Oracle Active Data Guard: Best Practices and New Features Deep Dive

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Safe Harbor

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Topics

(Active) Data Guard 19c

Oracle (Active) Data Guard features
What's new and what you want to know from the past

Data Guard Broker

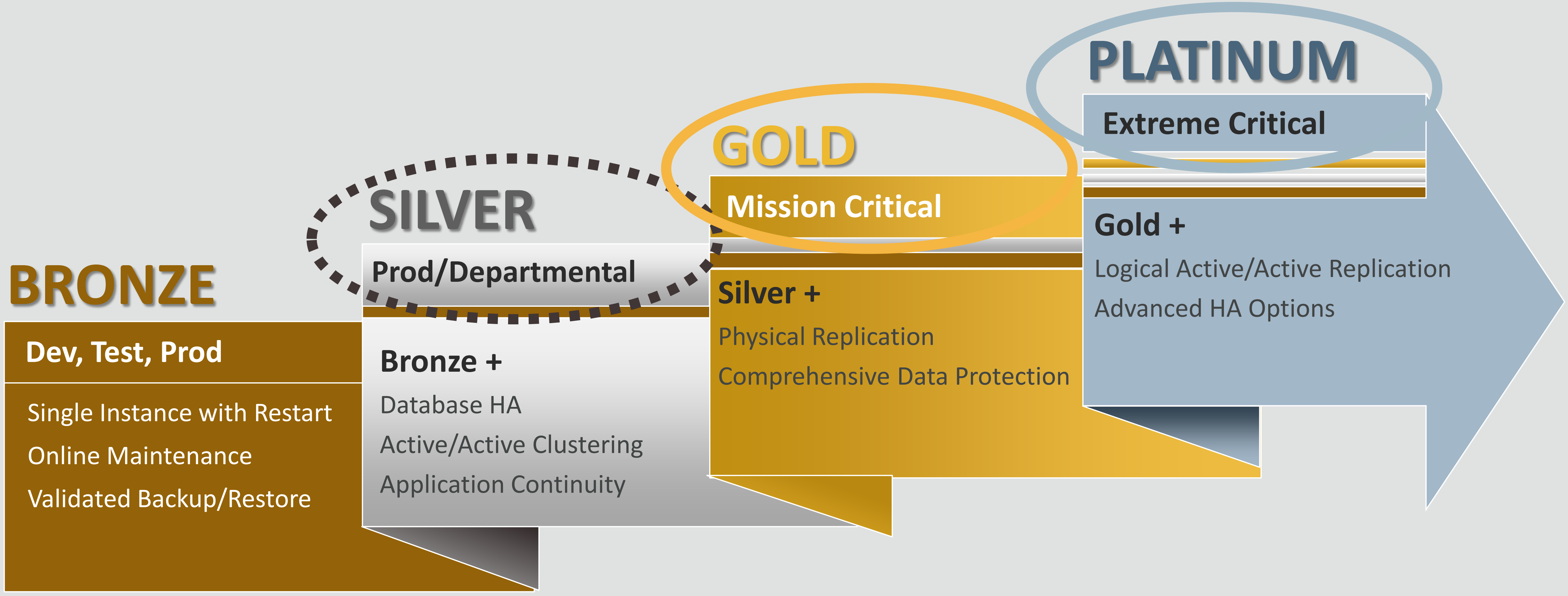
The way to manage your Data Guard implementation

Features for the future

What's coming?

Oracle MAA Reference Architectures

Align Oracle Capabilities with Customer Service Level Requirements



BRONZE

Dev, Test, Prod

Single Instance with Restart

Online Maintenance

Validated Backup/Restore

SILVER

Prod/Departmental

Bronze +

Database HA

Active/Active Clustering

Application Continuity

GOLD

Mission Critical

Silver +

Physical Replication

Comprehensive Data Protection

PLATINUM

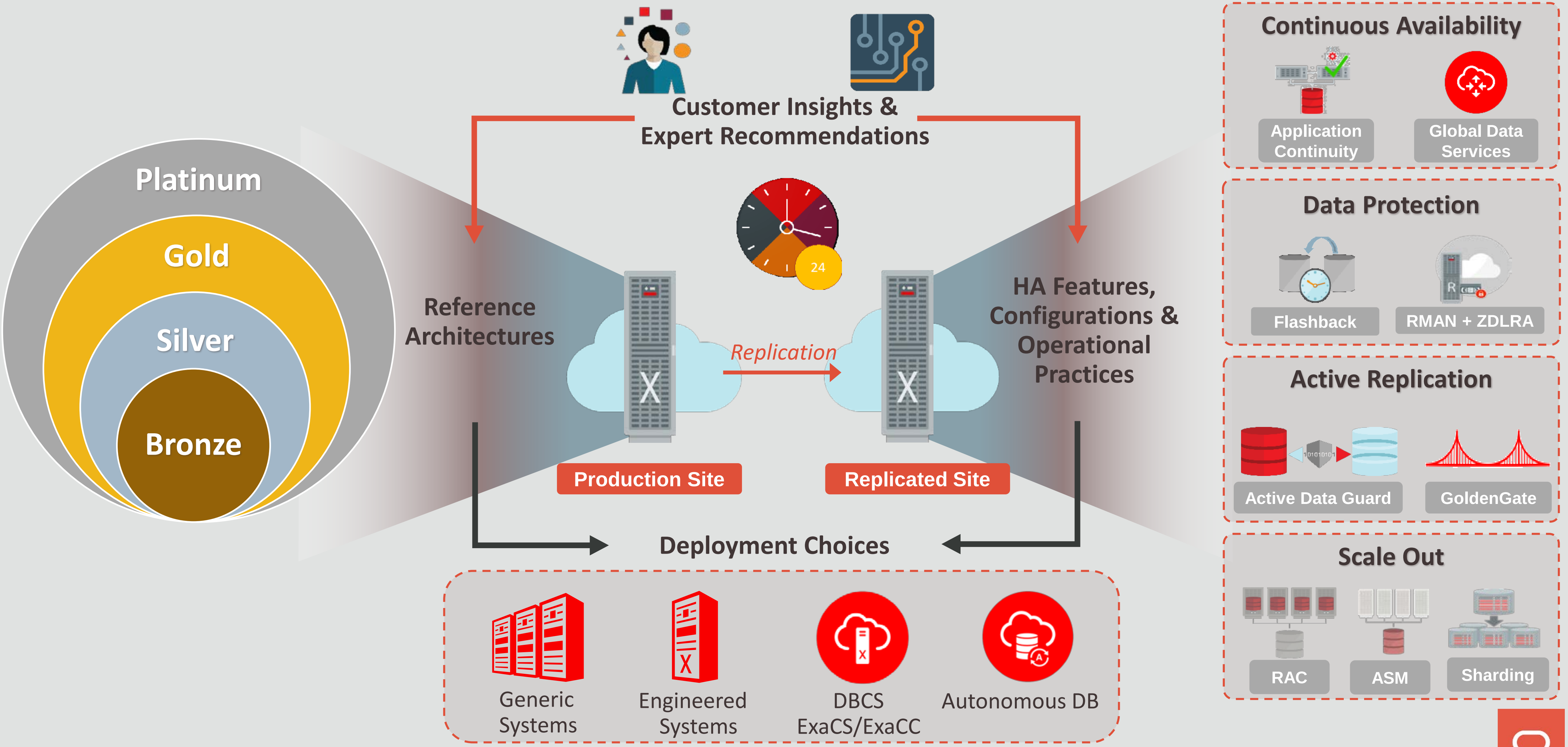
Extreme Critical

Gold +

Logical Active/Active Replication

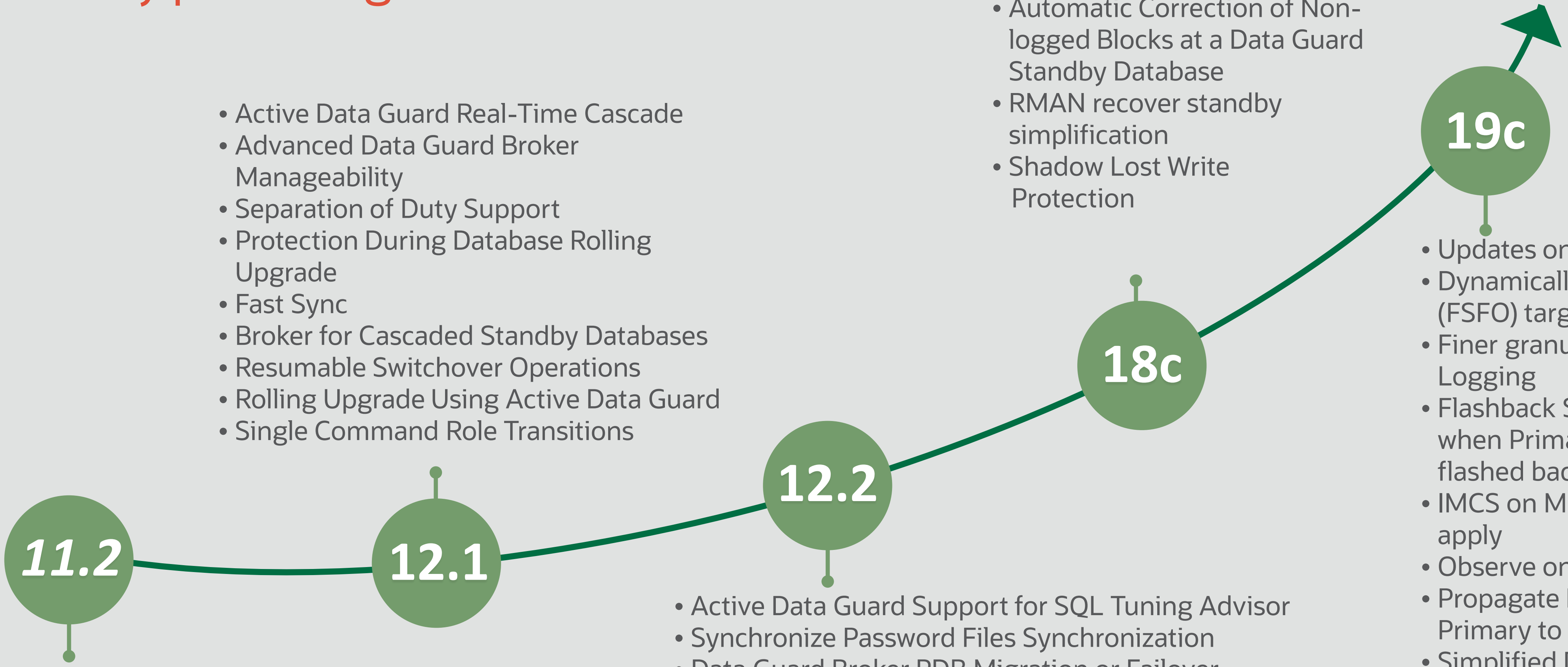
Advanced HA Options

Oracle Maximum Availability Architecture (MAA)



Oracle (Active) Data Guard

Actively protecting data towards the future



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 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

12.2

- 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

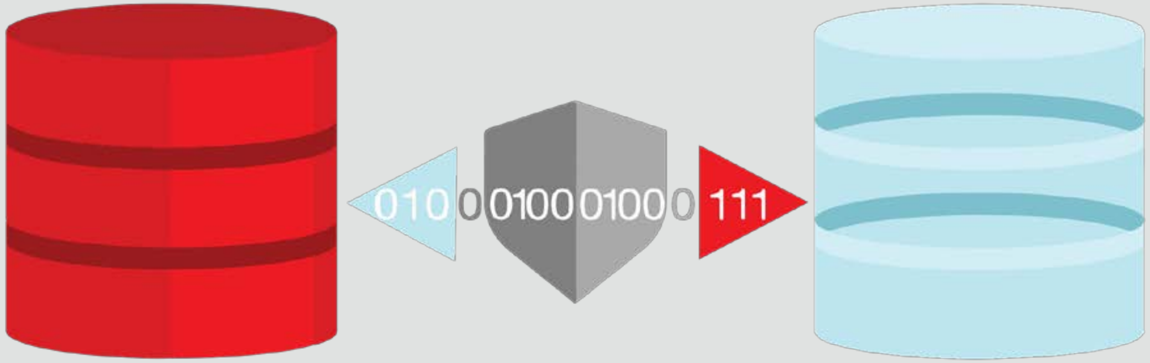
18c

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

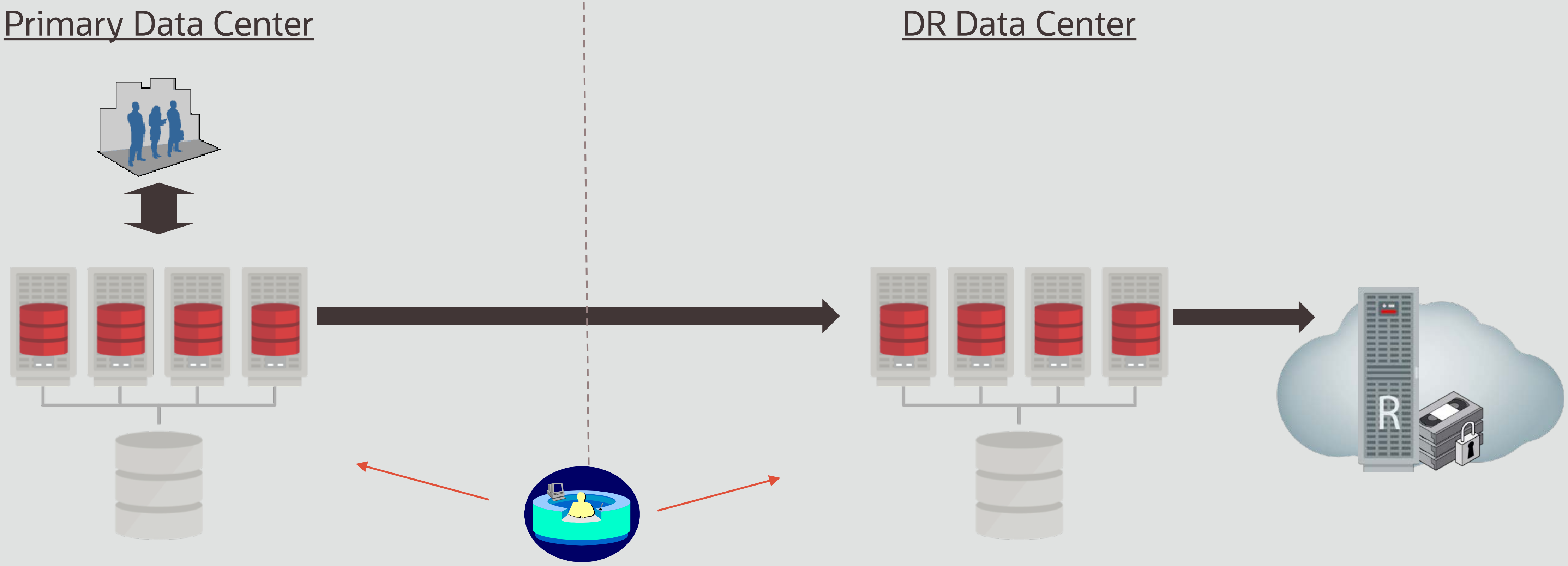
19c

- 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

(Active) Data Guard

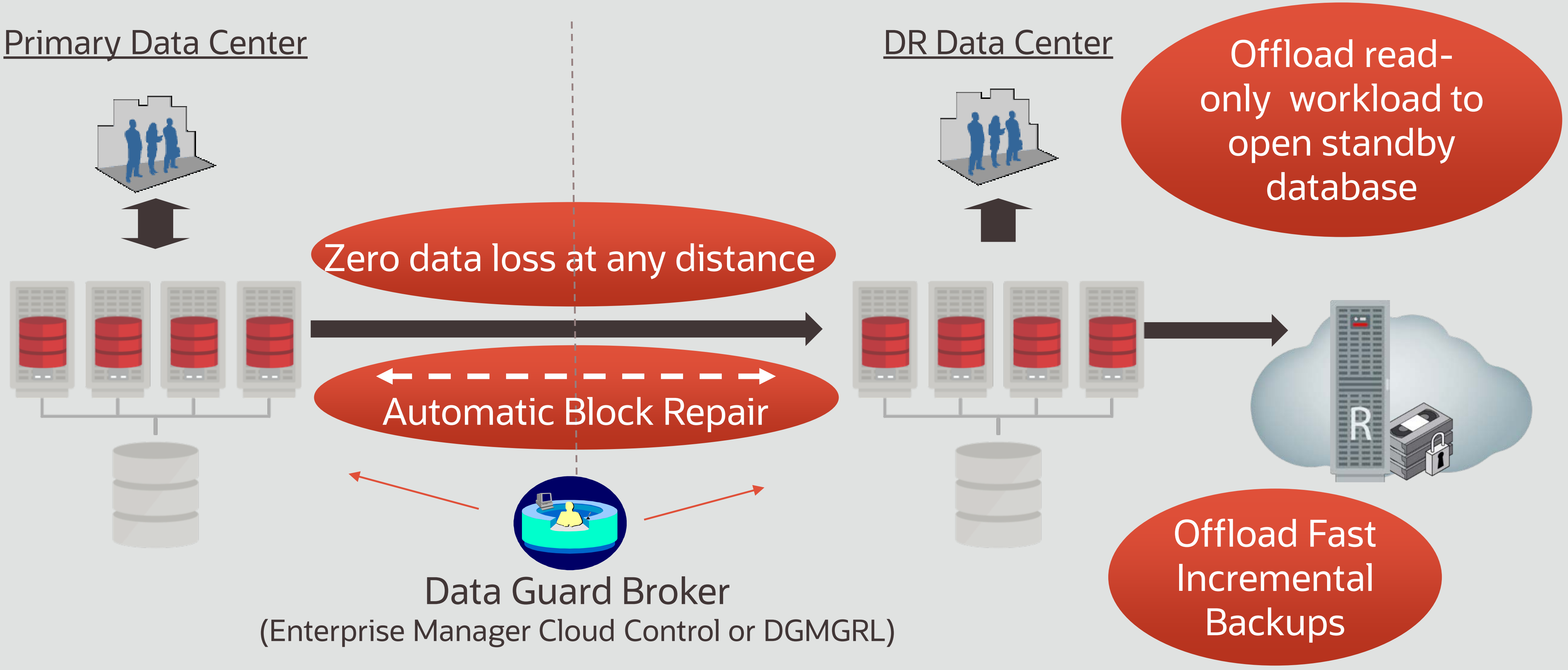


Data Guard: Real-time Data Protection & Availability



Data Guard Broker
(Enterprise Manager Cloud Control or DGMGRL)

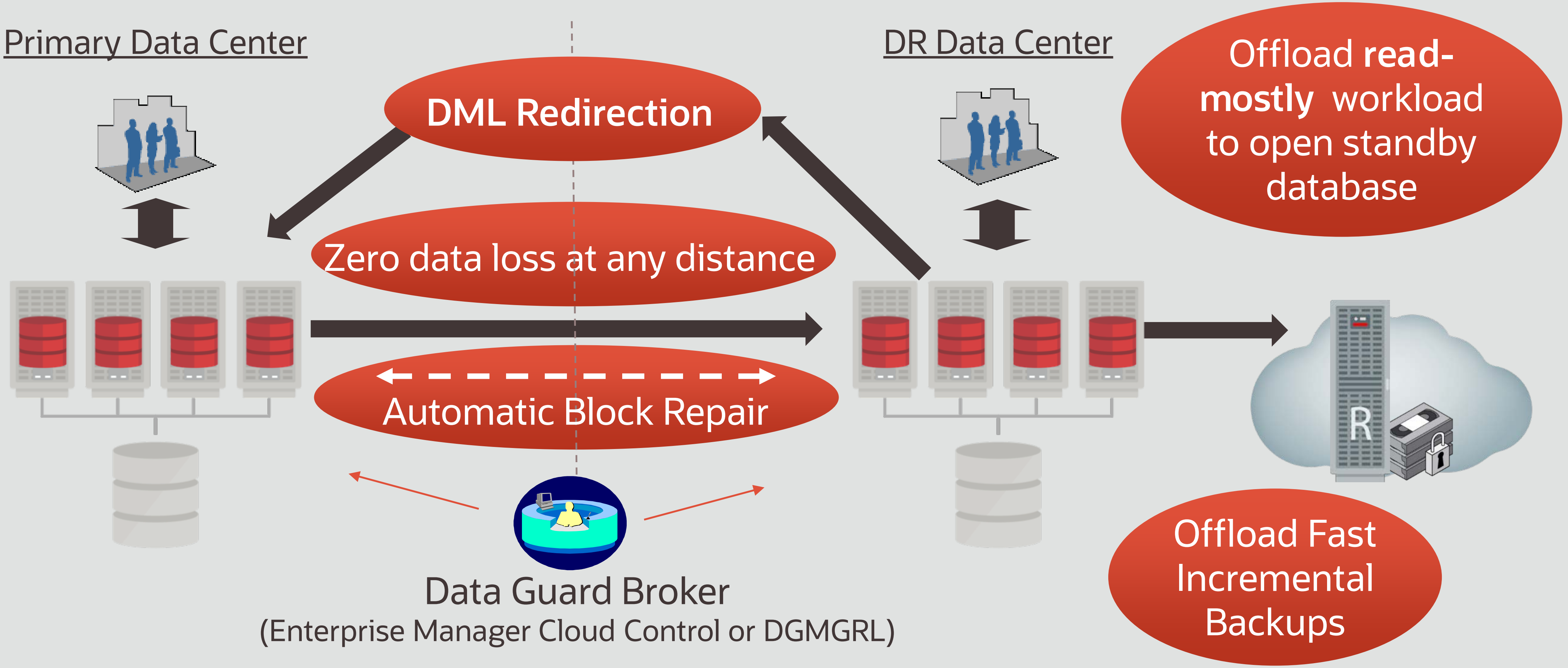
Active Data Guard: Advanced Capabilities



Primary Data Center
DR Data Center
Offload read-only workload to open standby database
Zero data loss at any distance
Automatic Block Repair
R
Offload Fast Incremental Backups
Data Guard Broker
(Enterprise Manager Cloud Control or DGMGRL)

Active Data Guard: Advanced Capabilities

NEW IN 19c



Primary Data Center
DR Data Center
DML Redirection
Zero data loss at any distance
Automatic Block Repair
Offload **read-mostly** workload to open standby database
Offload Fast Incremental Backups
R
Data Guard Broker
(Enterprise Manager Cloud Control or DGMGRL)

(Active) Data Guard Features 19c

- 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

NEW IN 19c

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.

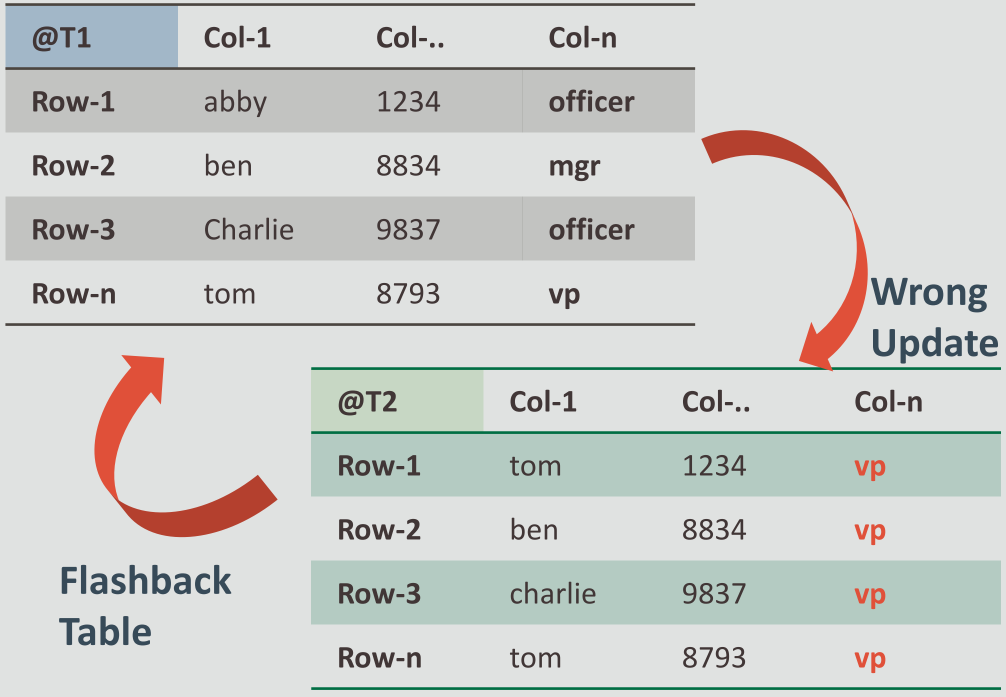
- `DATA_GUARD_MAX_LONGIO_TIME`

  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

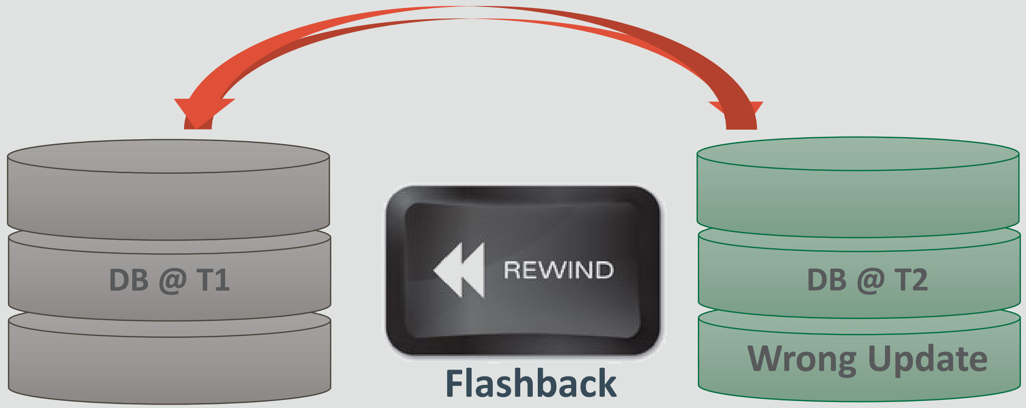


@T1	Col-1	Col-..	Col-n
Row-1	abby	1234	officer
Row-2	ben	8834	mgr
Row-3	Charlie	9837	officer
Row-n	tom	8793	vp

Wrong Update

@T2	Col-1	Col-..	Col-n
Row-1	tom	1234	vp
Row-2	ben	8834	vp
Row-3	charlie	9837	vp
Row-n	tom	8793	vp

Flashback Table



Flashback Database

Flashback Database Enhancements

NEW IN 19c

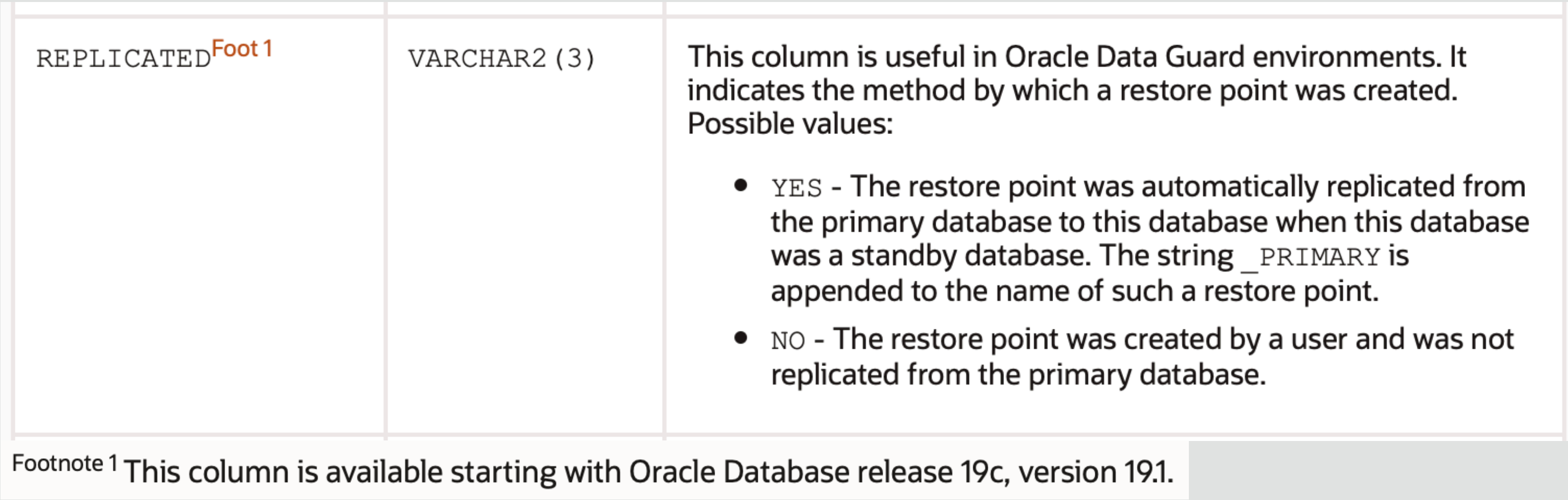
Restore Points automatically propagate from the primary to the standbys

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[Foot 1]	VARCHAR2(3)	This column is useful in Oracle Data Guard environments. It indicates the method by which a restore point was created. Possible values: • 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. • NO - The restore point was created by a user and was not replicated from the primary database.

[Footnote 1] This column is available starting with Oracle Database release 19c, version 19.1.

Flashback Database Enhancements

NEW IN 19c

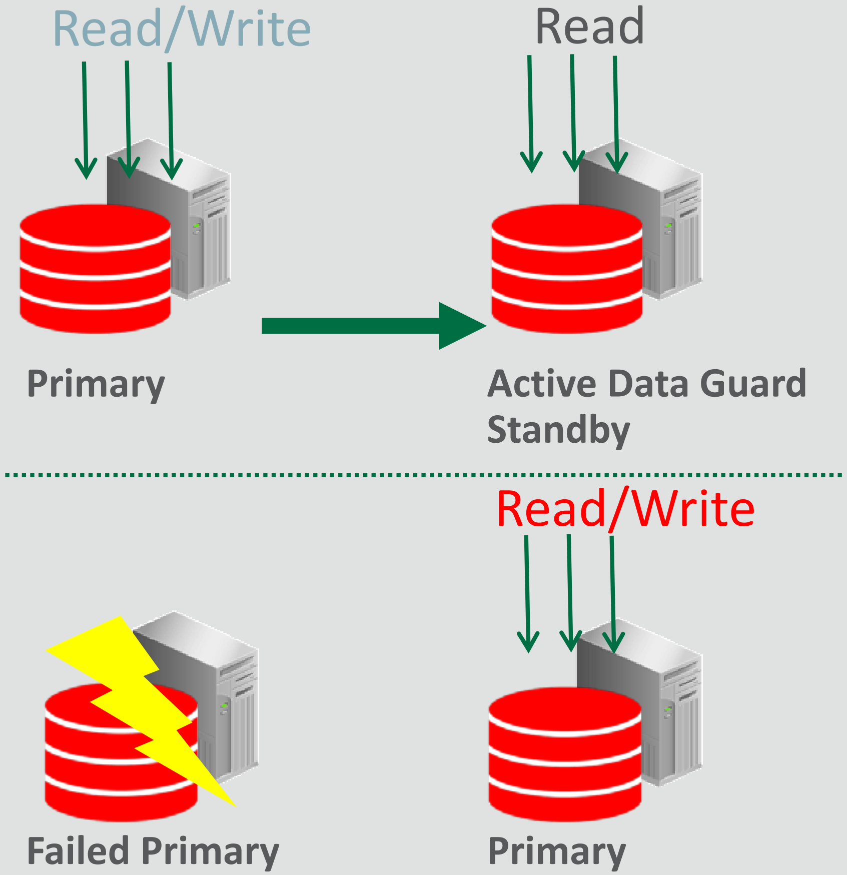
Standbys automatically follow the primary after a RESETLOGS operation

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:

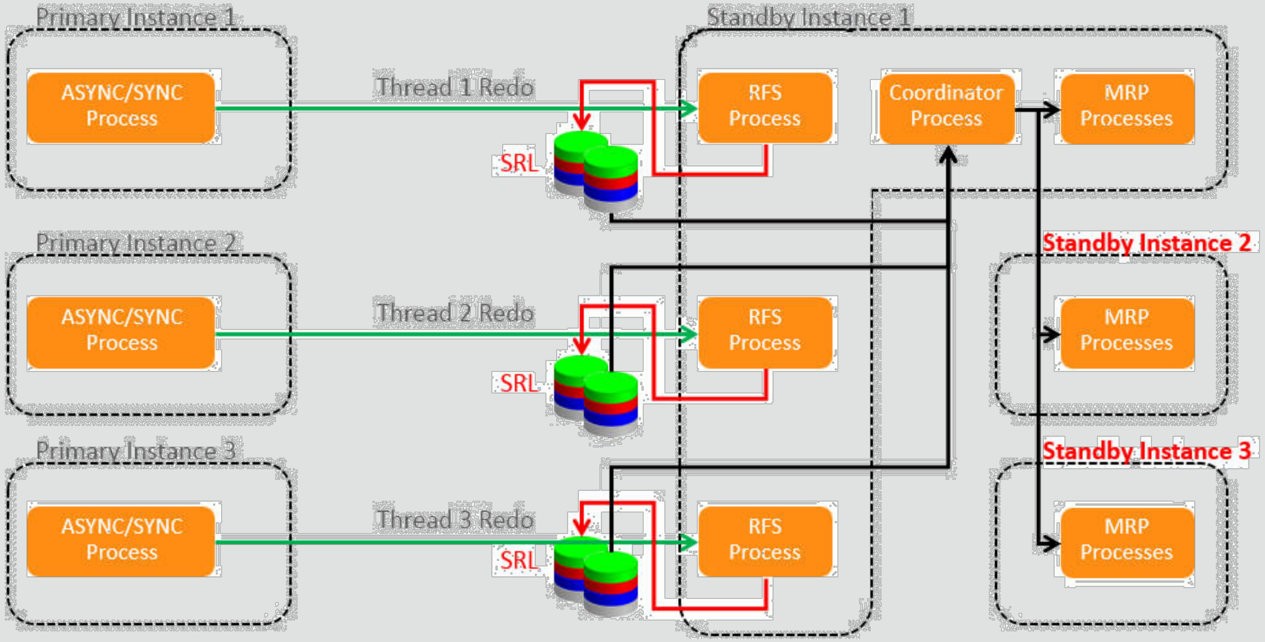
- Oracle Database 18c – Single Instance
- Oracle Database 19c – Oracle RAC Support

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)



Expanded ADG Application Features

Creating Private Temporary Tables on Active Data Guard

NEW IN 18c

Private (Local) Temporary Tables on an Active Data Guard standby database

- Are stored in memory on the standby
- Visible only to the session that created it
- Dropped at the end of a transaction or session

Expanded ADG Application Features

NEW IN 18c

Creating Global Temporary Tables on Active Data Guard

Global Temporary Tables (GTT) on an Active Data Guard standby database

- Are Enabled by setting parameter “`_enable_proxy_adg_redirect=TRUE`” and appropriate connectivity parameters using `log_archive_dest_x`
- Requires Standby to be caught up, with Real Time Apply running
- Create the GTT on the primary over an internal link
- Wait for the GTT redo to be replicated and applied to the Active Data Guard standby
- Return control to the user

Supported with Oracle Database 18c

Bigger Footprint of ADG Applications

NEW IN 19c

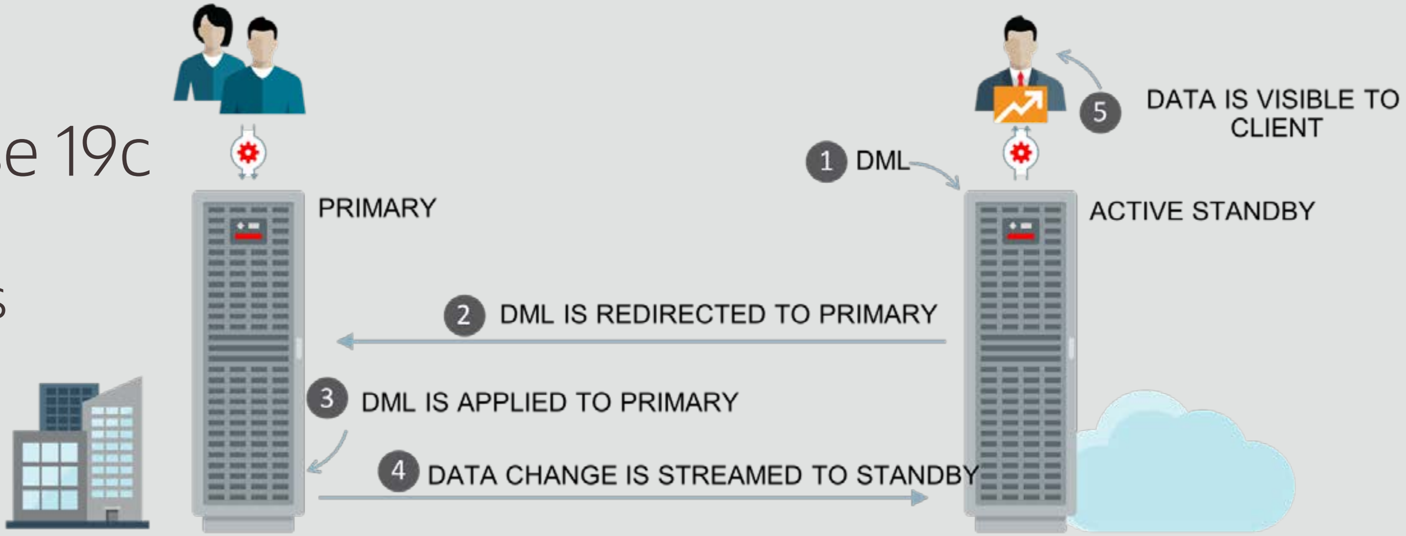
DML on ADG

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

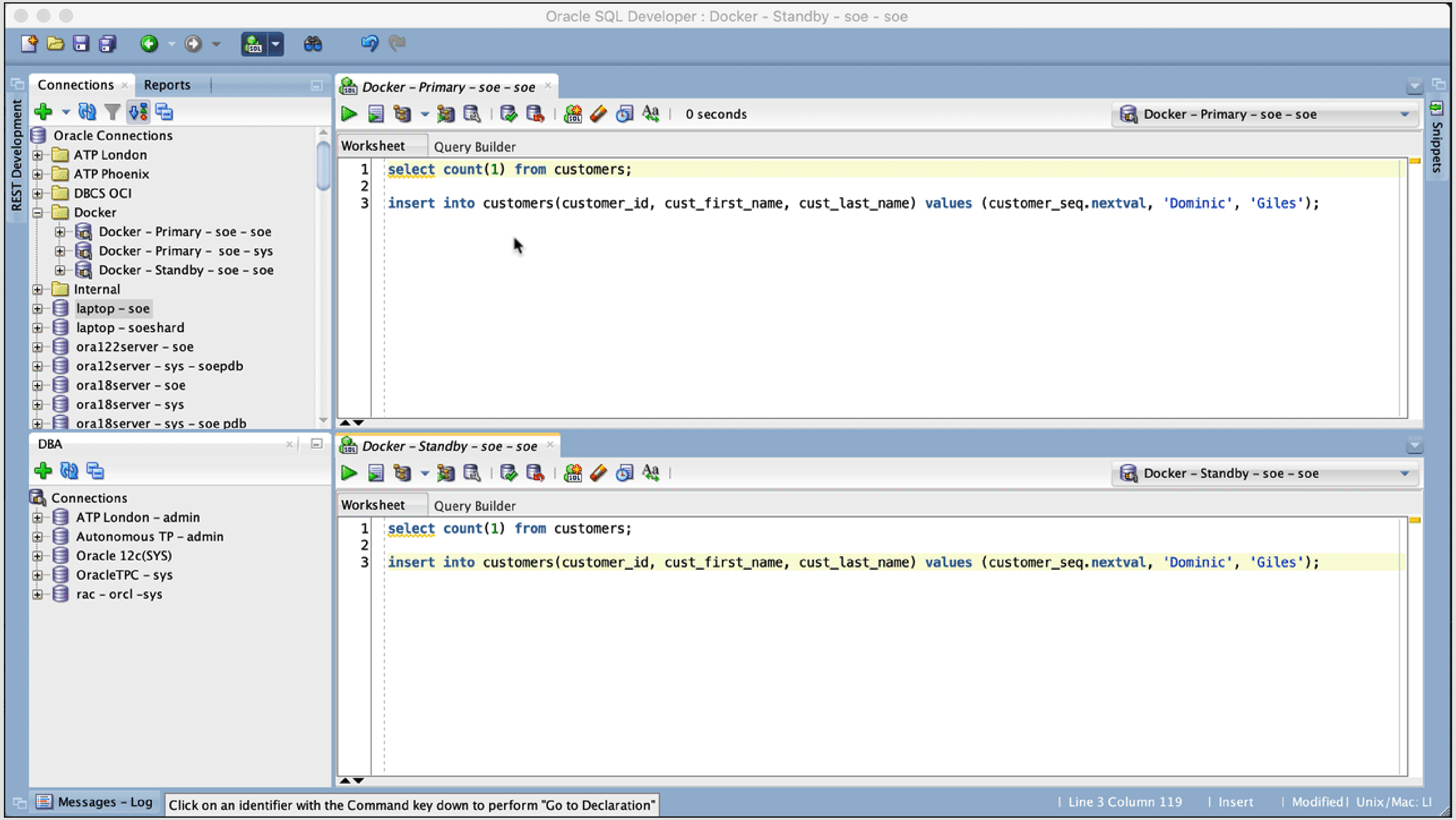
Targeted for "Read-Mostly, Occasional Updates" applications



PRIMARY
ACTIVE STANDBY
1 DML
2 DML IS REDIRECTED TO PRIMARY
3 DML IS APPLIED TO PRIMARY
4 DATA CHANGE IS STREAMED TO STANDBY
5 DATA IS VISIBLE TO CLIENT

Active Data Guard DML on ADG

NEW IN 19c



Docker – Primary – soe – soe

```
select count(1) from customers;

insert into customers(customer_id, cust_first_name, cust_last_name) values (customer_seq.nextval, 'Dominic', 'Giles');
```

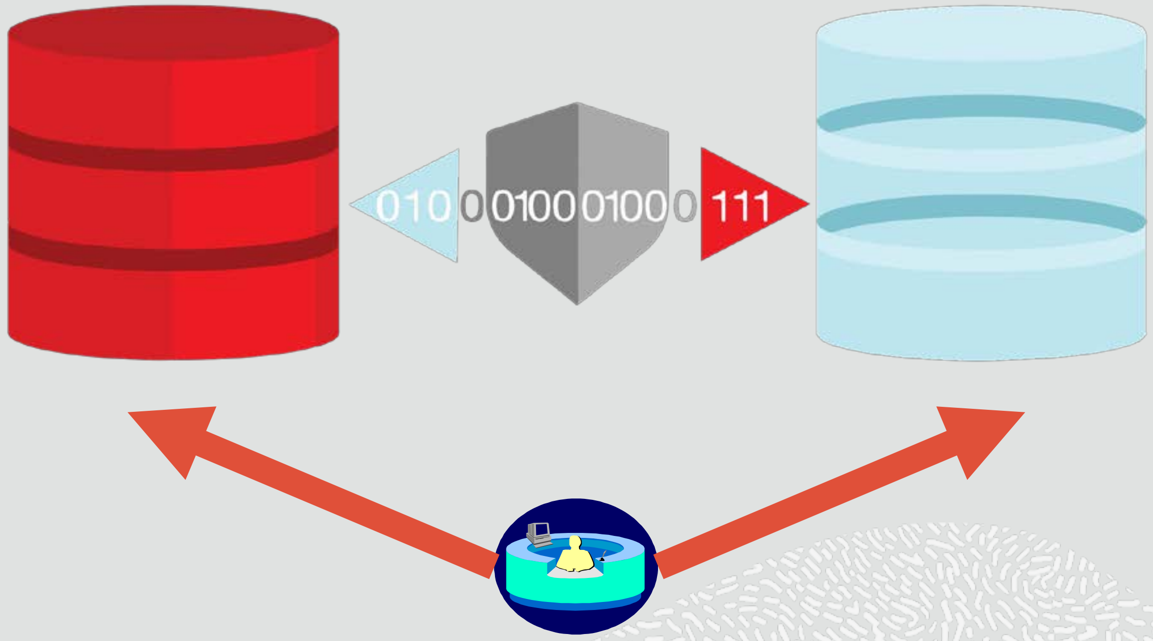
Docker – Standby – soe – soe

```
select count(1) from customers;

insert into customers(customer_id, cust_first_name, cust_last_name) values (customer_seq.nextval, 'Dominic', 'Giles');
```

Click on an identifier with the Command key down to perform "Go to Declaration"

Data Guard Broker



Data Guard Broker Features for 19c

- New TRACE_LEVEL qualifier replaces DEBUG
- New commands to set database initialization parameters
- Observe-only mode for Broker's Fast-Start Failover (FSFO)
- Change Fast-Start Failover (FSFO) target
- Show lag information for all configuration members
- New Local Archiving properties
- New commands to export and import a Broker configuration

SET TRACE_LEVEL USER|SUPPORT

NEW IN 19c

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
```

Set database initialization parameters

NEW IN 19c

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)
- LogFileNameConvert (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)

SET FAST_START FAILOVER TARGET [NOWAIT]

NEW IN 19c

Before Oracle Database 19c, The Observer moves to the next target

- Moving the target back to a previous standby requires disabling and enabling FSFO

Starting with Oracle Database 19c, users can execute the SET FAST_START FAILOVER TARGET command

- Disabling and enabling FSFO will not be required

Fast-Start Failover (FSFO): Observe-Only Mode

NEW IN 19c

Test fast-start failover without impacting the production database

- *Determine* when a failover or other interaction would have occurred during normal production processing
- *Discover* what circumstances would cause an automatic failover to occur
- *Tune* FSFO properties more precisely
- *Easier justify* using Fast-Start Failover s to reduce the recovery time for failovers

```
DGMGRL> ENABLE FAST_START FAILOVER OBSERVE ONLY;
Enabled in Observe-Only mode.
DGMGRL>
```

SHOW CONFIGURATION LAG

NEW IN 19c

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
```

Enhanced Local Archiving

NEW IN 19c

- 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

Export and Import the Broker Metadata File

NEW IN 19c

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>
```

Features for the future

- Standby CDB continuity
- Standardized Data Guard Broker Directory Structure
- Data Guard broker Far Sync instance creation
- Data Guard Broker Primary Database preparation
- Fast Start Failover Configuration Validation
- Fast Start Failover Failover Callouts
- Fast Start Failover Lag Allowance in Max Availability Mode

Standby CDB continuity

NEW IN 20c

In the past

- A short hold on the remaining standby PDBs

In the future

- When a PDB at Primary is cloned, PITR’ed, or when it undergoes flashback/open reset logs, ADG recovery and operations on remainder of the PDBs continues unabated

This helps to preserve the PDB isolation principle on ADG allowing us to maintain protection & query SLAs for remaining PDBs in exactly the same way as that on Primary for such operations.

Data Guard Broker Client Side Standardized Directory Structure

NEW IN 20c

$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

Data Guard Broker Far Sync Instance Creation

NEW IN 20c

The Data Guard Broker interface has been extended with a command that enables users to create and add a Far Sync instance to a Data Guard Broker environment.

Zero Data loss over long distance can be achieved by using the Data Guard Far Sync standby instances. To ease the setup and configuration of these instances the Oracle Data Guard Broker can now be used. This leads to easier and simplified setup which leverages the maintainability from the overall environment.

Oracle Data Guard Broker Primary Database Preparation

NEW IN 20c

Using one single command in the Oracle Data Guard Broker, the database can be completely prepared for being a primary database.

By using this feature the risk of human error on the future primary database is avoided. This can also be taken advantage of as the Data Guard Broker interface is scriptable, which leads to a more standardized environment by which complexity is removed and stability is increased.

Fast Start Failover Configuration Validation

NEW IN 20c

FSFO Configuration Validation checks and reports misconfigurations of a FSFO enabled system.

The command reports issues:

- that can prevent enabling or initiating FSFO, e.g., the FSFO target is lagging.
- that can affect what happens after FSFO, e.g., reinstatement.
- about the FSFO parameters that are setup inappropriately, e.g., too low FSFO threshold for RAC databases.
- on FSFO callout configuration files, e.g., inaccessible pre/post-callout scripts.

Fast Start Failover Failover Callouts

NEW IN 20c

When observer initiates a FSFO

- it performs a pre-FSFO if the Fast-Start Failover configuration file exists
- post-FSFO callout if the Fast-Start Failover configuration file exists

A role transition often incorporates manual pre- and post steps to be performed. By automating these steps in callout scripts, human errors are avoided and a more consistent environment behavior is achieved.

Fast Start Failover Lag Allowance in Max Availability Mode

NEW IN 20c

Fast-Start Failover (FSFO) can be enabled to failover despite a lag in redo apply

- using ASYNC apply
- potentially data loss controlled by the FastStartFailoverLagLimit property

FSFO Lag Allowance in Max Availability Mode should be enabled if RTO objectives need to be met and the RPO expectation is preserved despite a well-defined data loss.

This is of particular use if the potential loss leads to faster recovery time when switching over to a standby database using ASYNC while an additional standby database in SYNC mode is configured.

Thank You