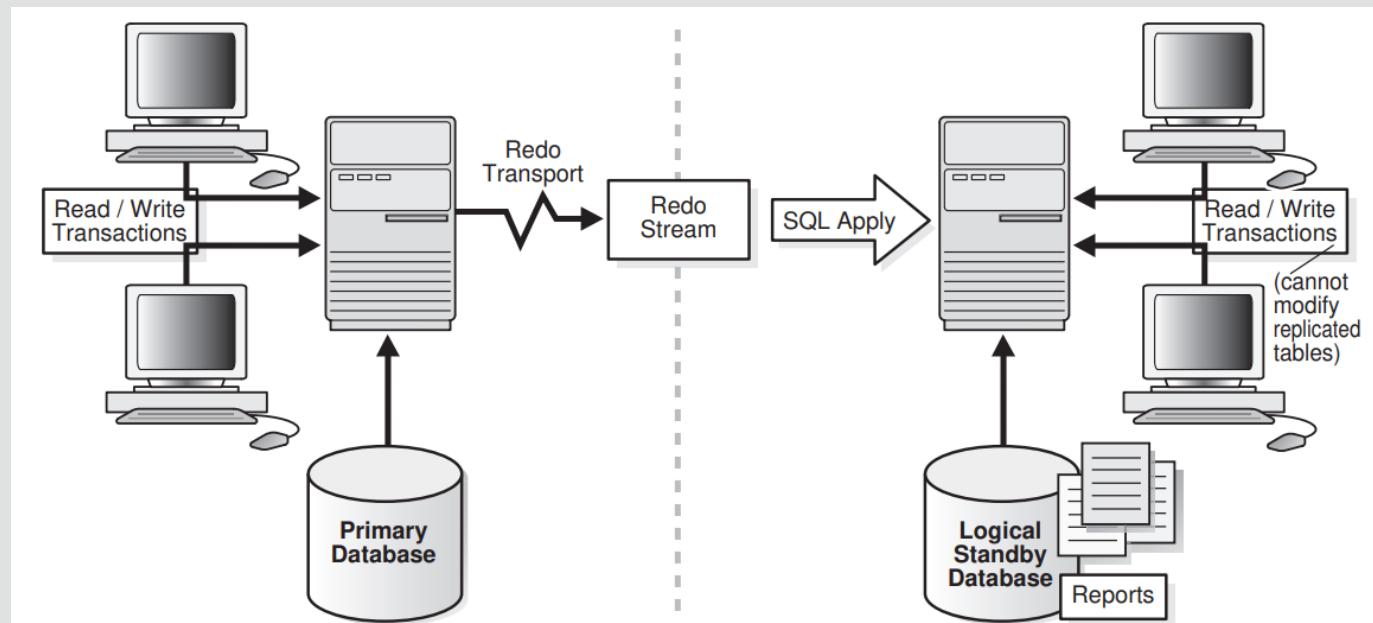
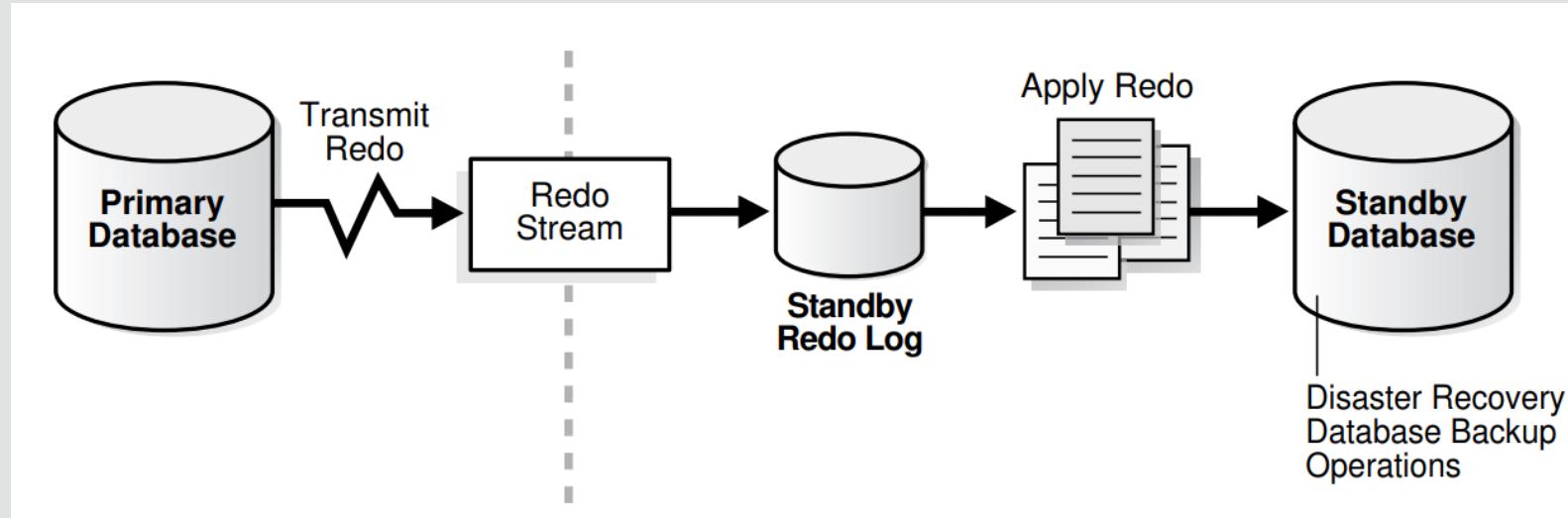
Oracle Data Guard ensures high availability, data protection, and disaster recovery for enterprise data

Create, maintain, manage, and monitor one or more standby databases to enable production databases to survive disasters and data corruptions.

It can be used with traditional backup, restoration, and cluster techniques to provide a high level of data protection and data availability.

With Oracle Data Guard, administrators can optionally improve production database performance by offloading resource-intensive backup and reporting operations to standby systems.

# Typical Data Guard Architectures



# Protection Modes

## Maximum Availability, Performance or Protection

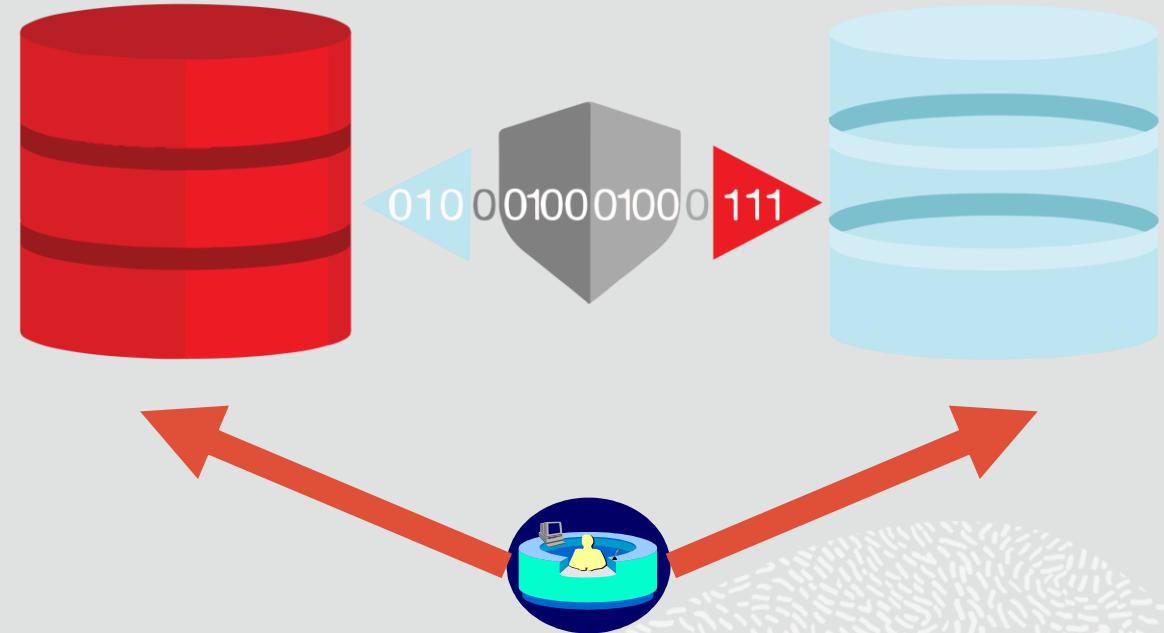
**Maximum Performance:** This is the default protection mode. It provides the highest level of data protection by allowing transactions to commit as soon as all redo data generated by those transactions has been written to the online log

**Maximum Protection:** The redo data needed to recover a transaction must be written to both the online redo log and to the standby redo log on at least one synchronized standby database before the transaction commits.

**Maximum Availability:** This protection mode provides the highest level of data protection that is possible without compromising the availability of a primary database, but How? Transactions do not commit until all redo data needed to recover those transactions has either been received in memory or written to the standby redo log



## Data Guard Broker



# Data Guard Broker

The Oracle Data Guard broker is a distributed management framework that automates and centralizes the creation, maintenance, and monitoring of Oracle Data Guard configurations.

## Main Tasks

- Add standbys
- Managing the protection mode
- Invoke & setup switchover or failover
- Validate configurations (network, db readiness, etc)

# Data Guard Broker - Architecture

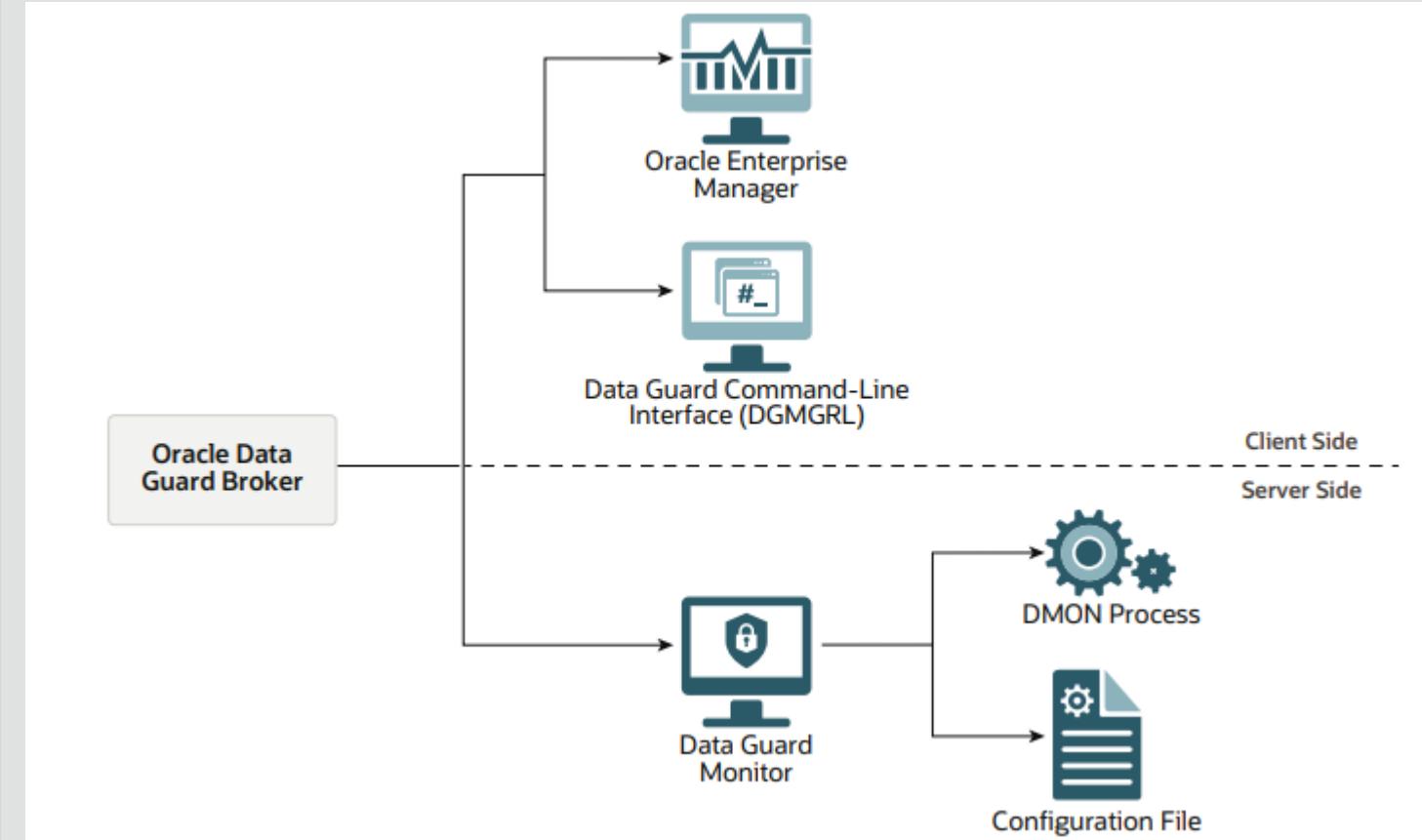
Benefits

Supports RAC

Automation

Built-in monitoring

Transparent to application



# Data Guard Broker Client Side Standardized Directory Structure

`$DG_ADMIN` is defined by an environment variable

`$DG_ADMIN` has the below subfolders

- Admin
- Config\_<ConfigurationSimpleNameLog>
- Dat
- Log
- Callout

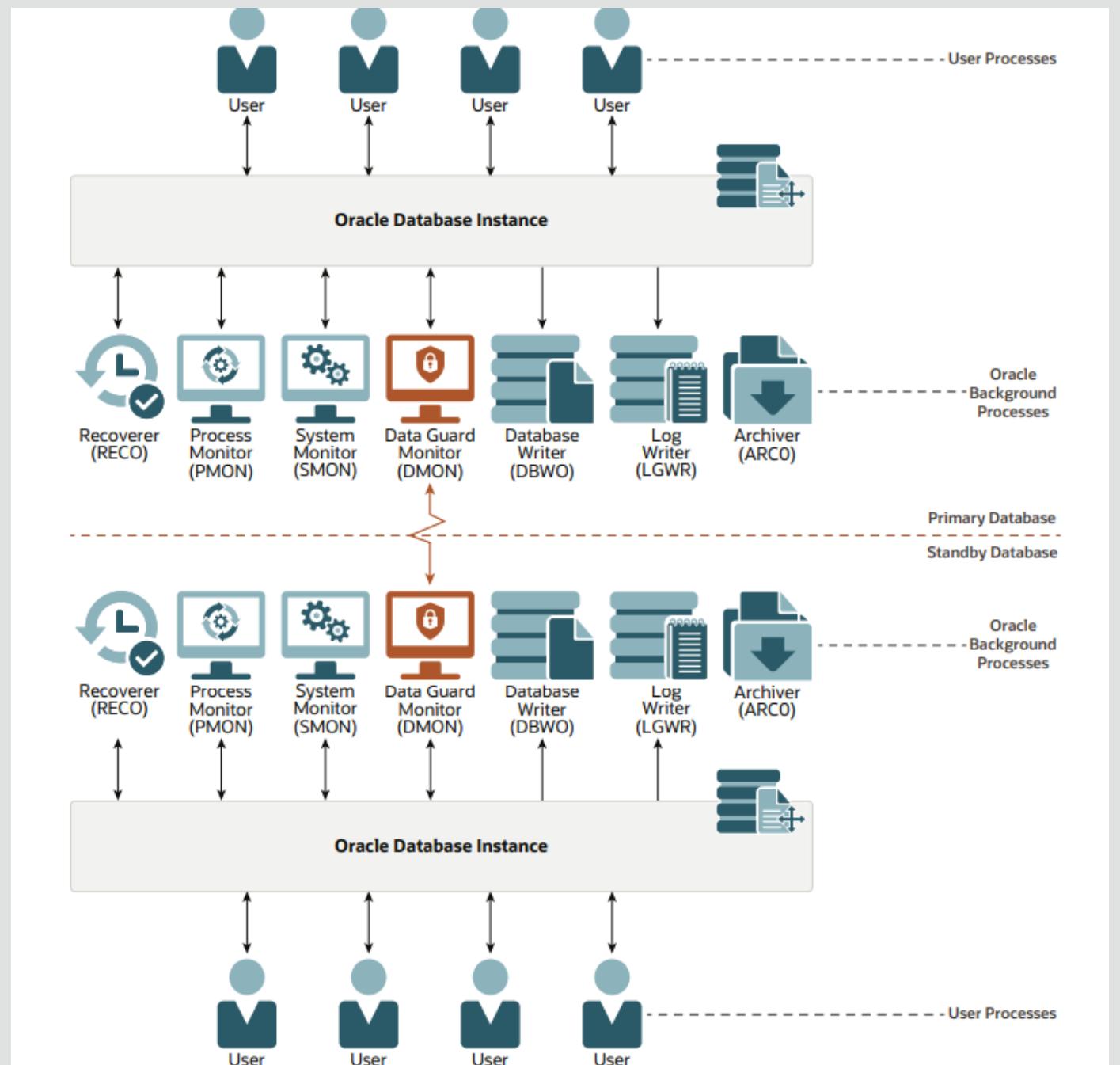
The Standardized Directory Structure helps :

- to keep your environments clean
- to keep your environments organized

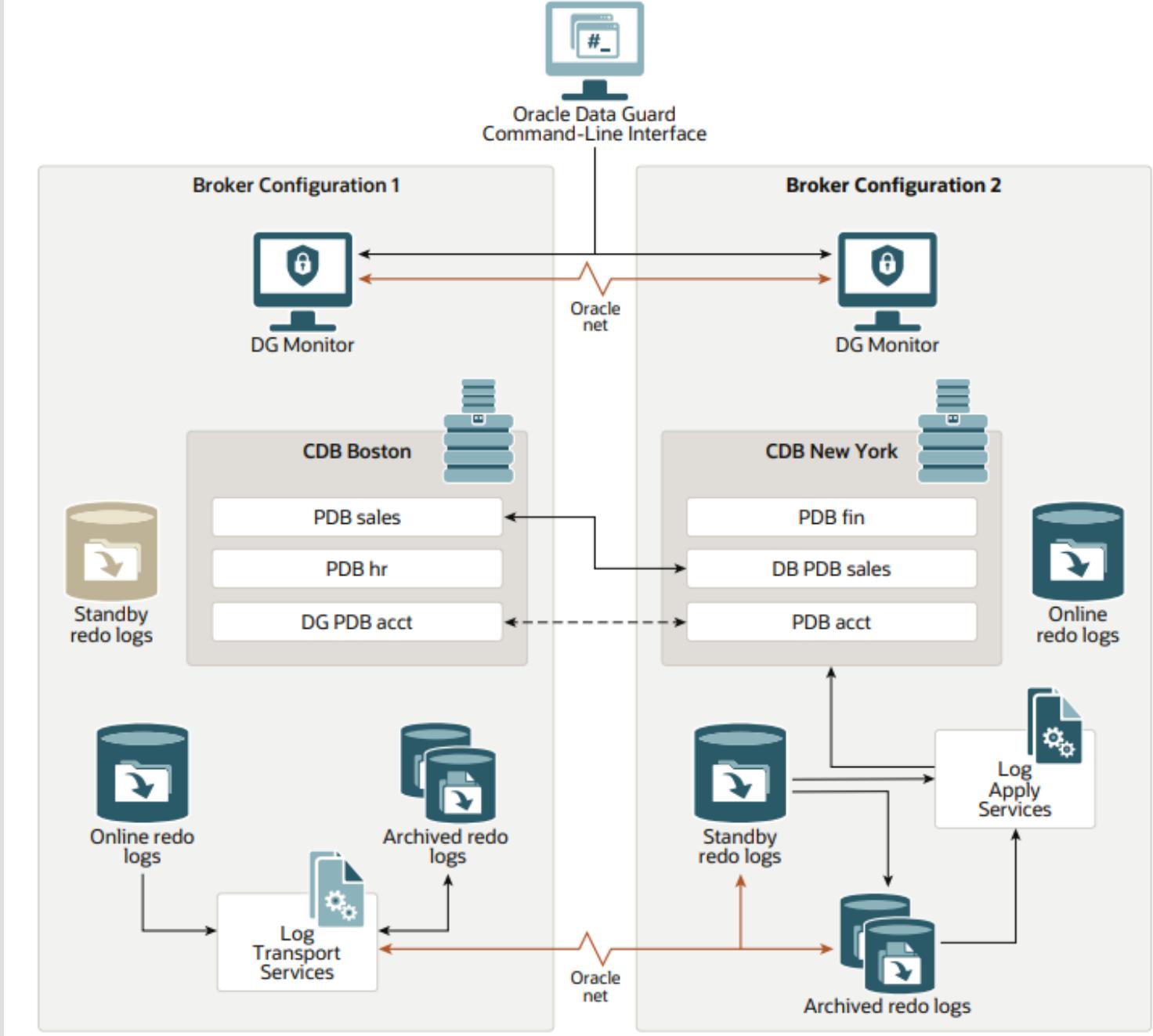


# DB DMON

## Background Process



# DG PDB Configuration



# Set database initialization parameters

Oracle Data Guard broker properties, now map to Database Parameters

ArchiveLagTarget (ARCHIVE\_LAG\_TARGET)

DataGuardSyncLatency (DATA\_GUARD\_SYNC\_LATENCY)

LogArchiveMaxProcesses (LOG\_ARCHIVE\_MAX\_PROCESSES)

LogArchiveMinSucceedDest (LOG\_ARCHIVE\_MIN\_SUCCEED\_DEST)

LogArchiveTrace (LOG\_ARCHIVE\_TRACE instance)

StandbyFileManagement (STANDBY\_FILE\_MANAGEMENT)

DbFileNameConvert (DB\_FILE\_NAME\_CONVERT static)

LogArchiveFormat (LOG\_ARCHIVE\_FORMAT static, instance)

LogFileConvert (LOG\_FILE\_NAME\_CONVERT static)

LsbyPreserveCommitOrder (PRESERVE\_COMMIT\_ORDER

DBMS\_LOGSTDBY package, static

→ apply needs restart)

LsbyMaxEventsRecorded (MAX\_EVENTS\_RECORDED of DBMS\_LOGSTDBY package)

LsbyMaxServers (MAX\_SERVERS of DBMS\_LOGSTDBY package, instance)

LsbyMaxSga (MAX\_SGA of DBMS\_LOGSTDBY package, instance)

LsbyRecordAppliedDdl (RECORD\_APPLIED\_DDL of DBMS\_LOGSTDBY package)

LsbyRecordSkippedDdl (RECORD\_SKIPPED\_DDL of DBMS\_LOGSTDBY package)

LsbyRecordSkipErrors (RECORD\_SKIP\_ERRORS of DBMS\_LOGSTDBY package)



# SHOW CONFIGURATION LAG

Conveniently view lag information for all members

```
DGMGRL> SHOW CONFIGURATION LAG;
Configuration - HA_Config
  Protection Mode: MaxPerformance
  Members:
    boston - Primary database
      chicago - Physical standby database
        Transport Lag:      0 seconds (computed 1 second ago)
        Apply Lag:         0 seconds (computed 1 second ago)
    newyork - Physical standby database
      Transport Lag:      0 seconds (computed 1 second ago)
      Apply Lag:         0 seconds (computed 1 second ago)
  Fast-Start Failover: DISABLED
  Configuration Status:
    SUCCESS
```



# Export and Import the Broker Metadata File

Users will be able to save a Broker readable copy of the configuration file

Allows a lost Broker configuration to be rebuilt without having to have all individual commands used at the start and during configuration lifetime

```
DGMGRL> EXPORT CONFIGURATION TO 'meta.xml' ;
```

```
Succeeded.
```

```
DGMGRL>
```

```
DGMGRL> IMPORT CONFIGURATION FROM 'meta.xml' ;
```

```
Succeeded. Run ENABLE CONFIGURATION to enable the imported configuration.
```

```
DGMGRL>
```



# SET TRACE\_LEVEL USER|SUPPORT

Replaces the DEBUG qualifier in Oracle Database 18c starting with 19c

More expandable in future, if new levels are necessary  
‘USER’ is the default

SHOW ALL changes to display the TRACE\_LEVEL instead of DEBUG

```
DGMGRL> show all;  
  
trace_level          USER  
echo                OFF  
time                OFF  
observerconfigfile = observer.ora
```

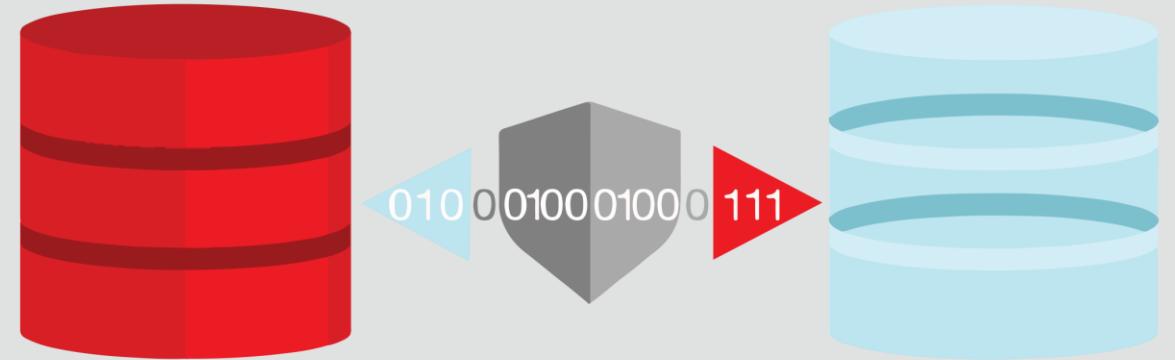


# Enhanced Local Archiving

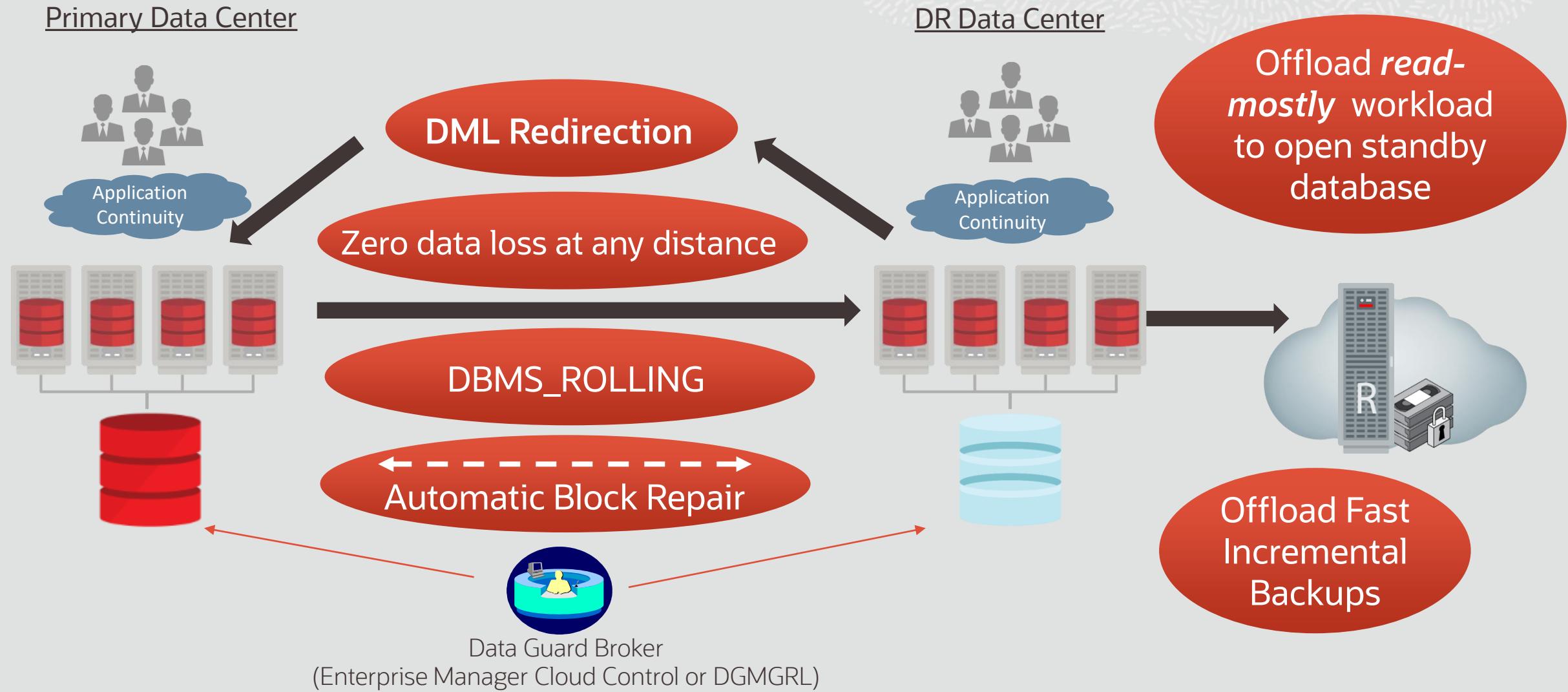
- ArchiveLocation
  - Online redo log archive (ORL) location for primary, logical, and snapshot standby databases, and optionally standby redo logs (SRL) if StandbyArchiveLocation is not set
- AlternateLocation
  - Alternate ORL archive location if ArchiveLocation fails
- StandbyArchiveLocation
  - Specifies the SRL archive location
- StandbyAlternateLocation
  - Alternate SRL archive location if StandbyArchiveLocation fails



## (Active) Data Guard



# Active Data Guard: Advanced Capabilities



# (Active) Data Guard Features

- Tuning automatic outage resolution
- Flashback Database Enhancements
- Buffer Cache preservation after role transition
- Improved Multi-Instance Redo Apply
- Bigger Footprint of Active Data Guard Applications



# Tunable Automatic Outage Resolution

Data Guard maintains internal mechanisms that detect and correct issues with its redo transport and gap resolution processes

In case of network or disk I/O problems, these mechanisms prevent those processes from hanging and causing unnecessarily long gaps

Use the following parameters to influence the outage resolution:

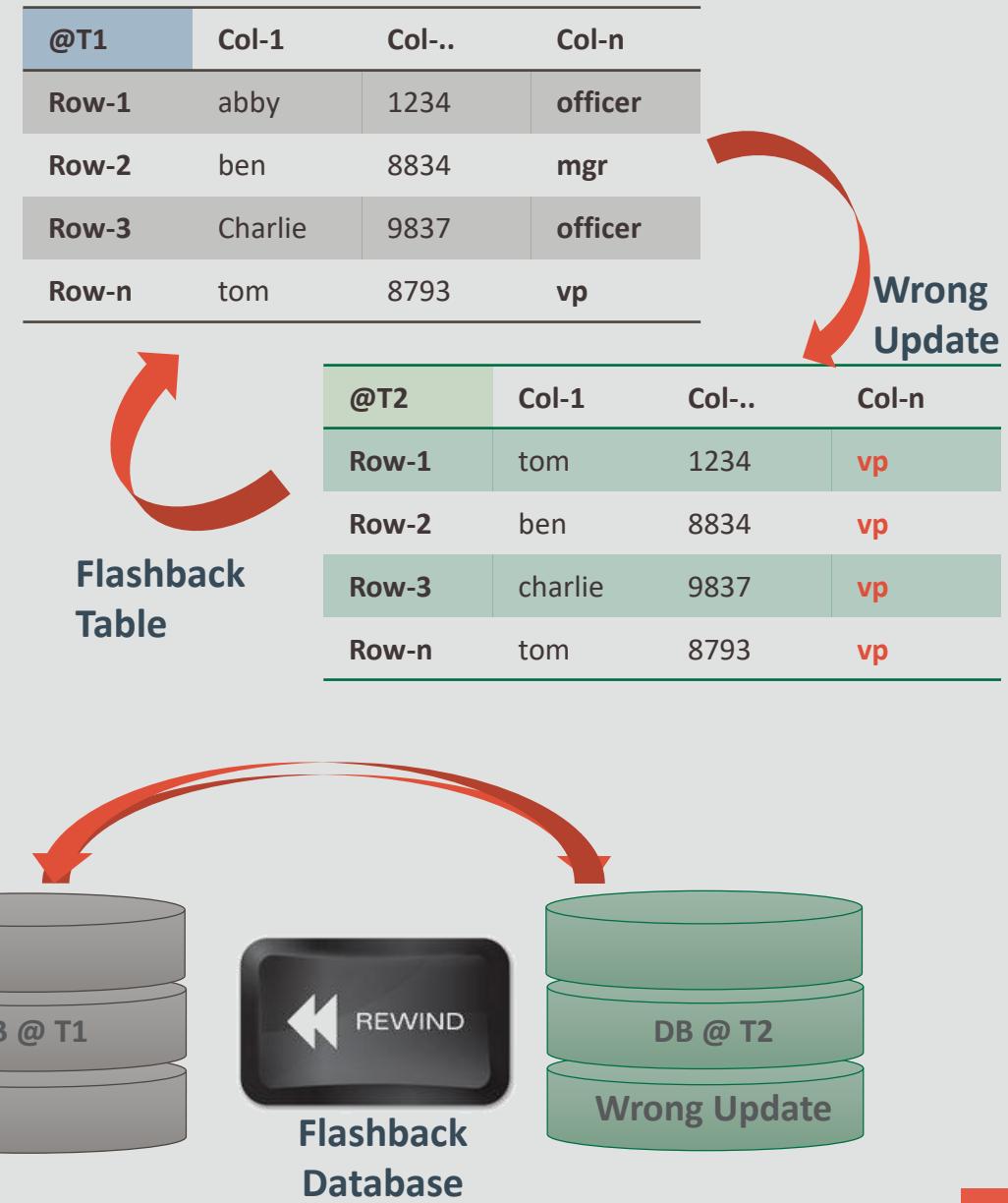
- `DATA_GUARD_MAX_IO_TIME`  
Sets the maximum number of seconds that can elapse before a process is considered hung while performing reads, writes, and status operations.
- `DATA_GUARD_MAX_LONGIO_TIME`  
Sets the maximum number of seconds as above, but for operations such as open and close



# Flashback Technologies

The “Rewind-Button” for the Database

- Fast point-in-time recovery (PITR) without expensive restore operation
- Error investigation
  - View data as of previous point in time
- Error correction
  - Back-out a transaction
  - Incorrect table updates
  - Rewind the entire database
- Integrated with other HA features:
  - Oracle Data Guard



# Flashback Database Enhancements

Restore Points automatically propagate from the primary to the standbys

Today, restore points are set on each Data Guard database individually

Requires multiple operations if the same restore point across the configuration is desired

With Oracle Database 19c,  
the primary restore points are automatically created on each standby

Identified by a suffix to the name of “\_PRIMARY”

REPLICATED <sup>Foot 1</sup>	VARCHAR2 (3)	This column is useful in Oracle Data Guard environments. It indicates the method by which a restore point was created. Possible values: <ul style="list-style-type: none"><li>• YES - The restore point was automatically replicated from the primary database to this database when this database was a standby database. The string _PRIMARY is appended to the name of such a restore point.</li><li>• NO - The restore point was created by a user and was not replicated from the primary database.</li></ul>
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Footnote<sup>1</sup> This column is available starting with Oracle Database release 19c, version 19.1.



# Flashback Database Enhancements

Standbys automatically follow the primary after a RESETLOGS operation

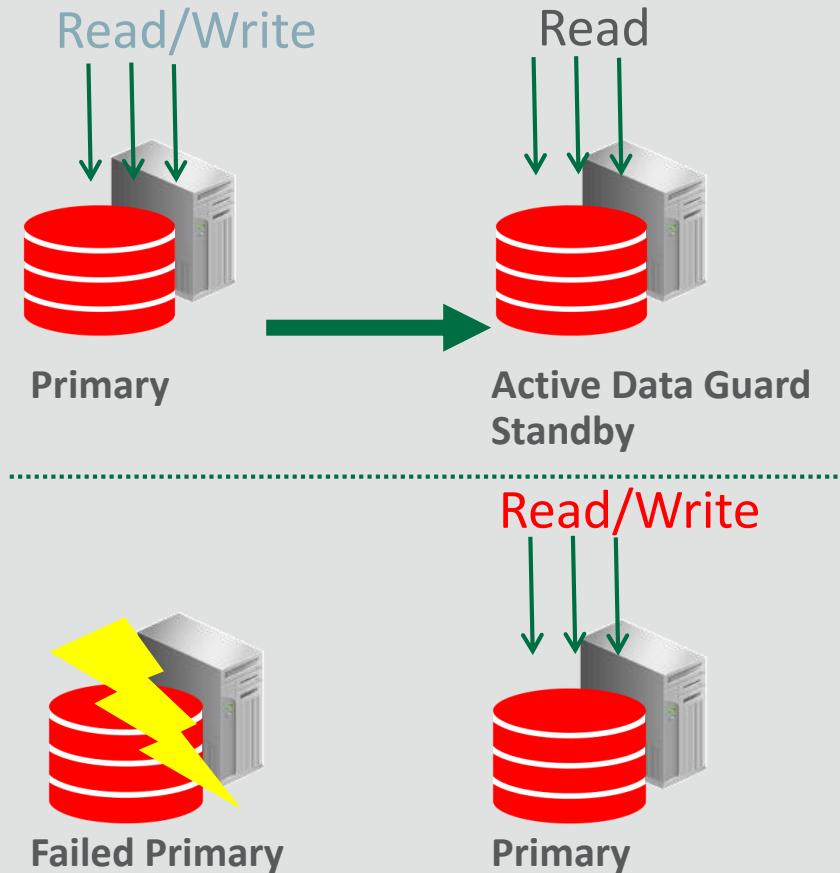
Today, after a flashback database and subsequent “resetlogs” operation has been performed on the primary, the standby database will follow the new incarnation, assuming the user first performs the same flashback operation on the standbys.

With Oracle Database 19c,  
flashback operations are propagated to the standbys automatically

Requires that the standbys are configured for flashback database and in MOUNT state first  
Standbys must have the same or larger setting for DB\_FLASHBACK\_RETENTION\_TARGET



# Buffer Cache preservation after role transition



The database buffer cache state is preserved on an ADG standby during a role change.

Automatically enabled

Configure services so that users can stay connected on a service that is valid in both PHYSICAL\_STANDBY and PRIMARY roles.

Supported versions:

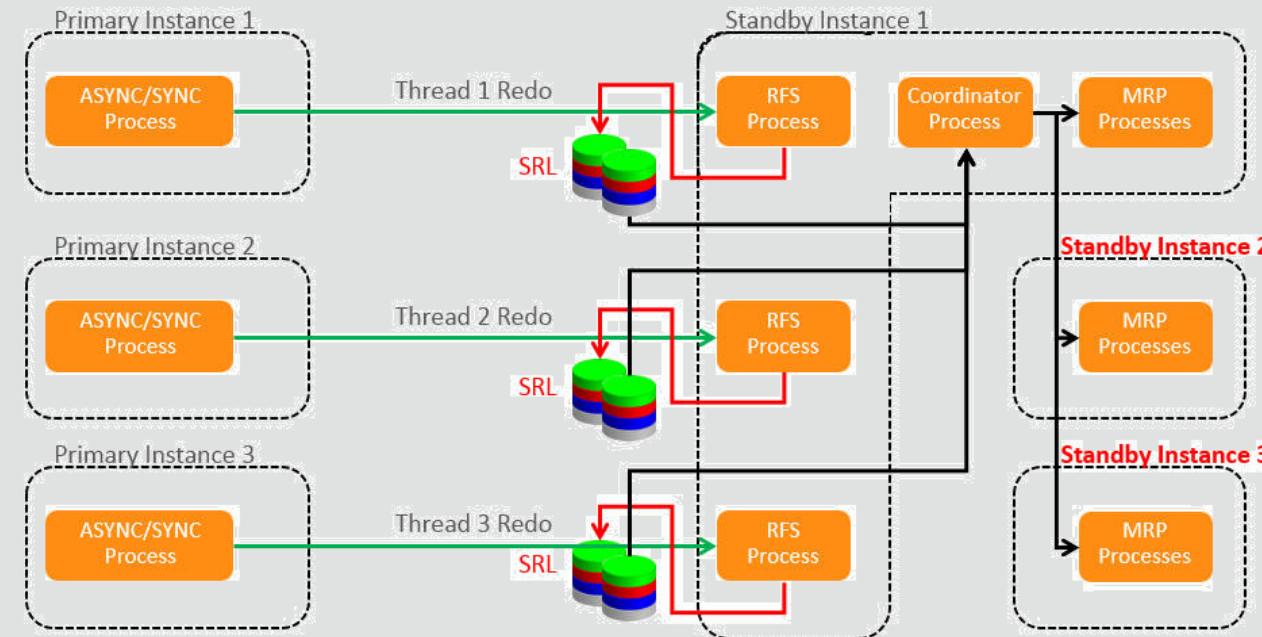
Oracle Database 18c – Single Instance  
Oracle Database 19c – Oracle RAC Support

# Improved Multi-Instance Redo Apply

Parallel redo log apply on Oracle RAC standby

Supported versions:

- Introduced with Oracle Database 12c Rel. 2
- Oracle Database 18c added support for Block Change Tracking enabled (ADG feature)
- Oracle Database 19c supports the In Memory Column Store (IMCS)



# Bigger Footprint of ADG Applications

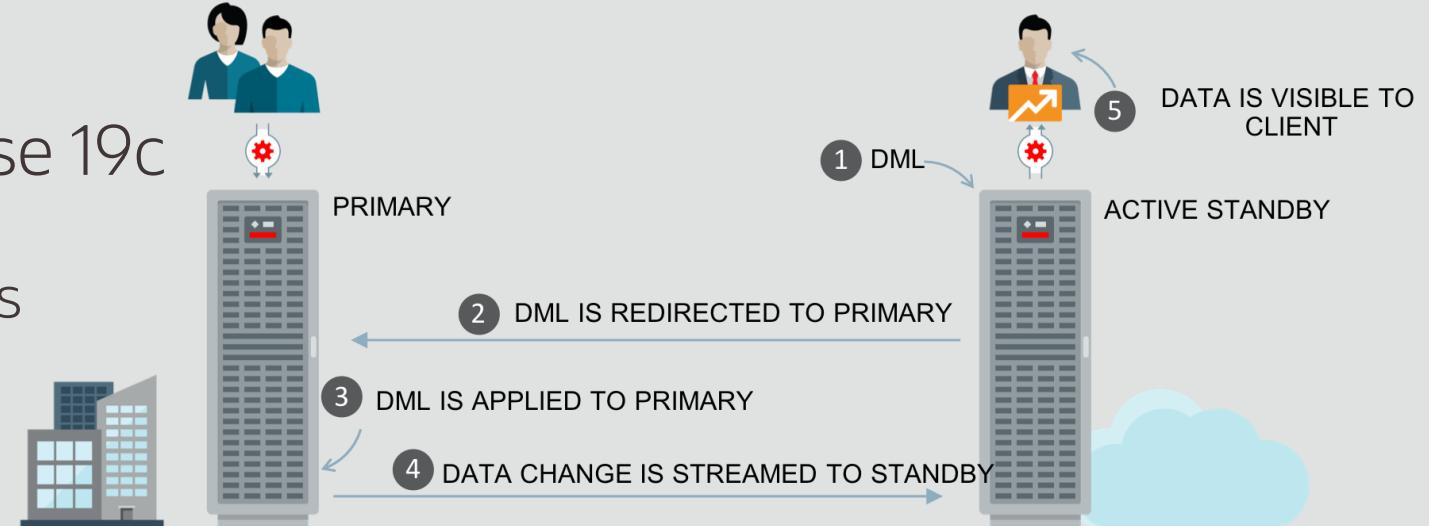
## DML on ADG

DML Re-direction is automatically performed from an Active Data Guard standby to the primary without compromising ACID

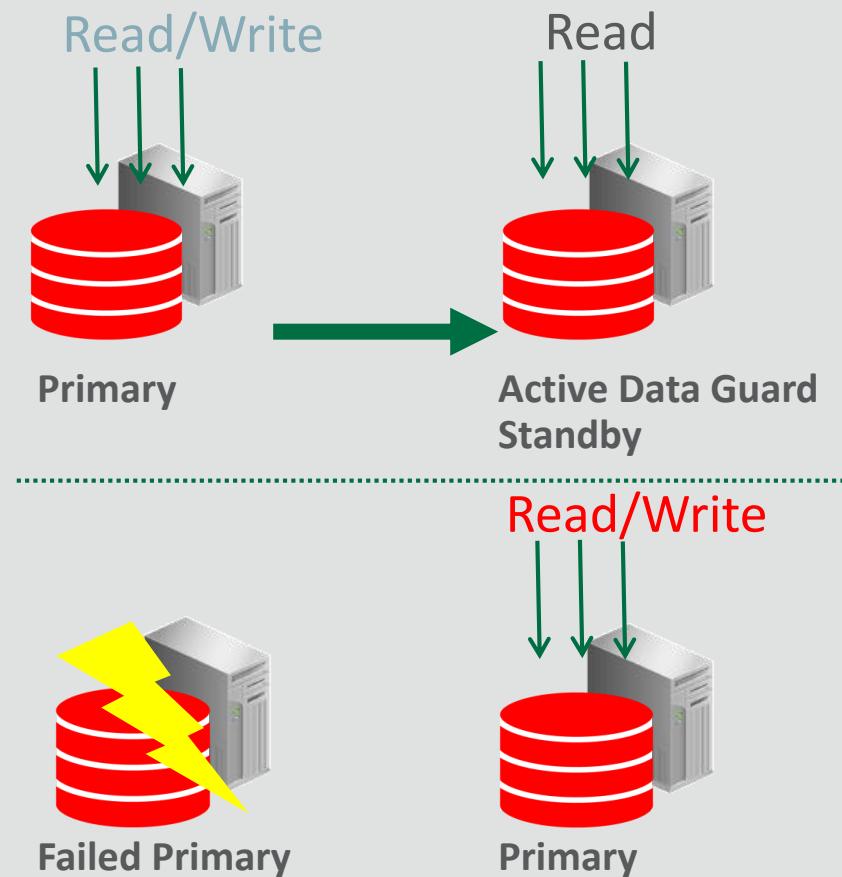
- New documented parameter `ADG_REDIRECT_DML` controls DML Redirection
- New `alter session ADG_REDIRECT_DML` allows for per-session override
- New `ADG_REDIRECT_PLSQL` commands

Supported with Oracle Database 19c

Targeted for “Read-Mostly, Occasional Updates” applications



# Standby Result Cache



The Result Cache state is preserved on an ADG standby during a role change.

## History

- In the past
  - database buffer cache is preserved
- In the future
  - Also result cache is preserved

Facilitates using the Active Standby database for queries without performance impact.

# Oracle (Active) Data Guard

Actively protecting data towards the future

- Active Data Guard Real-Time Cascade
- Advanced Data Guard Broker Manageability
- Separation of Duty Support
- Protection During Database Rolling Upgrade
- Fast Sync
- Broker for Cascaded Standby Databases
- Resumable Switchover Operations
- Rolling Upgrade Using Active Data Guard
- Single Command Role Transitions

**11.2**

- Configurable Real-Time Query Apply Lag Limit
- Integrated Support for Application Failover
- SPA Support for Active Data Guard Environment
- Support Up to 30 Standby Databases

**12.1**

- Active Data Guard Support for SQL Tuning Advisor
- Synchronize Password Files Synchronization
- Data Guard Broker PDB Migration or Failover
- Multi-Instance Redo Apply
- Oracle Data Guard Database Compare
- Oracle Data Guard Support for Oracle Diagnostics Pack
- Oracle Database In-Memory Support on Oracle Active Data Guard
- Preserving Application Connections During Role Changes
- Subset Standby

**12.2**

- Automatic Correction of Non-logged Blocks at a Data Guard Standby Database
- RMAN recover standby simplification
- Shadow Lost Write Protection

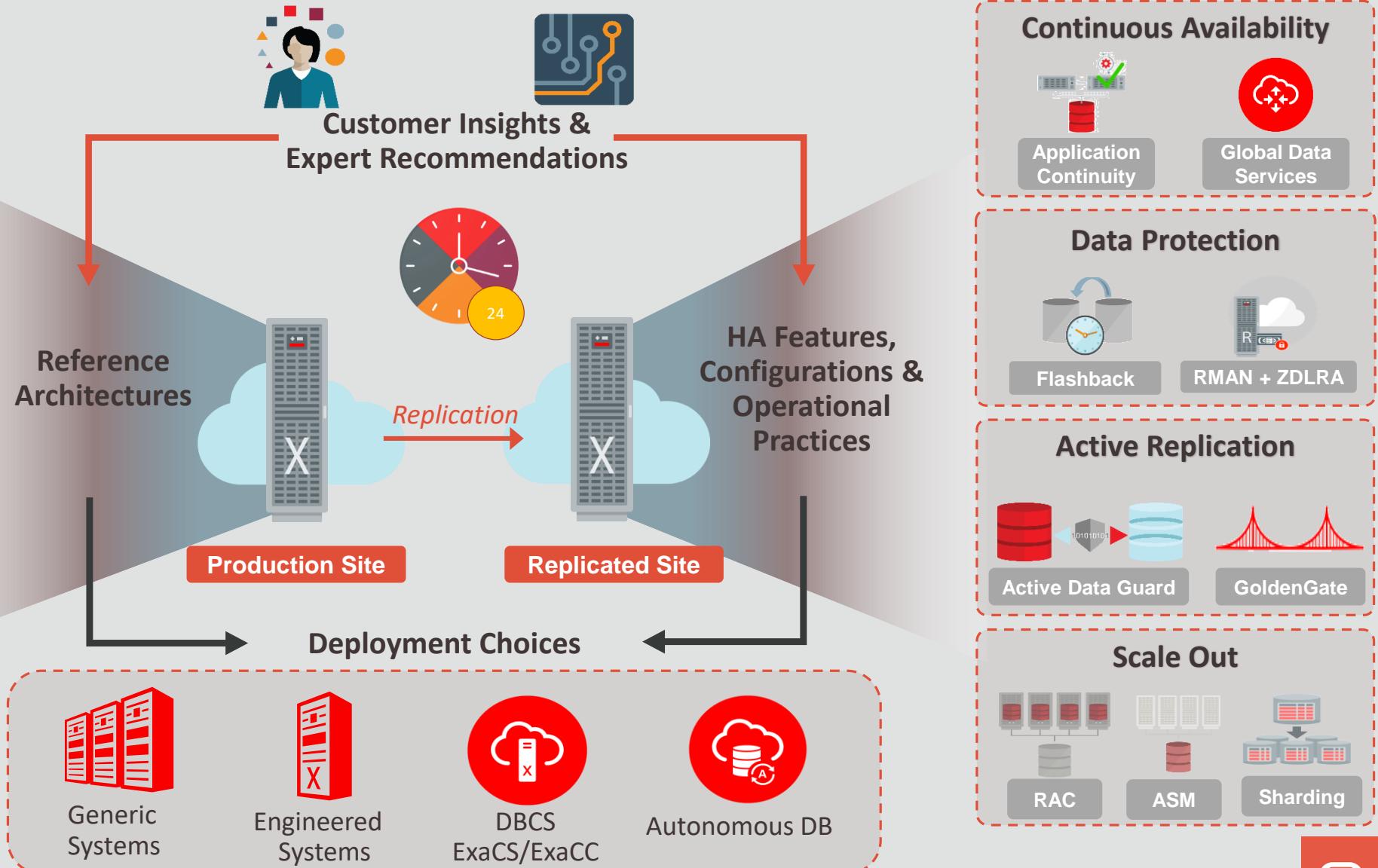
**18c**

- Updates on ADG
- Dynamically Fast-Start Failover (FSFO) target
- Finer granularity Supplemental Logging
- Flashback Standby database when Primary database is flashed back
- IMCS on Multi-Instance Redo apply
- Observe only mode for FSFO
- Propagate Restore Points from Primary to Standby site
- Simplified Database Parameter Management in a Broker Configuration

**19c**



# Oracle Maximum Availability Architecture (MAA)



# MAA Reference Architectures

Meet Downtime (RTO) and Data Loss (RPO) SLAs



MAA Reference Architectures	Topology	Suitable Databases
BRONZE	Single Instance + Backup	Dev, Test, Prod
SILVER	HA Clustering + Backup	Prod/Departmental
GOLD	HA Clustering + Disaster Recovery + Backup	Mission Critical
PLATINUM	Zero Data Loss & Zero Downtime	Extreme Critical

A vertical red arrow on the right side of the table points downwards, labeled "Downtime & Data Loss".

Addresses SLAs for Data Loss and Downtime during Planned & Unplanned Outages

# MAA Reference Architectures

Meet Downtime (RTO) and Data Loss (RPO) SLAs



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Addresses SLAs for Data Loss and Downtime during Planned & Unplanned Outages

# Thank You

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if you have any concerns please let us know



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LAD Partner Enablement  
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