Oracle OpenWorld 2019

SAN FRANCISCO

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

Pieter Van Puymbroeck Product Manager Oracle Data Guard & Active Data Guard

Mahesh Girkar Senior Director Software Development – Data Guard & Active Data Guard

Nitin Karkhanis Software Development Director – Data Guard & Active Data Guard

Safe Harbor

The preceding is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. The development, release, timing, and pricing of any features or functionality described for Oracle's products may change and remains at the sole discretion of Oracle Corporation.

Statements in this presentation relating to Oracle's future plans, expectations, beliefs, intentions and prospects are "forward-looking statements" and are subject to material risks and uncertainties. A detailed discussion of these factors and other risks that affect our business is contained in Oracle's Securities and Exchange Commission (SEC) filings, including our most recent reports on Form 10-K and Form 10-Q under the heading "Risk Factors." These filings are available on the SEC's website or on Oracle's website at http://www.oracle.com/investor. All information in this presentation is current as of September 2019 and Oracle undertakes no duty to update any statement in light of new information or future events.

Copyright © 2019 Oracle and/or its affiliates.

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

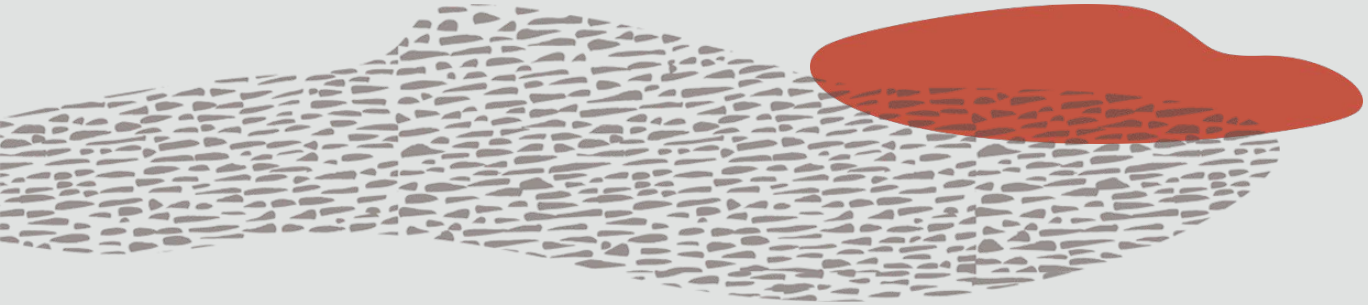
The way to manage your Data Guard implementation

Customer case - CERN

How Data Guard helps CERN to protect their data

Features for the future

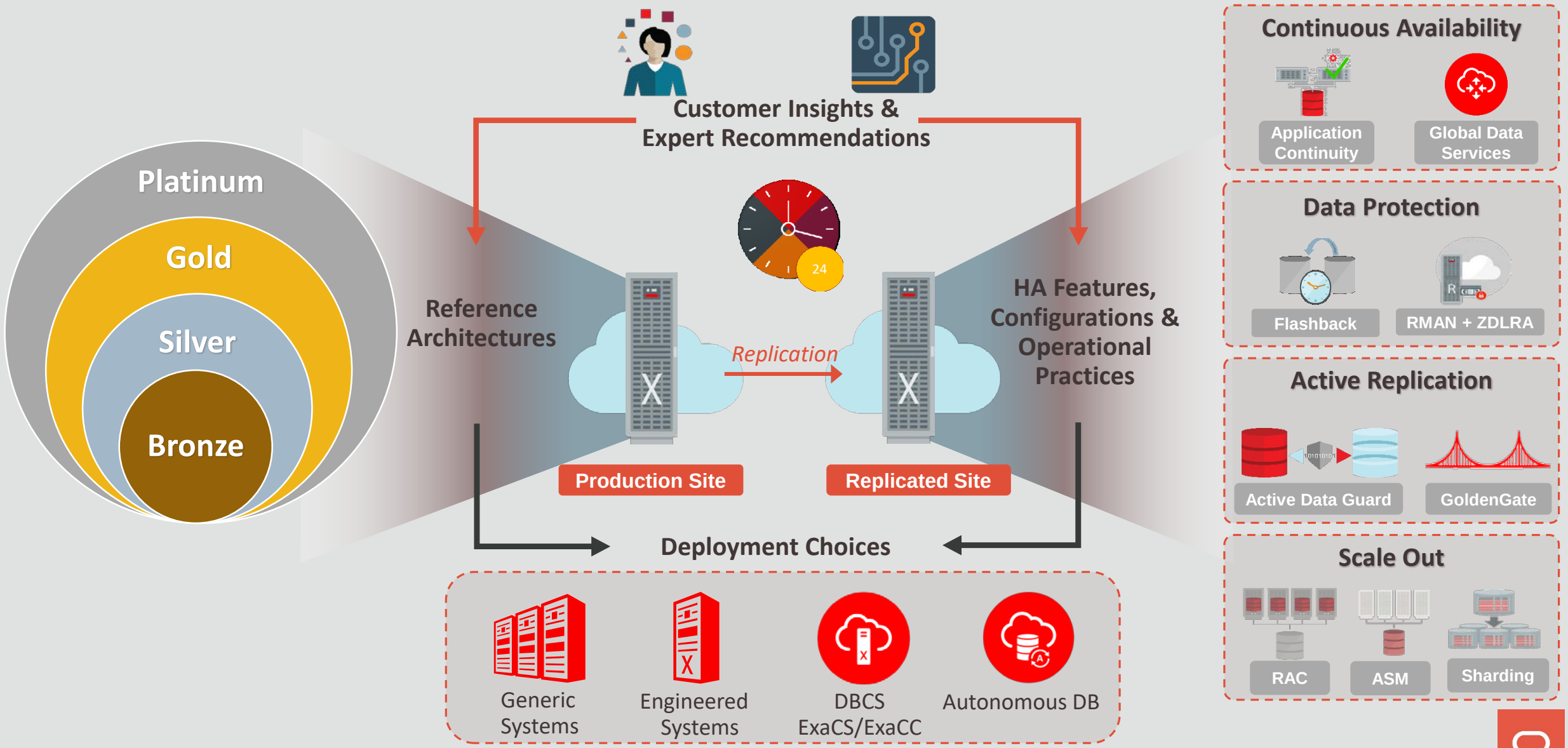
What's coming?



Oracle MAA Reference Architectures

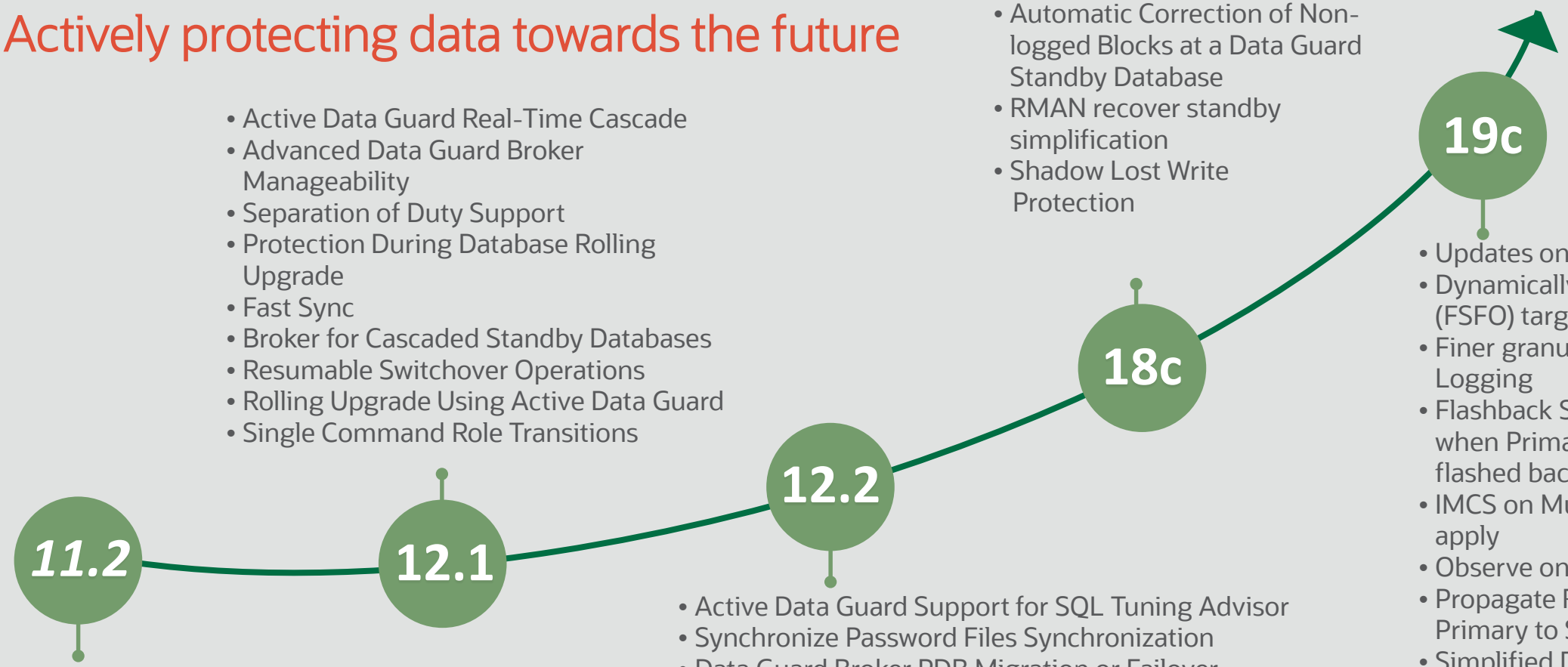
Align Oracle Capabilities with Customer Service Level Requirements

Oracle Maximum Availability Architecture (MAA)



Oracle (Active) Data Guard

Actively protecting data towards the future



- 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

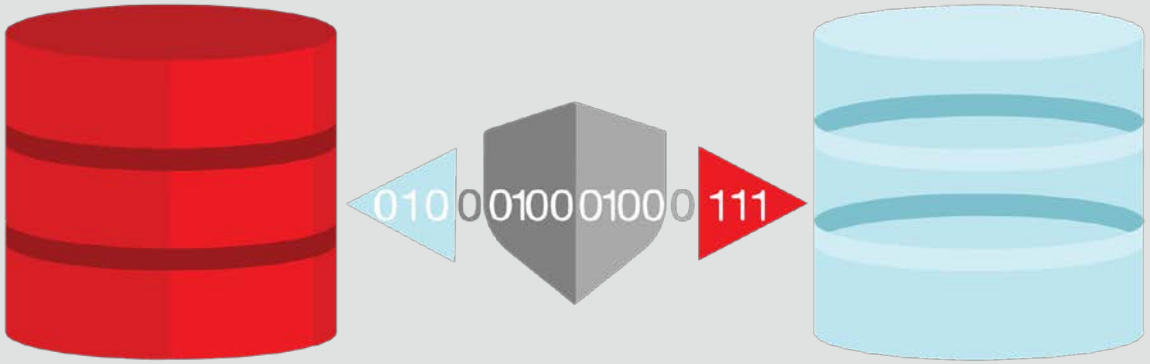
- Active Data Guard Real-Time Cascade
- Advanced Data Guard Broker Manageability
- Separation of Duty Support
- Protection During Database Rolling Upgrade
- Fast Sync
- Broker for Cascaded Standby Databases
- Resumable Switchover Operations
- Rolling Upgrade Using Active Data Guard
- Single Command Role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

- 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

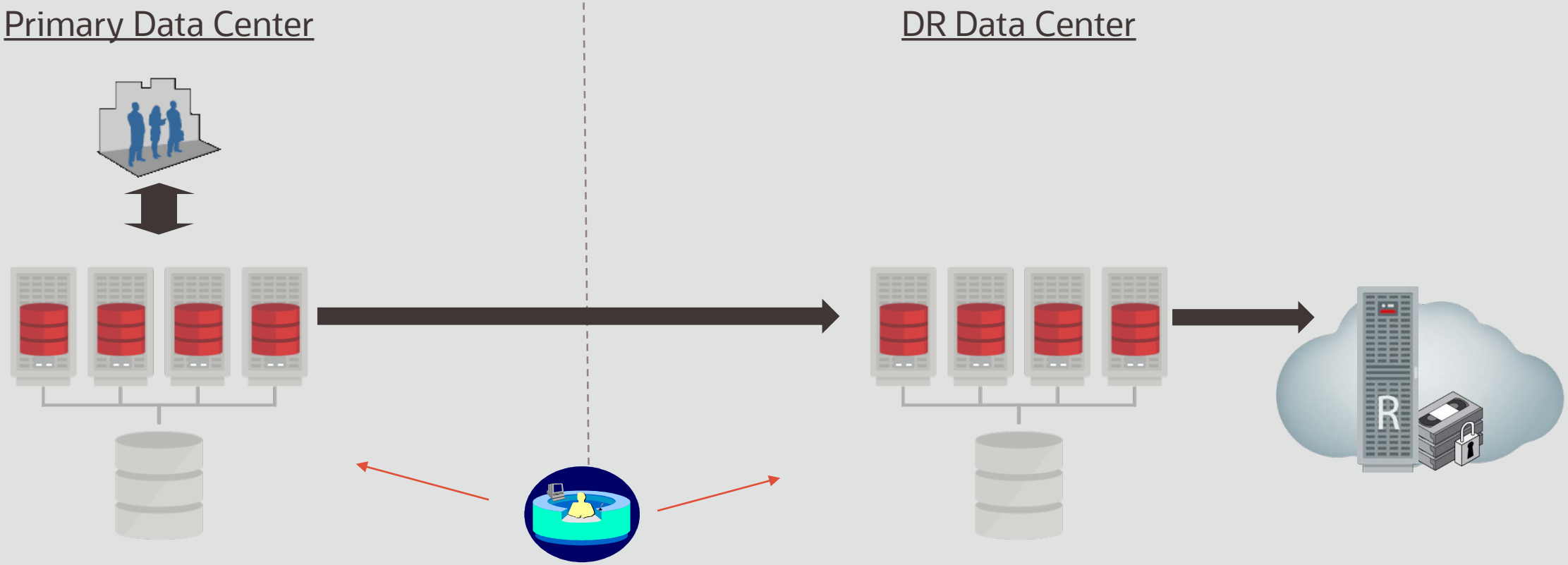
- Automatic Correction of Non-logged Blocks at a Data Guard Standby Database
- RMAN recover standby simplification
- Shadow Lost Write Protection

- 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



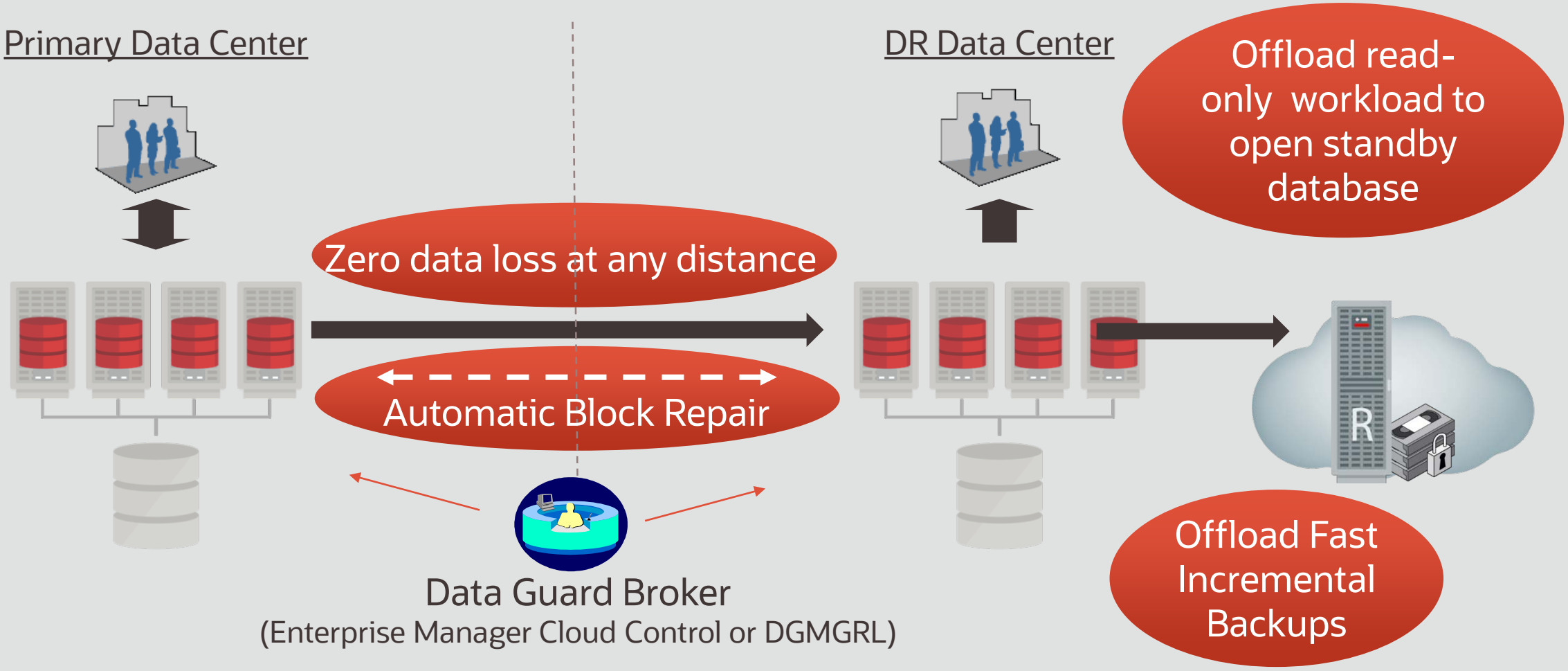
Copyright © 2019 Oracle and/or its affiliates.

ADG: More than a read-only database

Option	Availability	Included Features
Oracle Active Data Guard	Extra cost option: **EE**, **EE-ES** Included option: **PE**, **DBCS EE-EP**, **ExaCS**	Oracle Active Data Guard includes the following features: • Physical Standby with Real-time Query • Fast Incremental Backup on Physical Standby • Automatic Block Repair • Active Data Guard Far Sync • Global Data Services • Real-Time Cascade • Application Continuity • Rolling Upgrade using Active Data Guard • Active Data Guard DML Redirection (not available in Authorized Cloud Environments) In an Oracle Data Guard configuration: • Oracle Active Data Guard must be licensed on any standby databases with any of the above features in use, as well as the primary database. If there are additional standby databases in the Oracle Data Guard configuration that are not using any of the Oracle Active Data Guard features, those standby databases do not require an Oracle Active Data Guard license. • The container root (`CDB$Root`) of the standby database may be opened read-only without requiring an Oracle Active Data Guard license. An Oracle Active Data Guard license is only required if any of the pluggable databases in the standby is opened for read.

https://docs.oracle.com/en/database/oracle/oracle-database/19/dblic/Licensing-Information.html#GUID-AB56CEE3-955E-4E56-8B44-6075E889C283

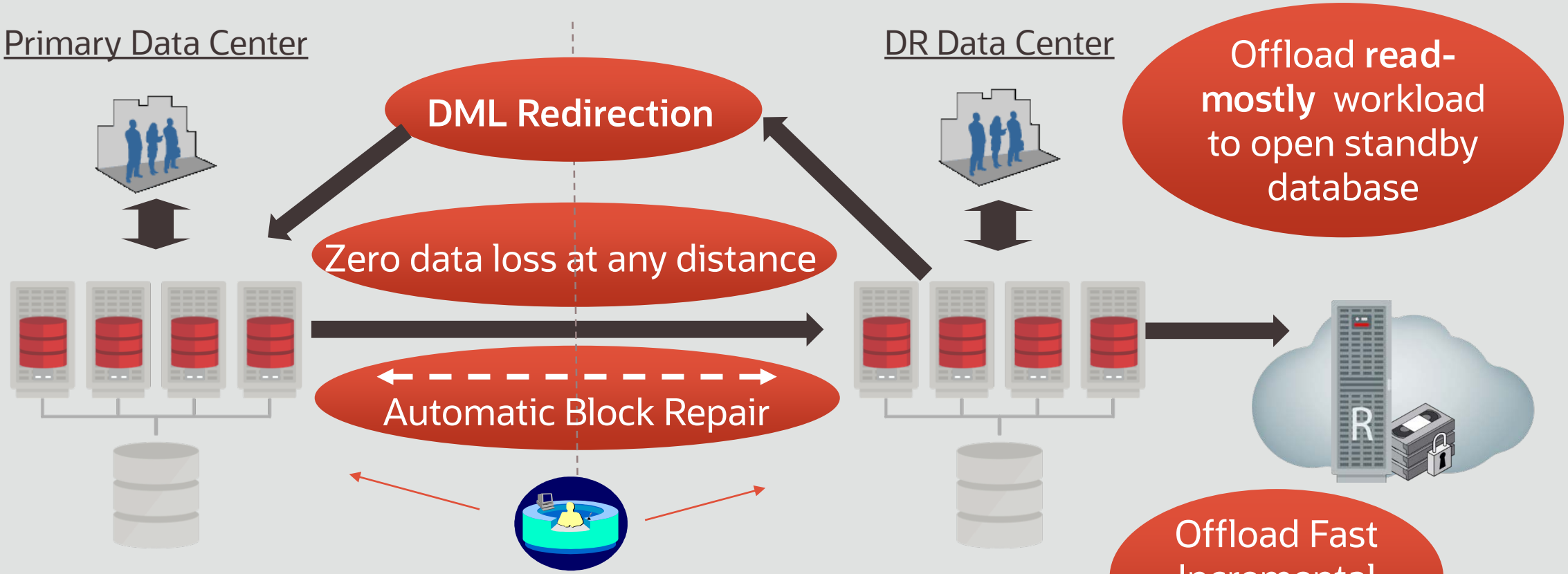
Active Data Guard: Advanced Capabilities



Copyright © 2019 Oracle and/or its affiliates.

Active Data Guard: Advanced Capabilities

NEW IN 19c



Copyright © 2019 Oracle and/or its affiliates.

(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

NEW IN 19c

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

NEW IN 19c

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[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.

NEW IN 19c

Flashback Database Enhancements

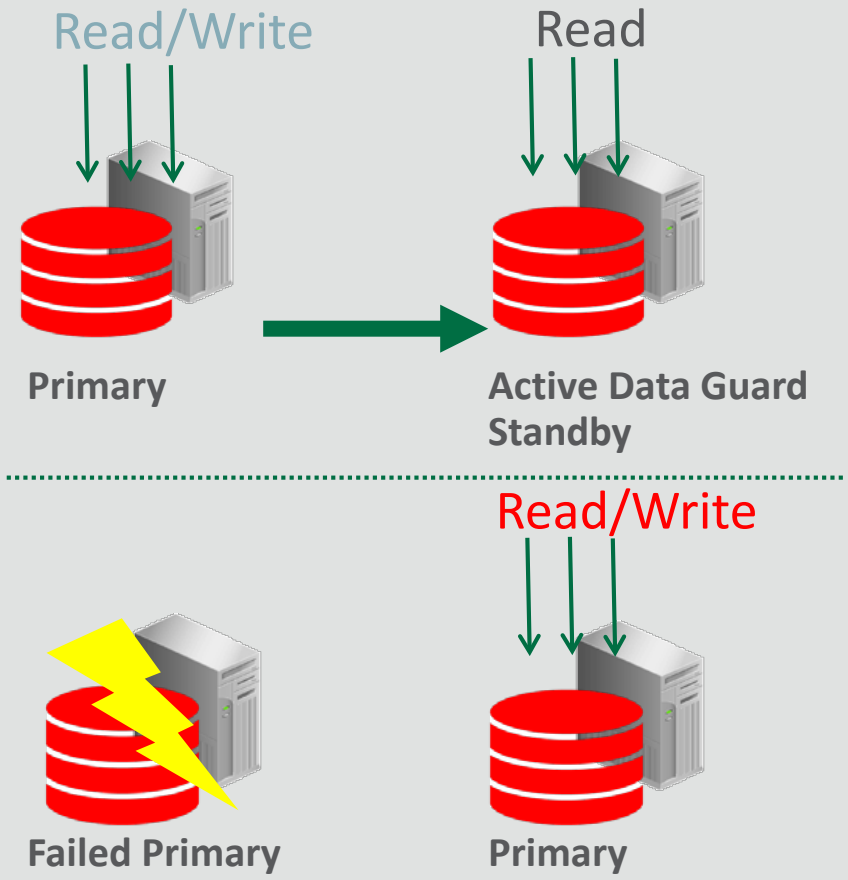
Standbys automatically follow the primary after a RESETLOGS operation

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:

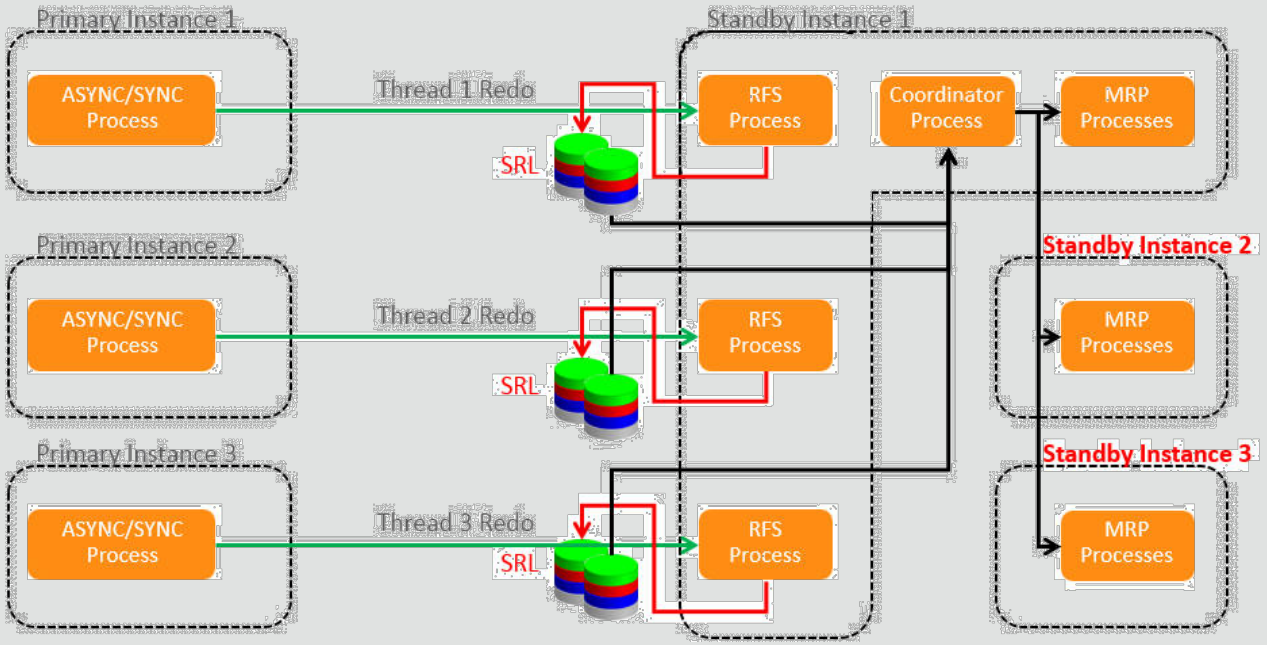
- Oracle Database 18c – Single Instance
- Oracle Database 19c – Oracle RAC Support

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

Creating Private Temporary Tables on Active Data Guard

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

NEW IN 18c

Bigger Footprint of ADG Applications

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

NEW IN 19c

Bigger Footprint of ADG Applications

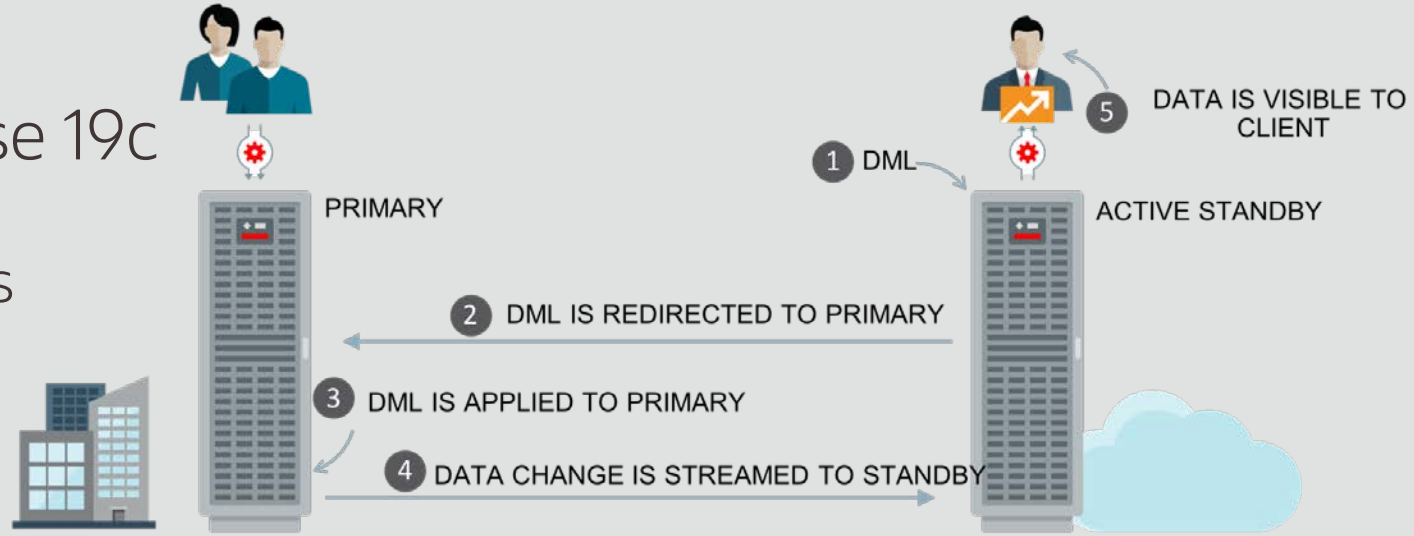
DML on ADG

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

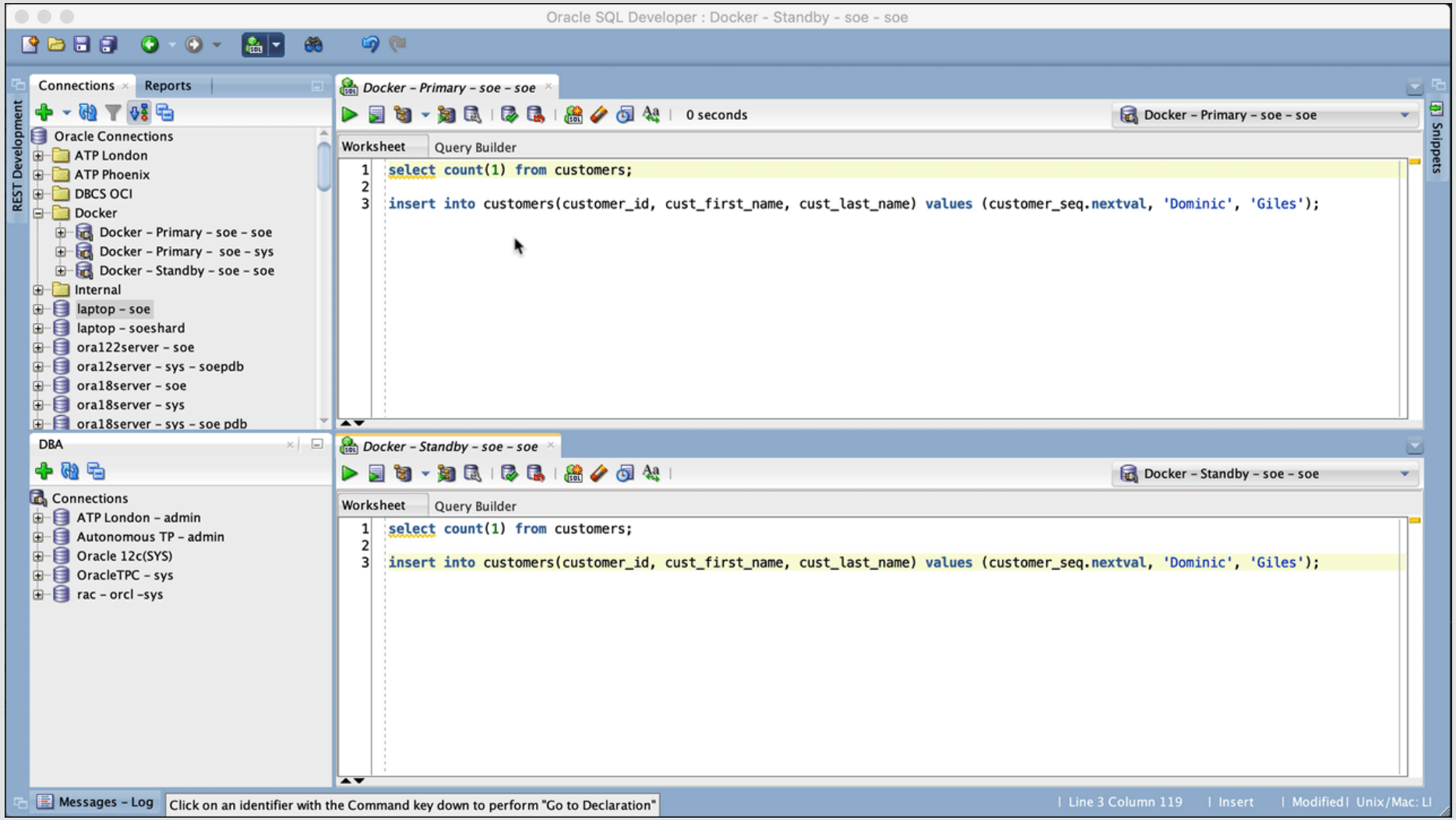
Supported with Oracle Database 19c

Targeted for "Read-Mostly, Occasional Updates" applications

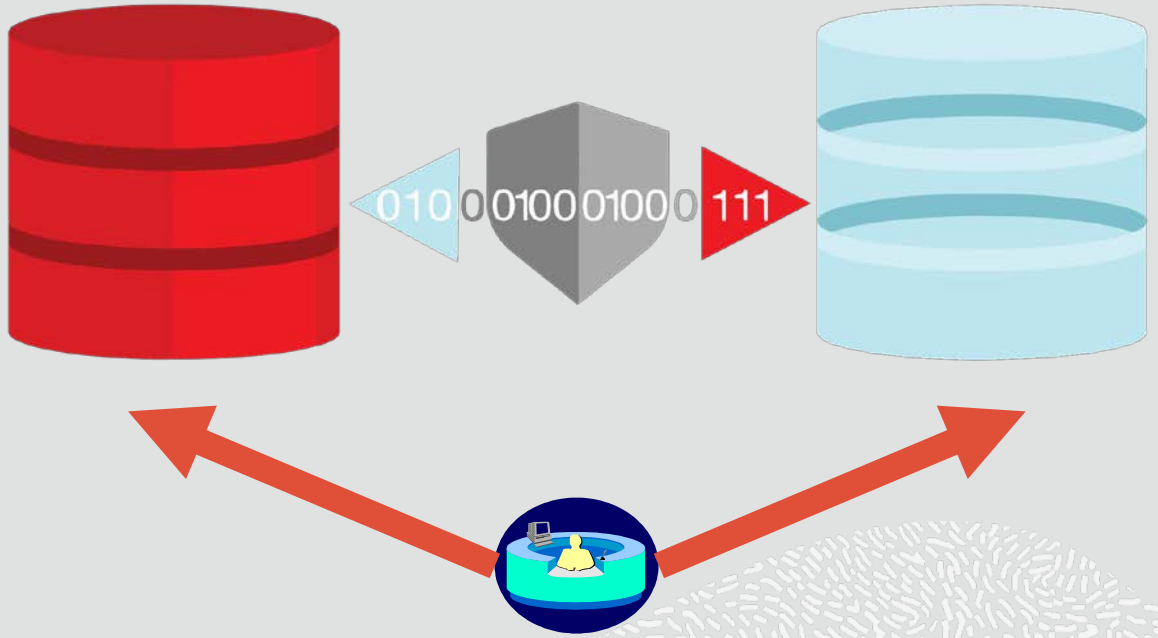


Active Data Guard DML on ADG

NEW IN 19c



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
```

NEW IN 19c

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)
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>
```

NEW IN 19c

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
```

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

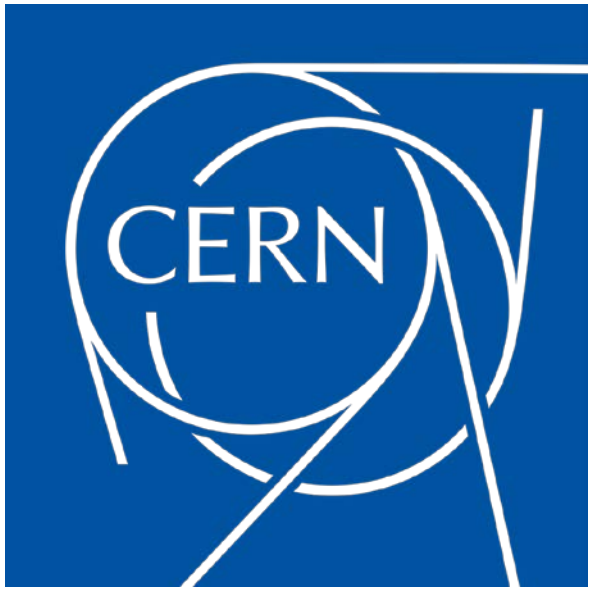
Users will be able to save a Broker readable copy of the configuration file

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>
```

Customer Case



Who am I?

Franck Pachot

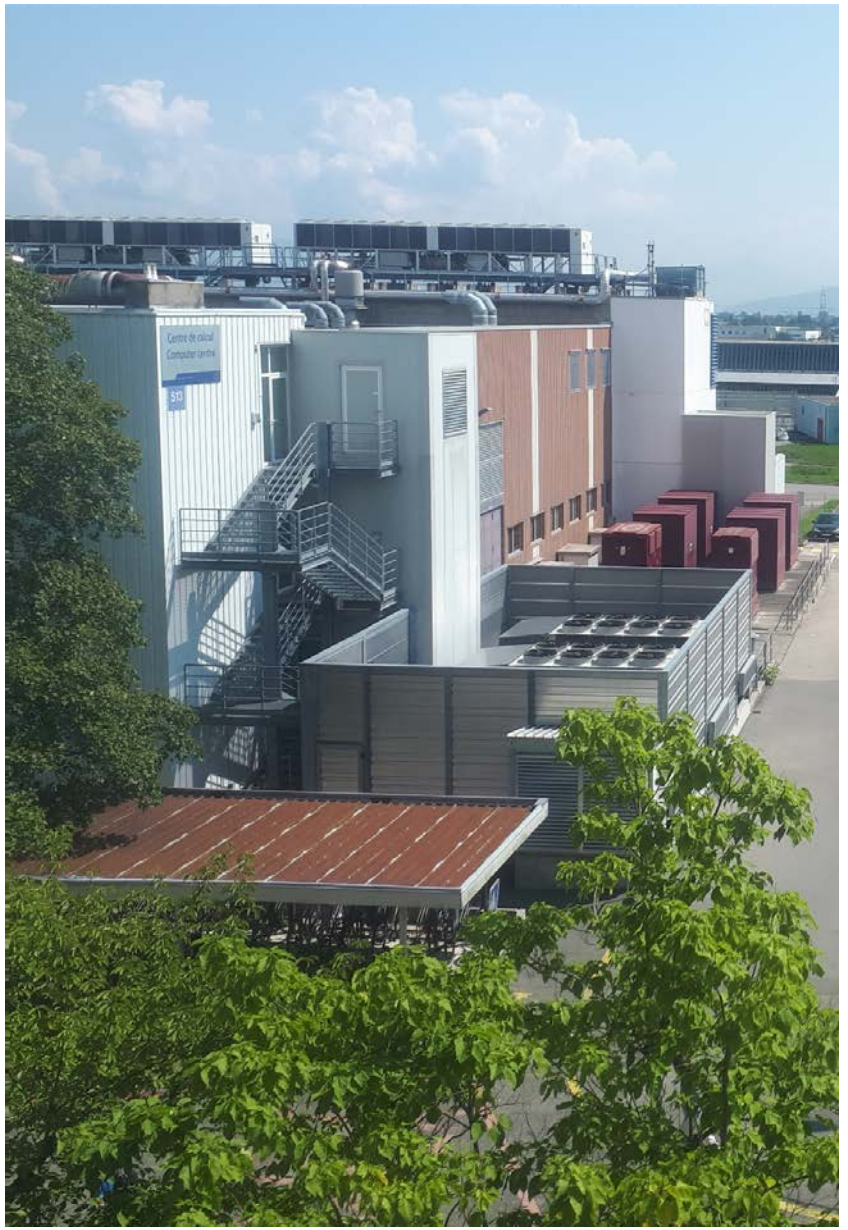
Database Engineer at CERN

- Twitter @FranckPachot
- Medium: https://medium.com/@FranckPachot

ORACLE ACE Director

OakTable®

ORACLE Certified Master Oracle Database 12c Administrator



The Large Hadron Collider (LHC)

Largest machine in the world

27km, 6000+ superconducting magnets

Fastest racetrack on Earth

Protons circulate 11245 times/s (99.9999991% the speed of light)

Emptiest place in the solar system

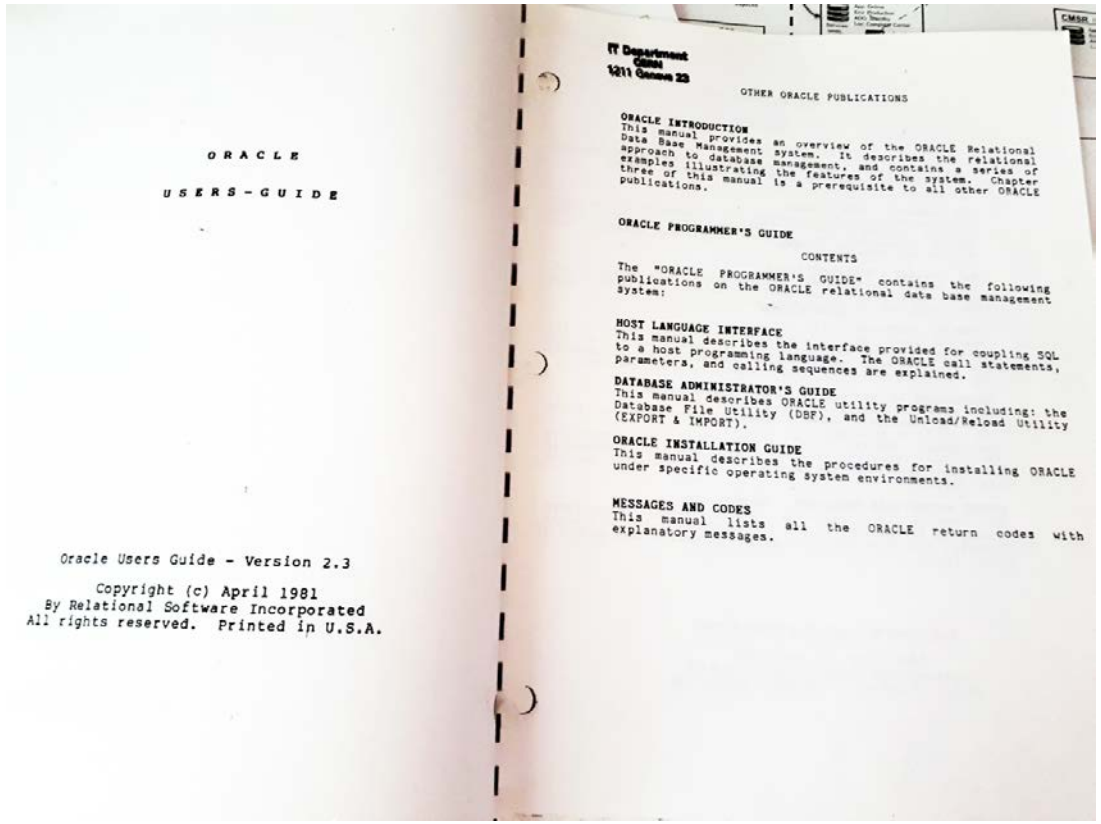
High vacuum inside the magnets

Hottest spot in the galaxy

During Lead ion collisions create temperatures 100 000x hotter than the heart of the sun

Oracle at CERN

1982, benchmark on version 2.3



ORACLE

USERS-GUIDE

Oracle Users Guide - Version 2.3

Copyright (c) April 1981
By Relational Software Incorporated
All rights reserved. Printed in U.S.A.

IT Department
CERN
1211 Geneva 23

OTHER ORACLE PUBLICATIONS

ORACLE INTRODUCTION
This manual provides an overview of the ORACLE Relational Data Base Management system. It describes the relational approach to database management, and contains a series of examples illustrating the features of the system. Chapter three of this manual is a prerequisite to all other ORACLE publications.

ORACLE PROGRAMMER'S GUIDE

CONTENTS

The "ORACLE PROGRAMMER'S GUIDE" contains the following publications on the ORACLE relational data base management system:

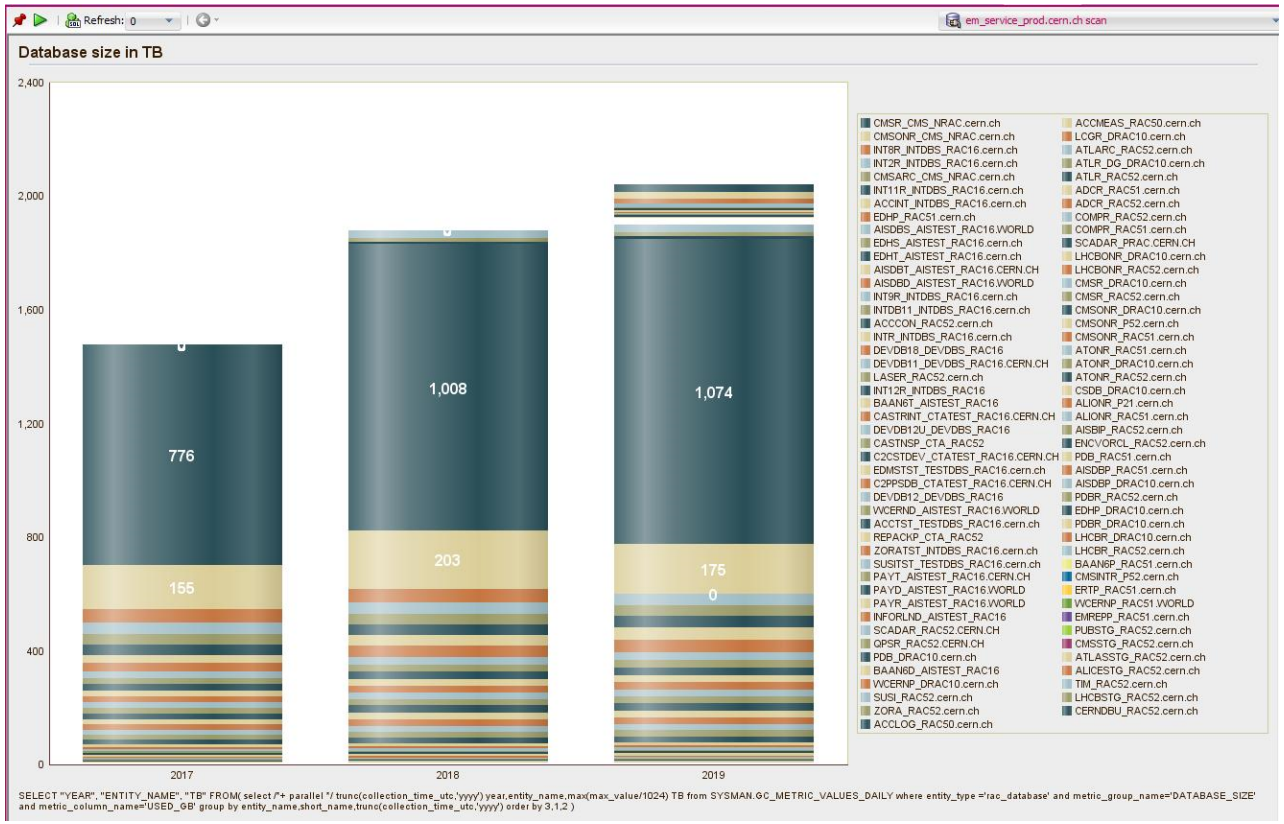
HOST LANGUAGE INTERFACE
This manual describes the interface provided for coupling SQL to a host programming language. The ORACLE call statements, parameters, and calling sequences are explained.

DATABASE ADMINISTRATOR'S GUIDE
This manual describes ORACLE utility programs including: the Database File Utility (DBF), and the Unload/Reload Utility (EXPORT & IMPORT).

ORACLE INSTALLATION GUIDE
This manual describes the procedures for installing ORACLE under specific operating system environments.

MESSAGES AND CODES
This manual lists all the ORACLE return codes with explanatory messages.

Today: 2PB, all productions in MAA



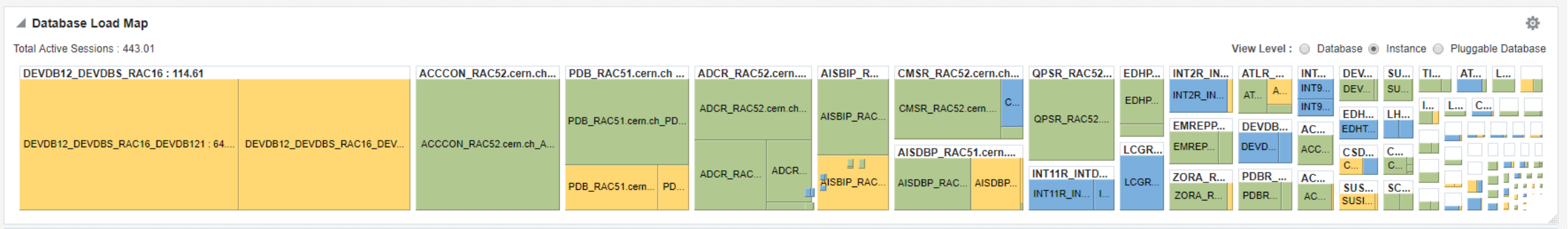
Databases at CERN

Physics databases, for each LHC experiment we have:

- "Online": highly critical for data ingestion
- "Offline": critical for data distribution and analysis (WLCG)

Administrative databases:

- like a 60yo company with 2000 employees and 10000 users worldwide



Active Data Guard at CERN

1. For Disaster Recovery
   - Primary in Meyrin
   - Standby in Wigner
   - 3x100 Gbit/s fiber (30ms)
2. For offloading backups
3. For security
   - Read/write (primary) on isolated technical network only, read-only ADG on general network

Our to-do 2019-20 (LHC shutdown)

Upgrades to 19c

- Test upgrade duration withg snapshot standby

Move DR from Wigner to Prevessin (5km)

- Using Role transition
- Running in SYNC Mode

Data Guard broker configuration for all databases

- FSFO observe-only mode

Extend Transparent Failover to more applications

- Connection Manager (CMAN) Traffic Director

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.

Confidential – Oracle Internal/Restricted/Highly Restricted

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 standardised environment by which complexity is removed and stability is increased.

Confidential – Oracle Internal/Restricted/Highly Restricted

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

Pieter Van Puymbroeck

Product Manager Oracle Active Data Guard
And Data Guard

Twitter @vanpupi

Blog https://vanpupi.stepi.net and
https://www.oracle.com/goto/DataGuard

LinkedIn https://linkedin.com/in/pietervanpuymbroeck

E-mail Pieter.van.puymbroeck@oracle.com