ORACLE

Real World Oracle Database Upgrade and Migration 19c & 23c

Warsaw – Feb 27, 2024

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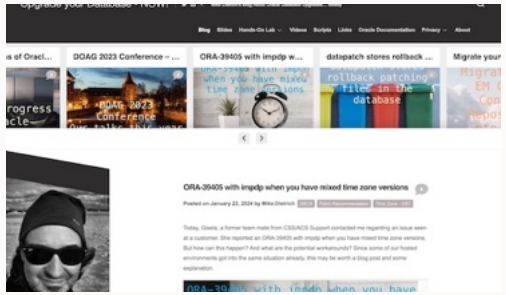

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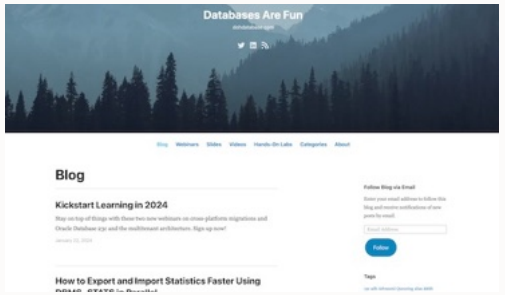

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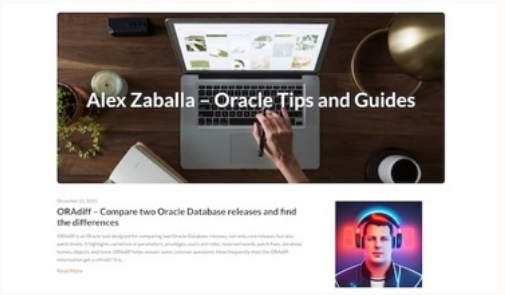

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Episode 1

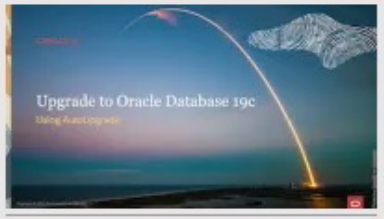
Release and Patching Strategy

105 minutes – Feb 4, 2021

Episode 2

AutoUpgrade to Oracle Database 19c

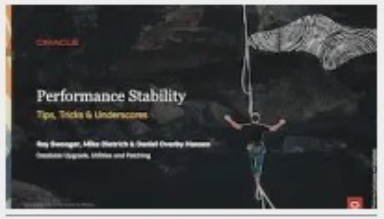
115 minutes – Feb 20, 2021



Episode 3

Performance Stability, Tips and Tricks and Underscores

120 minutes – Mar 4, 2021



Episode 4

Migration to Oracle Multitenant

120 minutes – Mar 16. 2021

Episode 5

Migration Strategies – Insights, Tips and Secrets

120 minutes – Mar 25, 2021

Episode 6

Move to the Cloud – Not only for techies

115 minutes – Apr 8, 2021

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Webinar | Multitenant

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Move to Oracle Database 23c

– Everything you need to know about Oracle Multitenant

May 16, 14:00 CET

Sign up

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AGENDA

09:30
Welcome
Release Strategy
Patching

11:00
Coffee break

11:15
Upgrade
Data Pump
Cloud Migration Advisor

12:45
Lunch

13:30
Performance Stability
Insights into
development

15:00
Coffee break

15:15
Oracle Database 23c
What's New
What's Coming

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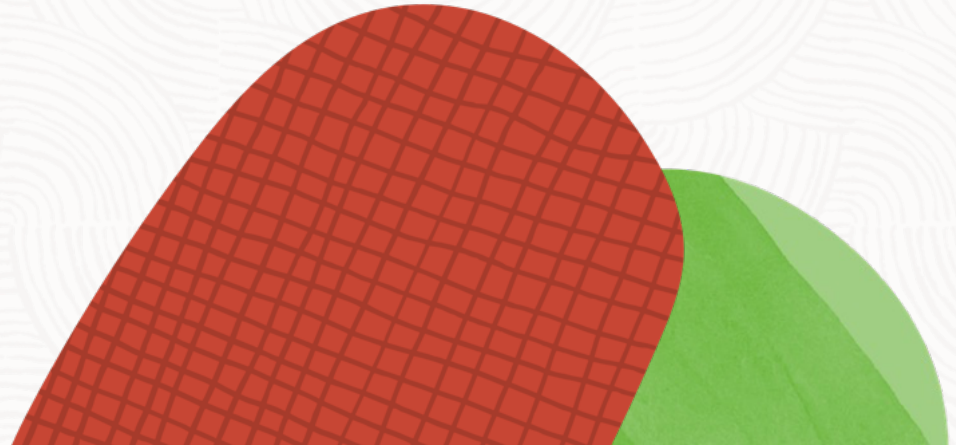
Release Strategy



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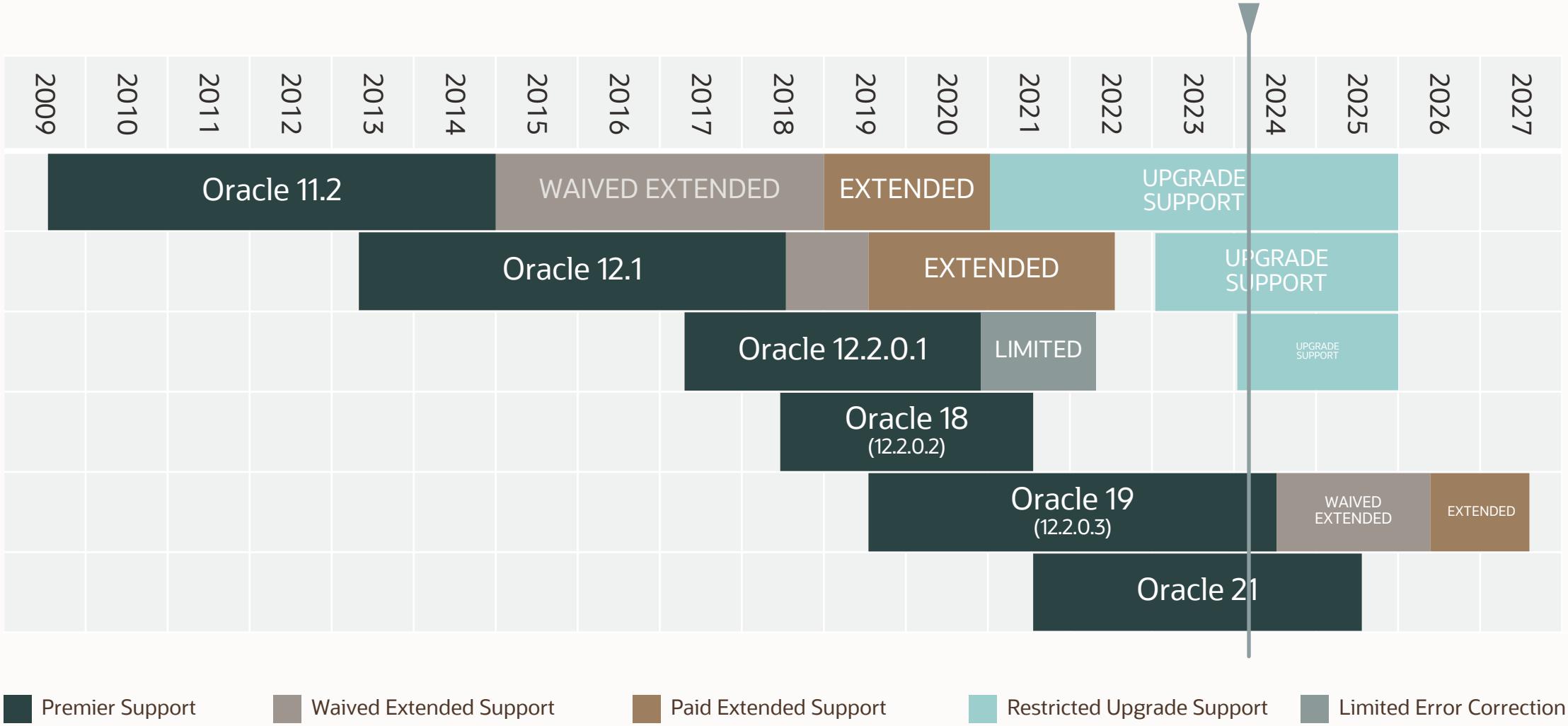
Lifetime Support Policy



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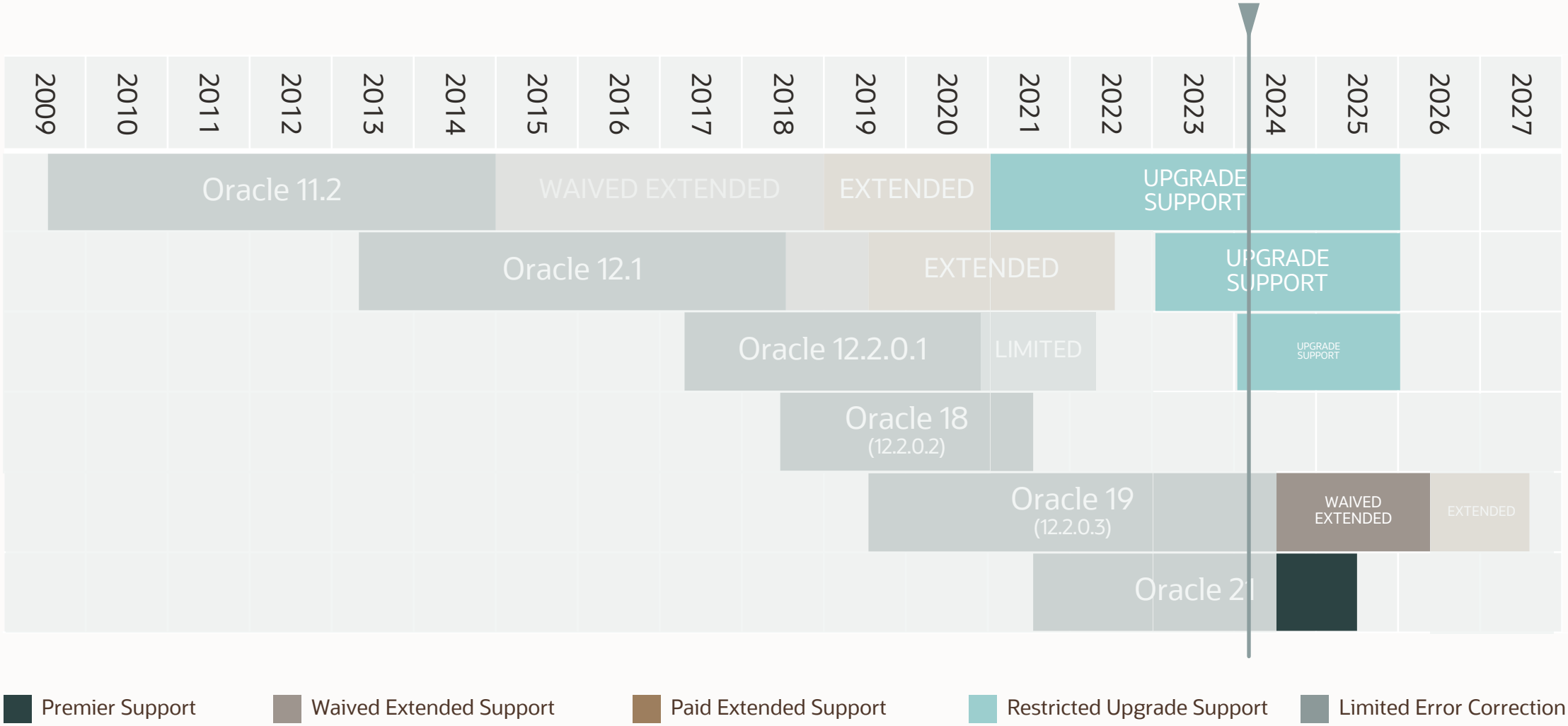
Lifetime Support Policy



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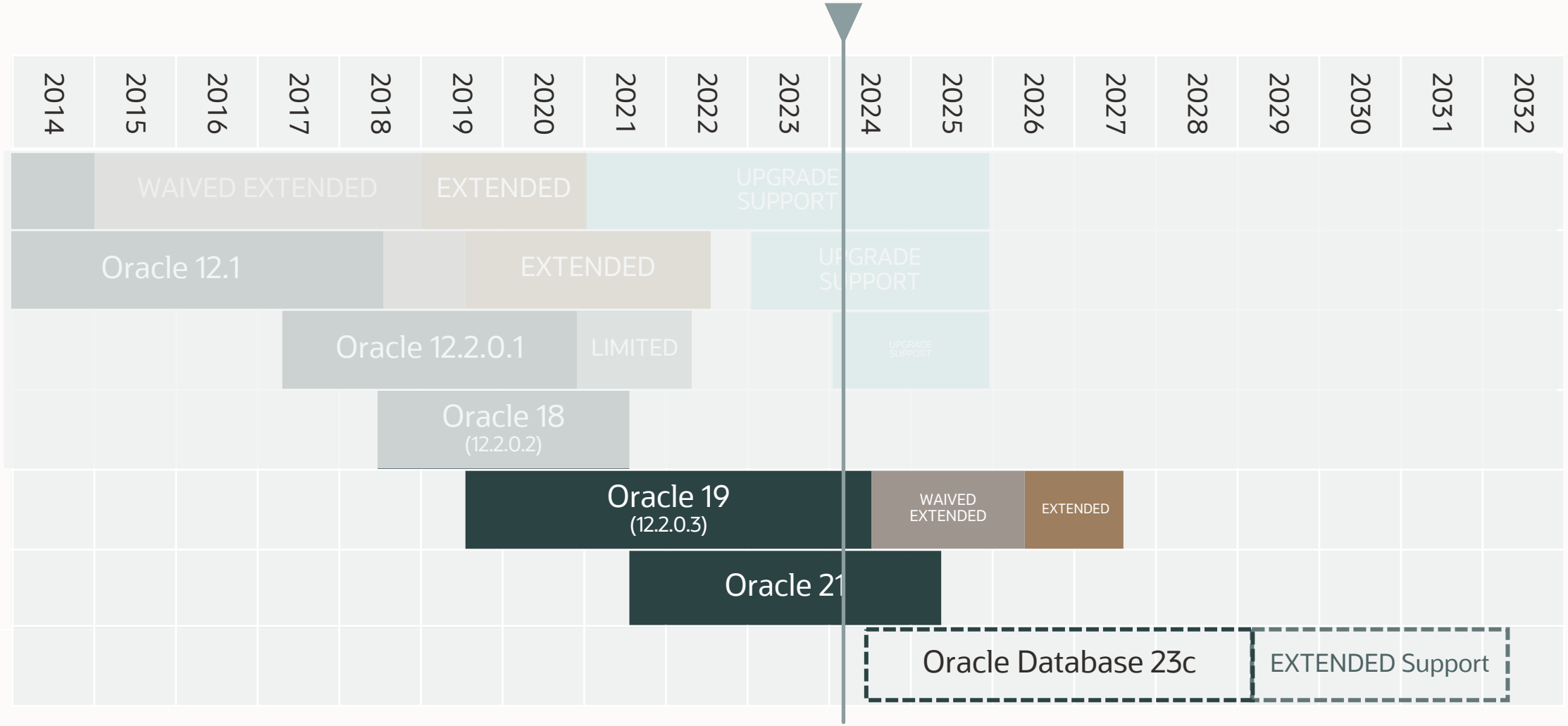

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Move production databases from one Long Term Support release to the next

- Release Schedule of Current Database Releases (Doc ID 742060.1)

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Next Long Term Support release

Oracle Database 23c

Upgrade possible only from:

- Oracle Database 19c
- Oracle Database 21c

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Database and Grid Infrastructure Patching

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Patching Best Practices

Installation

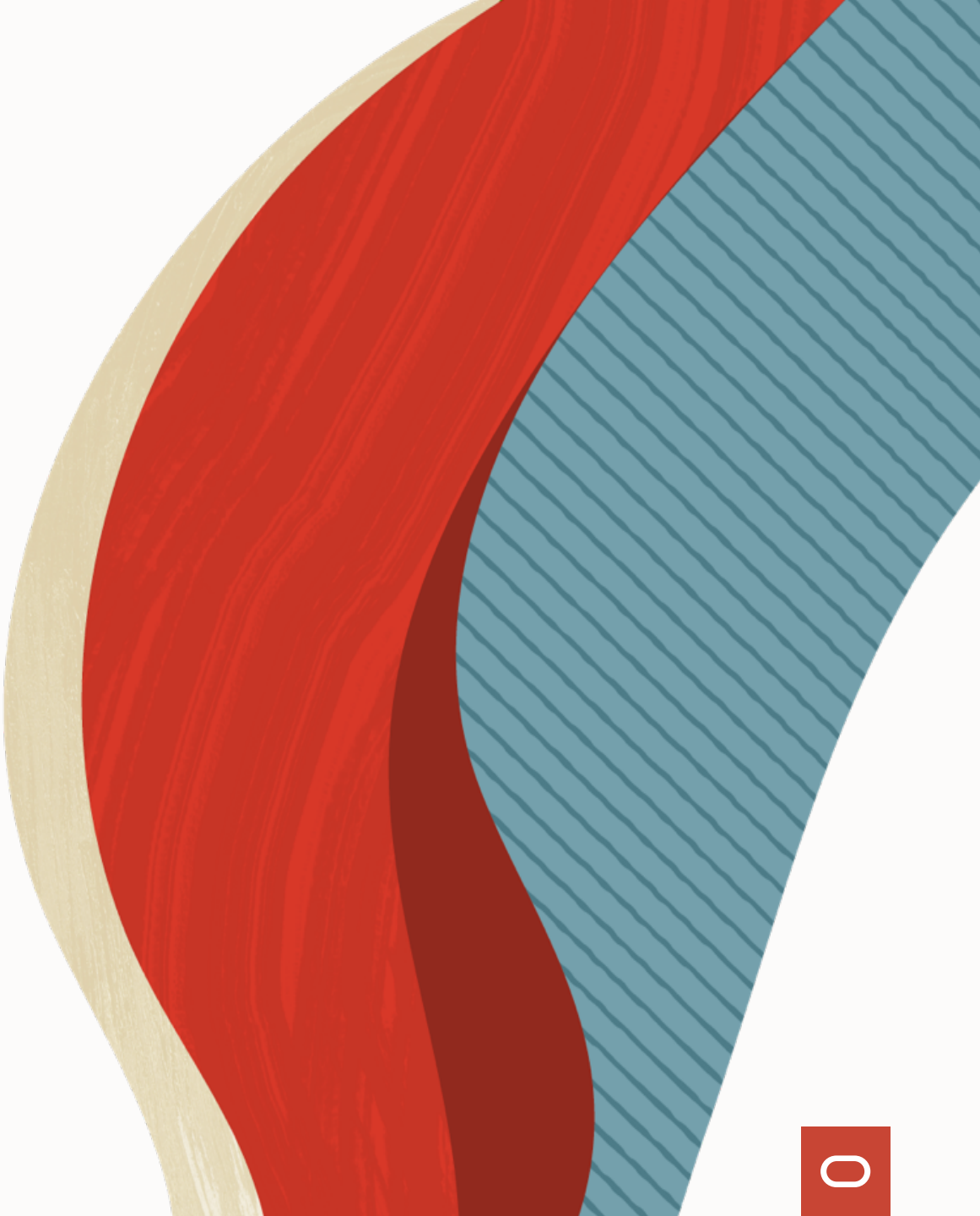
Basics

Methods

Grid Infrastructure

Datapatch

AutoUpgrade



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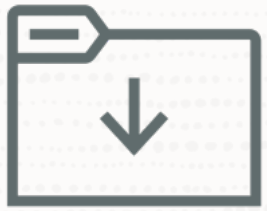

You always start with Oracle Database 19c base release

- Oracle Database 19.3.0

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Always apply the most recent RU

Use the Patch Download Assistant MOS Note: 2118136.2

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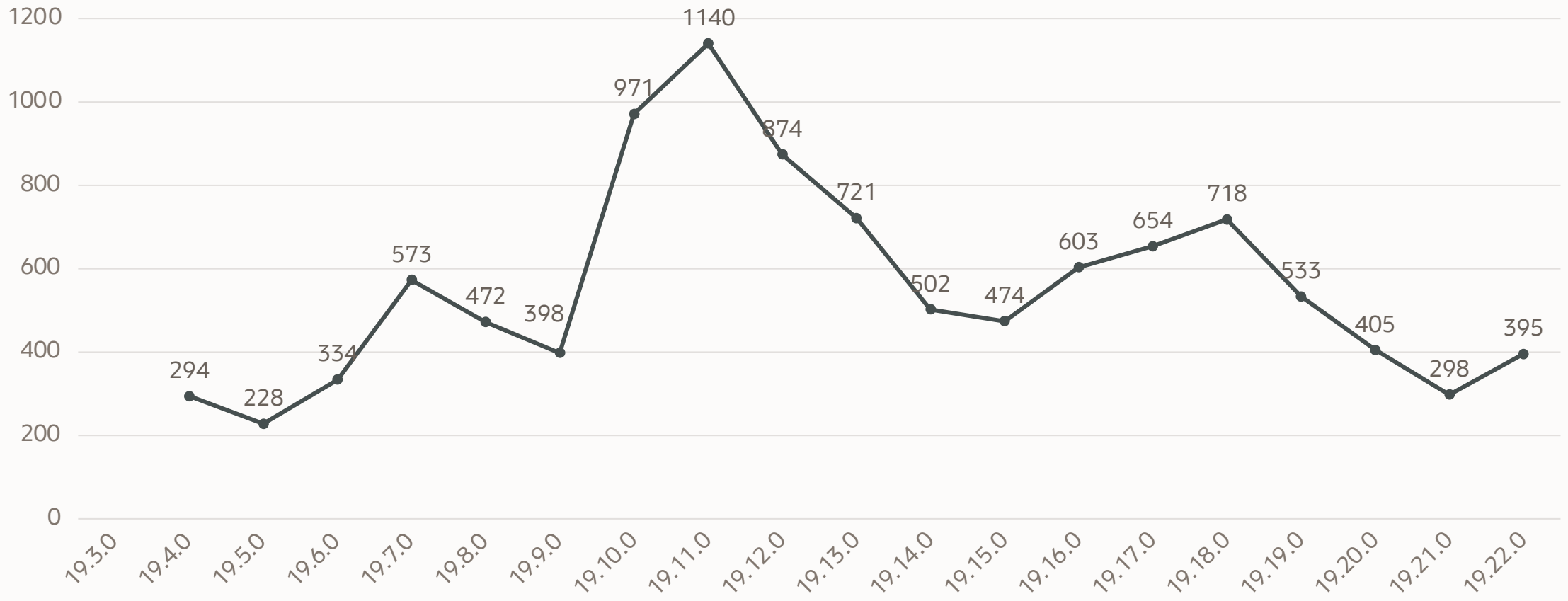
Release Update Contents



Database 19 Release Updates and Revisions Bugs Fixed Lists (Doc ID 2523220.1)

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If you don't apply a recent Release Update, you will miss thousands of fixes

- Almost 11k fixes with 19.22.0
- Almost 300 security fixes

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Apply the most important patches

Always use Important Recommended One-Off Patches: MOS Note: 555.1

Recommended Patches for 19.22 DB Home

Below is the list of important patches to consider applying on top of 19.22. In addition to the relevant patches listed below, you should also review patches in Database PSU/BP/Update/Revision - Known Issues Primary Note(Doc ID 1227443.1) and Oracle Database Patches to Consider for 19c (Doc ID 2781612.2) which contains patches to consider for specific areas such as Data Pump, Golden gate etc.

Bug	Fixed in RU	Fixed in MRP	Description	Patches	RAC Rolling Installable	Database Online Installable	Added
35692839		DBMRP 19.21.0.0.240220, DBMRP 19.22.0.0.240220	ORA-600 [ipc_recreate_que_2] [2] [8]" During Live Migration	[list-patches]	YES		08-FEB-2024
35990282		Not Applicable	[VOS] Linux: ORA-800 / Set Priority / DB Performance Merge Patch for 19.22 (Requires Root Access) - 34286265 34318125	[list-patches]	YES		18-JAN-2024
34304965			[ROW CACHE] 19c Tracking Bug for Row Cache Bug Fixes	[list-patches]	YES	YES	10-SEP-2023
34774667			[AQ] Global-buffer-overflow in pga at kwqalockqtwithinfo with ORA-00700 During PURGE_QUEUE_TABLE.	[list-patches]	YES		11-JUL-2023
29213893		Not Applicable	[QRY OPTIMIZER] DBMS_STATS Failing With Error Ora-1422 When Gathering Stats for User$ Table	[list-patches]			01-SEP-2021

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Monthly Recommended Patches

A collection of recommended one-off fixes
provided at monthly intervals
via a single downloadable patch

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Quarterly Release Updates

	2021				2022				2023				2024		
	January	April	July	October	January	April	July	October	January	April	July	October	January	April	July
19c	19.10.0	19.11.0	19.12.0	19.13.0	19.14.0	19.15.0	19.16.0	19.17.0	19.18.0	19.19.0	19.20.0	19.21.0	19.22.0	19.23.0	19.24.0
21c		21.3.0	21.4.0	21.5.0	21.6.0	21.7.0	21.8.0	21.9.0	21.10.0	21.11.0	21.12.0	21.13.0	21.14.0	21.15.0	

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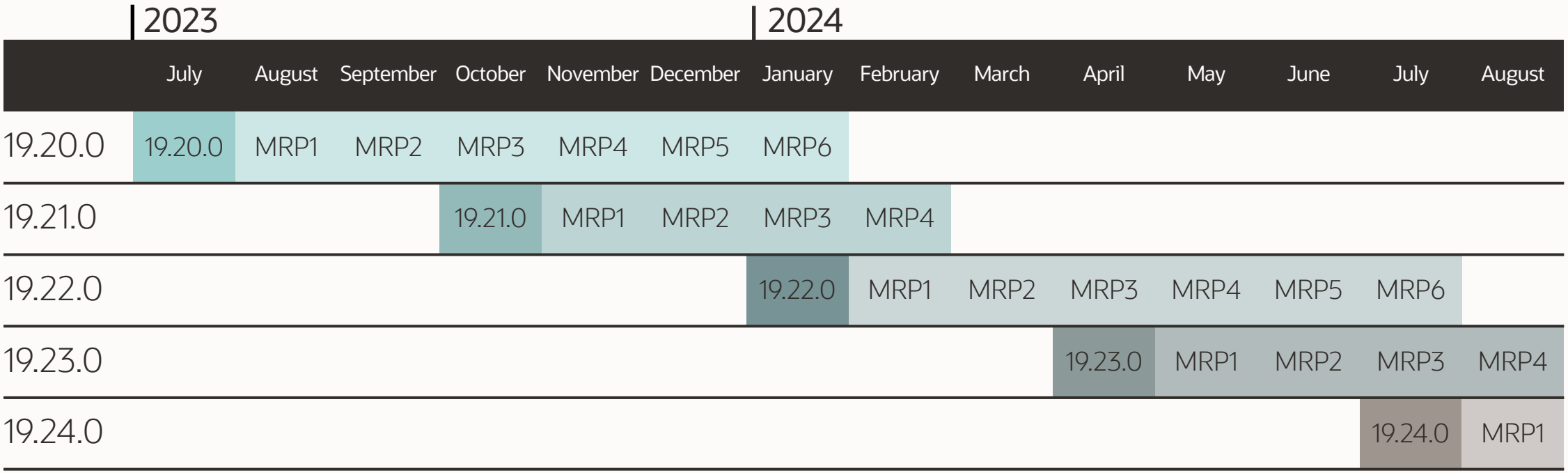
Monthly Recommended Patches



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An MRP is an optional collection of several important one-off patches

- Delivered as a merge patch

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An MRP does not change the release number

- Like `v$instance.version_full`

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MRPs are cumulative but only within one MRP line

- Example: 19.18.0 MRP5 contains all previous MRPs done for Oracle 19.18.0

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MRPs are Linux only

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Monthly Recommended Patches

Introducing Monthly Recommended Patches (MRPs) and FAQ (Doc ID 2898740.1)

Patching News: RURs are gone – long live MRPs (Blog Post)

Oracle Database 19c Important Recommended One-off Patches (Doc ID 555.1)

Oracle Database Patch Maintenance

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Sorry, but there is more to talk about …

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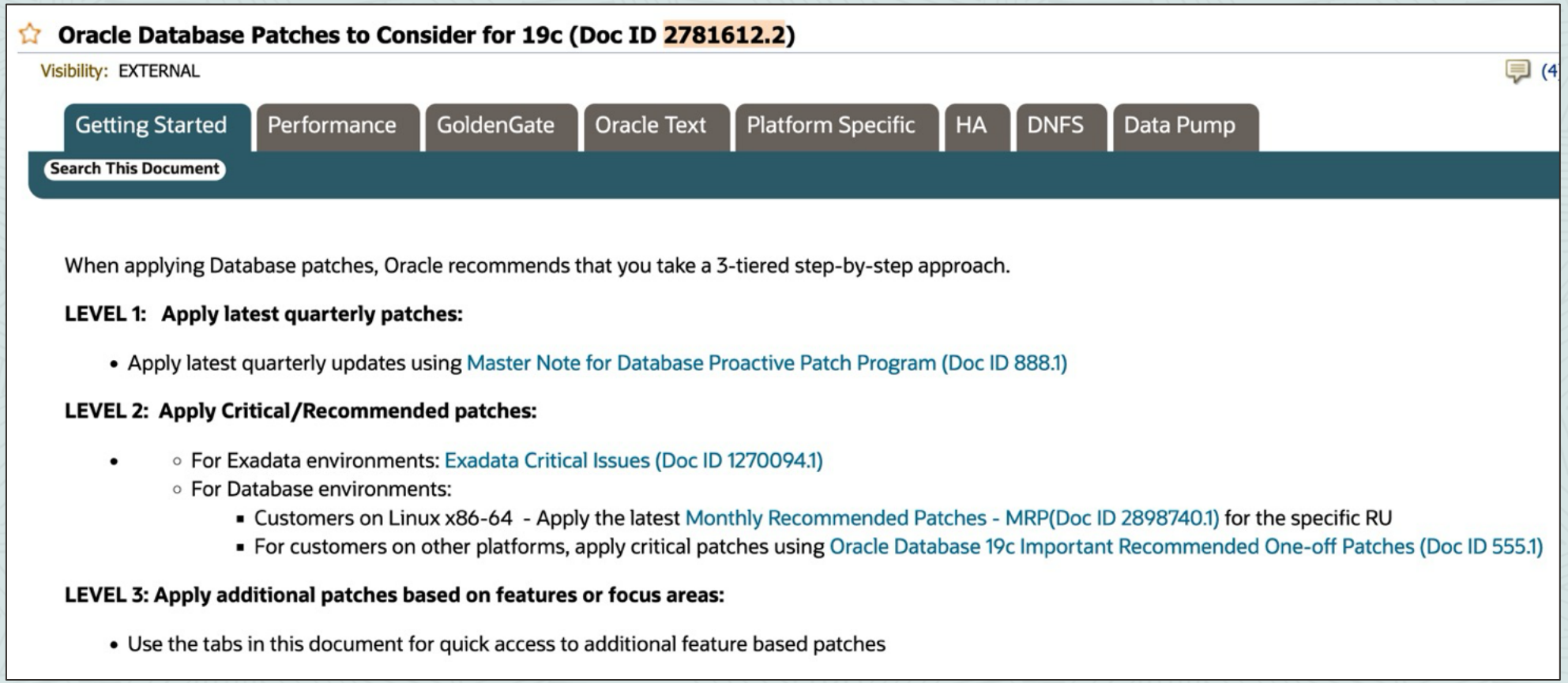
Apply additional important fixes and bundles

In addition, use Patches to Consider for 19c: MOS Note: 2781612.2



Oracle Database Patches to Consider for 19c (Doc ID 2781612.2)

Visibility: EXTERNAL

Getting Started | Performance | GoldenGate | Oracle Text | Platform Specific | HA | DNFS | Data Pump

Search This Document

When applying Database patches, Oracle recommends that you take a 3-tiered step-by-step approach.

LEVEL 1: Apply latest quarterly patches:

- Apply latest quarterly updates using Master Note for Database Proactive Patch Program (Doc ID 888.1)

LEVEL 2: Apply Critical/Recommended patches:

- For Exadata environments: Exadata Critical Issues (Doc ID 1270094.1)
- For Database environments:
  - Customers on Linux x86-64 - Apply the latest Monthly Recommended Patches - MRP(Doc ID 2898740.1) for the specific RU
  - For customers on other platforms, apply critical patches using Oracle Database 19c Important Recommended One-off Patches (Doc ID 555.1)

LEVEL 3: Apply additional patches based on features or focus areas:

- Use the tabs in this document for quick access to additional feature based patches

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Always use the latest OPatch

- Patch 6880880

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Binary patching runtime gets shorter when you use a brand new home

- Avoid cloned Oracle Homes and In-Place Patching
- Use `./opatch util deleteinactivepatches`

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Installation Tip

```
/home/oracle/stage
├── DPBP
│   ├── 35261302
│   └── PatchSearch.xml
├── MRP
│   ├── 35333937
│   │   ├── 34340632
│   │   ├── 35012562
│   │   ├── 35037877
│   │   ├── 35116995
│   │   └── 35225526
│   └── PatchSearch.xml
├── OJVM
│   ├── 35050341
│   └── PatchSearch.xml
└── RU
    ├── 35042068
    └── PatchSearch.xml
```

ONE SINGLE COMMAND

```
./runInstaller
  -applyRU /home/oracle/stage/RU/35042068
  -applyOneOffs ...
```


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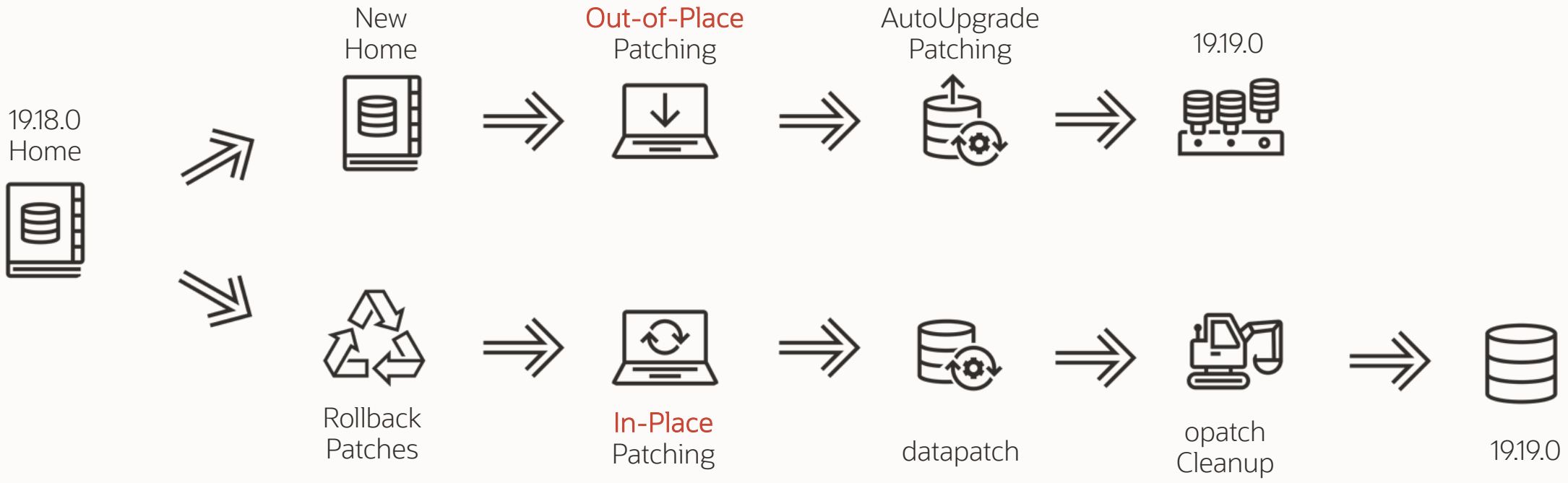
Exercise Patching?

Use our brand new Patch Me If You Can LiveLabs

- https://apexapps.oracle.com/pls/apex/dbpm/r/livelabs/view-workshop?wid=3740



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Patching Best Practices

Installation

Basics

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Grid Infrastructure

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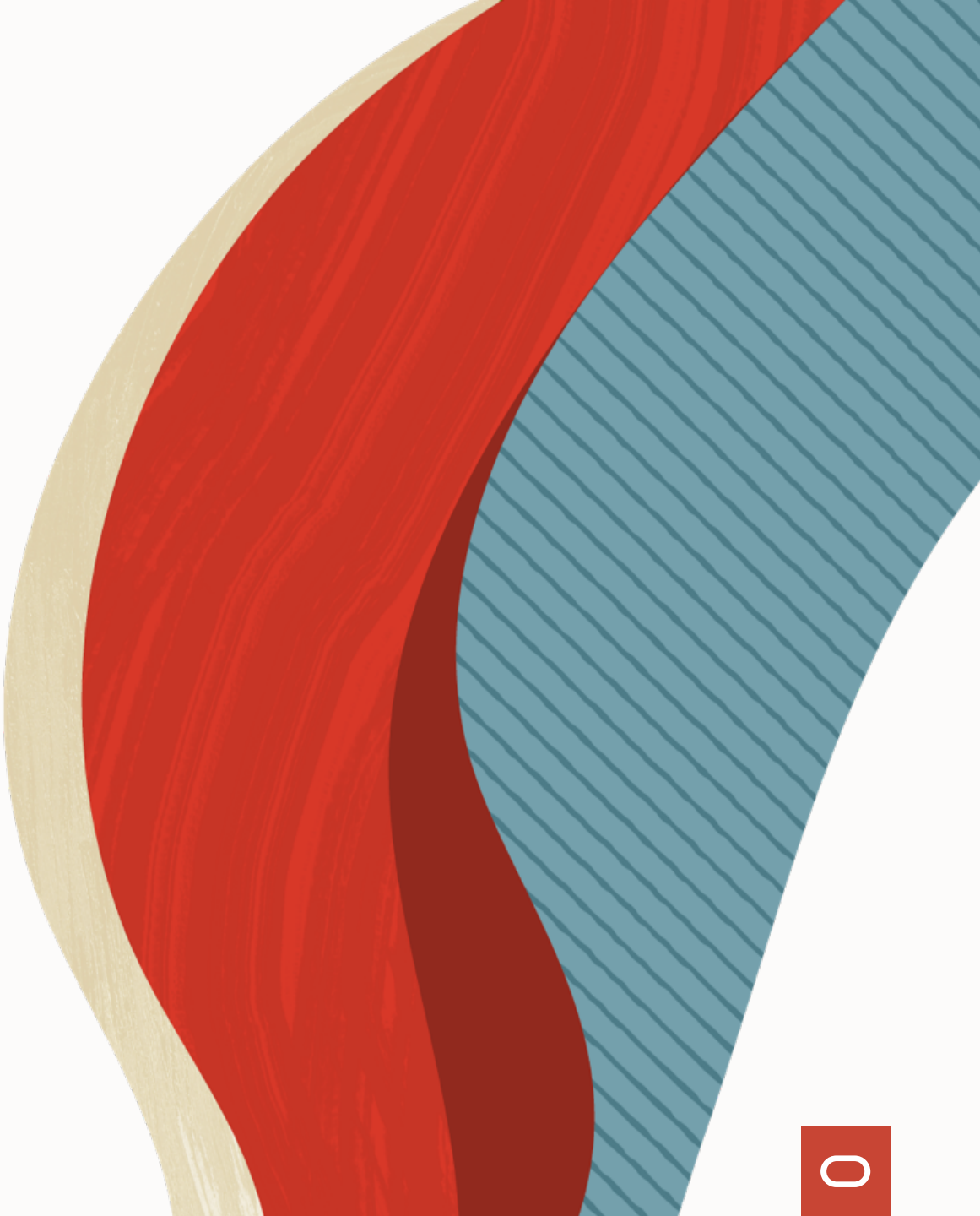
AutoUpgrade



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What can be in a patch?

FILES

New or changed executables, libs or files

```
bin/oracle
bin/srvctl
oracore/zoneinfo/timezone_42.dat
```

Apply and rollback scripts

```
sqlpatch/.../nnn_apply.sql
sqlpatch/.../nnn_rollback.sql
```

SQL
PL/SQL

New or changed objects

```
alter table sys.tab$ ...
create index sys.i_tab1 ...
create or replace package sys.dbms_scheduler ...
```


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How to apply a patch?

`opatch` → Applies binaries to an Oracle Home → All instances using this Oracle Home are down

`datapatch` → Applies SQL and PL/SQL changes to a database → Database is up

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What is installed?

In the Oracle Home?

```
$ opatch lsinventory
$ opatch lspatches
```

```
SQL> select
xmltransform(dbms_qopatch.get_opatch_lsinventory,
dbms_qopatch.get_opatch_xslt) from dual;
```

- Oracle Database 12.1 : FAQ on Queryable Patch Inventory (Doc ID 1530108.1)

In the database / PDB?

```
SQL> select * from cdb_registry_sqlpatch;
```


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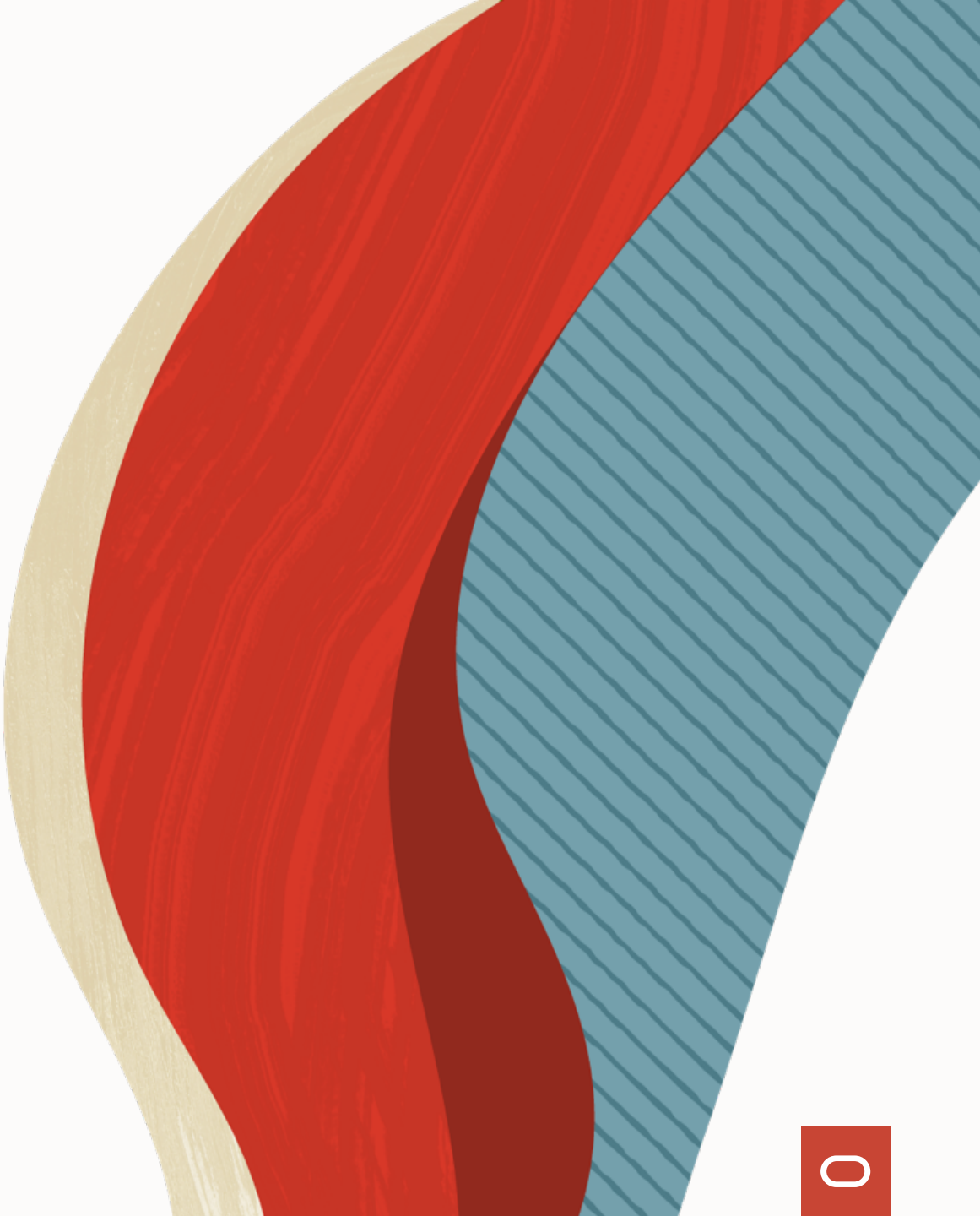

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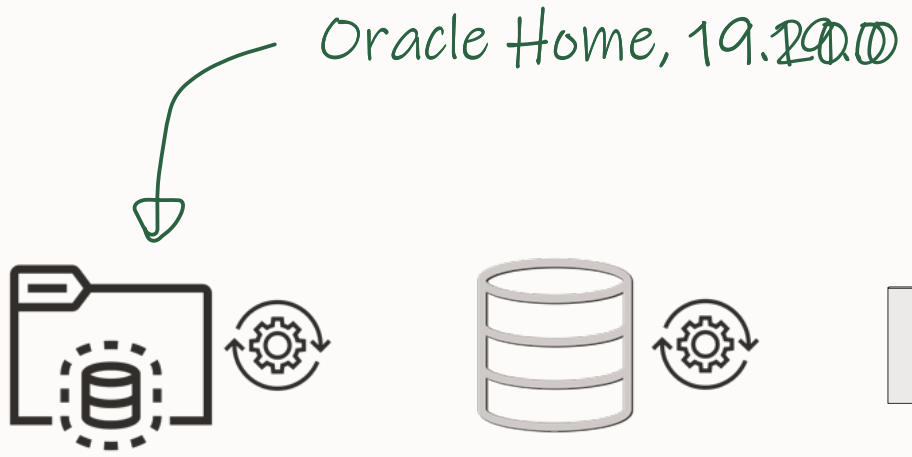
In-Place Patching




```
[oracle]$ $ORACLE_HOME/OPatch/datapatch -verbose
```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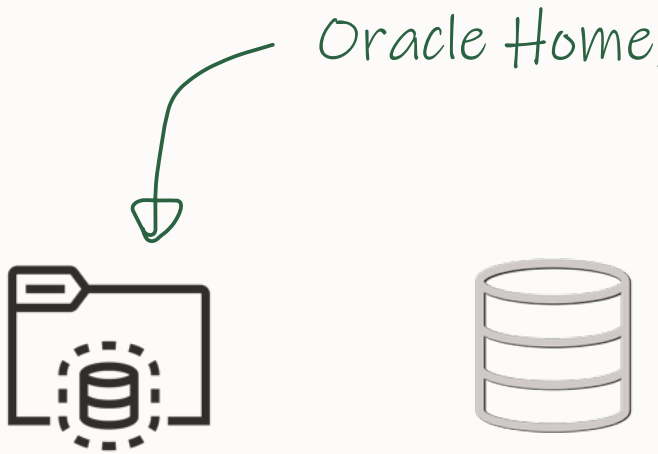
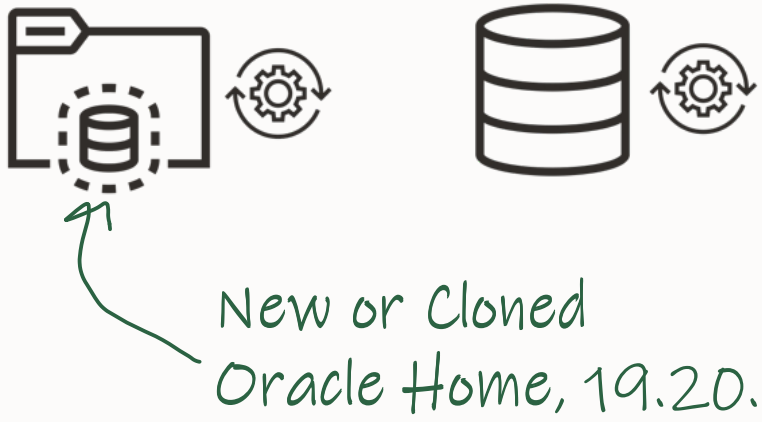
Out-of-Place Patching




```
SQL> SHUTDOWN IMMEDIATE
```




```
[oracle]$ $ORACLE_HOME/OPatch/datapatch -verbose
```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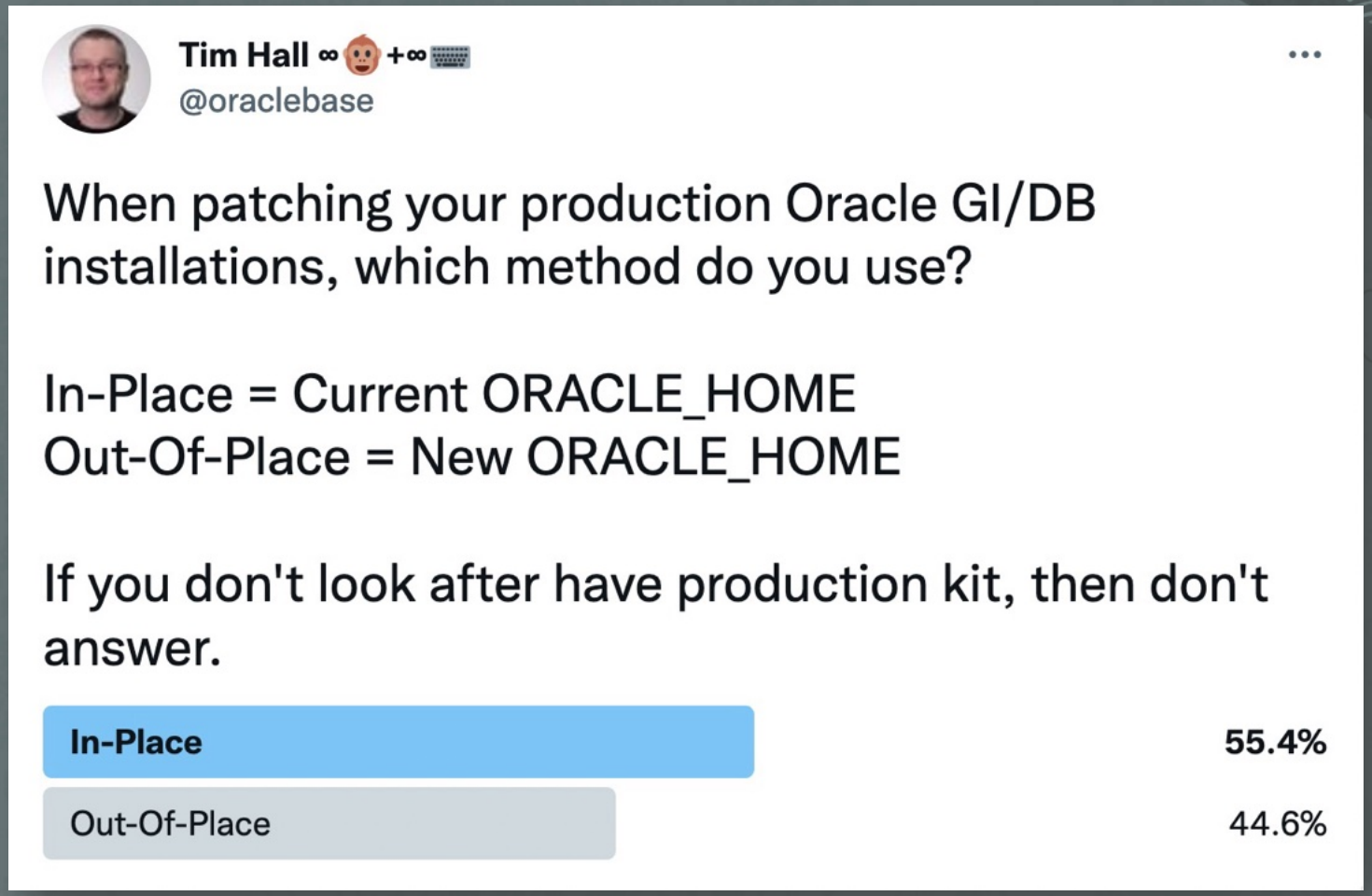

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Always patch Out-of-Place

- Don't argue with us ☺

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Safely test and verify patches with Standby-First Patch Apply

- Data Guard Standby-First Patch Apply (Doc ID 1265700.1)

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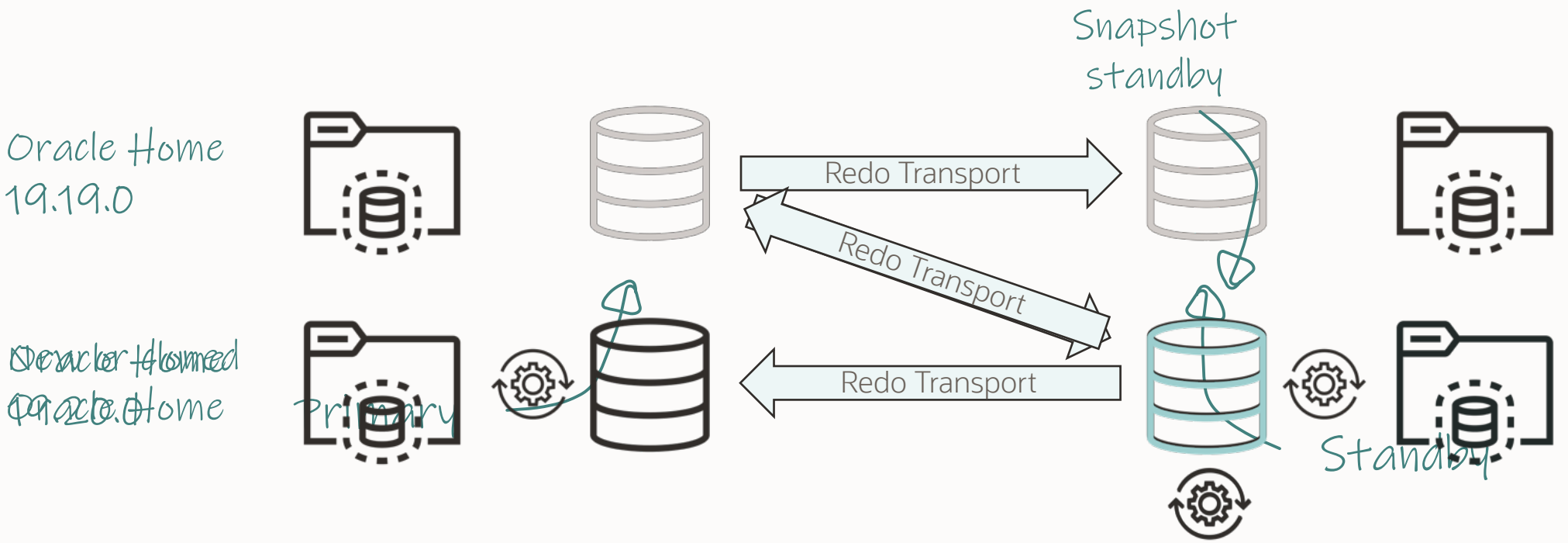
Standby-First Patching




```
[oracle]$ $ORACLE_HOME/OPatch/datapatch -verbose
```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Patch must Standby-First installable

- Check the patch readme

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Execute datapatch on the primary database

- Only execute datapatch when all homes are on the new patch

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Find additional restrictions in Data Guard Standby-First Patch Apply (Doc ID 1265700.1)

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Avoid database downtime with RAC Rolling Patch Apply

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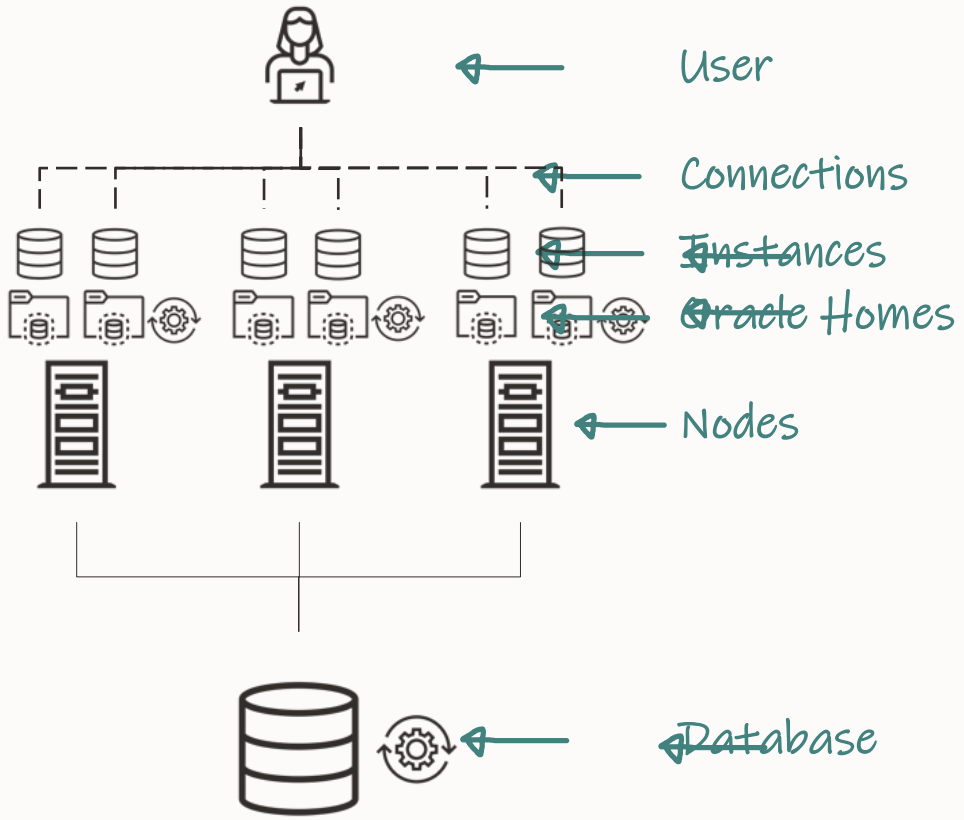
RAC Rolling Patching




```
$ $ORACLE_HOME/OPatch/opatchauto
```

- Clone Oracle Home
- Patch Oracle Home
- Move to new Oracle Home
- Execute datapatch

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Release updates are **always**:

Standby-First installable

RAC Rolling installable

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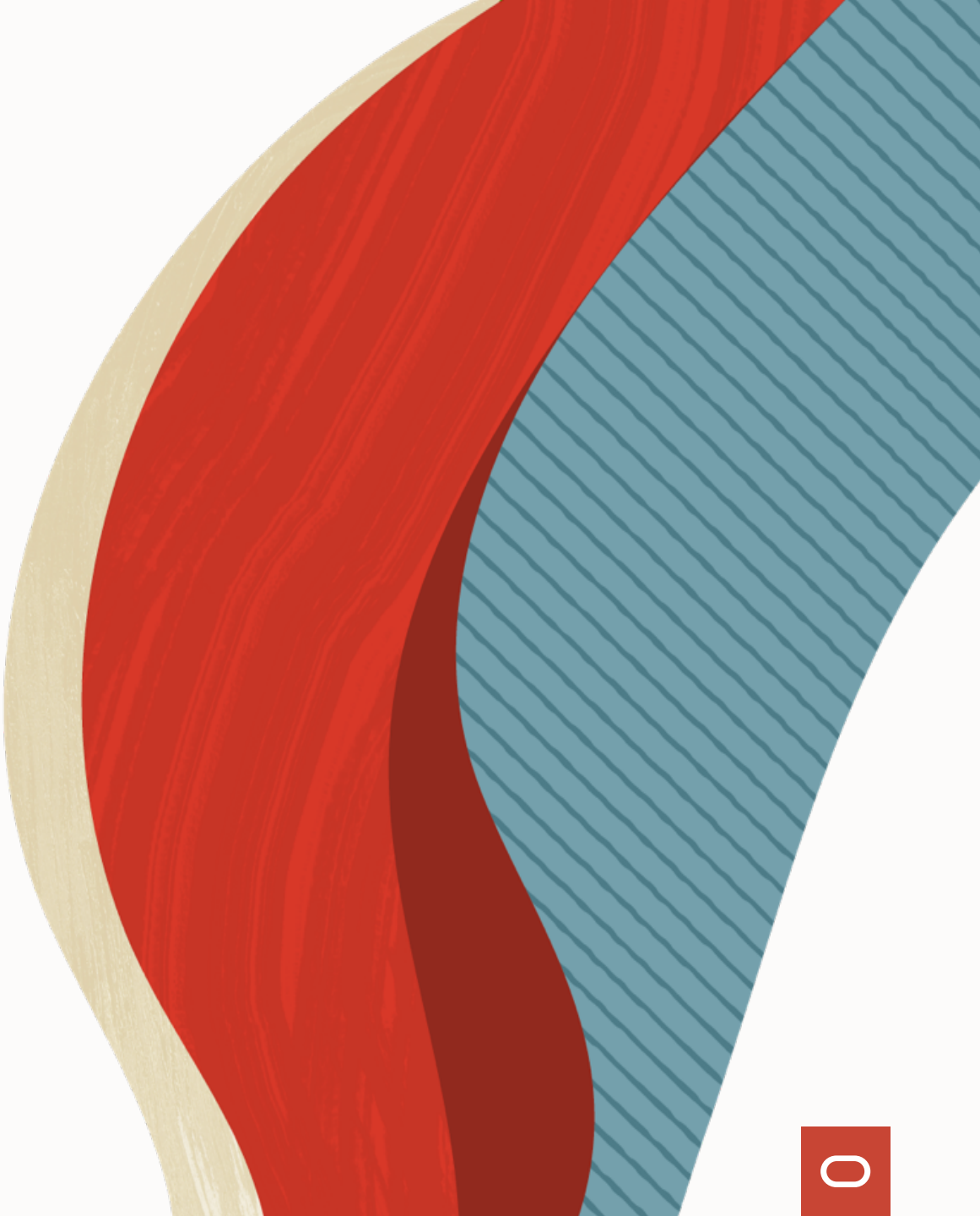

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Grid Infrastructure Patching Methods

1 In-place

Replaces existing Oracle Home

Uses `opatchauto`

2 Out-of-place

Creates a new Oracle Home

Uses `opatchauto` or `gridSetup`

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Grid Infrastructure Patching Methods

1 In-place

Replaces existing Oracle Home

Uses `opatchauto`

2 Out-of-place

Creates a new Oracle Home

Uses `opatchauto` or `gridSetup`

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Use Out-Of-Place Patching

- Minimize downtime
- Minimize risk during outage
- Easier rollback

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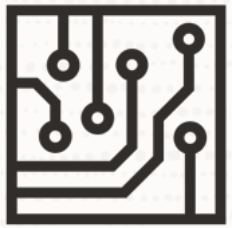

Use golden images

- Blog post

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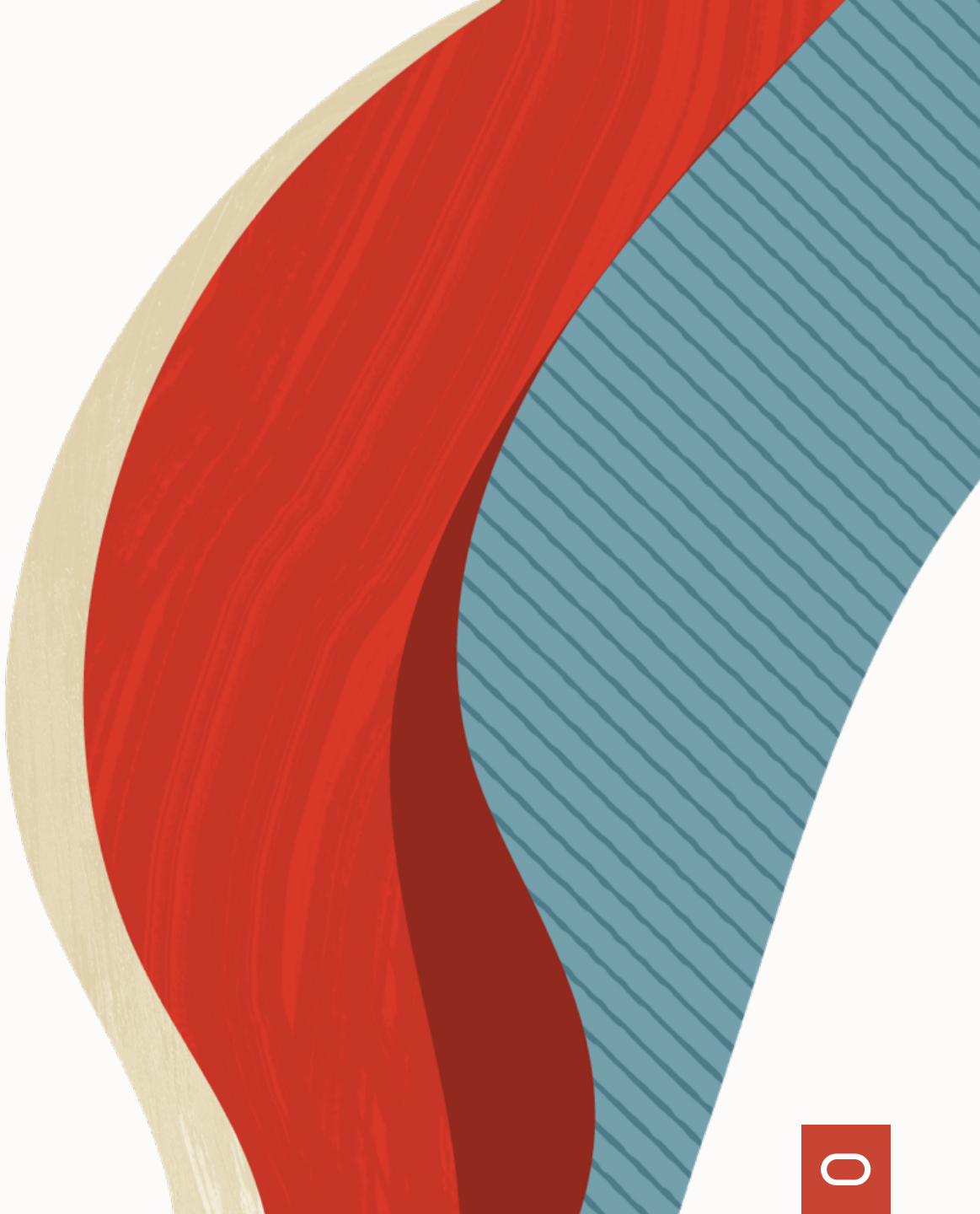
Demo

Install GI home
Apply Release Update
Create golden image



Watch on YouTube

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```
--Unzip base release and update OPatch

unzip -oq LINUX.X64_193000_grid_home.zip
mv OPatch OPatch_old
unzip p6880880...zip
```


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```
--Install the Oracle Home and apply Release Update and one-offs
--Specify multiple one-offs using comma-separated list

./gridSetup.sh -silent -applyRU <patch_dir> \
                       -applyOneOffs <patch_dir> \
                       ...
```


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```
--Always create your golden image from a "fresh" home
--Never use a production home

./gridSetup.sh -createGoldImage \
               -destinationLocation $GOLDIMAGEDIR \
               -silent
```


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```
--Deploy golden image throughout your environment
--Just unzip and attach on node 1, installer copies to other nodes

unzip -oq my_golden_image.zip
./gridSetup.sh -silent \
               oracle.install.db.CLUSTER_NODES=node1,node2 \
               ...
```


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Patching a cluster requires passwordless SSH connection between the nodes

- You can disable it after patching

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Should you patch Grid Infrastructure and Database Homes together, or separately?

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Patching GI and DB Homes together?

Option 1

TOGETHER

One maintenance window

Longer, single patching window

Several changes

Option 2

SEPARATELY

Two maintenance windows

Shorter window, but longer overall patching

One change at a time

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Keep GI and DB patch levels in synch

- This is what we test and run in our Cloud

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Unusual combinations are supported, but we strongly advice against it

- GI 19.16.0 and DB 19.20.0
- Node 1 with GI 19.16.0, node 2 with GI 19.18.0
- Patching node 1 on Monday, node 2 on Tuesday …
- Mix of GI and DB versions on various nodes

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Complete a rolling patching operation always as quickly as possible

- RAC: Frequently Asked Questions (Doc ID 220970.1)

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The following patching concepts
apply to Oracle Database patching as well

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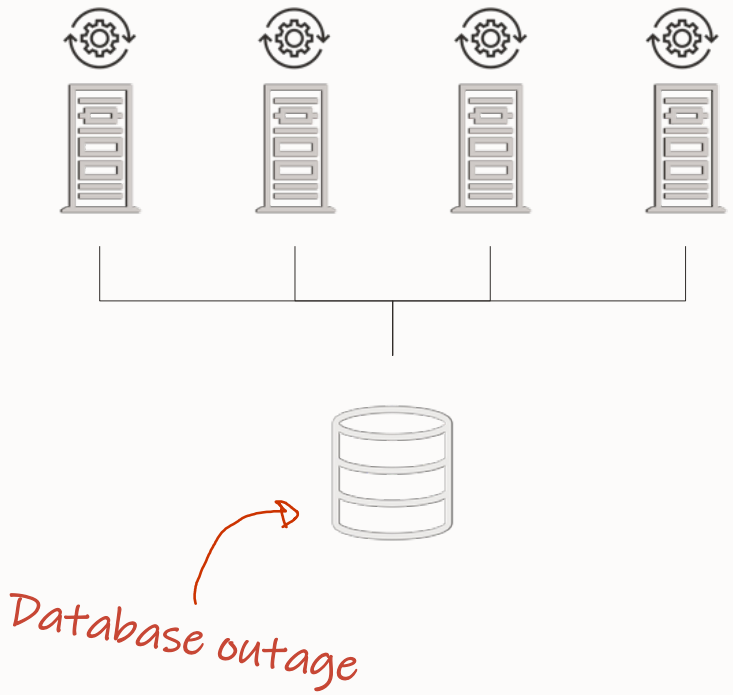
Grid Infrastructure Patching Concepts



ALL NODE

- All nodes patched at one time
- One long database outage
- Works for all patches, including non-rolling
- Cluster at full capacity except for outage

Rolling Patch - OPatch Support for RAC (Doc ID 244241.1)

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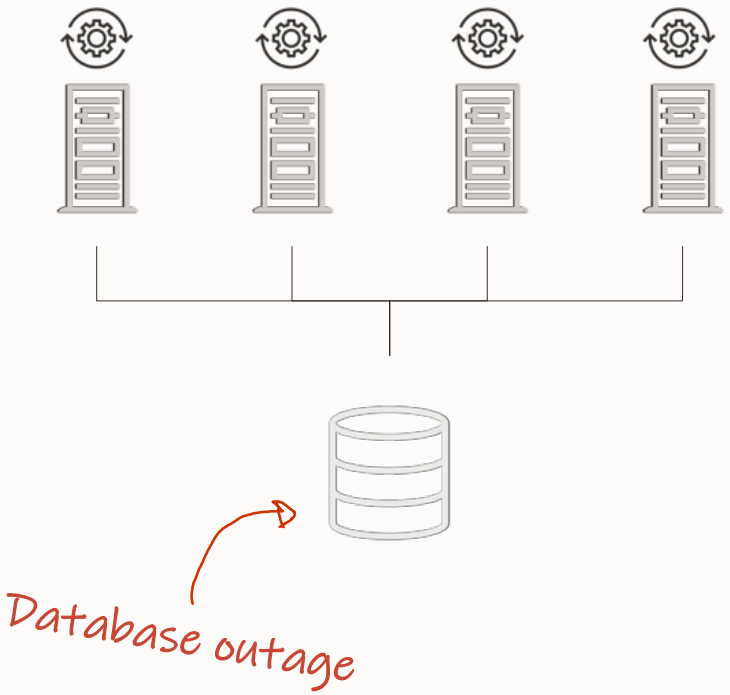
Grid Infrastructure Patching Concepts



MINIMUM DOWNTIME

- Nodes patched in two batches
- One short database outage
- Works for all patches, including non-rolling
- Other nodes must handle workload while another batch is patched

Rolling Patch - OPatch Support for RAC (Doc ID 244241.1)

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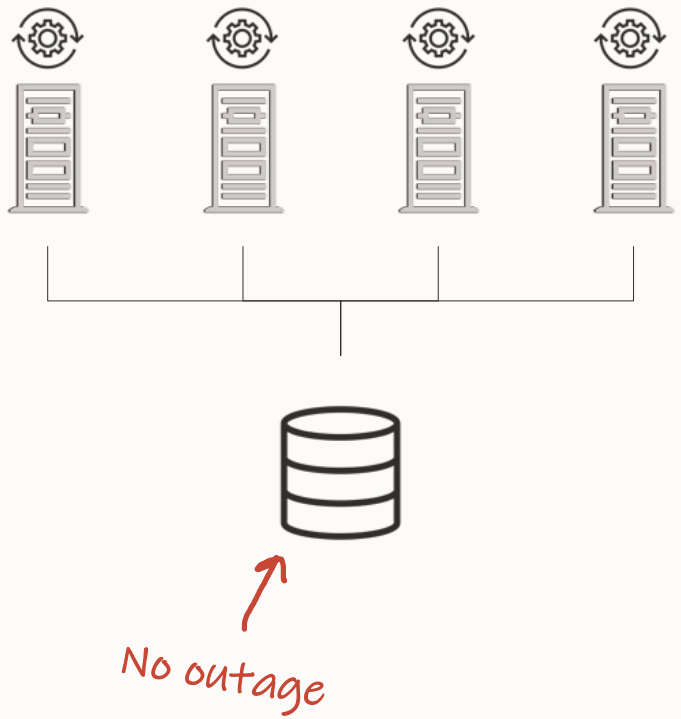
Grid Infrastructure Patching Concepts



ROLLING

- Each node patched separately
- No database outage
- Patch must be RAC rolling installable
- Other nodes must handle workload while one node is patched

Rolling Patch - OPatch Support for RAC (Doc ID 244241.1)

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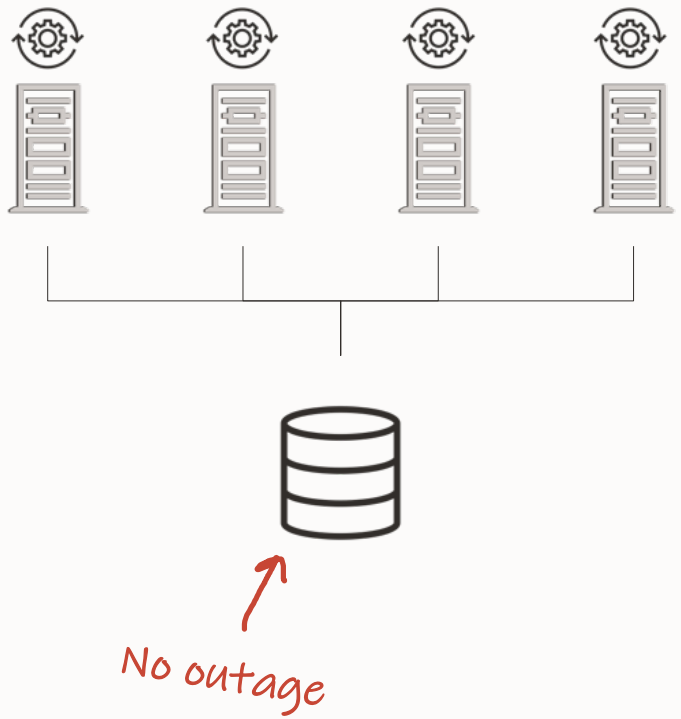
Grid Infrastructure Patching Concepts



ROLLING IN GROUPS

- Patch a subset together
- Useful when draining is a problem
- No database outage
- Patch must be RAC rolling installable
- Other nodes must handle workload while one node is patched

Rolling Patch - OPatch Support for RAC (Doc ID 244241.1)

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Rolling patching requires efficient draining

- Optionally, consider a *batched* approach

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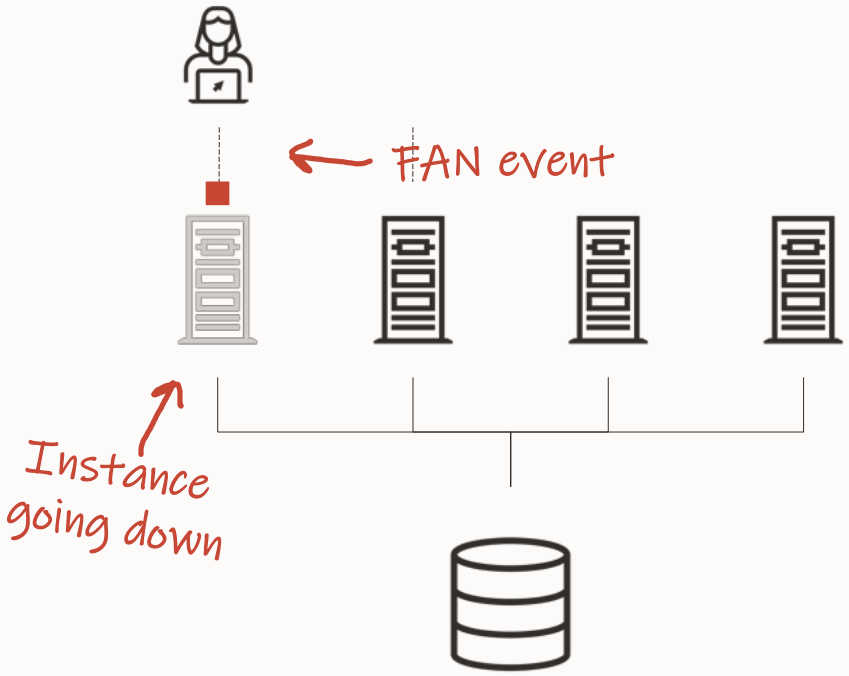
Draining Connections



DRAINING

- Allows users to finish their work and reconnect to another instance
- New sessions connect to other instances
- Sessions that don't drain in time are forcefully terminated
- Controlled by `drain_timeout` parameter in `srvctl` and `DBMS_SERVICE`

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Drain Timeout

Setting `drain_timeout` very low?

- This may cause login storms
  - Be cautions on databases with many connections

Setting `drain_timeout` very high?

- Load is spread on fewer instances
  - Cluster is in rolling patch mode for an extended period of time

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Comply with Maximum Availability Architecture (MAA) principles

- Continuous Availability - MAA Checklist for Applications for the Oracle Database

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top tips

PATCHING SUCCESS

Cluster Verification Utility

Patch Level

Application Continuity

OPatch

Use CVU before and after patching

Preferably through EXAchk or ORAchk

Identifies potential issues

Light-weight, non-intrusive

Always use the latest version

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top tips

PATCHING SUCCESS

Cluster Verification Utility

Patch Level

Application Continuity

OPatch

- Apply patches regularly
- Apply recent Release Updates
- Apply MRPs
- Keep GI and DB patch levels in sync

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top tips

PATCHING SUCCESS

Cluster Verification Utility

Patch Level

Application Continuity

OPatch

Completely hide interruptions from users

Hides planned and unplanned events

Comply with MAA guidelines

See also Transparent Application Continuity

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top tips

PATCHING SUCCESS

Cluster Verification Utility

Patch Level

Application Continuity

OPatch

Always use the latest version of OPatch

Use in GI and DB homes

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Patching Best Practices

Installation

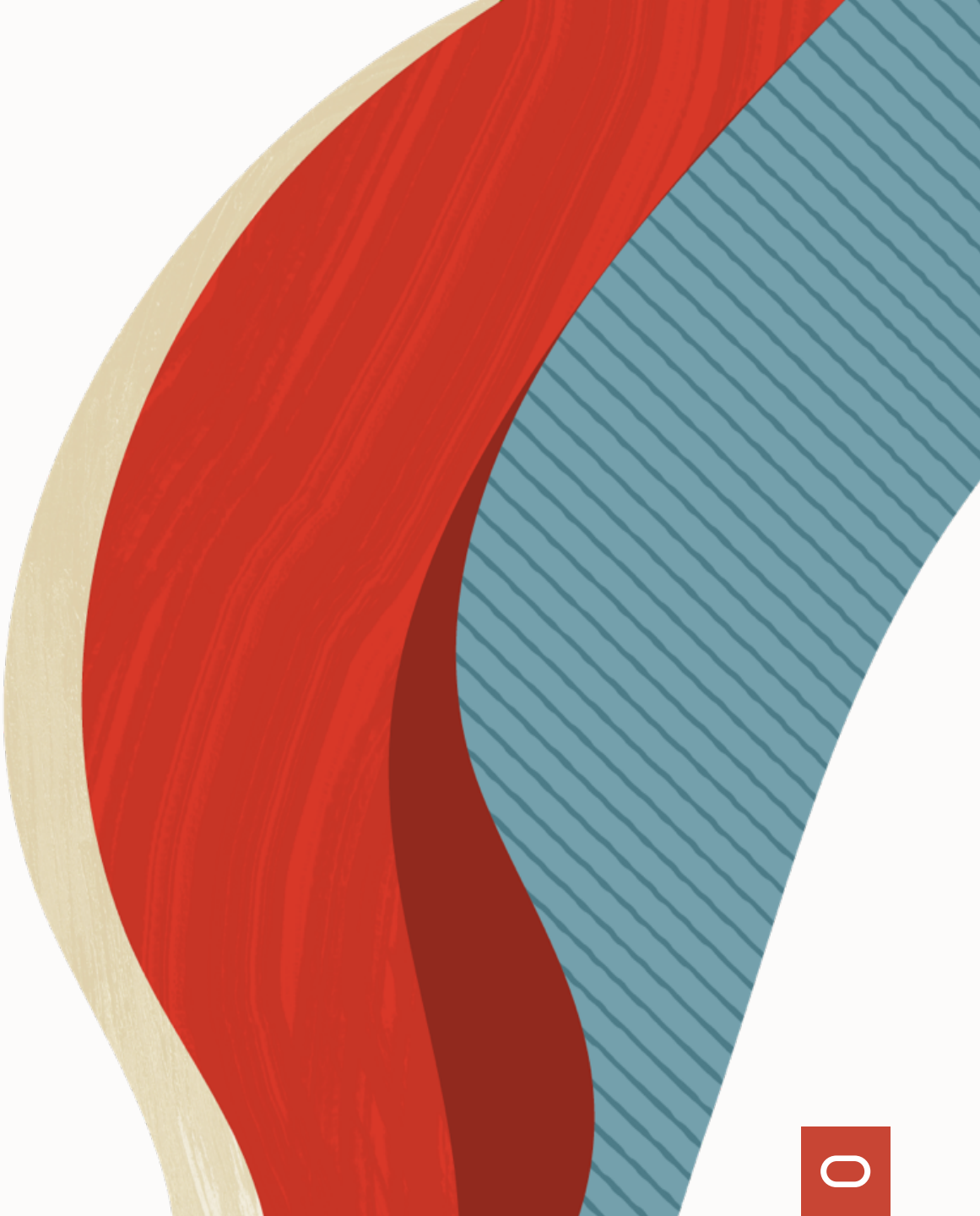
Basics

Methods

Grid Infrastructure

Datapatch

AutoUpgrade



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Patching a database

1

Start database in new Oracle Home

Start in normal open
Open all PDBs

2

Complete patching with `datapatch`

Found in `$ORACLE_HOME/OPatch`
One database per invocation
Multiple datapatch sessions in parallel
Datapatch User Guide (Doc ID 2680521.1)

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Patch multiple databases simultaneously by starting multiple instances of Datapatch

- Each Datapatch works on one database
- Be careful about resource consumption
- AutoUpgrade handles it for you

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Analyze the database for patching readiness using Datapatch Sanity Checks

- Datapatch User Guide (Doc ID 2680521.1)
- Executed by AutoUpgrade in analyze mode

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```
$ ./datapatch -sanity_checks

...

Check: DB Components status - OK
Check: PDB Violations - OK
Check: System invalid objects - OK
Check: Tablespace Status - OK
Check: Backup jobs - OK
Check: Temp Datafile exists - OK
Check: Datapump running - OK
Check: Container status - OK
Check: Encryption wallet - OK
Check: Dictionary statistics gathering - OK
Check: Scheduled Jobs - NOT OK (WARNING)
  Message: There are current running or scheduled jobs set to run on the next hour.
  Scheduled jobs may have an impact when run during patching.
  :
    JOB_NAME,NEXT_RUN_DATE,SCHEMA_NAME,STATE
    CLEANUP_TRANSIENT_PKG,23-MAY-23 11.08.53.000000 AM +01:00,APPUSER,SCHEDULED
```


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Recompile invalid objects
before invoking **`datapatch`**

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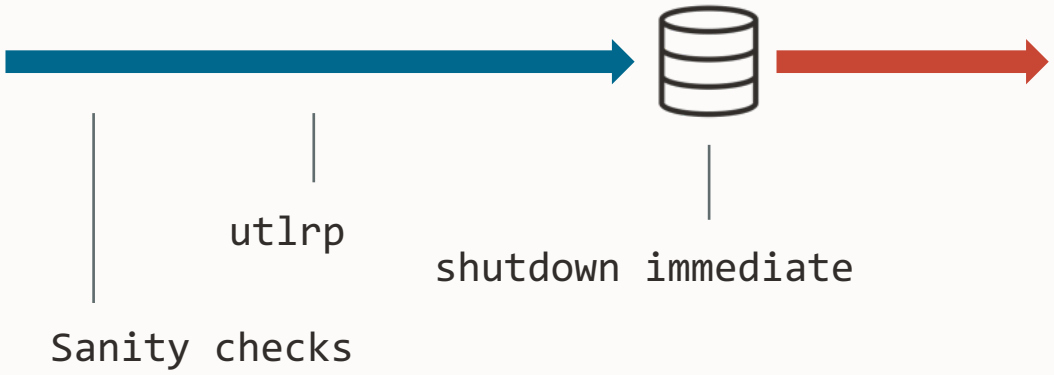
Patching Timeline



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The database must be open
Only open PDBs are patched

- Upgrade mode or restricted session is not needed

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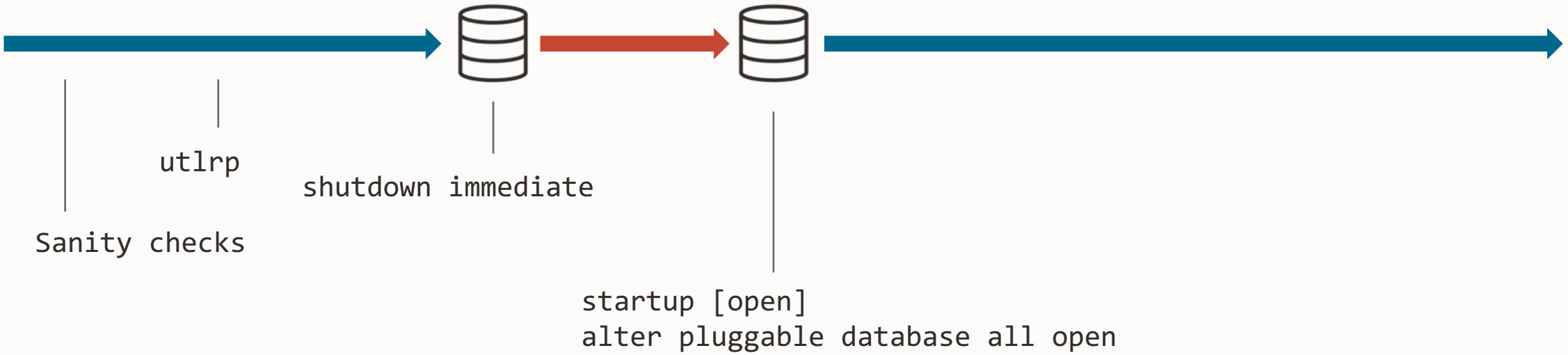
Patching Timeline



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You can run `datapatch` while users are connected to the database

- Details in blog post

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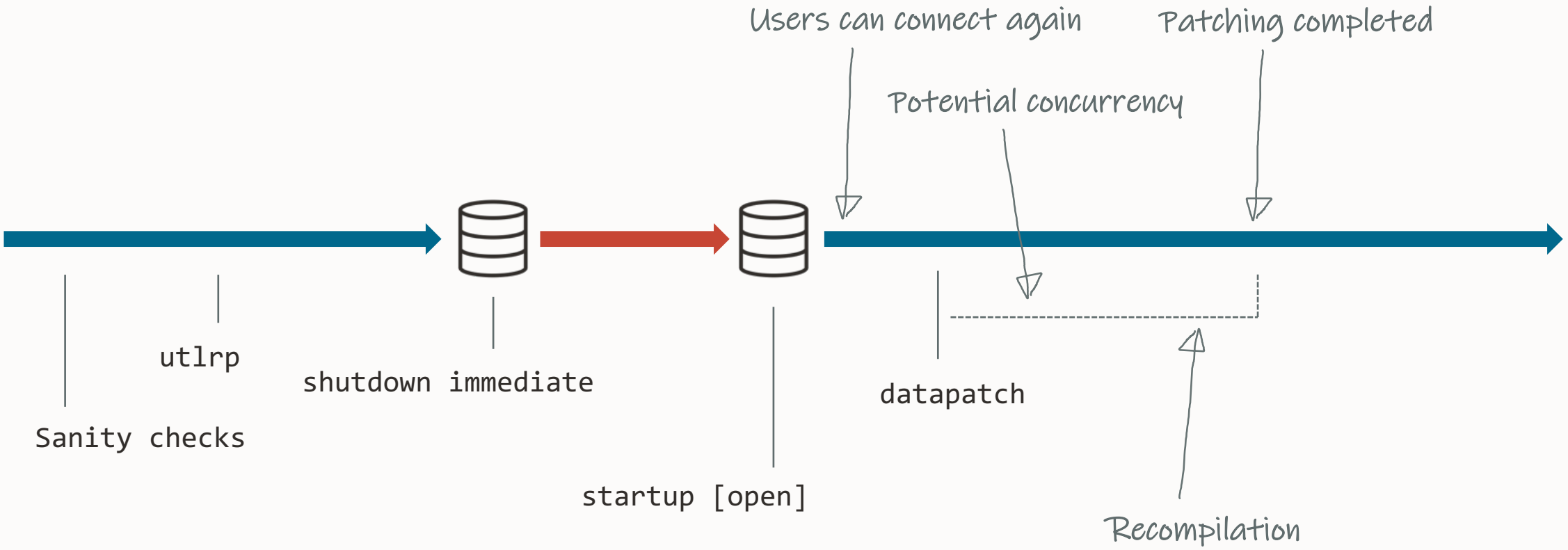
Patching Timeline



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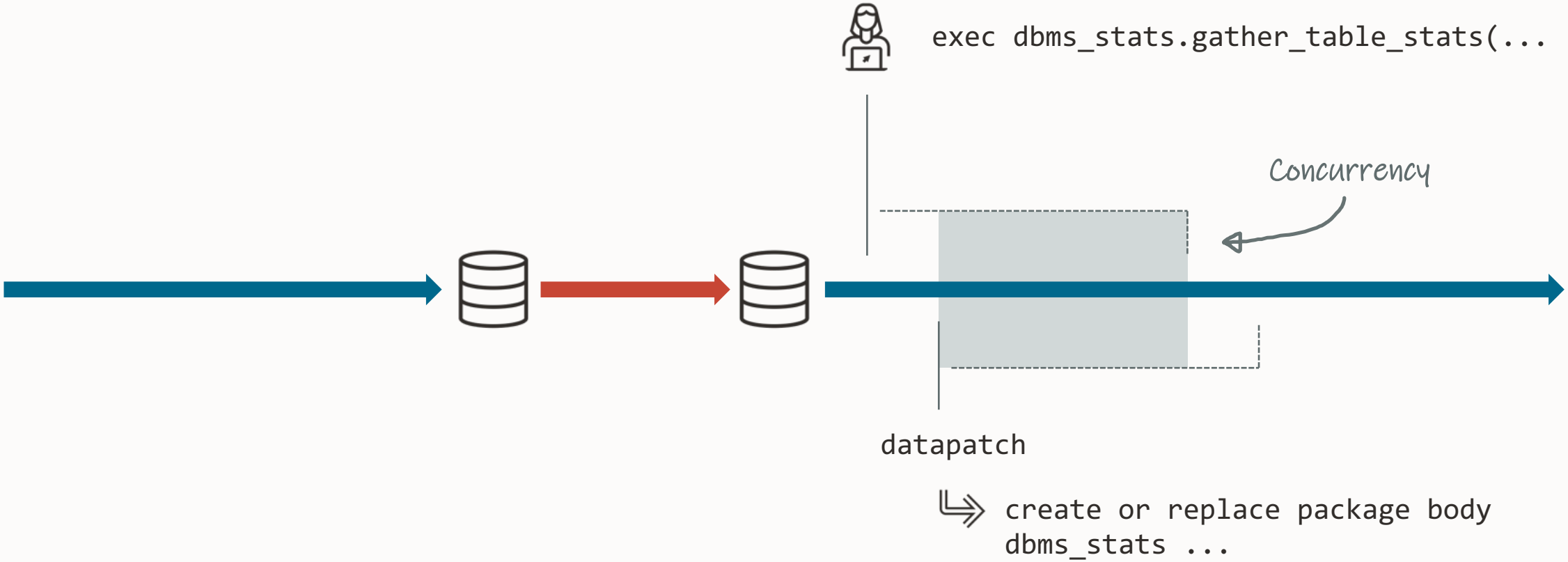
Patching Timeline



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Concurrency

- Datapatch waits 15 min to acquire a lock
  - On timeout, `ORA-04021 timeout occurred while waiting to lock object`

- Optionally, find blocking session and kill it

- Increase timeout using `-ddl_lock_timeout` *`<time-in-seconds>`*

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Disable the database scheduler (`job_queue_processes=0`)

- Also disables refresh of materialized views

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Postpone RMAN backups

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Stop Oracle GoldenGate while you are running datapatch

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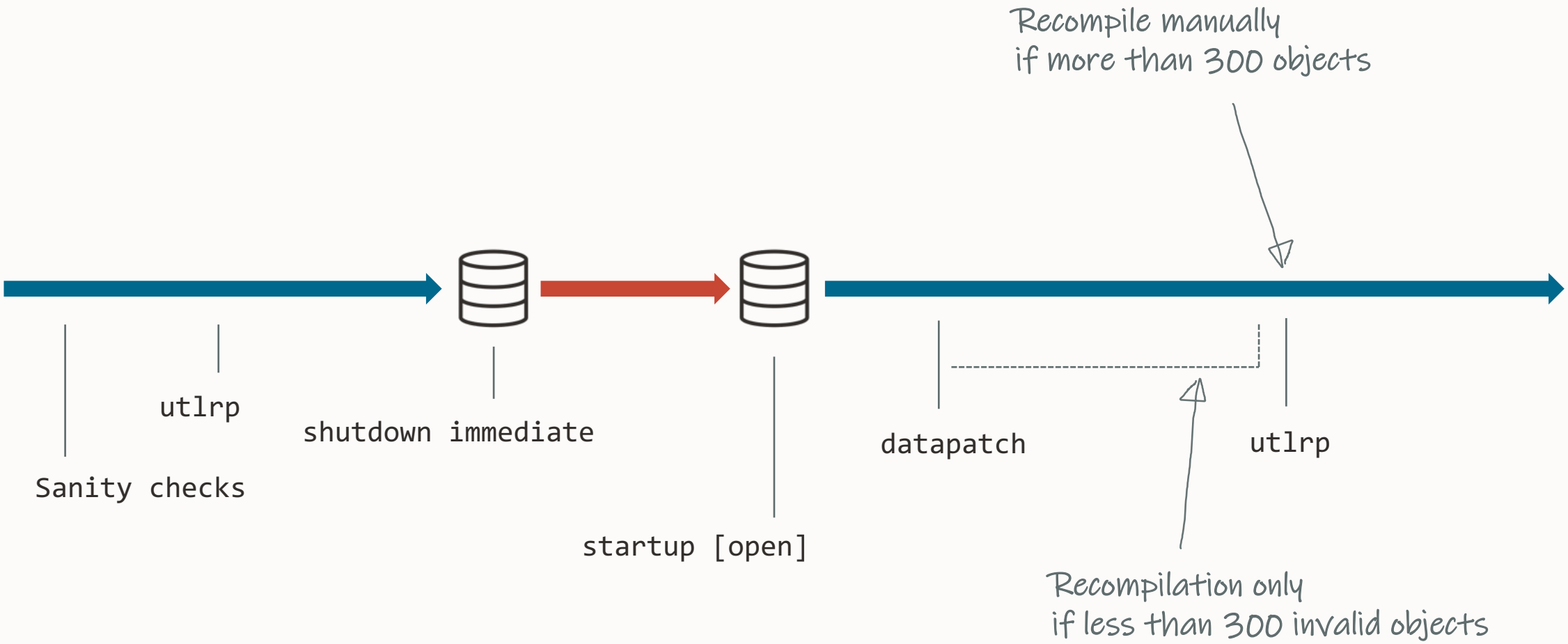
Patching Timeline



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Recompilation

Datapatch recompiles objects invalidated during patching

If more than 300 objects are invalidated no recompilation takes places

- Recompile manually
- Or, objects will be recompiled on usage

Adjust the threshold

```
datapatch ... -recomp_threshold 300
```

Consider recompiling invalid objects after patching

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```
$ ./datapatch -verbose
SQL Patching tool version 19.19.0.0.0 Production on Sun Jun 25 07:12:19 2023

.
.
.
.

Automatic recompilation incomplete; run utlrp.sql to revalidate.
  PDBs: PDB1 PDB$SEED

SQL Patching tool complete on Sun Jun 25 07:12:19 2023
```


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Datapatch uses **`REGISTRY$SQLPATCH_RU_INFO`** to control the patching operations

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If in doubt run `datapatch` again

- Datapatch only does what is needed
- You can run `datapatch` as many times as you like

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Datapatch Workflow

- Connect with SYSDBA privilege
- Using local connection

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Datapatch Workflow

- Check Datapatch infrastructure (tables/view/packages)
- *Patches Datapatch*

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Datapatch Workflow

- Uses queryable inventory (`DBMS_QOPATCH`)
- Checks all nodes in a cluster
- May use local inventory

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Datapatch Workflow

- Checks tables to learn which patches are present
  - `REGISTRY$SQLPATCH_RU_INFO`
  - `REGISTRY$SQLPATCH`

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Datapatch Workflow

- Compare binary and SQL inventory
- Check patch metadata
- Build plan
- Check Oracle home for apply/rollback scripts

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Datapatch Workflow

Connect to database → Boot-strapping → Binary inventory → SQL inventory → **Build plan** → Apply / rollback → Verify logs

Patch	Node 1	Node 2	SQL inv.	Action
Patch 1	Not present	Not present	Present	Rollback
Patch 2	Present	Present	Not present	Apply
Patch 3	Present	Present	Present	No action
Patch 4	Present	Not present	Not present	No action

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Datapatch Workflow

- Performs actions according to plan
- Errors in this phase are most likely a *bad patch*

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Datapatch Workflow

- Check the log files
- Looks for specific patterns
- Updates the result of the actions to the Datapatch tables

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Datapatch Rollback Scripts

Apply/rollback scripts:

```
$ORACLE_HOME/sqlpatch/.../nnn_apply.sql
$ORACLE_HOME/sqlpatch/.../nnn_rollback.sql
```

Rollback scripts (zipped as BLOB):

```
SELECT  PATCH_DIRECTORY
FROM    REGISTRY$SQLPATCH_RU_INFO
```


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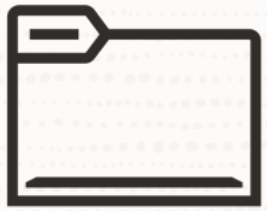

Update database directories using `rdbms/admin/utlfixdirs.sql`

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Patching Best Practices

Installation

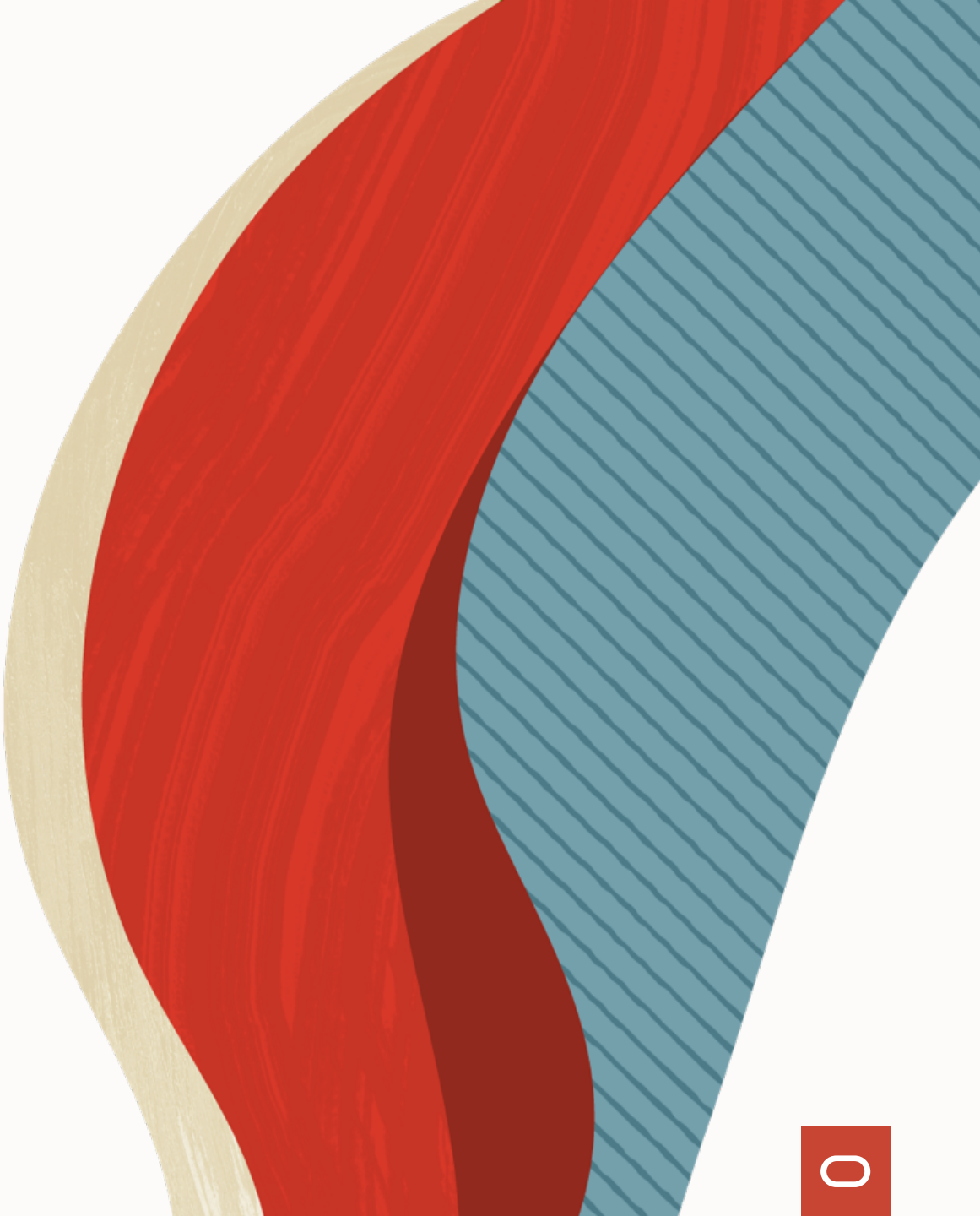
Basics

Methods

Grid Infrastructure

Datapatch

AutoUpgrade



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We made upgrading easy.
Now we make patching just as easy.

AutoUpgrade functionality extended to patching

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```
$ cat DB19.cfg

patch1.source_home=/u01/app/oracle/product/19/dbhome_19_18_0
patch1.target_home=/u01/app/oracle/product/19/dbhome_19_20_0
patch1.sid=DB19


$ java -jar autoupgrade.jar -config DB19.cfg -mode deploy
```


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Fleet Patching

AutoUpgrade

Automate your patching process and benefit from the familiar AutoUpgrade

Fleet Patching and Provisioning

Go fleet scale with FPP and benefit from additional functionality like deployment of Oracle Home

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Break

We'll start again in 15 minutes

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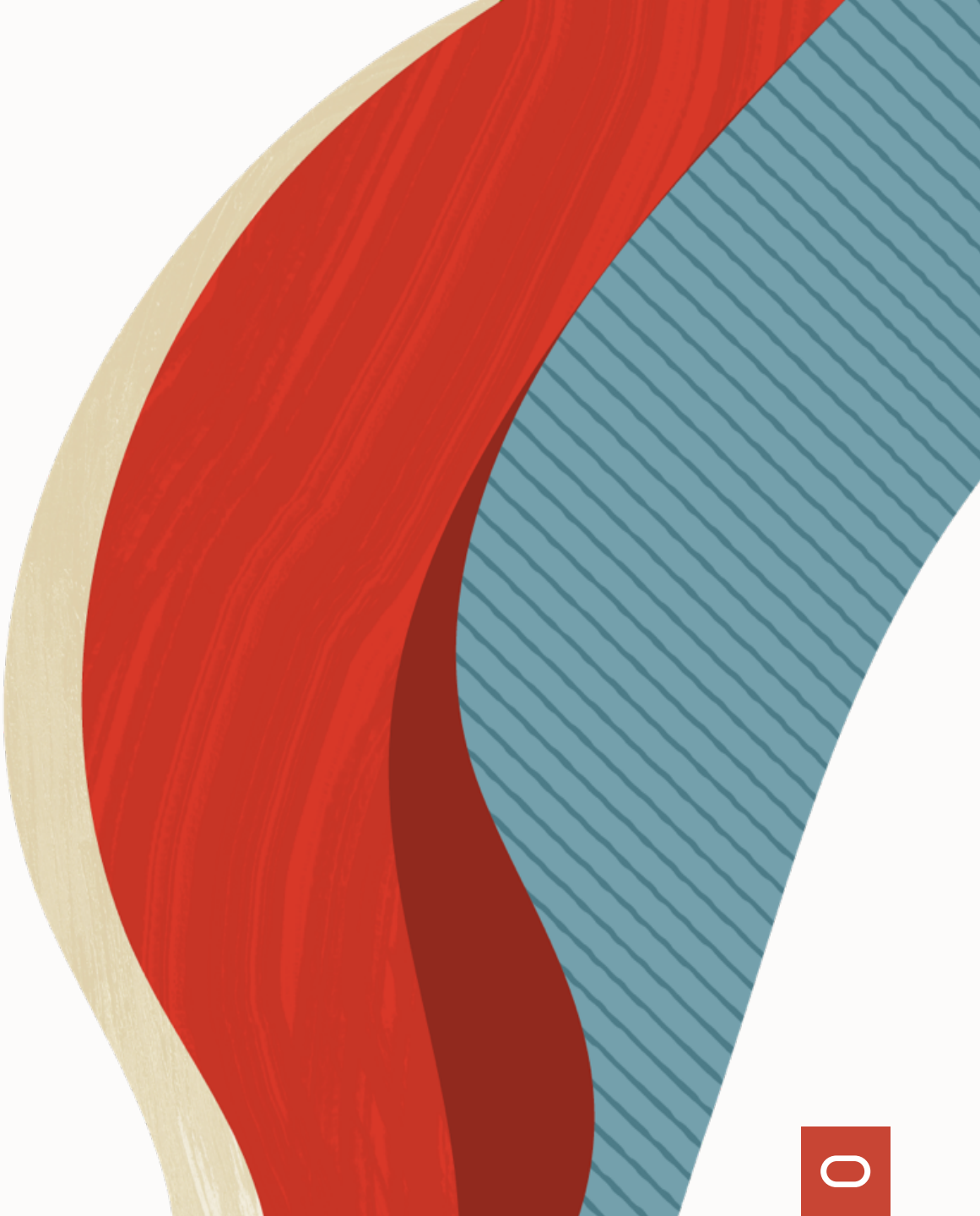
Before upgrade

How to upgrade and convert

After upgrade



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Do you want to upgrade?

Oracle Database 11.2.0.4
Oracle Database 12.1.0.2
Oracle Database 12.2.0.1
Oracle Database 18c

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Oracle Database 11.2.0.4
Oracle Database 12.1.0.2
Oracle Database 12.2.0.1
Oracle Database 18c

Oracle Database 19c

Oracle Database 23c

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Oracle Database 23c supports the multitenant architecture only

- You must convert your database to a PDB

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```
--Use up to 3 user-created PDBs
--without a license for Multitenant option.
--Applies to Oracle Database 19c and newer, including SE2

alter system set max_pdbs=3;
```


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Ensure your clients can connect to Oracle Database 23c

- Upgrade your clients well in advance of the upgrade

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Client / Server Interoperability

Client Version	Server Version						
	23c	21c	19c	18c	12.2.0	12.1.0	11.2.0
23c[#11]	Yes	Yes	Yes	No	No	No	No
21c	Yes	Yes	Yes	Was	Was	Yes[#12]	No
19c	Yes	Yes	Yes	Was	Was	Yes[#12]	Yes[#9]
18c	No	Was	Was	Was	Was	Was	Was
12.2.0	No	Was	Was	Was	Was	Was	Was
12.1.0	No	Yes[#12]	Yes[#12]	Was	Was	Yes[#12]	Yes[#12]
11.2.0	No	No	Yes[#9]	Was	Was	Yes[#12]	Yes[#9]

MOS Note: 207303.1 - Client / Server Interoperability Support Matrix

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JDBC Interoperability

Currently, only JDBC driver 23c can connect to Oracle Database 23c
(subject to change)

For up-to-date information:

Starting With Oracle JDBC Drivers - Installation, Certification, and More! (Doc ID 401934.1)

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On important databases, execute a dictionary check before upgrade

- Formerly known as *Health Check*
- MOS Doc ID 1366971

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```
upg1.sid=DB19
upg1.source_home=/opt/oracle/product/19c
upg1.target_home=/opt/oracle/product/23c
upg1.target_cdb=CDB1
upg1.run_dictionary_health=full
#To run only the critical checks
#upg1.run_dictionary_health=critical
```


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```
upg1.sid=DB19
upg1.source_home=/opt/oracle/product/19c
upg1.target_home=/opt/oracle/product/23c
upg1.target_cdb=CDB1
upg1.run_dictionary_health=full
#To run only the critical checks
#upg1.run_dictionary_health=critical
```

```
dbms_dictionary_check on 05-SEP-2023 09:41:30
-----------------------------------------------
Catalog Version 19.0.0.0.0 (1900000000)
db_name: DB19
Is CDB?: NO
Trace File: /opt/oracle/diag/rdbms/db19/DB19/trace/DB19_ora_25104_DICTCHECK.trc
                                    Catalog       Fixed
Procedure Name                      Version    Vs Release    Timestamp      Result
----------------------------------- ---------- -- ---------- -------------- ------
.- OIDOnObjCol                      ... 1900000000 <=  *All Rel* 09/05 09:41:30
PASS
.- LobNotInObj                      ... 1900000000 <=  *All Rel* 09/05 09:41:30
PASS
.- SourceNotInObj                   ... 1900000000 <=  *All Rel* 09/05 09:41:30
PASS
.- OversizedFiles                   ... 1900000000 <=  *All Rel* 09/05 09:41:30
PASS
.- PoorDefaultStorage               ... 1900000000 <=  *All Rel* 09/05 09:41:30
PASS
.- PoorStorage                      ... 1900000000 <=  *All Rel* 09/05 09:41:30

*** 2023-09-05T09:41:30.934258+00:00
PASS
.- TabPartCountMismatch             ... 1900000000 <=  *All Rel* 09/05 09:41:30
PASS
.- TabComPartObj                    ... 1900000000 <=  *All Rel* 09/05 09:41:30
PASS
.- Mview                            ... 1900000000 <=  *All Rel* 09/05 09:41:30
PASS
.- ValidDir                         ... 1900000000 <=  *All Rel* 09/05 09:41:30
PASS
.- DuplicateDataobj                 ... 1900000000 <=  *All Rel* 09/05 09:41:30
PASS
.- ObjSyn                           ... 1900000000 <=  *All Rel* 09/05 09:41:31
PASS
.- ObjSeq                           ... 1900000000 <=  *All Rel* 09/05 09:41:31
PASS
```


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Ensure dictionary and fixed objects statistics are accurate

- Save downtime by gathering in advance

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```
begin
    --dbms_stats.gather_dictionary_stats;
    dbms_stats.gather_schema_stats('SYS');
    dbms_stats.gather_schema_stats('SYSTEM');
    dbms_stats.gather_fixed_objects_stats;
end;
/
```


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```
begin
   dbms_stats.gather_schema_stats('SYS');
   dbms_stats.gather_schema_stats('SYSTEM');
   dbms_stats.gather_fixed_objects_stats;
end;
/
```

"After gathering dictionary stats, our Data Pump export went from 46 to 8 minutes"

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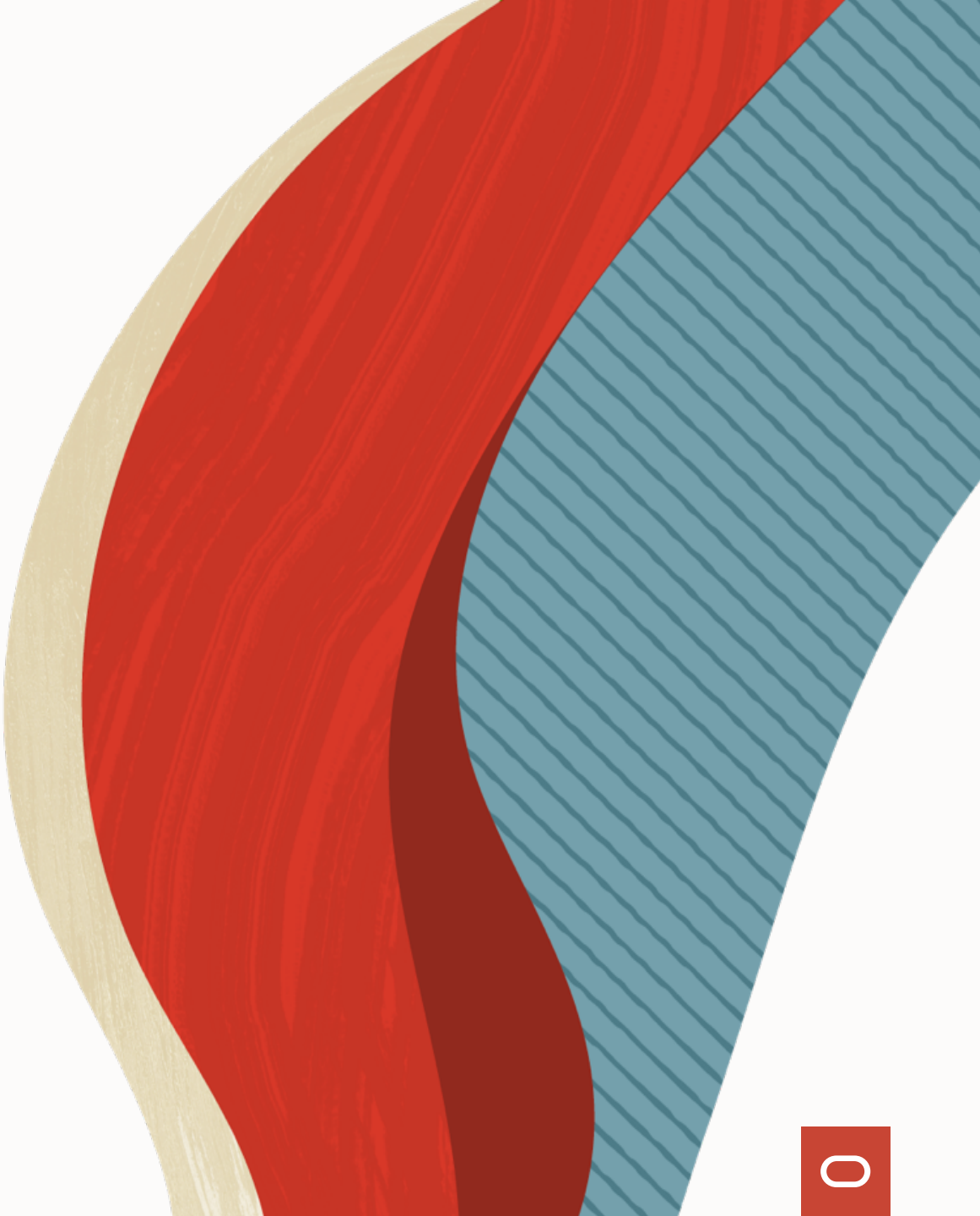
Before upgrade

How to upgrade and convert

After upgrade



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How do you start?

Installation

Download and install
Oracle Database 23c

Container Database

AutoUpgrade

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Installation of Oracle Home is simpler

- Gold images with recent Release Update
- Available for Oracle Database 23c

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Simplified Installation

1. Download software
2. Download patches
3. Unzip
4. Update OPatch
5. Install
6. Apply patches

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Simplified Installation

1. Download software
2. ~~Download patches~~
3. Unzip
4. ~~Update OPatch~~
5. Install
6. ~~Apply patches~~

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Simplified Installation

1 Download software

2 Unzip

3 Install

Fully updated Oracle Home

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In Oracle Database 23c an Oracle Home is read-write by default

- Reverting behavior change from Oracle Database 21c
- Read-only Oracle Home is now an optional configuration

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How do you start?

Installation

Container Database

Create a new CDB in
Oracle Database 23c

AutoUpgrade

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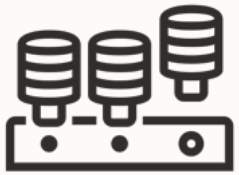
Create Container Database



1 Character set

2 Components

3 `COMPATIBLE`

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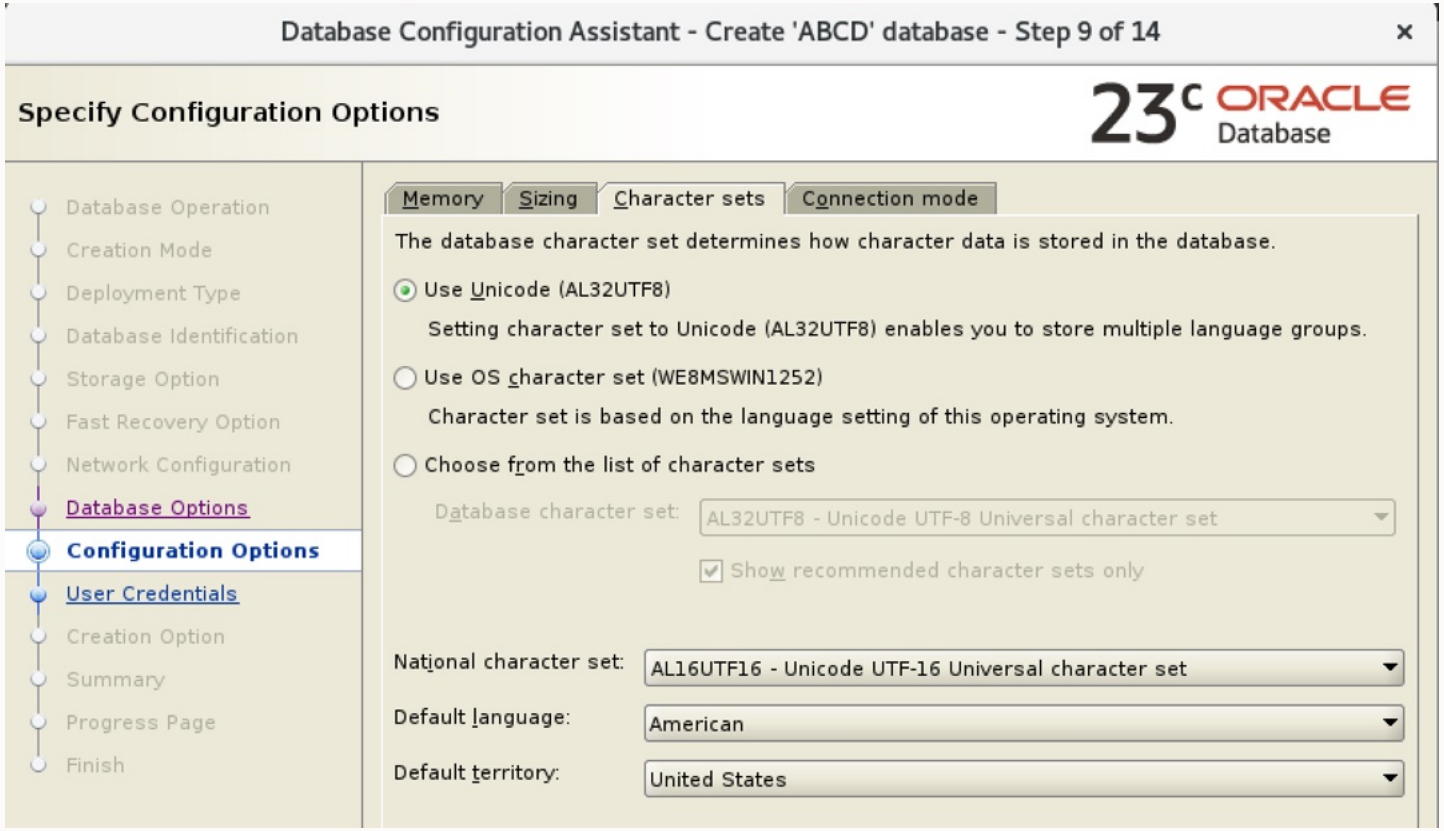
Create Container Database

1 Character set

- Always choose AL32UTF8
- Allows PDBs with any character set

2 Components

3 COMPATIBLE



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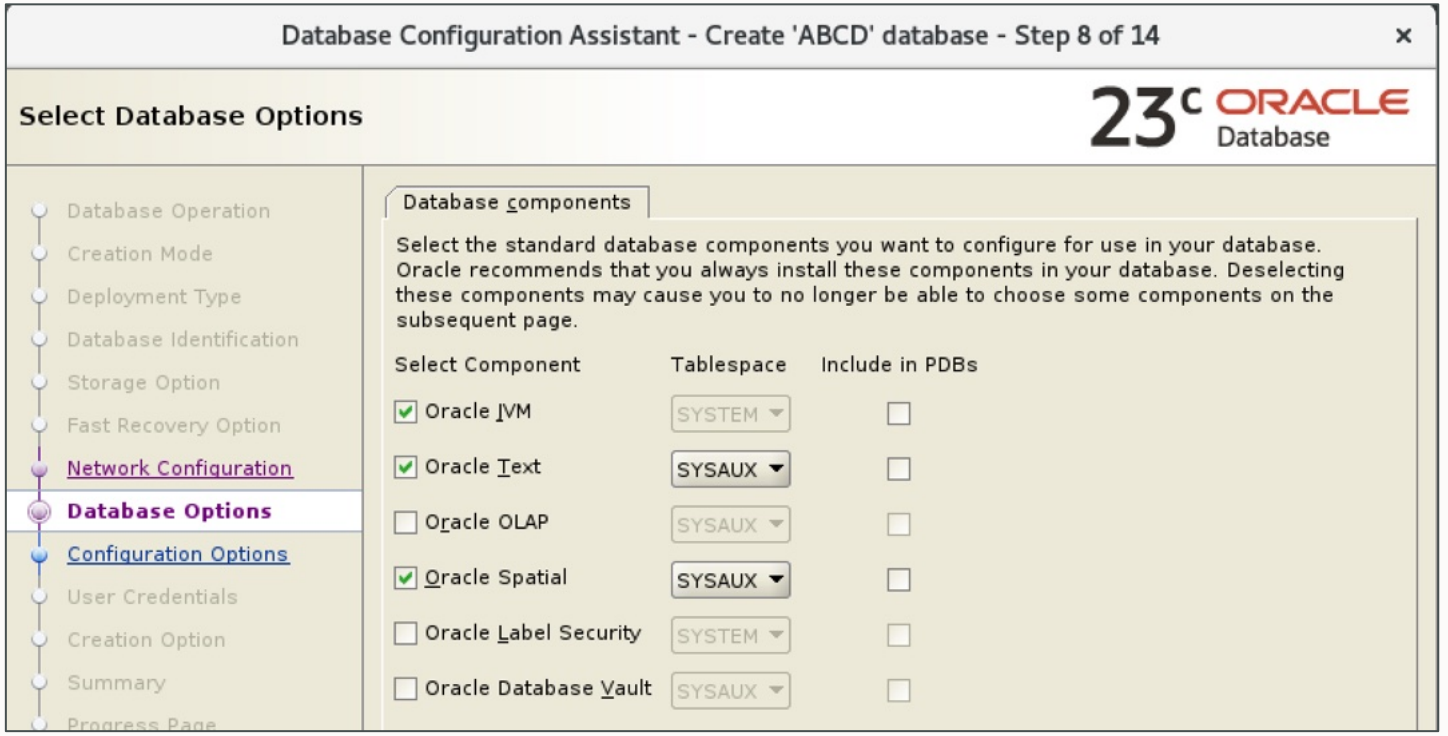
Create Container Database

1 Character set

2 Components

- Install as many as you need
- No more than that

3 `COMPATIBLE`



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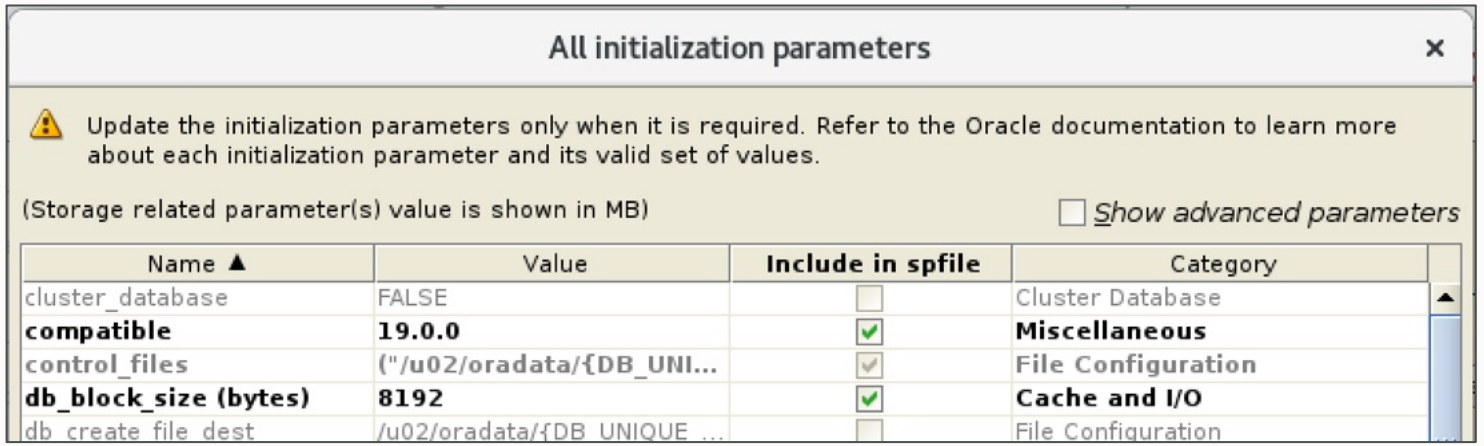
Create Container Database

1 Character set

2 Components



3 COMPATIBLE

- Keep at the default setting, *23.0.0*
- Unless you want the option of downgrade

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```
--Allows CDB views to include information on PDB$SEED objects.
--By default, such information is hidden.
--https://mikedietrichde.com/2017/07/21/why-exclude_seed_cdb_view-is-now-an-underscore-in-oracle-12-2/

alter system set "_exclude_seed_cdb_view"=false;
```


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How do you start?

Installation

Container Database

AutoUpgrade

Download latest version, create your config file and start the process

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Always download the latest version of AutoUpgrade

- My Oracle Support Doc ID 2485457.1

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```
$ java -jar autoupgrade.jar –version

build.version 23.3.230829
build.date 2023/08/29 19:47:13 -0700
build.hash 8ab1875
build.hash_date 2023/08/29 03:54:58 -0700
build.supported_target_versions 12.2,18,19,21,23
build.type test
build.label (HEAD, origin/devel)
```


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Flow

1 Plug in

2 Upgrade

3 Convert

23c

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Demo

Upgrade to Oracle Database 23c

- Using AutoUpgrade
- Including PDB conversion

Watch on YouTube

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```
SQL> select version_full from v$instance;

VERSION_FULL
------------
23.3.0.23.9
```


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Non-CDB to PDB conversion is irreversible

What are your rollback options?

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ROLLBACK

Backup / restore

Ensure you have a recent backup and requires time to restore and recover

Copy data files

Requires time and disk space to hold a copy of the data files

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ROLLBACK

Backup / restore

Ensure you have a recent backup and requires time to restore and recover

Copy data files

Requires time and disk space to hold a copy of the data files

Refreshable clone

Requires ~~time and~~ disk space to hold a copy of the data files

Requires Oracle Database 12.2 or newer

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Refreshable Clone

CREATE

Create PDB from non-CDB over a database link

REFRESH

Apply redo from non-CDB to keep PDB up-to-date

OUTAGE

Disconnect users and refresh PDB for the last time

CONVERT

To become a proper PDB, it must be converted

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Refreshable Clone

Source non-CDB	Target CDB

```
CREATE USER dblinkuser
       IDENTIFIED BY ... ;

GRANT CREATE SESSION,
      CREATE PLUGGABLE DATABASE,
      SELECT_CATALOG_ROLE TO dblinkuser;

GRANT READ ON sys.enc$ TO dblinkuser;
```

```
CREATE DATABASE LINK CLONEPDB
       CONNECT TO dblinkuser
       IDENTIFIED BY ...
       USING 'noncdb-alias';
```


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Refreshable Clone

Source non-CDB	Target CDB

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=NONCDB1
upg1.target_cdb=CDB1
upg1.source_dblink.NONCDB1=CLONEPDB
upg1.target_pdb_name.NONCDB1=PDB1

--Specify relative start time
--upg1.start_time=+1h30m
```


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Refreshable Clone

Source non-CDB	Target CDB

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=NONCDB1
upg1.target_cdb=CDB1
upg1.source_dblink.NONCDB1=CLONEPDB 300
upg1.target_pdb_name.NONCDB1=PDB1

--Specify relative start time
--upg1.start_time=+1h30m
```


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Refreshable Clone

Source non-CDB	Target CDB

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=NONCDB1
upg1.target_cdb=CDB1
upg1.source_dblink.NONCDB1=CLONEPDB 300
upg1.target_pdb_name.NONCDB1=PDB1
upg1.start_time=22/10/2023 02:00:00
--Specify relative start time
--upg1.start_time=+1h30m
```


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Refreshable Clone

1

Run on source

```
autoupgrade.jar ... -mode analyze
autoupgrade.jar ... -mode fixups
```

2

Run on target

```
autoupgrade.jar ... -mode deploy
```


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Refreshable Clone

```
autoupgrade.jar ... -mode deploy
```

```
upg1.start_time=22/10/2023 02:00:00
```


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The source non-CDB stays intact to allow rollback

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Works for unplug-plug upgrades as well

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Zürcher
Kantonalbank

Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

A reliable partner for over 150 years

- The bank for the people of Zurich since 1870
- With over 5’100 employees one of the largest employers in the canton of Zurich
- Globally networked full-service bank with strong regional and local roots

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Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

Current situation

- Oracle databases on old OS and on Oracle Exadata
- 2023:
  - Migrate everything to Exadata until end of 2023
  - Consolidation to Multitenant and to the next long-term support release

Planned solution: AutoUpgrade

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Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

Test setup

- 3 non-CDB databases of different size

Source	Size / GB
TEST40 (108)	165
TEST42 (107)	555
TEST41 (106)	18’496

- Exadata X6-2 compute node
- 7 storage cells (2x X6-2L / 3x X7-2L / 2x X8-2L)
- Oracle Database 19.15.0
- No additional options

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Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

Cloning user

```
create user dblinkuser identified by Oracle_4UOracle_4U;
```

Permissions

```
grant CONNECT, RESOURCE, CREATE PLUGGABLE DATABASE,
      SELECT_CATALOG_ROLE to dblinkuser;
grant ALL ON SYS.ENC$ to dblinkuser;
```

Database link

```
create database link TEST42.DOMAIN connect to dblinkuser
identified by oracle_4uoracle_4u using ‘test42.domain’;
```


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Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

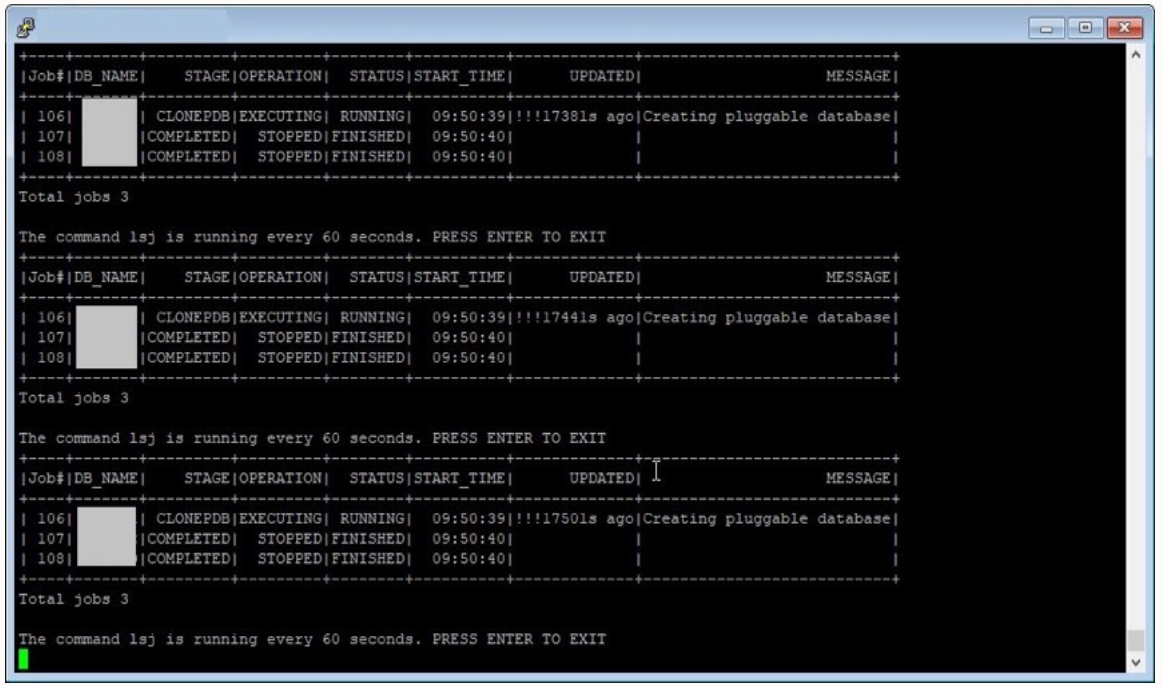
Preparation

Migration

Success?

Remarks

Migration in progress



Source	Runtime/Min
TEST40 (108)	26
TEST42 (107)	ongoing
TEST41 (106)	ongoing

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Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

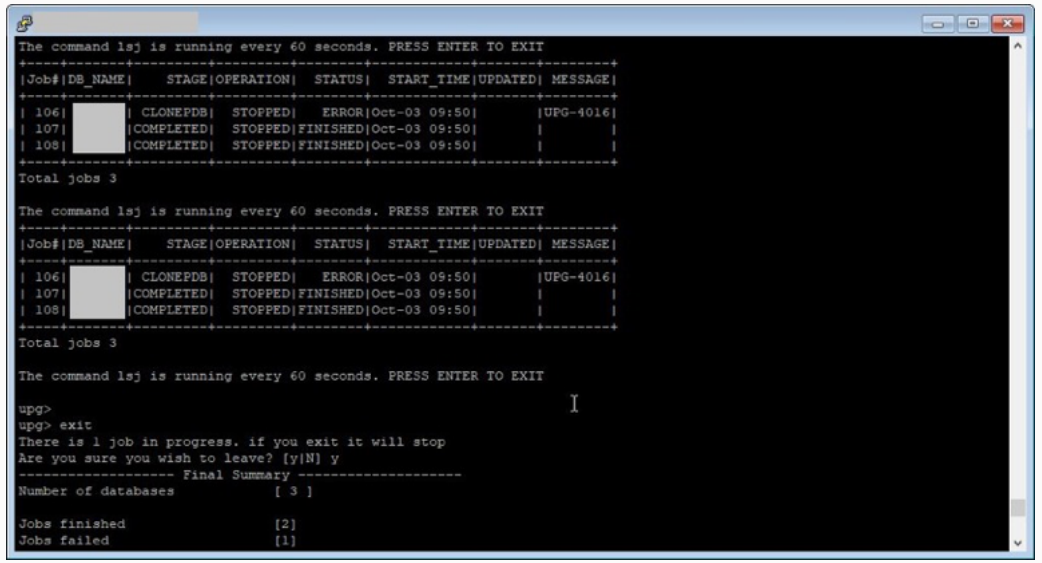
Preparation

Migration

Success?

Remarks

Migration completed



Source	Runtime/Min
TEST40 (108)	26
TEST42 (107)	226 (~3.5h)
TEST41 (106)	1770 (29h)

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Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

First non-CDBs migrated successfully

- Project is ongoing

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Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

For large databases, make sure archives aren't cleaned up

- Solution: restore archivelogs from backup

User profile with IDLE_TIME lead to kill of the session

- Solution: assign a different profile to the clone user

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Summary

- Very comfortable to use
  - Everything happens automatically
  - Does not require user interaction
- Simple syntax
- No license costs associated
- Perfect for pre-migration test

- Very Stable

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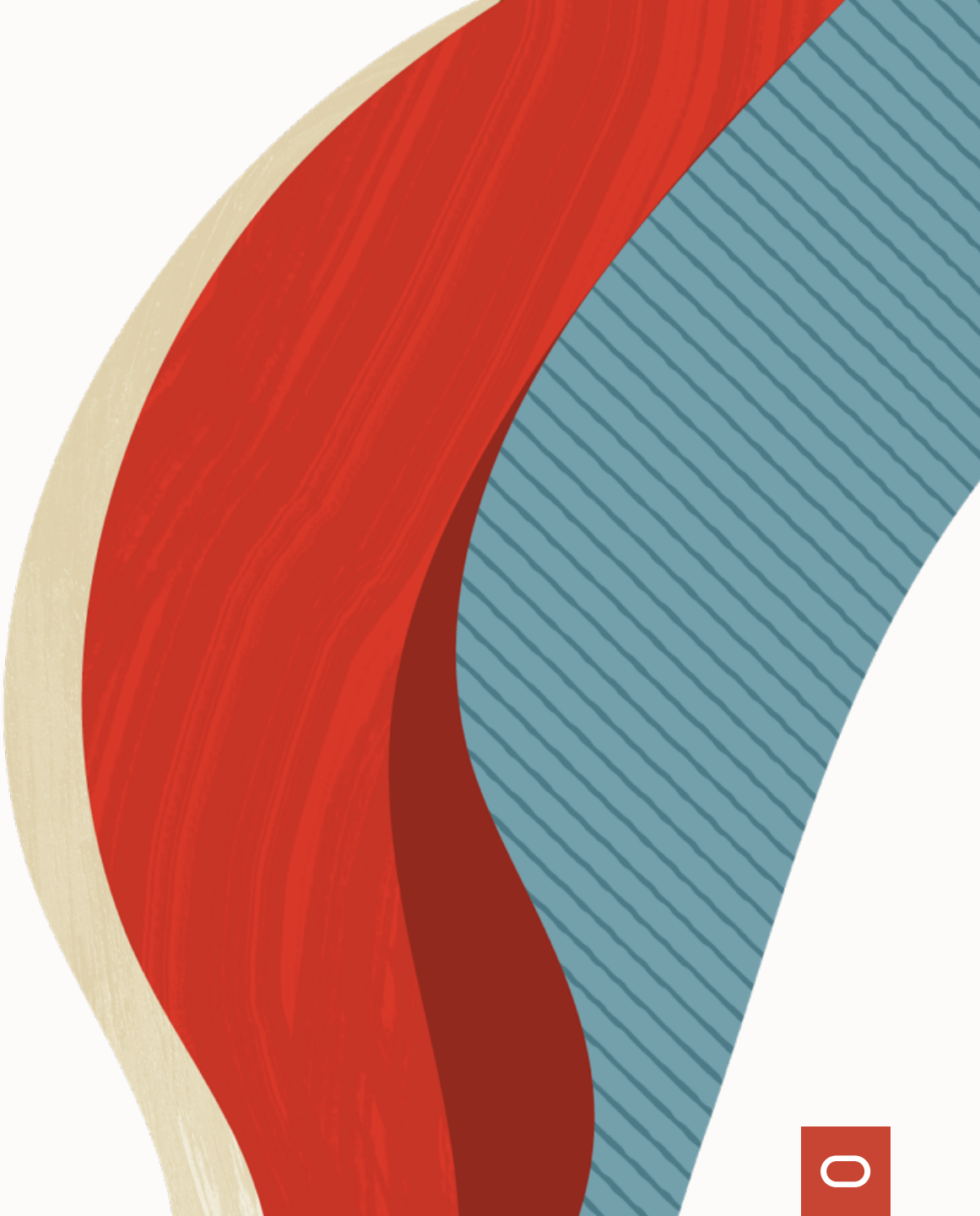
Before upgrade

How to upgrade and convert

After upgrade



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Fallback Options | After Go-Live

1 Back to 19c non-CDB

- Data Pump
- GoldenGate

2 Back to 19c, stay multitenant

- Downgrade
- `COMPATIBLE` must be *19.0.0* in 23c CDB

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Backup your database after migration

- Level 0
- Practice restore with pre-plugin backups

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Check your standby databases

- Special attention is needed for standby databases

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```
--Default config file setting
--PDB is not fully created on standbys
--Recovery is needed

upg1.manage_standbys_clause=standbys=none
```


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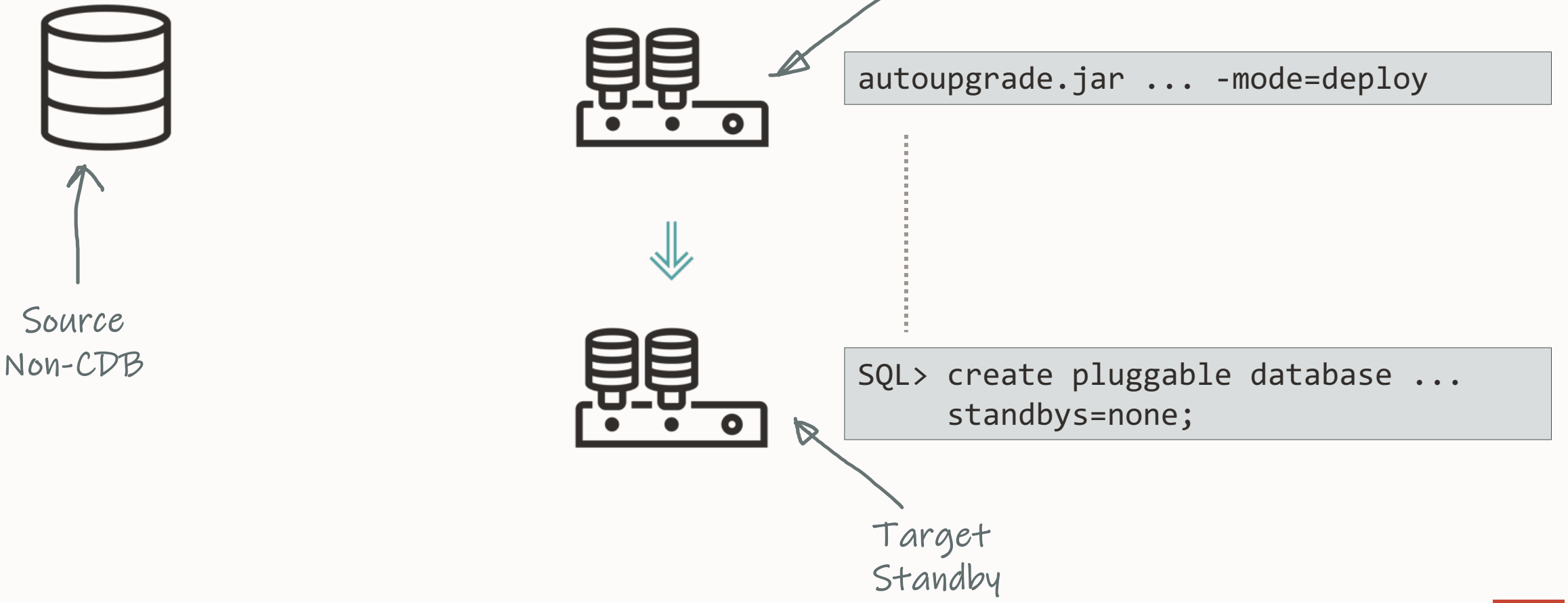

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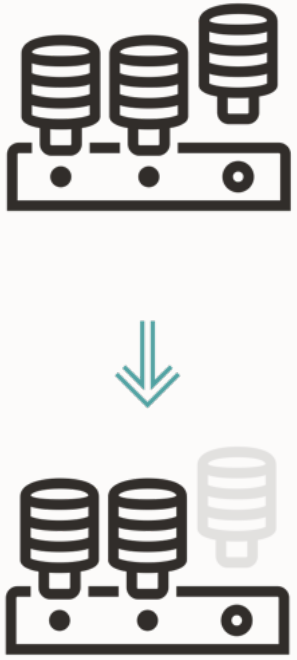

```
autoupgrade.jar ... -mode=deploy
```

```
SQL> create pluggable database ...
     standbys=none;
```

PDB created
Data files missing

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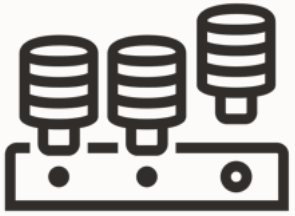
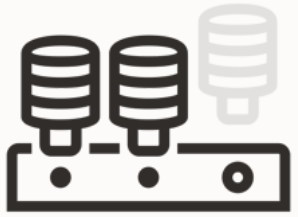


```
SQL> show pdbs

CON_NAME     OPEN MODE
PDB1         READ WRITE
```



```
SQL> show pdbs

CON_NAME     OPEN MODE
PDB1         MOUNTED
```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```
SQL> select name, recovery_status
     from v$pdbs;

NAME     RECOVERY_STATUS
PDB1     DISABLED
```


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```
RMAN> restore pluggable database
      ... from service ... ;

SQL> alter pluggable database
     enable recovery;
SQL> alter database datafile
     ... online;
```


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Data Guard | STANDBYS=NONE

Making Use Deferred PDB Recovery and the STANDBYS=NONE Feature with Oracle Multitenant (Doc ID 1916648.1)

Making Use Deferred PDB Recovery and the STANDBYS=NONE Feature with Oracle Multitenant (Doc ID 1916648.1)

In this Document

Goal
Solution
Creating a PDB with the STANDBYS=NONE clause in a Data Guard configuration with 1 physical standby
Showing how the cloned PDB will appear in certain tables and views on the physical standby
Performing a Data Guard Role Transition with a PDB in DISABLED RECOVERY
The zero downtime instantiation process using RMAN for copying the files from the primary to standby
Steps required for enabling recovery on the PDB after the files have been copied
Steps to DISABLE RECOVERY of a Pluggable Database
Conclusion
References

APPLIES TO:

Oracle Cloud Infrastructure - Database Service - Version N/A and later
Oracle Database Cloud Service - Version N/A and later
Oracle Database - Enterprise Edition - Version 12.1.0.2 and later
Oracle Database Cloud Schema Service - Version N/A and later
Oracle Database Exadata Express Cloud Service - Version N/A and later
Information in this document applies to any platform.

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```
--To change the default behavior
--Take care - don't break your standby database
--Works only for databases without ASM or OMF

upg1.manage_standbys_clause=standbys=all
```


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Data Guard | Re-use Data Files

12.2.0.1
Non-CDB
Primary

```
SQL> select name from v$datafile where con_id=3;

NAME
--------------------------------------------------------------------------------
+DATA/DB_BOSTON/DD934E8207292138E053E801000A8351/DATAFILE/system.269.1103046537
+DATA/DB_BOSTON/DD934E8207292138E053E801000A8351/DATAFILE/sysaux.270.1103046537
+DATA/DB_BOSTON/DD934E8207292138E053E801000A8351/DATAFILE/users.273.1103046827
```

12.2.0.1
Non-CDB
Standby

```
SQL> select name from v$datafile where con_id=3;

NAME
--------------------------------------------------------------------------------
+DATA/DB_FRA27D/DD934E8207292138E053E801000A8351/DATAFILE/system.265.1103050007
+DATA/DB_FRA27D/DD934E8207292138E053E801000A8351/DATAFILE/sysaux.266.1103050007
+DATA/DB_FRA27D/DD934E8207292138E053E801000A8351/DATAFILE/users.269.1103050009
```


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Data Guard | Re-use Data Files

12.2.0.1
Non-CDB
Primary

12.2.0.1
Non-CDB
Standby

The manifest file contains

- File path on primary database only
- Not standby database

```
SQL> alter pluggable database PDB1 unplug into '/tmp/manifest_PDB1.xml';
```

```
<?xml version="1.0" encoding="UTF-8"?>
<PDB>
  <xmlversion>1</xmlversion>
  <pdbname>PDB1</pdbname>
  ...
  <guid>DDB49CFEFD8ED4FCE053E801000A078C</guid>
  ...
  <tablespace>
    <name>USERS</name>
    ...
    <file>

<path>+DATA/DB_BOSTON/DD934E8207292138E053E801000A8351/DATAFILE/users.273.1103046
827</path>
```


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Data Guard | Re-use Data Files

Target primary

19c CDB Primary

```
SQL> create pluggable database PDB1 using '/tmp/manifest_PDB1.xml' ... ;
```

- Manifest file lists the location of data files on primary
- No information about standby databases
- Standby database scans its own OMF directory for data files
- Standby ignores file names and look at file headers

19c CDB Standby

Target standby

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I'll just copy the file in ASM

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```
ASMCMD> cp users.269.1103050009
        +DATA/DB_FRA27D/.../users.273.1103046827

ASMCMD-8016: copy source '+DATA/DB_FRA27D/.../users.269.1103050009' and target
'+DATA/DB_FRA27D/.../users.273.1103046827' failed
ORA-15056: additional error message
ORA-15046: ASM file name 'users.273.1103046827' is not in single-file creation form
ORA-06512: at "SYS.X$DBMS_DISKGROUP", line 617
ORA-06512: at line 3 (DBD ERROR: OCIStmtExecute)
```


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Only a database can produce files with ASM/OMF data file names

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Data Guard | Re-use Data Files

19c
CDB
Primary

19c
CDB
Standby

ASM alias to the rescue!

- On standby, create aliases for the primary data files

```
ASMCMD> alter diskgroup data add alias '...' for '...' ;
```

- Plug in PDB, standby will find aliases and find the real file locations
  From alert log

```
Recovery scanning directory +DATA/DB_BOSTON/... for any matching files
Deleted Oracle managed file +DATA/DB_BOSTON/...
Successfully added datafile 37 to media recovery
Datafile #37: +DATA/DB_FRA27D/.../DATAFILE/users.269.1103050009'
```


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Move data files into proper OMF location using online data file move

- Remove aliases when no longer needed

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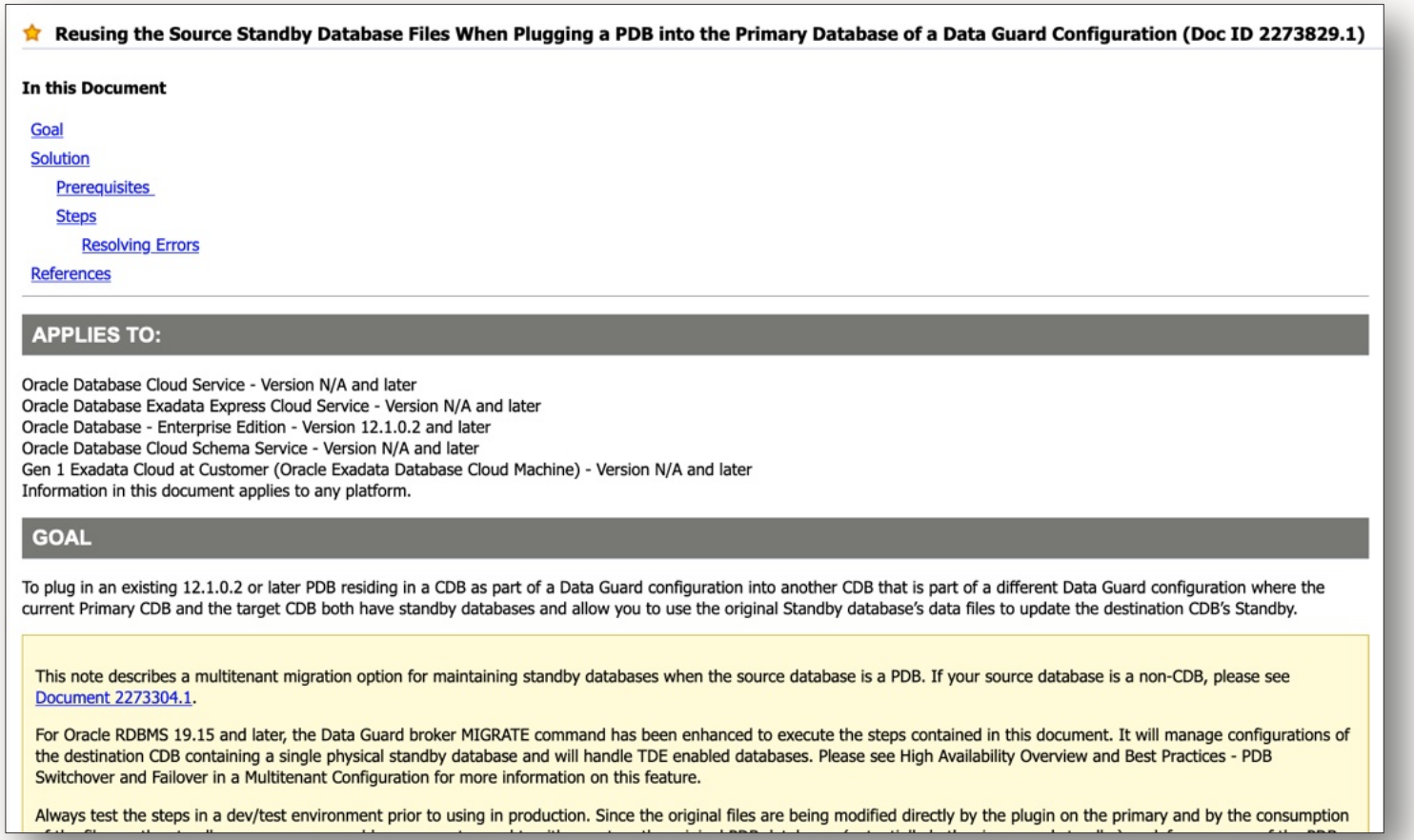
Data Guard | STANDBYS=ALL

Reusing the Source Standby Database Files When Plugging a PDB into the Primary Database of a Data Guard Configuration (Doc ID 2273829.1)



Reusing the Source Standby Database Files When Plugging a PDB into the Primary Database of a Data Guard Configuration (Doc ID 2273829.1)

In this Document

Goal
Solution
Prerequisites
Steps
Resolving Errors
References

APPLIES TO:

Oracle Database Cloud Service - Version N/A and later
Oracle Database Exadata Express Cloud Service - Version N/A and later
Oracle Database - Enterprise Edition - Version 12.1.0.2 and later
Oracle Database Cloud Schema Service - Version N/A and later
Gen 1 Exadata Cloud at Customer (Oracle Exadata Database Cloud Machine) - Version N/A and later
Information in this document applies to any platform.

GOAL

To plug in an existing 12.1.0.2 or later PDB residing in a CDB as part of a Data Guard configuration into another CDB that is part of a different Data Guard configuration where the current Primary CDB and the target CDB both have standby databases and allow you to use the original Standby database's data files to update the destination CDB's Standby.

This note describes a multitenant migration option for maintaining standby databases when the source database is a PDB. If your source database is a non-CDB, please see Document 2273304.1.

For Oracle RDBMS 19.15 and later, the Data Guard broker MIGRATE command has been enhanced to execute the steps contained in this document. It will manage configurations of the destination CDB containing a single physical standby database and will handle TDE enabled databases. Please see High Availability Overview and Best Practices - PDB Switchover and Failover in a Multitenant Configuration for more information on this feature.

Always test the steps in a dev/test environment prior to using in production. Since the original files are being modified directly by the plugin on the primary and by the consumption

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Data Guard | Additional Information

Data Guard Impact on Oracle Multitenant Environments (Doc ID 2049127.1)

The physical standby database and redo apply will normally expect a new PDB's datafiles to have been pre-copied to the standby site and be in such a state that redo received from the primary database can be immediately applied. The standby database ignores any file name conversion specification on the CREATE PLUGGABLE DATABASE statement and relies solely on the standby database's initialization parameter settings for DB_CREATE_FILE_DEST and DB_FILE_NAME_CONVERT for locations and file naming.

For these cases, Oracle recommends deferring recovery of the PDB using the STANDBYS=NONE clause on the CREATE PLUGGABLE DATABASE statement. Recovery of the PDB can be enabled at some point in the future once the PDB's data files have been copied from the primary database to the standby database in a manner similar to that documented in Document 1916648.1.

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Confused? We explain all the details in our AutoUpgrade 2.0 webinar

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Don't jeopardize your Data Guard

- Test the procedure and verify your environment

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```
--Default value is for CDBs with many PDBs
--Other places, it leads to concurrency issues
--Reset back to 12.1 default as described in MOS 2431353.1

alter system set "_cursor_obsolete_threshold"=1024;
```


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```
--Database collects SQL Plan Directives even when adaptive
--statistics are off.
--If you do not use Adaptive Statistics (optimizer_adaptive_statistics)
--then turn it completely off as described in MOS 2209560.1

alter system set "_sql_plan_directive_mgmt_control"=0;
```


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```
--Database collects expression statistics for SQL Plan Directives,
--Auto-Indexing and In-Memory.
--If you don't use any of these, then turn it to the 11.2 value of "1".
--Tables being used in dictionary: EXP_HEAD$, EXP_OBJ$, EXP_STAT$
--Value of "0" fully disables tracking.

alter system set "_column_tracking_level"=1;
```


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We need real-world experience with 23c

- We are looking for reference customers

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You can also migrate with Data Pump or Transportable Tablespaces

- Suitable when direct upgrade is not possible
- Smaller databases
- Reorganizing data

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The Data Pump LOB Mystery

And how to solve it

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A short history of **binary data types**

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v4	LONG and LONG RAW
8.0	CLOB and BLOB
11g	SecureFile LOBs

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v4	LONG and LONG RAW
8.0	BasicFile LOBs
11g	SecureFile LOBs

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v4

LONG and LONG RAW

- Only 1 column per table
- Max size: 2GB - 1

8.0

BasicFile LOBs

- Performance constraints
- No Parallel DML allowed
- Max size: (4GB - 1) * DB_BLOCK_SIZE

11g

SecureFile LOBs

- Improved performance
- Data Pump can use multiple workers or Parallel Query
- Deduplication, encryption and more
- Max size: same as with CLOB/BLOB

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As of today, all legacy binary data types should have been migrated to SecureFile LOBs

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```
--Always convert LOBs to SecureFile on import
--Imports into SecureFile is always the fastest approach
--For further info, see Doc ID 490228.1

impdp ... transform=lob_storage:securefile
```


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Different LOB types

Internal LOBs stored inside the database

- `CLOB`
- `NCLOB`
- `BLOB`

External LOBs stored outside the database

- `BFILE`

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Initialization Parameter

DB_SECUREFILE

- NEVER
- PERMITTED
- PREFERRED
- ALWAYS
- IGNORE

LOBs are created as SecureFile LOBs unless explicitly stated

Tablespace must use Automatic Segment Space Management (ASSM)

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Data Pump & LOBs

Things to know and consider

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No parallelism with BasicFile LOBs

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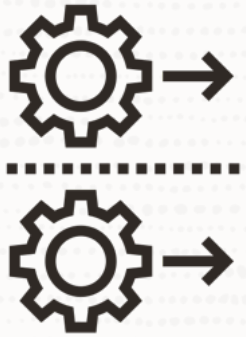

Always use SecureFile LOBs

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*But why is there only **one worker**?*

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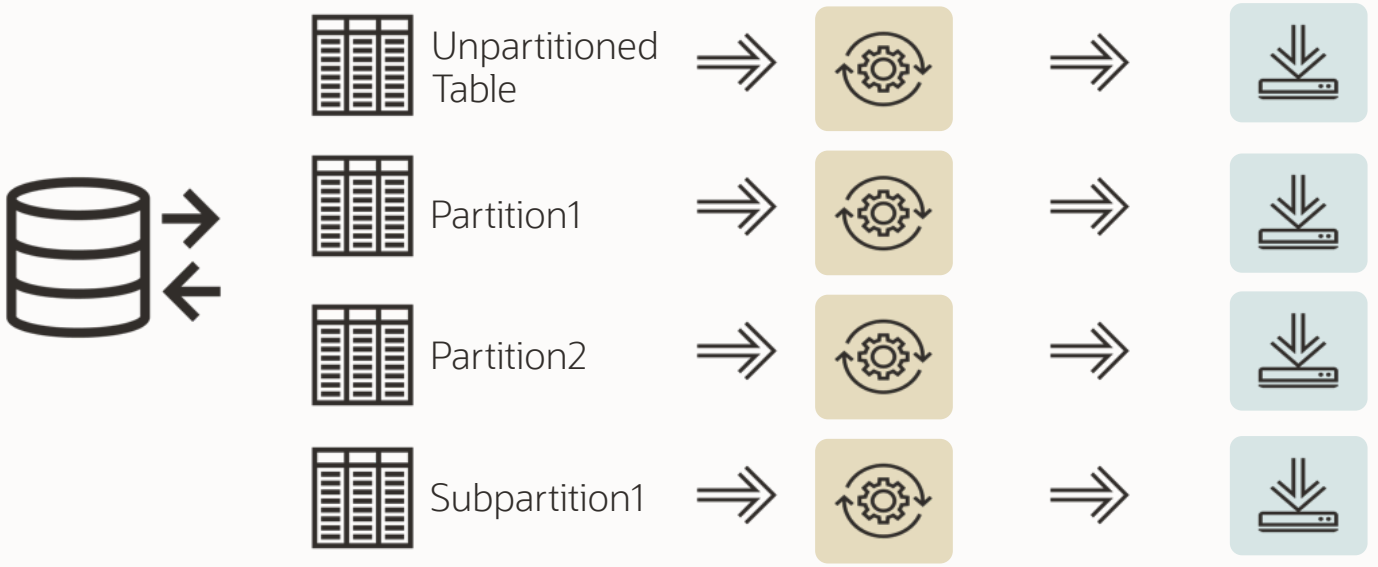
Data Pump | Parallel Worker Activity

Data Pump employs one worker per table data object



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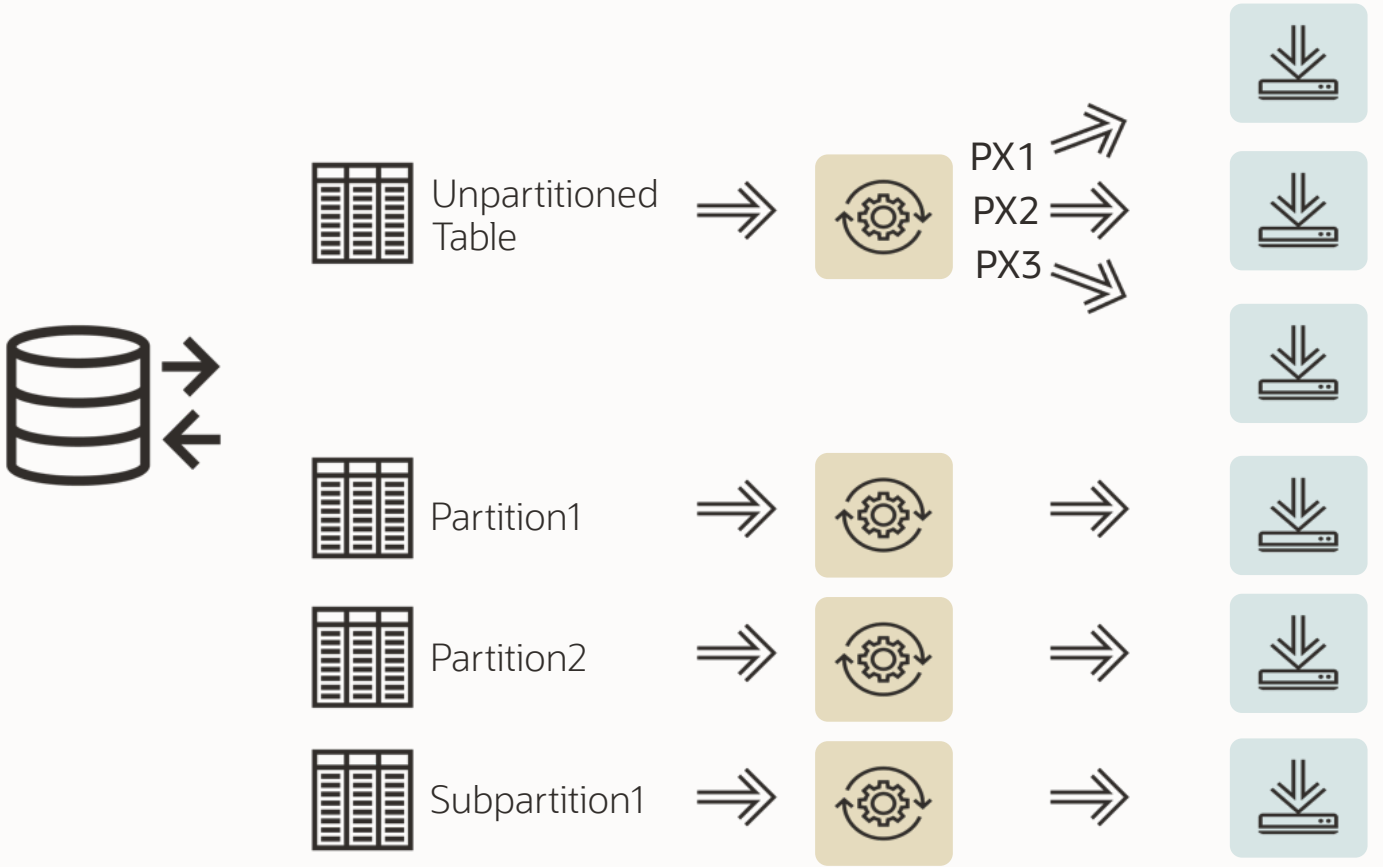
Data Pump | Worker as PQ Coordinator

If a table data object is >250MB, Data Pump can invoke parallel query



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LOB Export | Example Table

```
CREATE OR REPLACE DIRECTORY BLOB_DIR AS '/tmp/mydir';
```

```
CREATE TABLE tab1 ( id NUMBER, blob_data BLOB )
  LOB (blob_data) store as securefile;
```

```
BEGIN ... DBMS_LOB.LOADBLOBFROMFILE ...
```

```
exec DBMS_STATS.GATHER_TABLE_STATS('HUGO','TAB1');
```

For a complete example, please visit oracle-base.com

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LOB data is stored out-of-row in a separate LOB segment

- Smaller LOBs less than 4000 byte store in-row
- Oracle Database 23c holds 8000 bytes in-row

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Starting Data Pump – Test:

```
DIRECTORY=DATA_PUMP_DIR
DUMPFILE=MYDUMP%L.DMP
LOGFILE=MYDUMP01.LOG
SCHEMAS=HUGO
LOGTIME=ALL
METRICS=YES
PARALLEL=8
```


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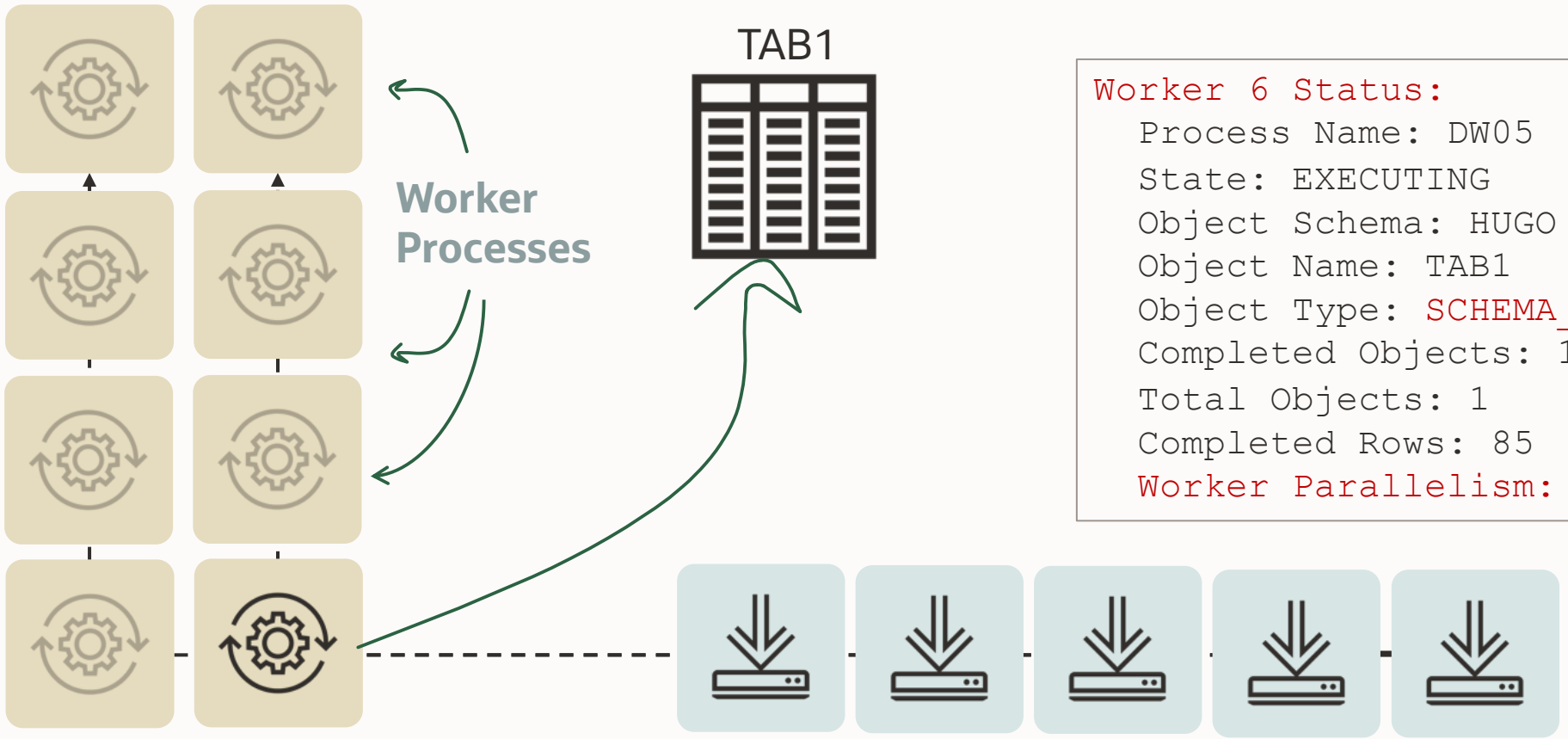
LOB Export | Lazy Workers?

8 workers, 5 dump files – and only 1 worker exports TAB1




```
Worker 6 Status:
  Process Name: DW05
  State: EXECUTING
  Object Schema: HUGO
  Object Name: TAB1
  Object Type: SCHEMA_EXPORT/...
  Completed Objects: 1
  Total Objects: 1
  Completed Rows: 85
  Worker Parallelism: 1
```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Maybe the table's PARALLEL DEGREE is too low?

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LOB Export | Parallel Degree

TAB1

```
ALTER TABLE tab1 PARALLEL 8;
```

TAB1

```
select degree
from DBA_TABLES
where table_name='TAB1';

 DEGREE
_______________
          1
```

```
select degree
from DBA_TABLES
where table_name='TAB1';

 DEGREE
_______________
          8
```


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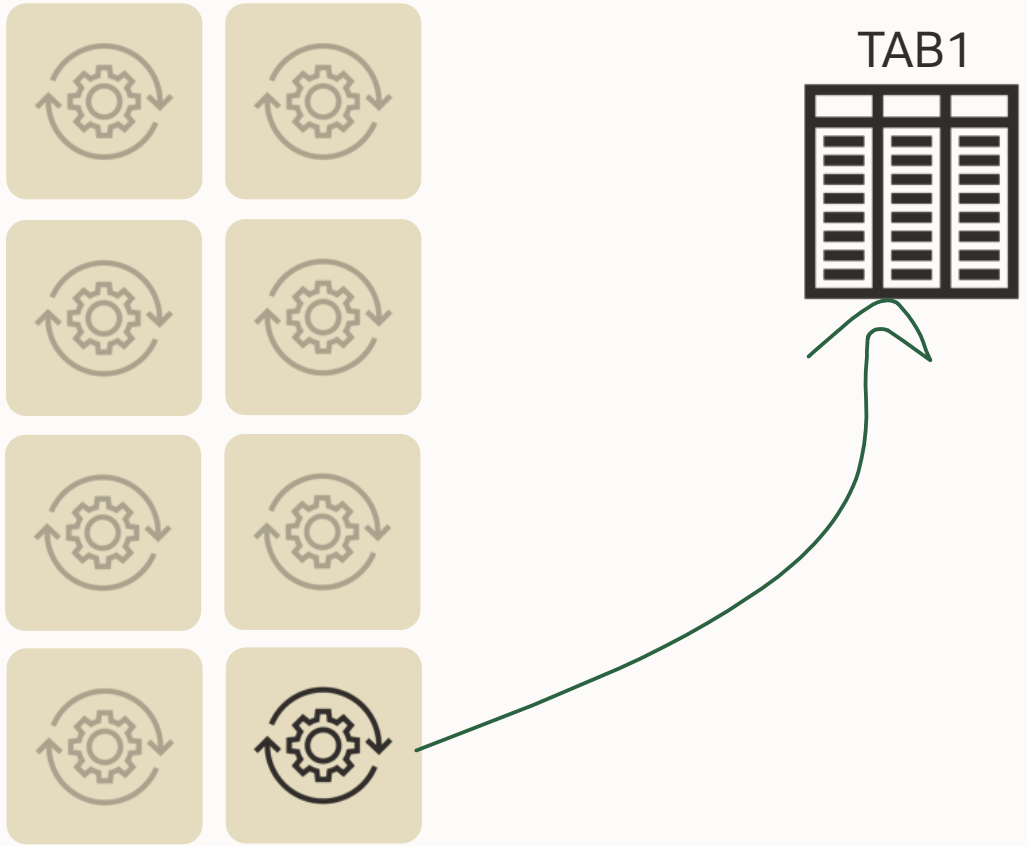
LOB Export | Parallel Degree

8 workers, 5 dump files – and only 1 worker exports TAB1




```
Worker 1 Status:
  Process Name: DW08
  State: EXECUTING
  Object Schema: HUGO
  Object Name: TAB1
  Object Type: SCHEMA_EXPORT/...
  Completed Objects: 1
  Total Objects: 1
  Completed Rows: 85
  Worker Parallelism: 1
```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LOB Export | Table Segments and Extents

TAB1

Segments

Extents

```
select BYTES, BLOCKS, EXTENTS
from   DBA_SEGMENTS
where  SEGMENT_NAME = 'TAB1'
and    OWNER = 'HUGO';
```

BYTES	BLOCKS	EXTENTS
131072	16	2

```
select ROUND(SUM(BYTES)/1024/1024/1024,2) "GB"
from   DBA_EXTENTS
where  SEGMENT_NAME IN
           (select SEGMENT_NAME
            from   DBA_LOBS
            where  TABLE_NAME = 'TAB1'
            and    OWNER = 'HUGO');
```

GB
10.31

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LOB Export | Table Statistics

TAB1

Table

Columns

```
select NUM_ROWS, BLOCKS, AVG_ROW_LEN
from   DBA_TAB_STATISTICS
where  TABLE_NAME = 'TAB1';
```

NUM_ROWS	BLOCKS	AVG_ROW_LEN
85	13	720

```
select COLUMN_NAME, NUM_DISTINCT,
       SAMPLE_SIZE, AVG_COL_LEN
from   DBA_TAB_COL_STATISTICS
where  TABLE_NAME='TAB1';
```

COLUMN_N	NUM_DIST	SAMPLE_SIZE	AVG_COL_LEN
ID	1	85	3
BLOB_DATA	0	85	717

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It looks like as if Data Pump does not know anything about the dimensions of the LOB segment

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LOB Export | User Objects

```
select OBJECT_NAME, OBJECT_TYPE from DBA_OBJECTS
where OWNER = 'HUGO';

                    OBJECT_NAME     OBJECT_TYPE
_____________________________________ ___________________
TAB1                                  TABLE
SYS_IL0000070285C00002$$              INDEX
SYS_LOB0000070285C00002$$             LOB
```


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Is it possible to *analyze* the LOB segment?

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This is not possible.
So what's next?

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LOB Export | Manipulating Statistics

```
begin
 DBMS_STATS.SET_TABLE_STATS (
    ownname => 'HUGO',
    tabname => 'TAB1',
    numrows => 10000000,
    numblks => 1000000,
    avgrlen => 11460);
 end;
 /
```


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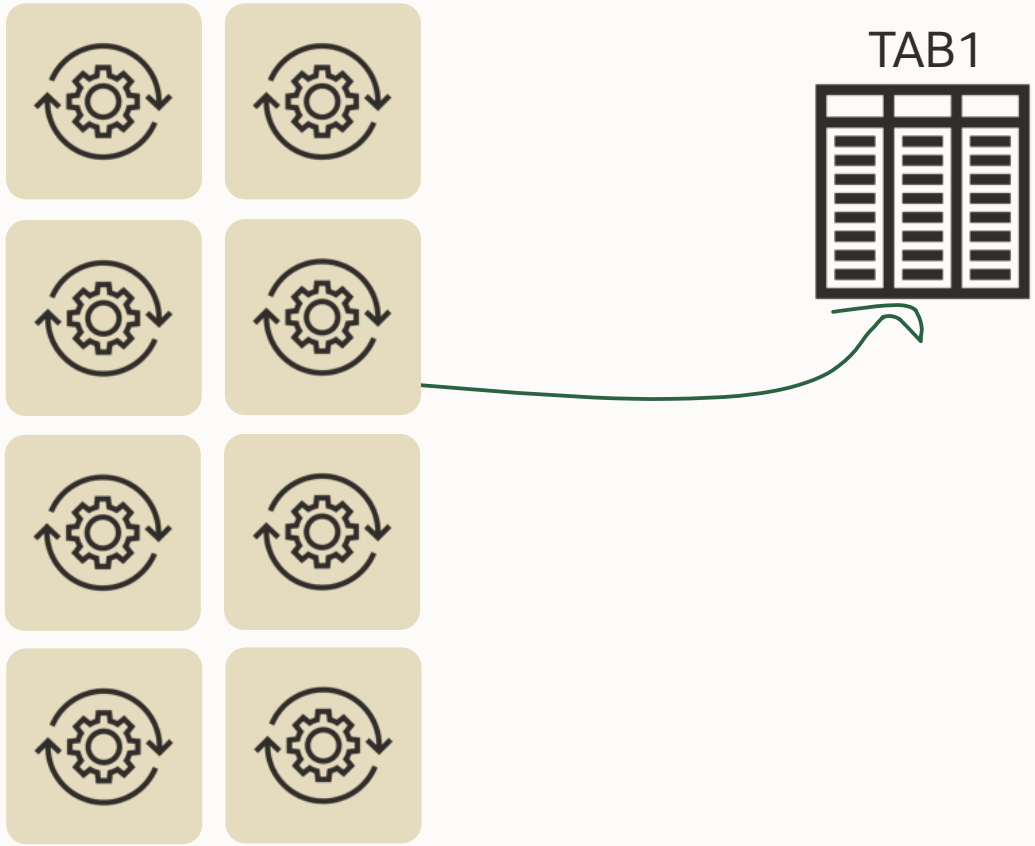
LOB Export | Parallel Degree

Relief! Workers do PQ now!




```
Worker 2 Status:
  Process Name: DW01
  State: EXECUTING
  Object Schema: HUGO
  Object Name: TAB1
  Object Type: SCHEMA_EXPORT/...
  Completed Objects: 1
  Total Objects: 1
  Completed Rows: 85
  Worker Parallelism: 7
```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How about another approach …

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LOB Export | ESTIMATE=BLOCKS

```
expdp hugo/oracle ESTIMATE=BLOCKS…

12-SEP-23 15:50:30.288: W-7 Startup took 0 seconds
12-SEP-23 15:50:31.409: W-1 Processing object type SCHEMA_EXPORT/TABLE/TABLE_DATA
12-SEP-23 15:50:31.735: W-1 .  estimated "HUGO"."TAB1”            10.24 GB
12-SEP-23 15:50:31.735: W-1 .  estimated "HUGO"."T1”                11 MB
12-SEP-23 15:50:31.735: W-1 .  estimated "HUGO"."T4"                 7 MB
12-SEP-23 15:50:31.735: W-1 .  estimated "HUGO"."T2"                 4 MB
12-SEP-23 15:50:31.735: W-1 .  estimated "HUGO"."T5"               256 KB
12-SEP-23 15:50:31.735: W-1 .  estimated "HUGO"."T3”                64 KB
.
.
.
```

Tech Tip: Make sure you are on 19.18 or later with the Data Pump Bundle Patch installed!

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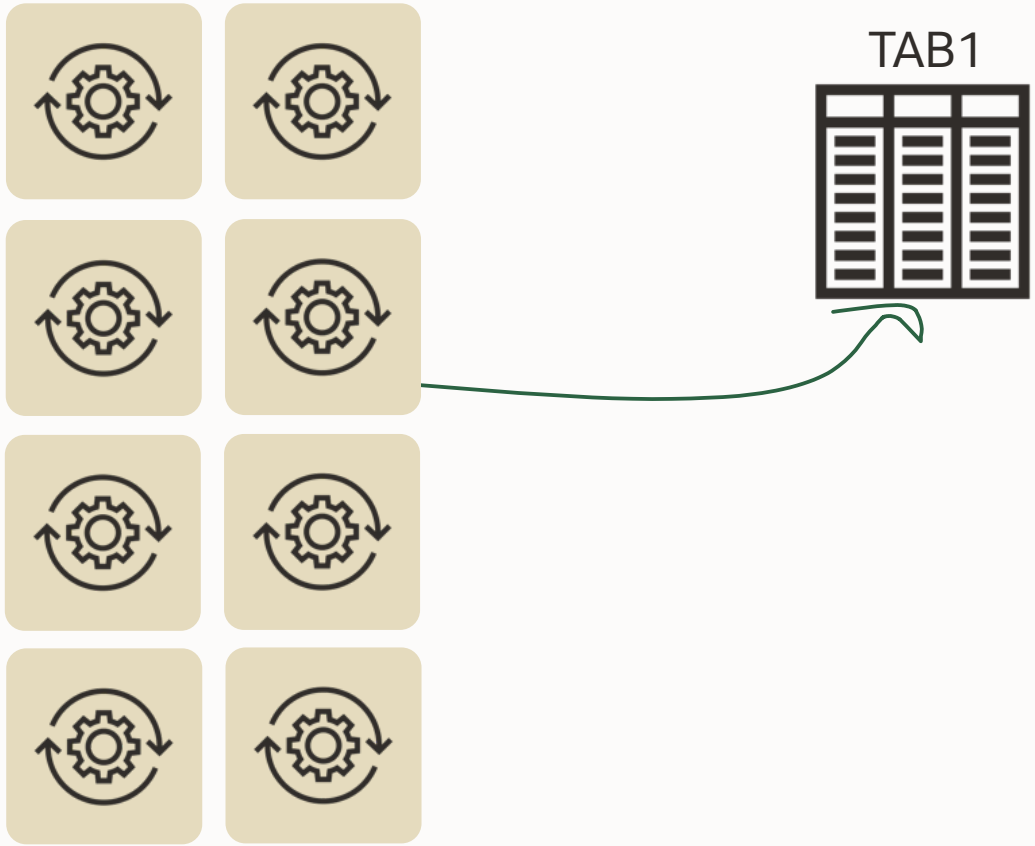
LOB Export | ESTIMATE=BLOCKS

Relief again! Workers do PQ now, too!




```
Worker 2 Status:
  Process Name: DW01
  State: EXECUTING
  Object Schema: HUGO
  Object Name: TAB1
  Object Type: SCHEMA_EXPORT/...
  Completed Objects: 1
  Total Objects: 1
  Completed Rows: 85
  Worker Parallelism: 7
```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How do we get more workers to export data?

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Boost parallelism by using partitioned tables

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LOB Export | Which Approach is Better?

Faking Statistics

- Must be done for each table
- Requires testing to get best result
- Could be overwritten by stats gathering

ESTIMATE=BLOCKS

- Just one parameter for the whole export
- Estimate phase adds time to export
- Requires patch applied in 19c

We are working on an approach that combines the best of both. Stay tuned to the upgrade blog!

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"And BFILE LOBs?"

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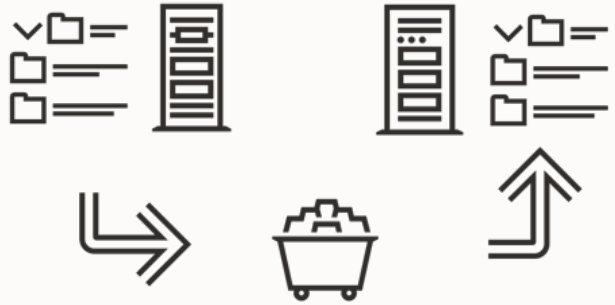
BFILE LOBs

External LOBs stored outside the database

Full export:
- Directory definition gets exported/imported
- You must copy the files

Schema export:
- You must create the directory within the database
- You must copy the files

Table export:
- You must create the directory within the database
- You must copy the files



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Save downtime by copying the external files in advance

- `BFILES` are always read-only

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If the directory path changes, ensure to update the **`DIRECTORY`** object

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LOB Export | What if you still have BasicFiles LOBs?

Option 1

- Convert to SecureFile LOBs during impdp
  - `TRANSFORM=LOB_STORAGE:SECUREFILE`
  - `DB_SECUREFILE=ALWAYS`

Option 2

- Multiple Data Pump jobs in parallel exporting subsets of rows
  - `expdp parallel=1 table=1 query=”where <subset 1>”`
    `expdp parallel=1 table=1 query=”where <subset 2>”`
    `expdp parallel=1 table=1 query=”where <subset 3>”`
    `expdp parallel=1 table=1 query=”where <subset 4>”`

Pro Tip: More details in this blog post

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Apply the Data Pump Bundle Patch

- MOS Note: 2819284.1

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Fewer Bugs

Important patches are included.
Monitor for bugs that affects many customers.

Faster Patching

The bundle patch changes the way Data Pump is patched. Subsequent patches apply faster.

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Speeds up future patching significantly

- Can be applied online
- For RAC Rolling you must ensure to have no active Data Pump jobs

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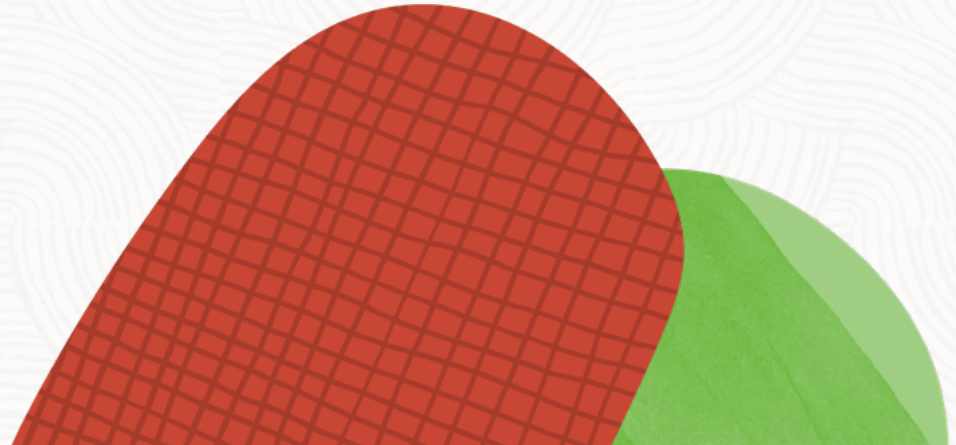
Cloud Migration Advisor

Your ultimate migration guidance tool, not only for cloud migrations



Migration Challenges

How do you easily migrate hundreds and
thousands of databases, to the cloud, to ADB or on-prem?

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36 migration methods.

Which one is the **best**?

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Roy Swonger

Daniel Overby Hansen

>100 years of database upgrade and migration experience

Combined in one single tool

CMA

Cloud Migration Advisor

Rodrigo Jorge

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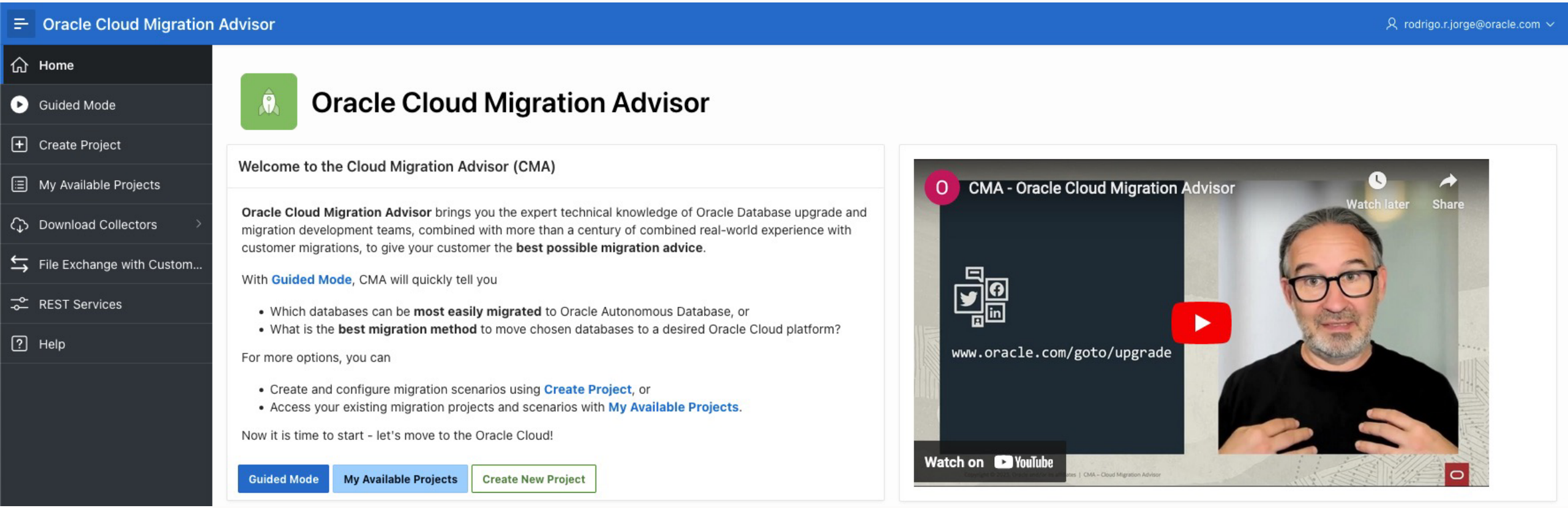
Cloud Migration Advisor



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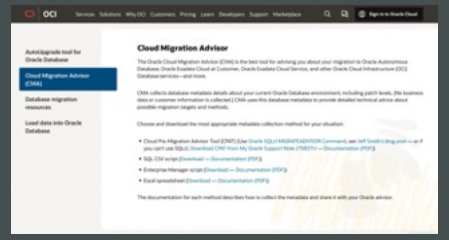
Step 1

Customer collects estate information

Cloud Migration Advisor

https://www.oracle.com/goto/upgrade



Customer Fleet

Download Extractor

- **CPAT**
- SQL Extractor
- **OEM Extractor**
- Excel sheet

Collect Information

Secure Upload to Oracle

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Start here:

www.oracle.com/goto/upgrade

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Step 2

Load estate information into CMA

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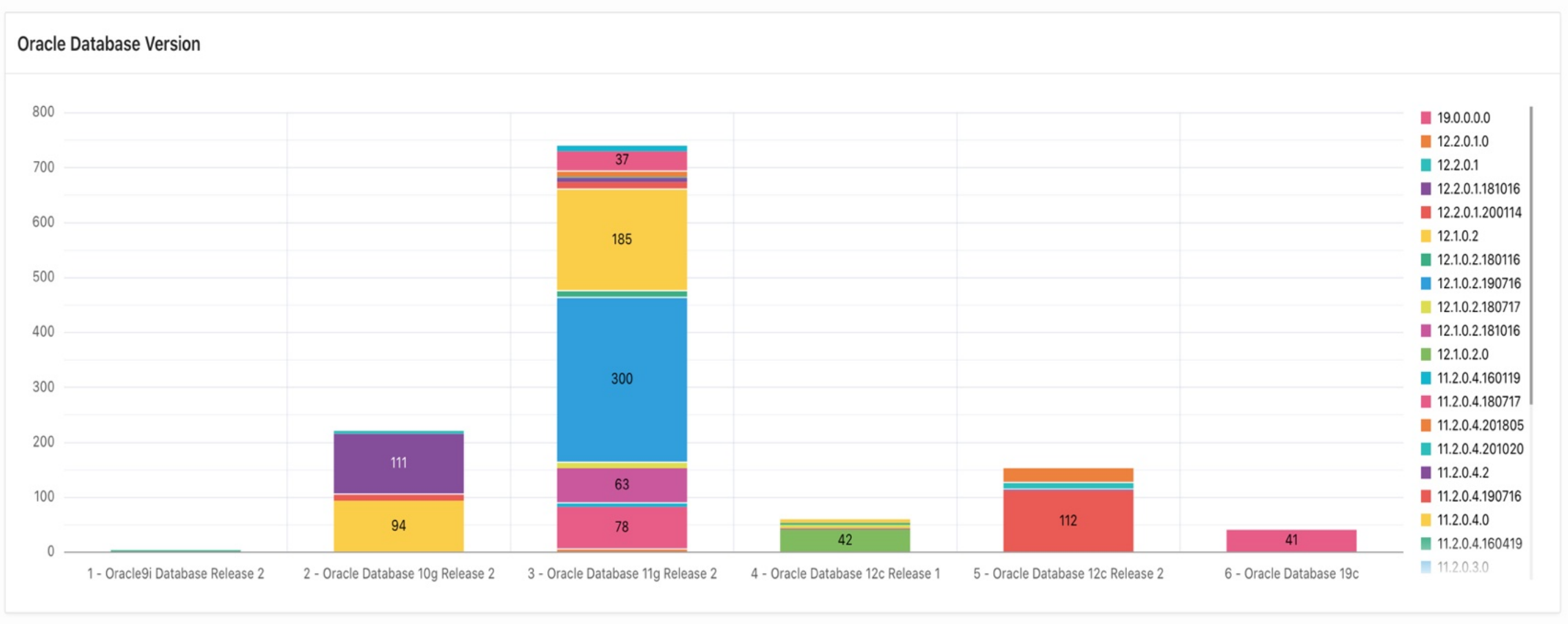
Cloud Migration Advisor

Landscape Overview



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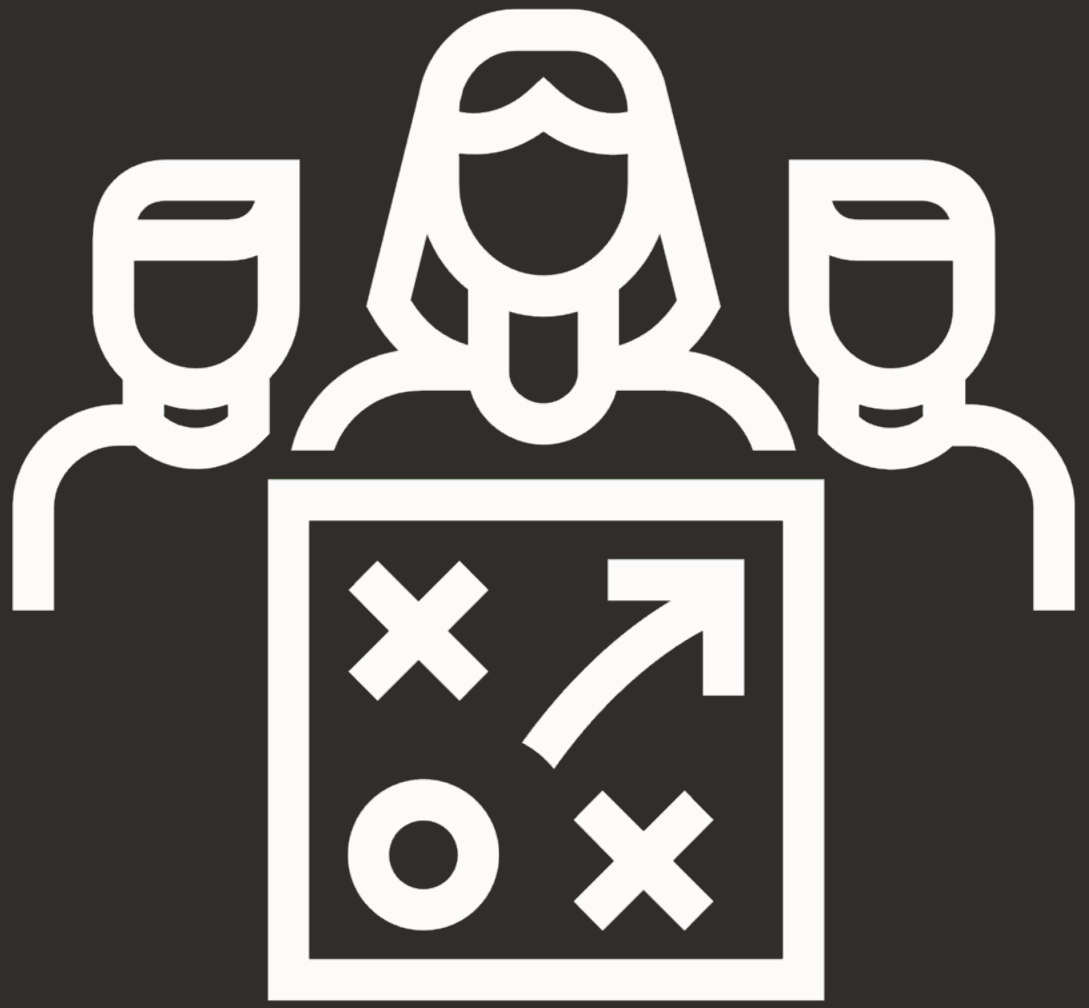
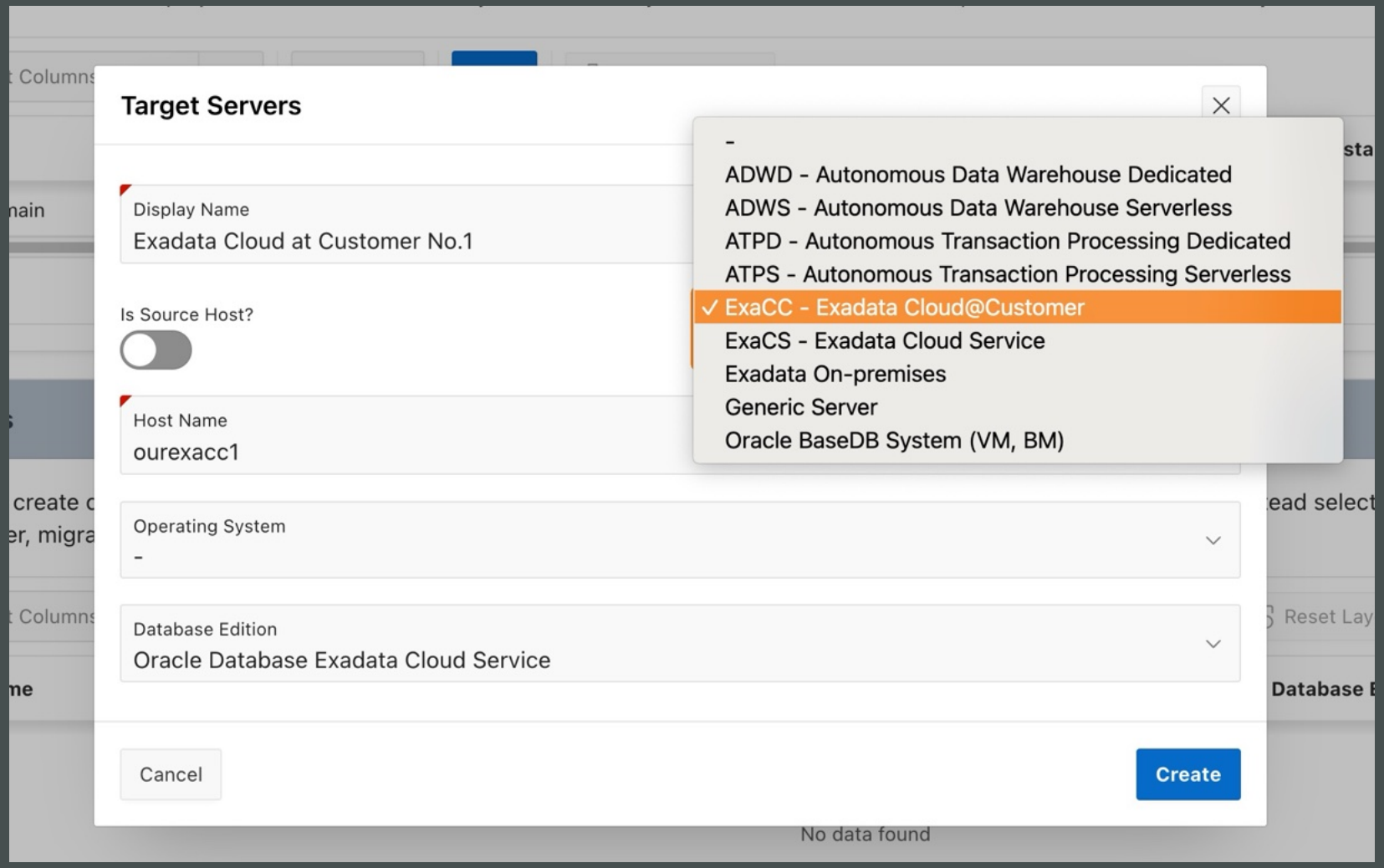


Step 3

Add additional information and constraints

Cloud Migration Advisor | Add New Target Server



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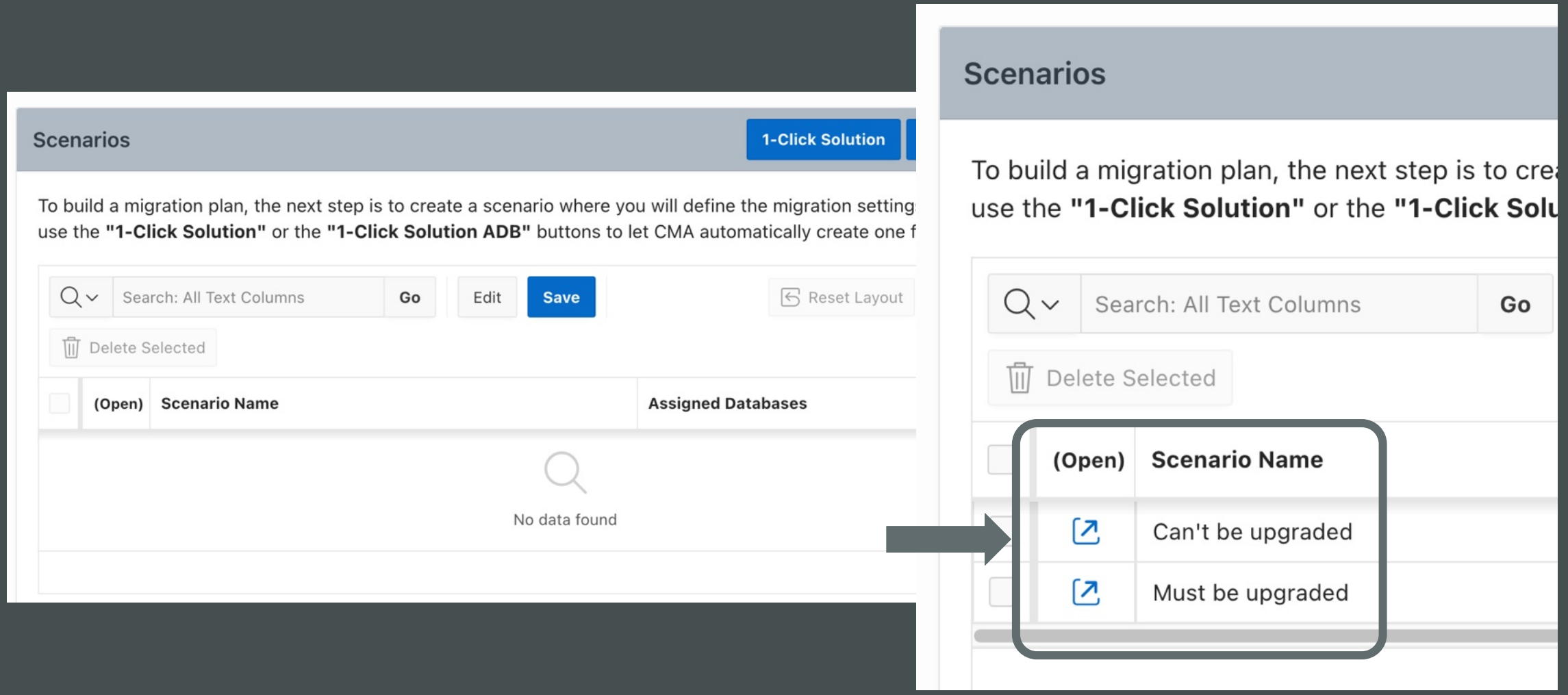
Step 4

Group the databases into scenarios and customize methods

Cloud Migration Advisor | Scenarios



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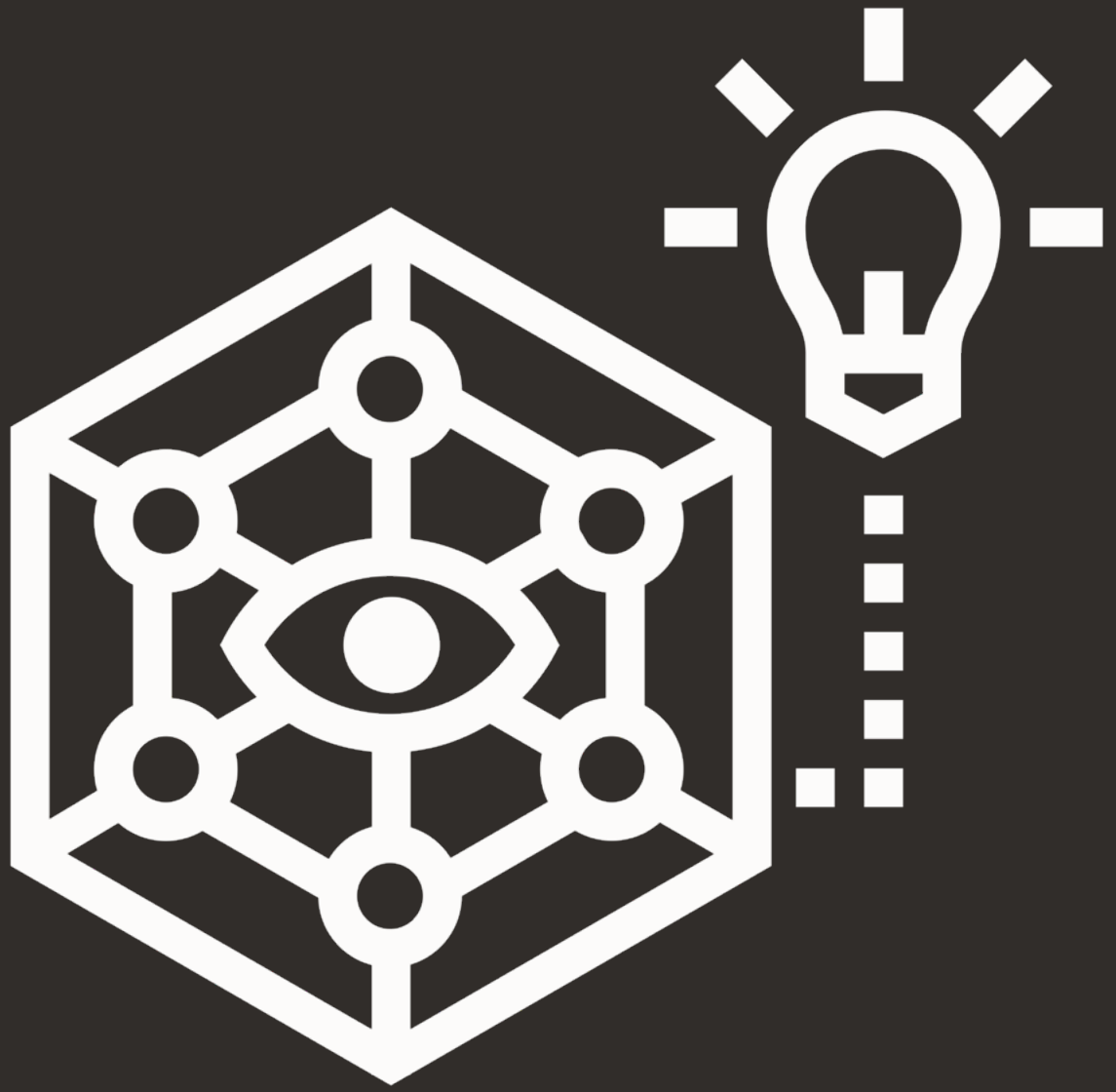
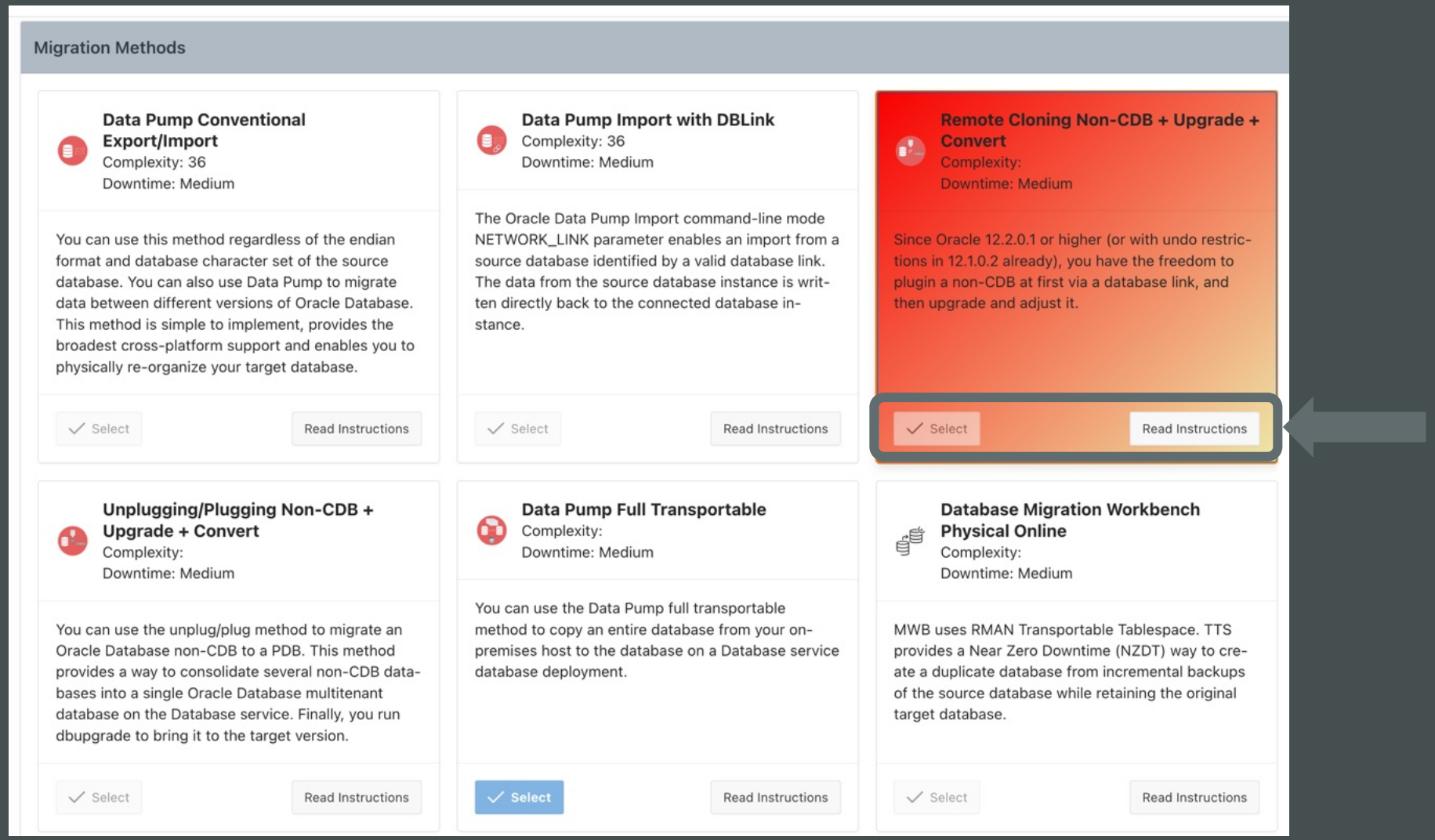


Step 5

Create solution

Cloud Migration Advisor | Solution - Methods



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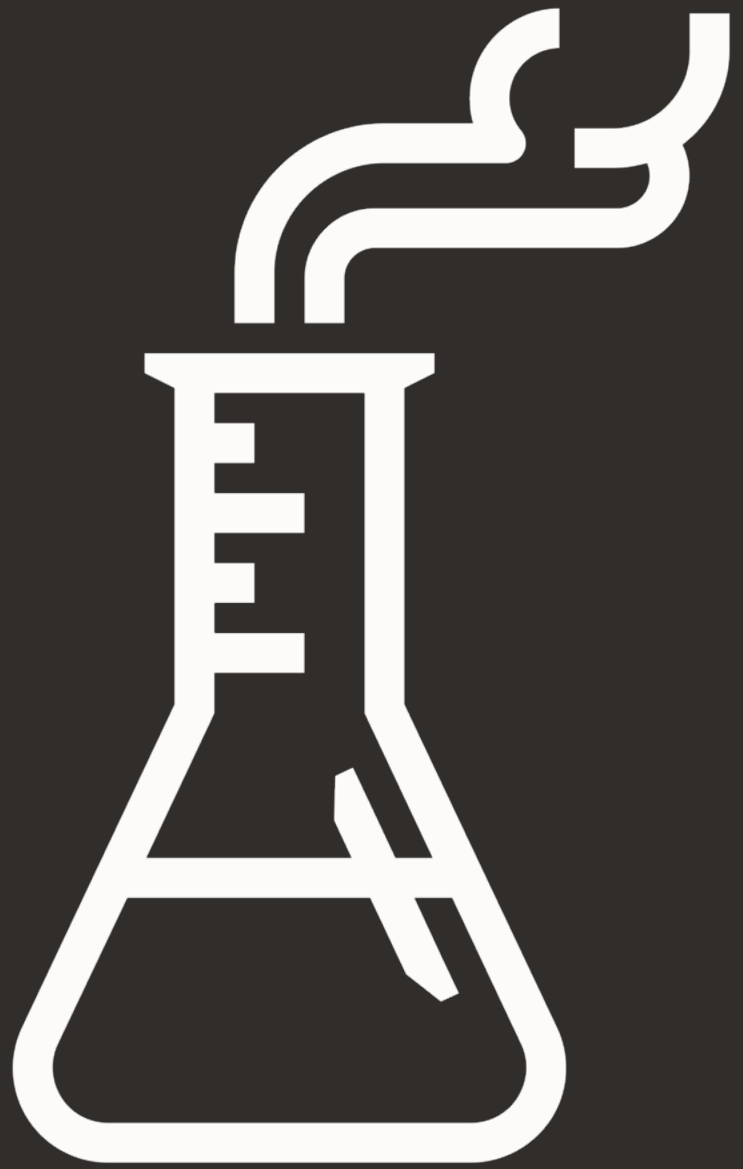

What else?

Important Features

Cloud Migration Advisor | Features

- Obfuscate hostnames and database names
- Configure individual weight and scoring
- Automatic purge
- Strict user isolation

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Cloud Migration Advisor | How to get it?

Downloadable version

- Vagrant Build for a Virtual Box image
- ZIP File for simple deployment in AlwaysFree Autonomous DB

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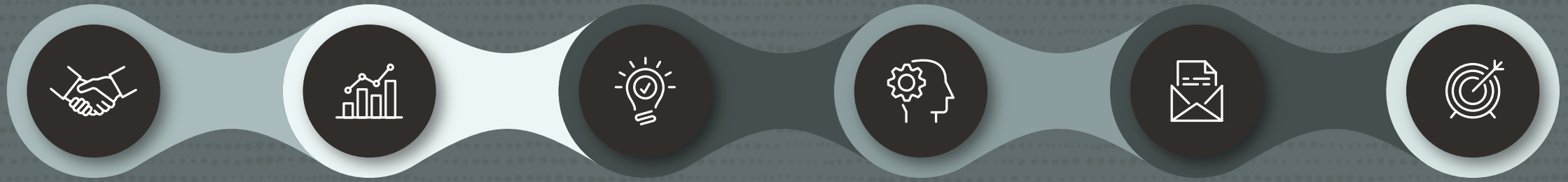
CMA | Workflow



Create Project

Extract & Load

Update Data

Define Scenario

Select Target

Solution & Success

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Lunch Break

We start again at 13:30

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AGENDA

09:30
Welcome
Release Strategy
Patching

11:00
Coffee break

11:15
Upgrade
Data Pump
Cloud Migration Advisor

12:45
Lunch

13:30
Performance Stability
Insights into
development

15:00
Coffee break

15:15
Oracle Database 23c
What's New
What's Coming

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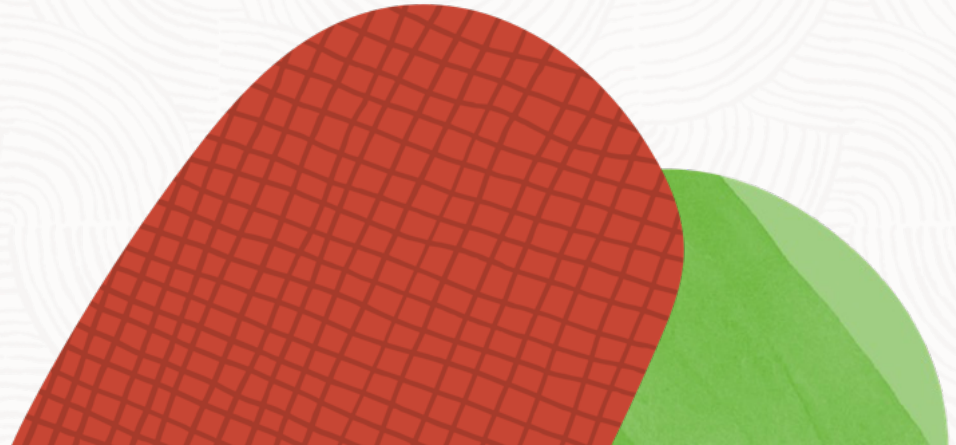
Performance Stability Prescription



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Performance Stability Prescription

Photo by Urip Dunker on Unsplash

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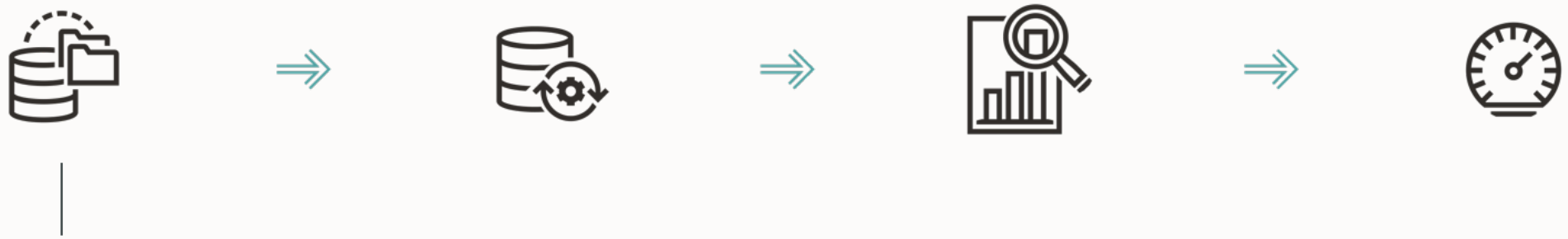
Performance Stability Prescription



Collect workload information

- Sample from cursor cache
- Gather from AWR

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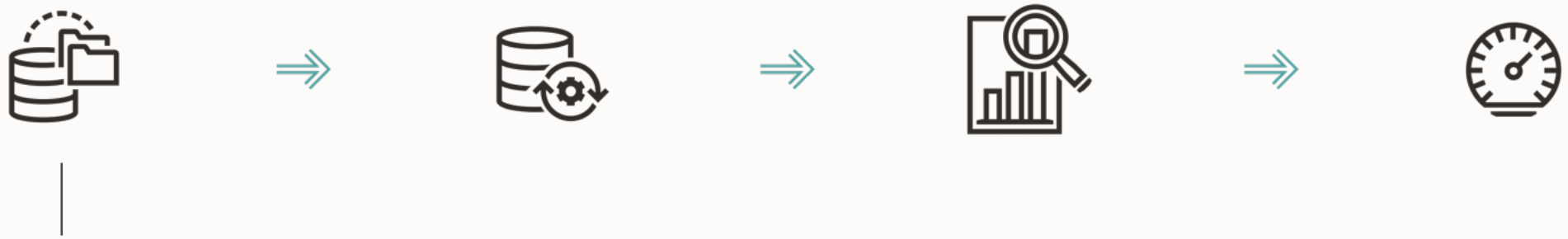
Performance Stability Prescription



```
SQL> --Load statements from cursor cache
SQL> exec dbms_sqlset.capture_cursor_cache_sqlset( ...
SQL>
SQL> --Load statements from AWR
SQL> open ... table(dbms_sqltune.select_workload_repository) ..
SQL> dbms_sqlset.load_sqlset(...', cur);
```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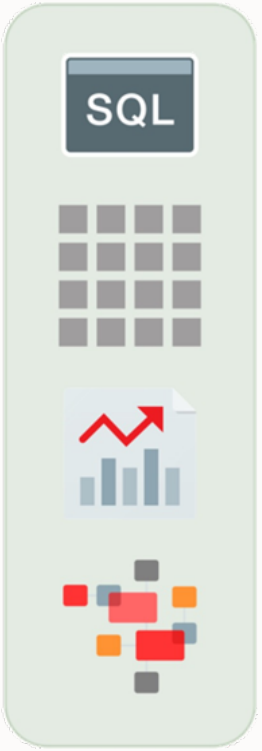
SQL Tuning Set | Definition

SQL statement

Context

Statistics

Plans



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Gather at least a full month of workload data

- Assist in testing your database
- Useful in solving post-upgrade performance problems

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Workload Information

AWR – Automatic Workload Repository

Change the retention to a minimum of 40 days

```
exec dbms_workload_repository.modify_snapshot_settings(
        retention=>57600,
        interval=>30);
```

Collect SQL statements and plans

Use AWR as main source

Capture from Cursor Cache for OLTP

Collect statements, plans and stats in SQL Tuning Sets

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Performance Stability Prescription

Upgrade test database

Load workload data
(SQL Tuning Set)

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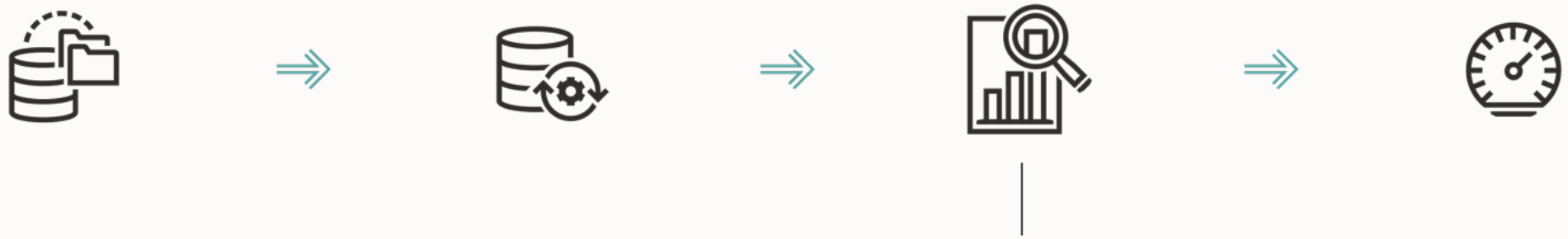
Performance Stability Prescription



AWR Diff Report

SQL Performance Analyzer tests your workload

Report with all regressing statements

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AWR | Diff Report

Use script `awrddrpt.sql`

Top Timed Events

- Events with a "-" did not make the Top list in this set of snapshots, but are displayed for comparison purposes

1st						2nd					
Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time	Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time
CPU time			68,289.05		43.73	db file sequential read	User I/O	22,193,998	114,919.21	5.18	23.17
db file sequential read	User I/O	6,686,953	37,737.81	5.64	24.17	enq: SS - contention	Configuration	3,913	98,997.90	25,299.74	19.96
gc buffer busy	Cluster	12,508,244	23,886.55	1.91	15.30	CPU time			73,786.55		14.88
TCP Socket (KGAS)	Network	680,629	12,514.65	18.39	8.01	row cache lock	Concurrency	73,940	48,472.30	655.56	9.77
db file scattered read	User I/O	1,572,296	4,271.68	2.72	2.74	reliable message	Other	41,148	47,600.87	1,156.82	9.60

Requires Enterprise Edition + Diagnostic pack

Pro tip: For migrations, you can transport AWR data

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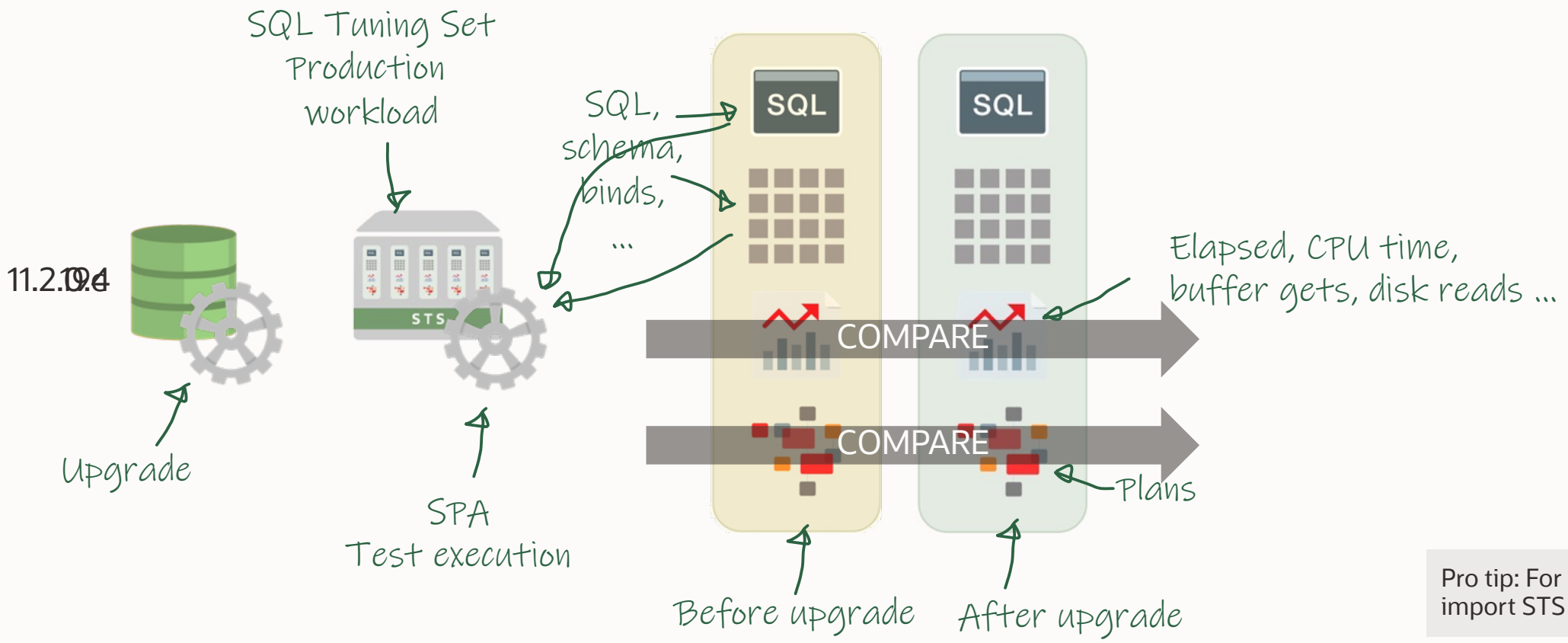
SQL Performance Analyzer | Concept



Pro tip: For migrations,
import STS into target database

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SQL Performance Analyzer | Report

Top 21 SQL Sorted by Absolute Value of Change Impact on the Workload

object_id	sql_id	Impact on Workload	Execution Frequency	Metric Before	Metric After	Impact on SQL	Plan Change
52	csv0xdm9c394t	4.02%	3262	6149.0885959534	4208	31.57%	n
41	7m5h0wf6stq0q	2.79%	21694	692.311883470084	490	29.22%	y
34	4wg725nwpxb1z	2.3%	19715	692.202079634796	509	26.47%	y
40	7jyw5gy3d1t1b	-1.43%	31816	12.0617299471964	83	-588.13%	n
36	5ps73nuy5f2vj	1.06%	31819	61.1872151858952	9	85.29%	n
44	88fgqncchy6wg	-.41%	325424	6.00316202861498	8	-33.26%	n
57	g5u7xuchhfu62	.39%	32790	26.6833180847819	8	70.02%	n

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SQL Performance Analyzer | Report

Execution Plan Before Change:

Plan Hash Value : 3642382161

Id	Operation	Name	Rows	Bytes	Cost	Time
0	SELECT STATEMENT				245	
1	SORT AGGREGATE		1	24		
2	TABLE ACCESS BY INDEX ROWID	CUSTOMER	23	552	245	00:00:03
3	INDEX RANGE SCAN	CUSTOMER_I1	2888		10	00:00:01

Execution Plan After Change:

Plan Id : 138

Plan Hash Value : 1075826057

Id	Operation	Name	Rows	Bytes	Cost	Time
0	SELECT STATEMENT		1	24	245	00:00:01
1	SORT AGGREGATE		1	24		
* 2	TABLE ACCESS BY INDEX ROWID BATCHED	CUSTOMER	23	552	245	00:00:01
* 3	INDEX RANGE SCAN	CUSTOMER_I1	2888		10	00:00:01

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SQL Performance Analyzer | Report

Regressed SQL Statements

	SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
			SQL Trial 1	SQL Trial 2		
⇩	3fv28gfu9y0aq	-0.050	26,504	29,573	-11.580	Y
⇩	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

From production workload

From test execution

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SQL Performance Analyzer | Report

Regressed SQL Statements

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SQL Performance Analyzer | Report

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⇩	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

SQL Details: czzzubf8fjz96

Parsing Schema APPS Execution Frequency 3

▷ SQL Text

```
SELECT /* my_query_21 */ /*+ ORDERED INDEX(t1) USE_HASH(t1) */ 'B' || t2.take_02 take_02, 'B' || t2.take_15
take_15, 'B' || t2.take_08 take_08, 'r' || t3.record_nr price_eur_id,...
```

Single Execution Statistics

	Execution Statistic Name	Net Impact on Workload (%)	Execution Statistic Collected		Net Impact on SQL (%)
			SQL Trial 1	SQL Trial 2	
⇩	Elapsed Time (sec)	-0.240	0.112	0.164	-46.170
⇧	Parse Time (sec)	0.220	0.001	0.001	14.490
⇩	CPU Time (sec)	-0.030	0.108	0.114	-5.040
⇨	User I/O Time (sec)	0.000	0.000	0.000	0.000
⇩	Buffer Gets	-0.030	1,410	1,981	-40.500

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SQL Performance Analyzer | Report

Regressed SQL Statements

	SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
			SQL Trial 1	SQL Trial 2		
⇩	3fv28gfu9y0aq	-0.050	26,504	29,573	-11.580	Y
⇩	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

Plan Comparison

SQL_TRIAL_1353942463446

Plan Hash Value 1165613724

Expand All | Collapse All

Operation	Line ID	Object	Rows	Cost	Predicate
▽ SELECT STATEMENT	0		1	9,830	
▽ HASH GROUP BY	1		1	9,830	
▽ MERGE JOIN	2		1	9,829	
▽ SORT JOIN	3		8	9,795	
▽ HASH JOIN	4		8	9,794	"T1"."PERIOD_CODE"="T4"."FLYER...
INDEX RANGE SCAN	5	APPS.IDX$$_080F0004	1	2	"T4"."EXPORT_LIC_NR"=14659
▽ HASH JOIN	6		14,210	9,792	"T1"."SKU_NR"="T2"."SKU_NR" AN...

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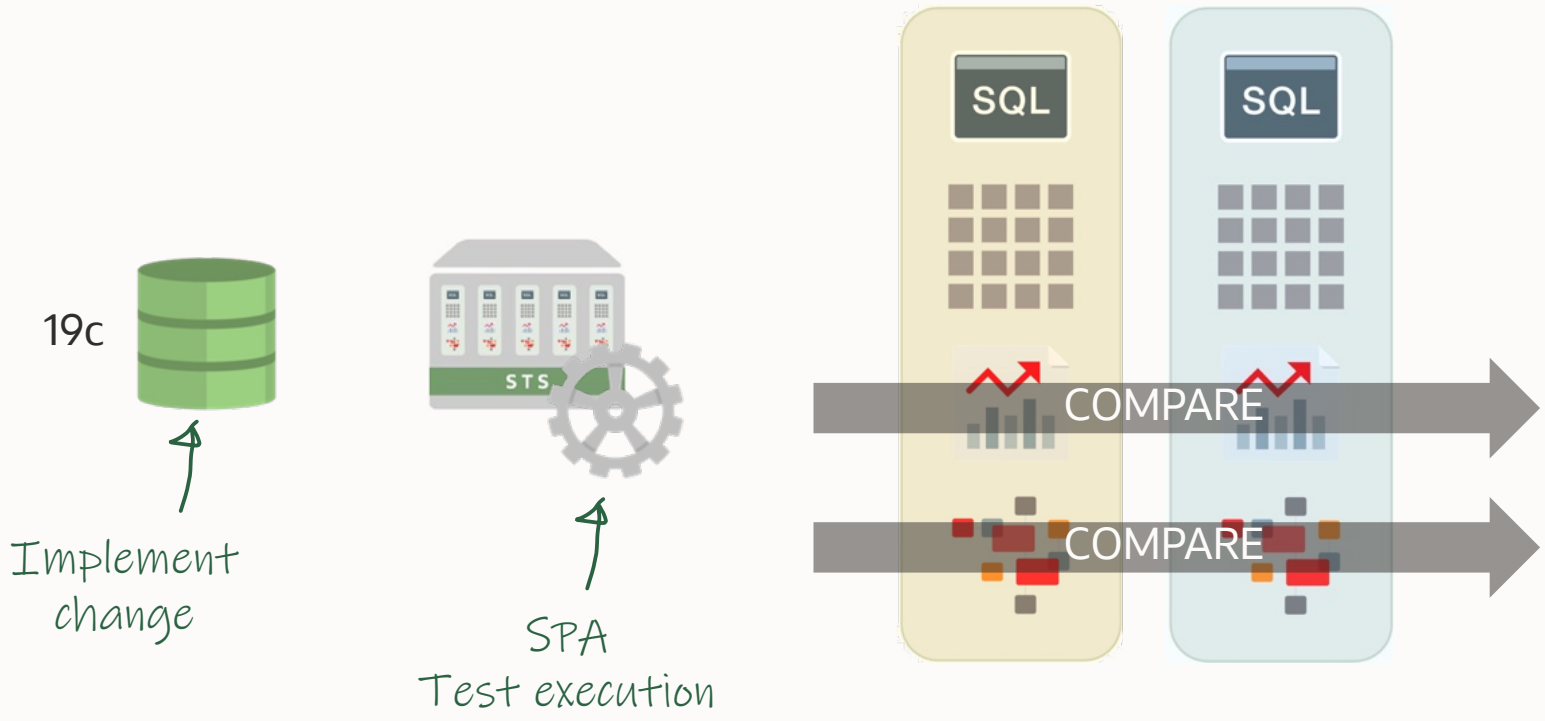
SPA | Continuous Improvement



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```
--If your queries have a lot of binds, you may tweak the below
--underscore. It defines how much bind data will be kept in memory
--for each query. Default at 400 is often too low.
--Find procedures and more on:
--https://blogs.oracle.com/coretec/post/spa-in-autonomous-database

alter system set "_cursor_bind_capture_area_size"=3999;
```


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Performance Stability Prescription

Tune SQLs with regressed plans

Create SQL Plan Baselines

Transport to production database

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```
declare
   l_task varchar2(64);
   l_report clob;
begin
   l_task := dbms_sqltune.create_tuning_task(sql_id=> ... );

   dbms_sqltune.execute_tuning_task(l_task);

   l_report := dbms_sqltune.report_tuning_task(l_task);

   dbms_output.put_line(l_report);
end;
/
```


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SQL Tuning Advisor | Example

```
-------------------------------------------------------------------------------
FINDINGS SECTION (8 findings)
-------------------------------------------------------------------------------

1- Statistics Finding
---------------------
  Optimizer statistics for table "SYS"."TABPART$" and its indices are stale.

  Recommendation
  --------------
  - Consider collecting optimizer statistics for this table.
    execute dbms_stats.gather_table_stats(ownname => 'SYS', tabname =>
            'TABPART$', estimate_percent => DBMS_STATS.AUTO_SAMPLE_SIZE,
            method_opt => 'FOR ALL COLUMNS SIZE AUTO');

  Rationale
  ---------
    The optimizer requires up-to-date statistics for the table in order to
    select a good execution plan.
```


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SQL Tuning Advisor | Example

```
FINDINGS SECTION (8 findings)
-----------------------------

1- Statistics Finding
---------------------
  Optimizer statistics for table "SY

  Recommendation
  --------------
  - Consider collecting optimizer st
    execute dbms_stats.gather_table_
            'TABPART$', estimate_per
            method_opt => 'FOR ALL C

  Rationale
  ---------
    The optimizer requires up-to-dat
    select a good execution plan.
```

```
6- SQL Profile Finding (see explain plans section below)
--------------------------------------------------------
  A potentially better execution plan was found for this statement.

  Recommendation (estimated benefit: 67.2%)
  -----------------------------------------
  - Consider accepting the recommended SQL profile.
    execute dbms_sqltune.accept_sql_profile(task_name => 'TASK_21944',
            task_owner => 'SYS', replace => TRUE);

  Validation results
  ------------------
  The SQL profile was tested by executing both its plan and the original plan
  and measuring their respective execution statistics. A plan may have been
  only partially executed if the other could be run to completion in less time.
```


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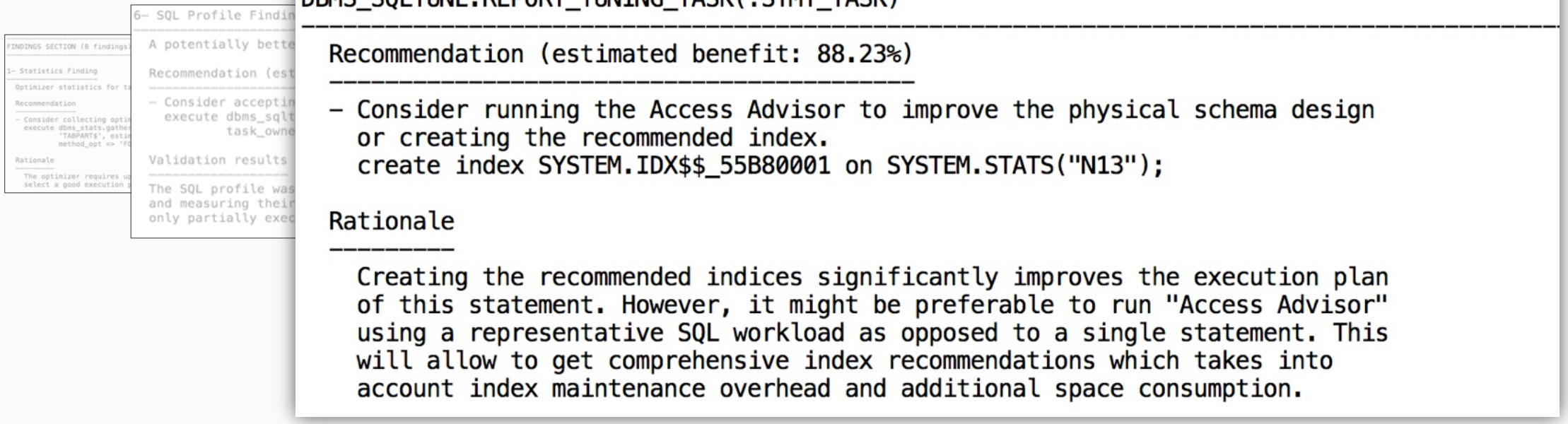
SQL Tuning Advisor | Example



```
7- Index Finding (see explain plans section below)
--------------------------------------------------
  The execution plan of this statement can be improved by creating one or more
  indices.


DBMS_SQLTUNE.REPORT_TUNING_TASK(:STMT_TASK)
--------------------------------------------------------------------------------
  Recommendation (estimated benefit: 88.23%)
  ------------------------------------------
  - Consider running the Access Advisor to improve the physical schema design
    or creating the recommended index.
    create index SYSTEM.IDX$$_55B80001 on SYSTEM.STATS("N13");

  Rationale
  ---------
    Creating the recommended indices significantly improves the execution plan
    of this statement. However, it might be preferable to run "Access Advisor"
    using a representative SQL workload as opposed to a single statement. This
    will allow to get comprehensive index recommendations which takes into
    account index maintenance overhead and additional space consumption.
```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SQL Tuning Advisor | Findings

Types of findings:

- Rewriting SQL statements
- Creation of SQL plan baselines
- Gathering object statistics
- Creation of indexes
- Creation of SQL profiles
- …. and more

Pro tip: SQL Developer has a good interface to SQL Tuning Advisor

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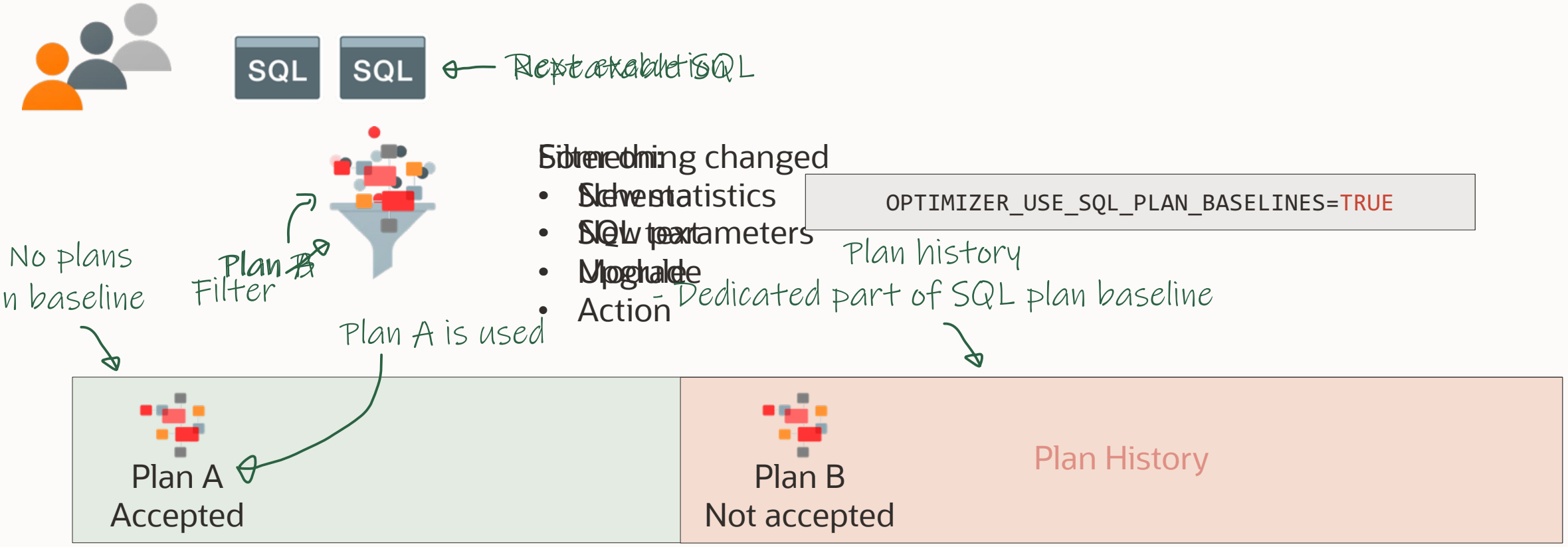
SQL Plan Management | Concept



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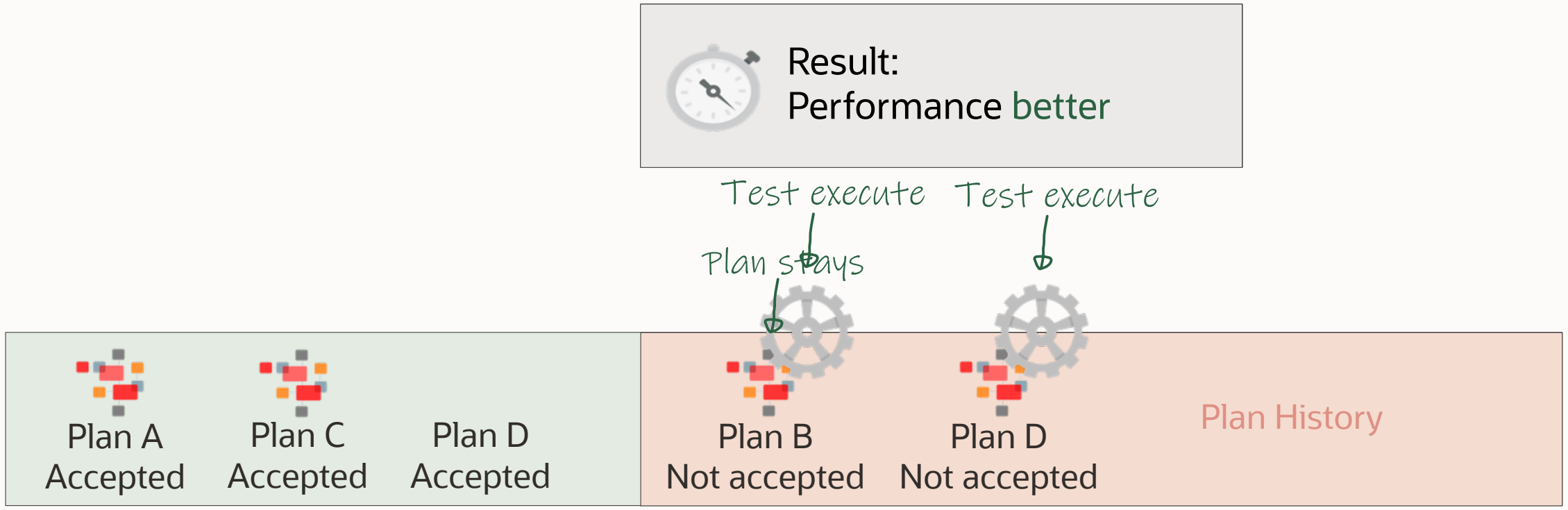
SPM | Evolve



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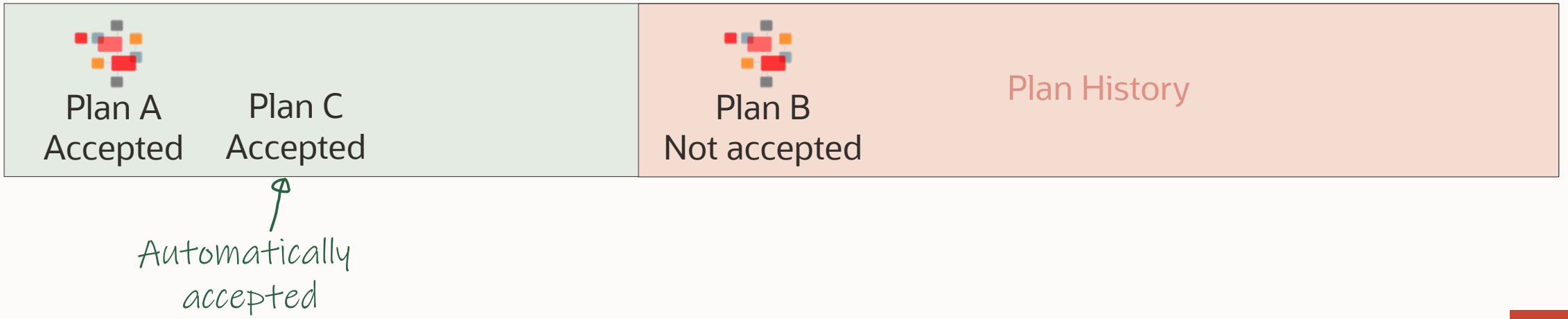
SPM | Load from STS

```
SQL> DECLARE
       cnt number;
   BEGIN
       cnt := DBMS_SPM.LOAD_PLANS_FROM_SQLSET('UPG_STS_1');
   END;
/
```



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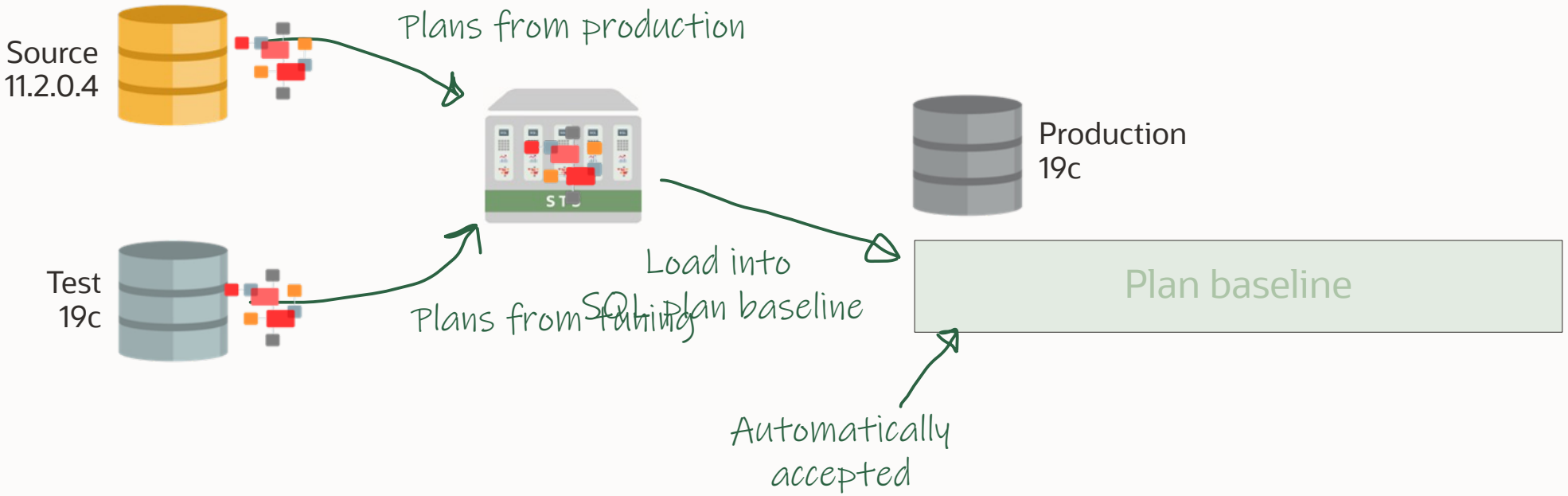
SPM | Use Case



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SPM | What if … literals

SQL Plan Management in a system with literals is not a good fit

- Many distinct statements
- `CURSOR_SHARING = FORCE`? No!

Optimal solution: Change your application to use bind variables

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Use SQL Profiles for statements with literals

- Part of Tuning Pack

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```
dbms_sqltune.accept_sql_profile(..., category=>'TEST_ENV');

alter session set sqltune_category='TEST_ENV';
```


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```
dbms_sqltune.accept_sql_profile(..., category=>'TEST_ENV');

alter session set sqltune_category='TEST_ENV';

--After testing, fully enabled profile
dbms_sqltune.alter_sql_profile(..., attribute_name=>'CATEGORY', value=>'DEFAULT');
```


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SQL Profiles | Facts

- Stores a set of hints that causes the optimizer to select a plan
- Affects one statement only
- Transparent to application
- Useful with literals using `FORCE_MATCH=TRUE`
- Persistent and transportable

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There is only one tool to ensure plan stability:

SQL Plan Management

Don't use

- `OPTIMIZER_FEATURES_ENABLE`
- `COMPATIBLE`

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try it out for free

IT'S EASY

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If you don't have the right license, use a database system in OCI

- Relevant options and packs included in most cloud offerings

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Use OCI for performance testing

Export SQL Tuning Set

Export SQL Plan Baselines

Generate SPA report
Create SQL Plan Baselines

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Performance Tips & Tricks

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Use as few initialization parameters as possible

- Stick to the defaults
- Stick to vendor recommendations

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Only use underscores and events to solve specific situations

- Only under guidance of Oracle Support

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COMPATIBLE vs. OPTIMIZER_FEATURES_ENABLE

COMPATIBLE

- Enables features
- Always use the default value of a release (e.g. 19.0.0)

OPTIMIZER_FEATURES_ENABLE

- Just reverts to the parameters used in a previous release
- Avoid using it if possible
- This is not a Swiss Army knife!
- You will turn off a lot of great features

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Patches For Optimal Performance

1. Install the latest Release Update
2. Install the latest Monthly Recommended Patches
3. Check for important recommended one-off patches (Doc ID 555.1)
4. Check for other SQL performance bug fixes (Doc ID 2773715.1)

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Enable Optimizer Fixes

5 Selectively enable optimizer fixes using `DBMS_OPTIM_BUNDLE`

```
begin
  dbms_optim_bundle.enable_optim_fixes(
   action                      => 'ON',
   scope                       => 'BOTH',
   current_setting_precedence => 'YES');
end;
/
```

Find available bug fixes in ORAdiff or `dbms_optim_bundle.GetBugsForBundle`

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Don't gather new optimizer statistics after upgrade

- Upgrades from 11.2.0.4 might be different

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Don't gather system statistics

- In most cases, the defaults are fine
- Might be a good idea on Exadata Database Machine
- Optimizer blog

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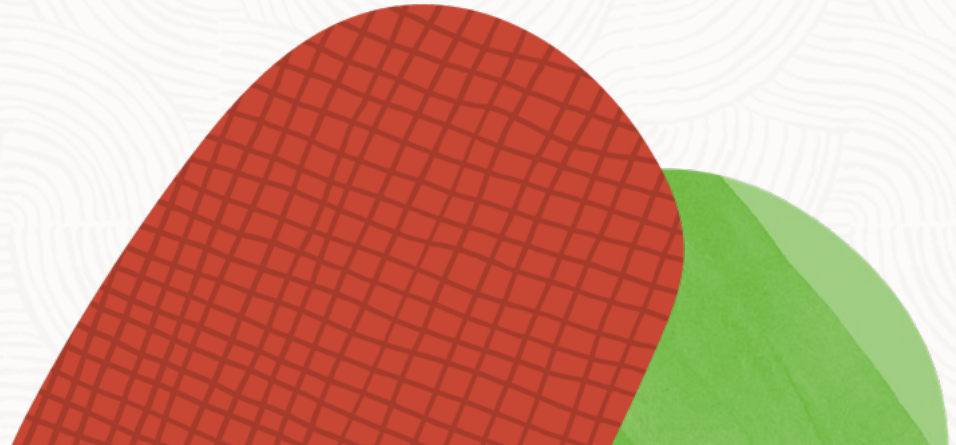
Insights into the Oracle Database Development Process



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REALITY CHECK

A true customer story

Photo by Tobias Bjerknes on Unsplash

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BIG PROBLEM!!

You open an SR
You work with Oracle Support
And at worst case ...

Photo by Sebastian Herrmann on Unsplash

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… you hit a bug!!

Photo by Tobias Bjerknes on Unsplash

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But ... don't worry!

It is fixed! In Oracle 23c!

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Photo by Andre Hunter on Unsplash

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THREE PARTIES

- You
- Oracle Support
- Oracle Development

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Insights into the Patching Process

- Report via My Oracle Support
- Service Request inspected by automation

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How many Service Requests are solved by automation within one day?

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60 % of Service Requests get solved
by automation within one single day

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Insights into the Patching Process

- Support Engineer creates a bug

- Help us help you:
  - Clear description
  - Reproducible test case
  - Logs, traces, dumps
  - Various release tests

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Bug 41886745 : ORA-600 [happens_on_mondays_only] before java is brewed

Bug Attributes

Type	B - Defect	**Fixed in Product Version**	
Severity	2 - Severe Loss of Service	**Product Version**	19.17.0.0.0
Status	10 - New	**Platform**	226 - Linux x86-64
Created	Oct 17, 2022	**Platform Version**	ORACLE LINUX 7
Updated	Oct 17, 2022	**Base Bug**	N/A
Database Version	19.17.0.0.0	**Affects Platforms**	Generic
Product Source	Oracle	Knowledge, Patches, Service Requests and Bugs related to this bug	

Related Products

Line	Oracle Database Products	**Family**	Oracle Database Suite
Area	Oracle Database	**Product**	5 - Oracle Database - Enterprise Edition

```
Hdr: 41886745 : ORA-600 [happens_on_mondays_only] before java is brewed
Abstract: Happens on most important sales table. Sales are yelling ... loudly
```

When **your case** needs further attention

1

Update the SR
and raise severity

2

Call Oracle Support

Blog Post: Request Management Attention for your SR

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Insights into the Patching Process

- Developer creates a fix
- Always in MAIN branch first

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Insights into the Patching Process

- Developer creates a fix
- Always in MAIN branch first
- Regression tests on Farm in OCI
  - Subset of tests before merge
  - All tests run daily, ~1 million functional tests (runtime ~25.000 hours)

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Insights into the Patching Process

- In case, fix isn't working as expected?
  - Fix the fix
  - Regression tests again
- Fix is ok?
  - Merge into MAIN
  - Merge can only happen with no failing tests

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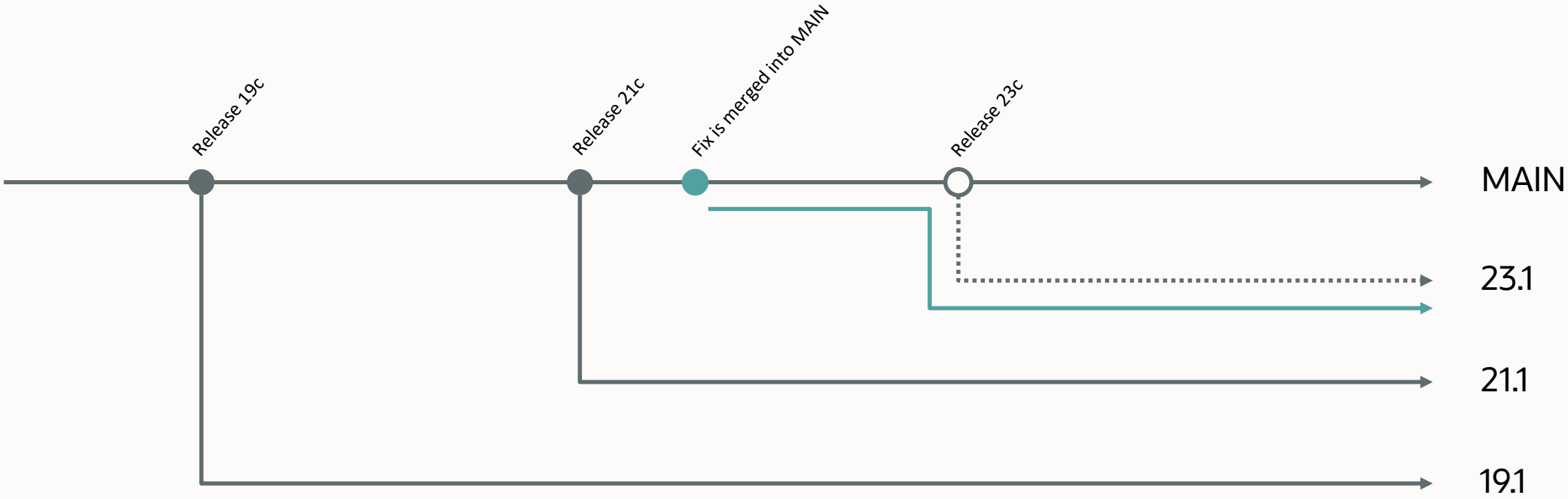
Branches


Release 19c
Release 21c
Fix is merged into MAIN
Release 23c
MAIN
23.1
21.1
19.1

Bug 41886745 : ORA-600 [happens_on_mondays_only] before java is brewed

Bug Attributes

Type	B - Defect	**Fixed in Product Version**	23.1
Severity	2 - Severe Loss of Service	**Product Version**	19.17.0.0.0
Status	80 - Development to QA/Fix Delivered Internal	**Platform**	226 - Linux x86-64
Created	Oct 17, 2022	**Platform Version**	ORACLE LINUX 7
Updated	Oct 17, 2022	**Base Bug**	N/A
Database Version	19.17.0.0.0	**Affects Platforms**	Generic
Product Source	Oracle	Knowledge, Patches, Service Requests and Bugs related to this bug	

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```
Hdr: 41886745 : ORA-600 [happens_on_mondays_only] before java is brewed
Abstract: Happens on most important sales table. Sales are yelling ... loudly
```

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Insights into the Patching Process

- Backport created on request
- Backports are specific for a release
  and usually also for a patch level, e.g., on top of 19.22.0
- `opatch lsinventory`

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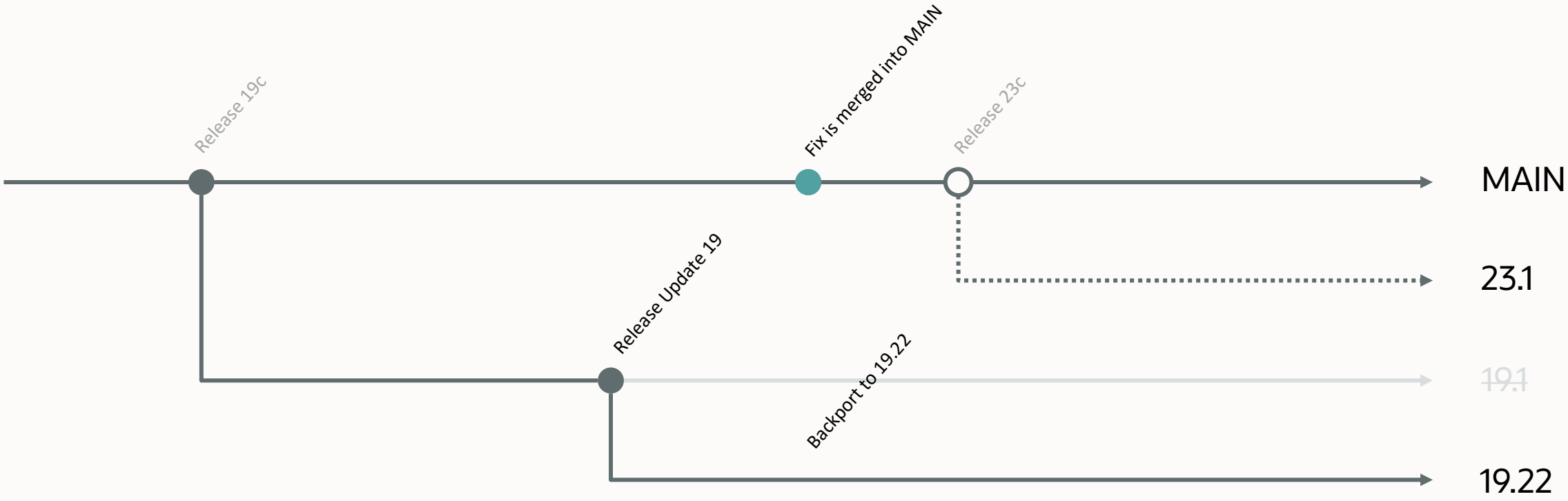
Backport


Release 19c
Fix is merged into MAIN
Release 23c
MAIN
23.1
Release Update 19
Backport to 19.22
19.1
19.22

Insights into the Patching Process

- Automated flow, manual handling might be required
  - Some conflicts
  - Dependencies
- Manual handling may postpone patch delivery

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Patch Simple Search Results

Filters: Patch Name or Number is 31517417; Platform is Linux x86-64;

Edit Search

Table ▾ View ▾ Detach Share Link

Patch Name	Description	Release	Platform (Language)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.16.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.15.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.14.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.13.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.12.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.11.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.10.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.9.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.8.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.6.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.4.0.0.0DBRU	Generic Platform (American English)

19.7.0 missing

Why is the patch not in the next Release Update?

Insights into the Patching Process

- What goes into a Release Update?
- Screening and monitoring for candidates
- Support can request inclusion via base bug

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Request for Inclusion

Recommended Patches for 19.18 DB Home

Below is the list of important patches to consider applying on top of 19.18. In addition to the relevant patches listed below, you should also review patches in Database PSU/BP/Update/Revision - Known Issues Primary Note(Doc ID 1227443.1) and Oracle Database Patches to Consider for 19c (Doc ID 2781612.2) which contains patches to consider for specific areas such as Data Pump, Golden gate etc.

Bug	Fixed in RU	Fixed in MRP	Description	Patches	NON ROLLING	Added
35037877 (replaces 20289608)			[SECURITY] EM patching may fail with ORA-4067	[list-patches]		20-APR-2023
32727143	19.19		[SQL EXECUTION] Transaction-level content isolation for transaction-duration global temporary tables	[list-patches]		20-APR-2023
34557500 (replaces 31544097)	19.19	DBMRP 19.17.0.0.230321, DBMRP 19.18.0.0.230321	[BLOCK TRACK] CTWR caused multiple instances to hung state on the RAC Standby DB	[list-patches]		20-APR-2023
34340632			[AQ] Smart Monitoring & Resiliency in AQ KGL Memory Usage To Help Message Cleanup And Prevent ORA-600 [KGL-HEAP-SIZE-EXCEEDED].	[list-patches]		14-APR-2023
35246710 (replaces 33803836)	19.19	DBMRP 19.18.0.0.230418	[BUFFER CACHE] High "Direct Path Read" Waits After 19.18 DBRU Patching	[list-patches]		08-APR-2023
34832725 (replaces			[SHRD CRSRS] ORA-4031 and / or High Shared Pool Latch Contention During Session Creation in	[list-		25-

Request for Inclusion

BUG 32765738 - AIM:ORA-7445 [KEWSSYSVF_1] - KEWSSYSVF_1

Edit this bug Bug Tree ARU Report

Bug No:	32765738 (Bug)
Filed By:	[redacted]
Updated By:	[redacted]
Sup Rep:	[redacted]
Customer:	[redacted]
Status:	80 - Development to QA/Fix Delivered Internal

BUG 32765738 - AIM:ORA-7445 [KEWSSYSVF_1] - KEWSSYSVF_1

Edit this bug Bug Tree ARU Re

Bug No: 32765738

Filed By:

Updated By:

Sup Rep:

Customer:

Status: 80 - Development to QA/Fix Delivered Internal

SRs in Bug Hierarchy: Open: 12 Others: 274 (Show Details)

Automatic Incident Management

Automatic Incident Management

- Scans for incidents
- Monitors also shared autonomous databases
- Automatically creates bugs
- Report and fix bugs before customers

Ensure your Service Request is associated with the corresponding bug

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Insights into the Patching Process

- Evaluated for Release Update inclusion
- Strict requirements apply
  - RAC Rolling
  - Standby-First

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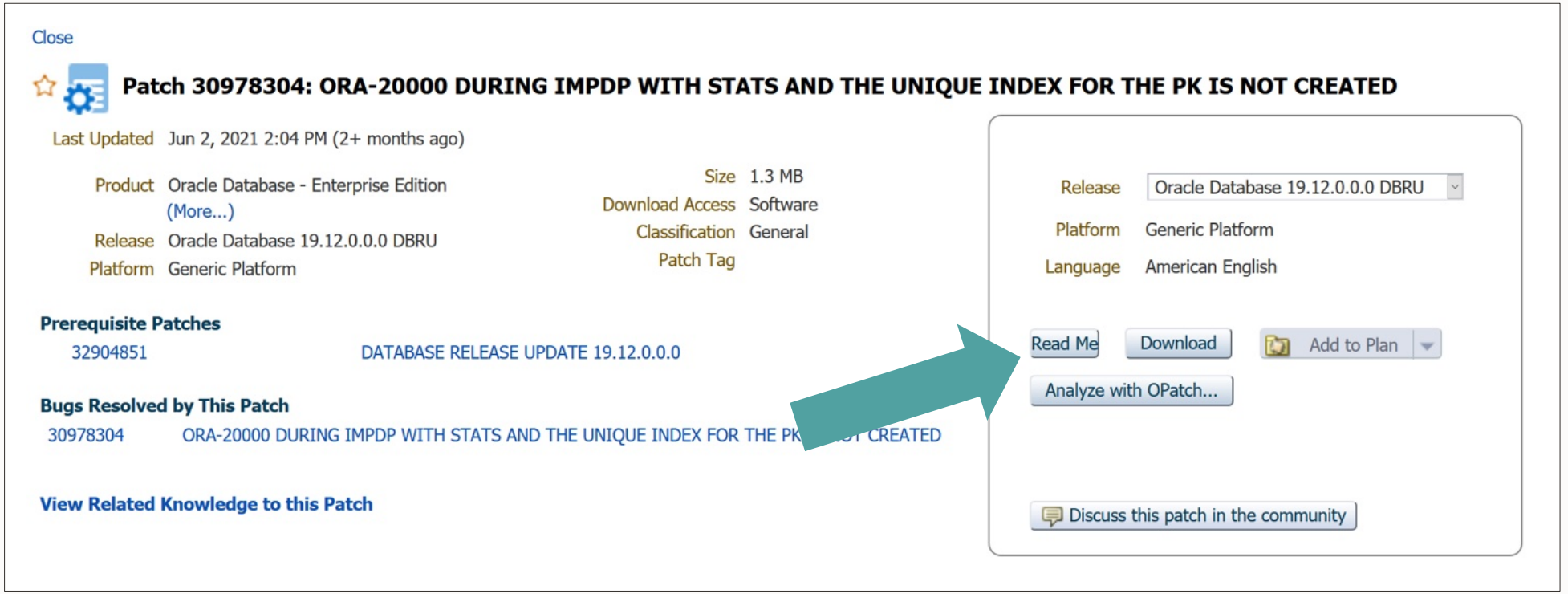
Inclusion Evaluation and Criteria



Inclusion Evaluation and Criteria

```
Oracle Database 19 Release 19.12.0.0.210720DBRU

ORACLE DATABASE Patch for Bug# 30978304 for Generic Platforms

This patch is non-RAC Rolling Installable.

This patch is non-Data Guard Standby-First Installable - Please read My Oracle Support Note
1265700.1 https://support.us.oracle.com/oip/faces/secure/km/DocumentDisplay.jspx?id=1265700.1
Oracle Patch Assurance - Data Guard Standby-First Patch Apply for details on how to remove risk
and reduce downtime when applying this patch.
```

NEVER INCLUDED

```
(1) Prerequisites
--------------------
Before you install or deinstall the patch, ensure that you meet the following requirements:
```

Insights into the Patching Process

- Limited number of fixes per Release Update
- Release Updates and Revisions regression tests

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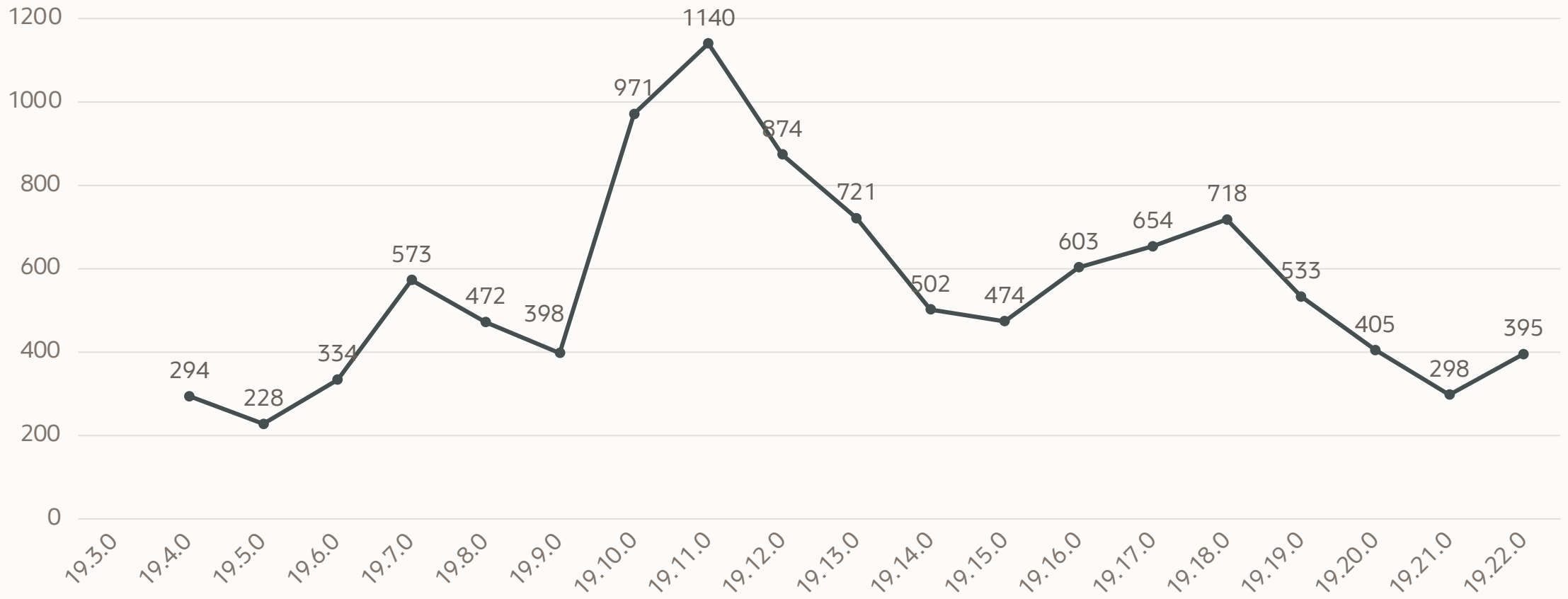
Release Update Contents



Database 19 Release Updates and Revisions Bugs Fixed Lists (Doc ID 2523220.1)

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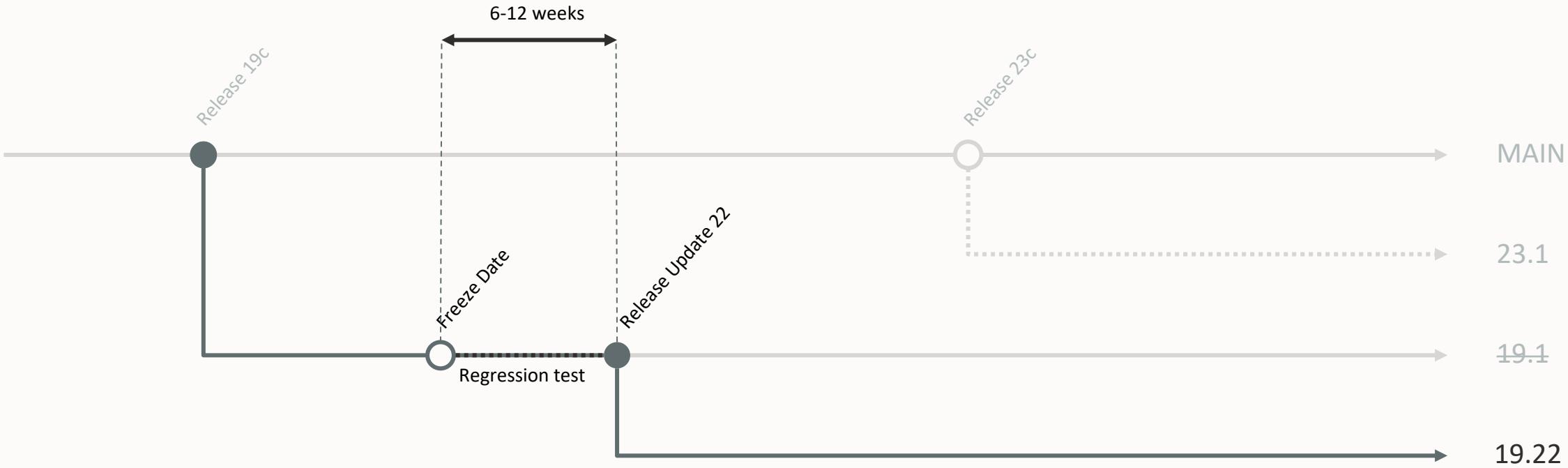
Limitation


6-12 weeks
Release 19c
Release 23c
MAIN
23.1
Freeze Date
Release Update 22
19.1
Regression test
19.22

WHY DO YOU ALWAYS ASK FOR

OPATCH lsinventory

Photo by Joel J. Martínez on Unsplash

TO AVOID CONFLICTS

Photo by Glomad Marketing on Unsplash

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```
$ORACLE_HOME/OPatch/opatch prereq CheckConflictAgainstOHWithDetail -ph ./

Invoking prereq "checkconflictagainstohwithdetail"
ZOP-40: The patch(es) has conflicts with other patches installed in the
Oracle Home (or) among themselves.
Prereq "checkConflictAgainstOHWithDetail" failed.
Summary of Conflict Analysis:
There are no patches that can be applied now.
Following patches have conflicts. Please contact Oracle Support and get
the merged patch of the patches :
35012562, 35095748
Conflicts/Supersets for each patch are:
Patch : 35095748
Conflict with 35012562
Conflict details:
/u01/app/oracle/product/19.19.0/db_1/lib/libserver19.a:kko.o

OPatch succeeded.
```


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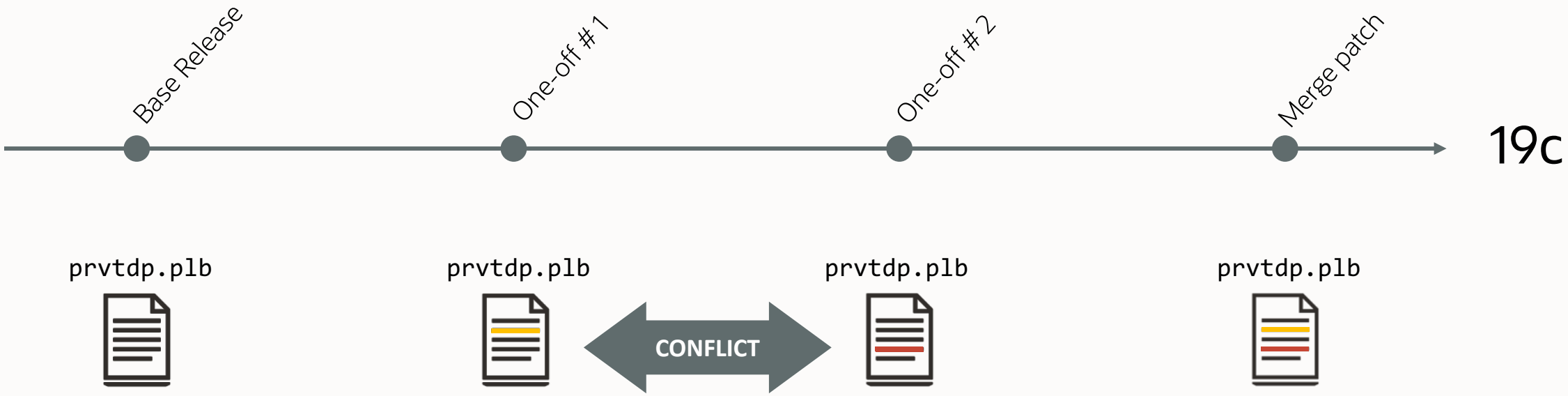
Basic Facts | Conflicts



On your Service Request, always attach the output of `opatch lsinventory`

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Don't name it

- `optch_lsinvt.txt`
- `tekst_fra_opatch.txt`
- `alle_meine_patches.txt`
- `textodeopatch.txt`

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Just name it `opatch_lsinventory.txt`

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But ... I am on MS Windows ...

Photo by Sebastian Herrmann on Unsplash

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Windows is different ...

Photo by Clint Patterson on Unsplash

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Windows Bundle Patches is the term used for Release Updates on Windows

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A Windows Bundle Patch and a Release Update from the same quarter, e.g., April 2023, do not contain the same patches

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Comparing Release Updates and Bundle Patches

19.19.0 Linux Release Update

- 533 bug fixes
- 5 were not in the Windows bundle patch

19.19.0 Windows Bundle Patch

- 153 additional bug fixes
- 528 bug fixes in common

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Where do I find the Windows Bundle Patches?

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Assistant: Download Reference for Oracle Database/GI Update, Revision, PSU, SPU(CPU), Bundle Patches, Patchsets and Base Releases (Doc ID 2118136.2)

Visibility: EXTERNAL (94)

Selection(s)

What would you like to download?

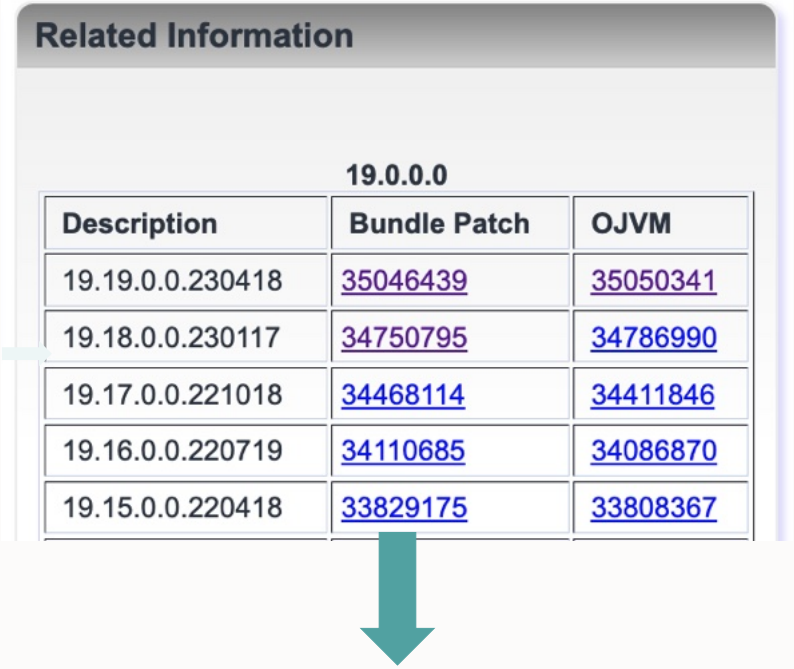
- ○ Oracle Database Base Releases
- ○ Oracle Database Patchsets
- ○ Oracle Database Release Updates (RUs)
- ○ Oracle Database Release Update Revisions (RURs - discontinued since Apr 2023)
- ○ Oracle Database PSU, SPU(CPU), Bundle Patches (Versions 12.1 & lower)
- ○ OJVM Update/PSU/Bundle Patches
- ◯ Latest Available Microsoft Windows Patches
- ○ Monthly Recommended Patches (MRPs)

Solution(s)

Possible Solutions w
you make your selec

Basic Facts | Patch Availability

MOS Note: 2118136.2 - Assistant: Download Reference for DB and GI Patch Bundles



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Basic Facts | Patch Availability

MOS Note: 2844795.1 - Apr 2022 Patch Availability Document (DB-only)

Released April 19, 2022

This document contains the following sections:

- Critical Patch Update April 2022 Patch Availability Document (PAD)
  - 1 Overview
    - 1.1 How To Use This Document
    - 1.2 Terminology in the Tables
    - 1.3 On-Request Patches
    - 1.4 CPU Program and My Oracle Support Patch Recommendations
    - 1.5 My Oracle Support (MOS) Conflict Checker Tool
  - 2 What's New in April 2022
    - 2.1 "Final CPU Information (Error Correction Policies)"
    - 2.2 "Post Release Patches"
    - 2.3 "Separate PADs for Separate Products"

Patch Details

Details for Patch 33829175 not found.

Microsoft Windows BP 21.0.0.0.220419	Patch 33829143	MS-Windows	14-Jun-2022
Microsoft Windows BP 19.15.0.0.220419	Patch 33829175	MS-Windows	17-May-2022

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Find the PAD by searching for
Patch Availability Document January 2024

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… Oracle on Windows is different

Photo by Clint Patterson on Unsplash

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But this MOS note is missing ...

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MOS Note is not accessible

MOS Notes into `UNDER REVIEW` state without telling you more details

- See blog post "This MOS note is not available anymore?"

Document cannot be displayed. Possible reasons are:

- The document id was entered incorrectly. Please check and try again.
- The document id does not exist (was referenced incorrectly).
- The document is not classified as publicly accessible ("non-public").
- The content is being updated and it is temporarily unavailable but will be made available again soon.

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Just try it again a few days

- If urgent, open an SR and check with Oracle Support

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Oracle Linux Development Platform

Photo by Danielle Barnes on Unsplash

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Porting

Oracle Linux x86-64

Porting

- Microsoft Windows
- Linux ARM (aarch64)
- SPARC Solaris
- Intel Solaris x86-64
- IBM AIX
- IBM zLinux
- HP UX Itanium
- BS2000

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Some of the platforms from our bug tracking system

Blast from the past

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Blast from the Past | Platforms

Microsoft Windows Phone
Oracle JRockit Virtual Edition x86
SunOS
Monta Vista x86
Acme Packet 1100
iTron
Embedded Linux on cnMIPS
Embedded Linux SH4
HP NonStop Itanium (OSS)
QNX Unix
Acme Packet 6100
Linux MIPS 64-bit
Fujitsu BS2000/OSD (SQ series)
Mediatek MTZ
HP NonStop (Guardian) on x86
Fujitsu BS2000
HP Tru64 UNIX

Tekelec
Qualcomm Brew MP
Netra Server X5-2 for Communications
HP NonStop S-series (Guardian)
HP OpenVMS Itanium
Monta Vista x86-64
OpenSolaris
SCO Unix
Net-Net 9200
Symbian EPOC
Linux ARM 32-bit VFP HardFP ABI
SGI Irix
ia64
Linux SPARC
Oracle Solaris on SPARC (32-bit)
HP NonStop Itanium (Guardian)
RIM BlackBerry

Netra X3-2 for Acme Packet
Oracle Solaris on SPARC (64-bit)
IBM S/390 Based Linux (31-bit)
Acme Packet 3900
SPARC
Fujitsu MSP-EX
Trusted Solaris
Net-Net 4250
HP OpenVMS VAX
HP-UX PA-RISC (32-bit)
Acme Packet 6300
Microsoft Windows CE
IBM z/OS on System z
StorageTek Hardware
Oracle Solaris on x86 (32-bit)
Fujitsu BS2000/OSD (SX series)
Linux ARM 64-bit

Novell NetWare
Linux on IBM Z
Data General
Pyramid
Talari
Palm Computing
HP NonStop (OSS) on x86
Unisys OS 2200
HP OpenVMS Alpha
Acme Packet 3820
FreeBSDx86
Oracle Solaris Express
VxWorks
Microsoft Windows (32-bit)
Sequent
Windows NT
nCube

Break

We start again at 15:15

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Oracle Database 23c

What's Changing

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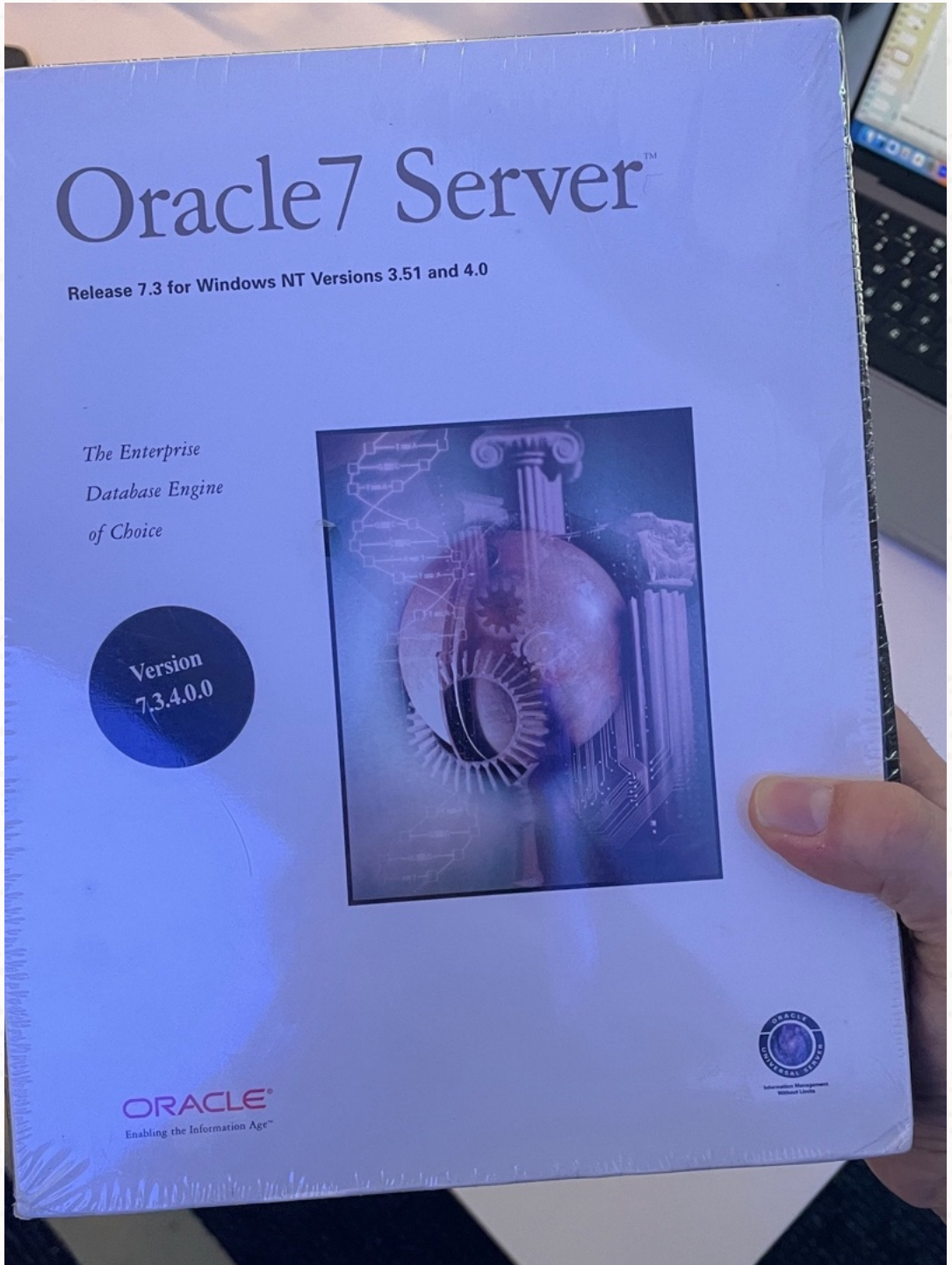

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Consult the Upgrade Guide for changes, desupports, and deprecations

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Traditional Auditing is desupported in Oracle Database 23c

- Migrate your policies to Unified Auditing

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TRADITIONAL AUDITING

- Database generates audit records
- You can't create new polices or change existing ones

UNIFIED AUDITING

- Use syntax converter script (MOS Doc ID 2909718.1)
- Do it before the upgrade

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Soon, AutoUpgrade is the only supported tool to upgrade your Oracle Database

- DBUA and command line upgrade will get desupported

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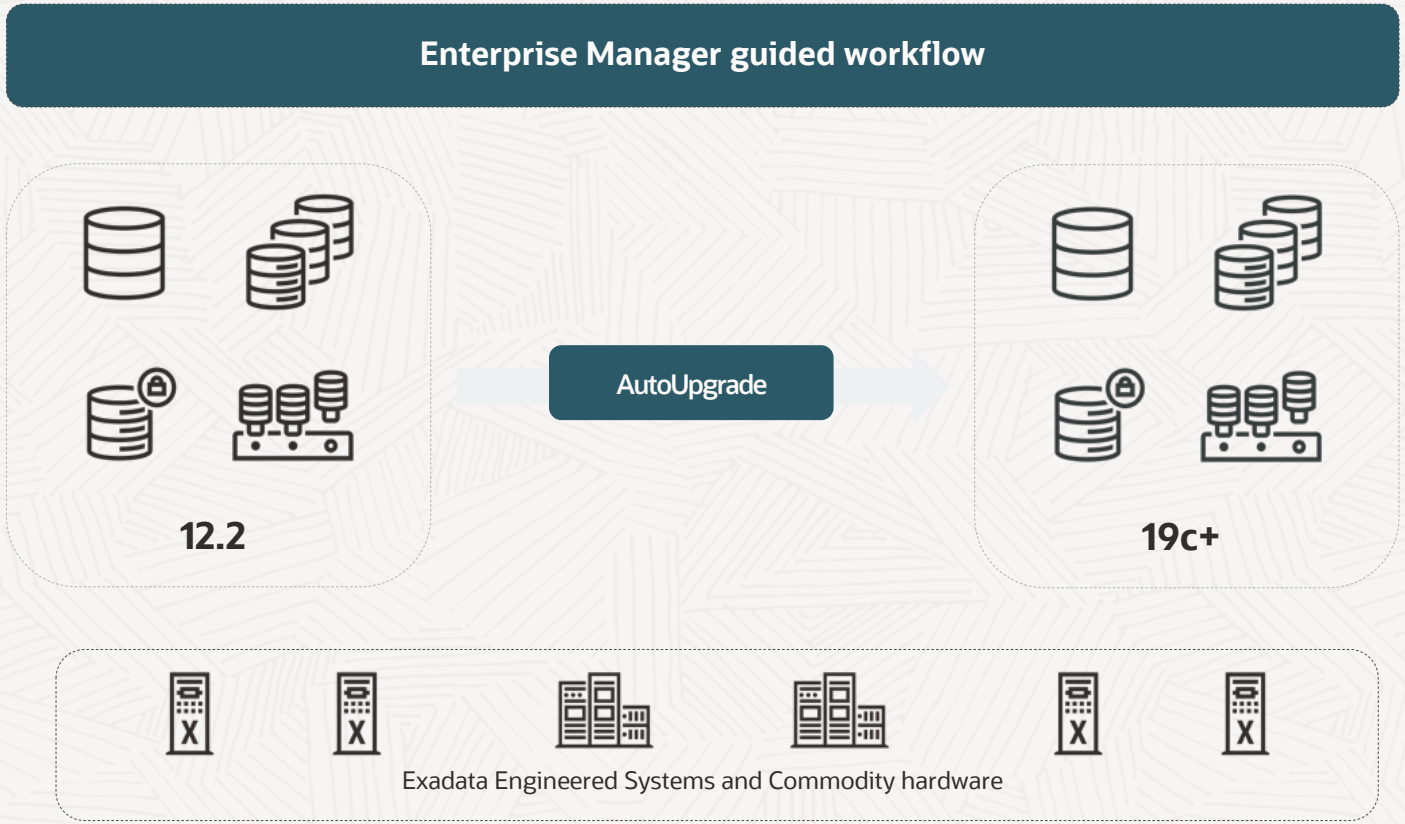
Enterprise Manager

AutoUpgrade integration into EM CC

- Fleet scale
- Non-CDB to PDB
- Non-rolling logical standby
- TDE
- REST and emcli automation



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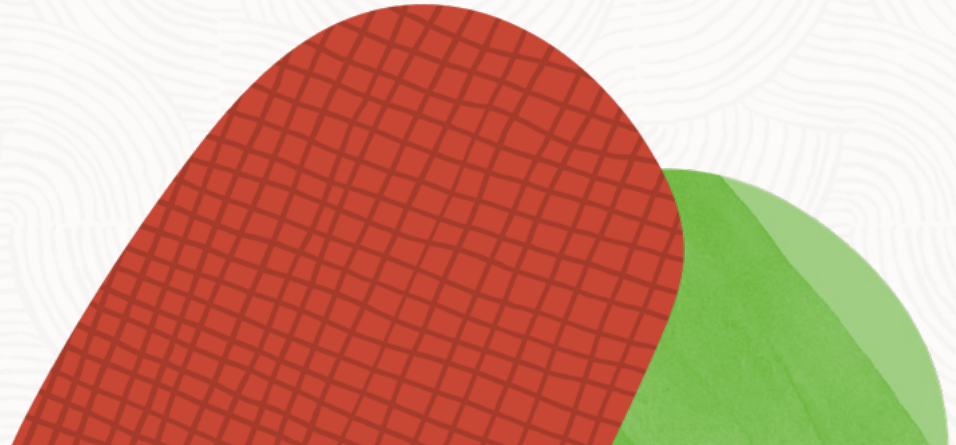
Oracle Database 23c

What's New



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Examine Oracle Database changes using ORAdiff

- Oracle Release Analyzer Diff Utility
- https://oradiff.oracle.com

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Home
Parameters
Users, Roles, etc
Privileges
Included Fixes
Oracle Database Home
Objects
Fixed Objects
Audit
System
Scheduler
Report

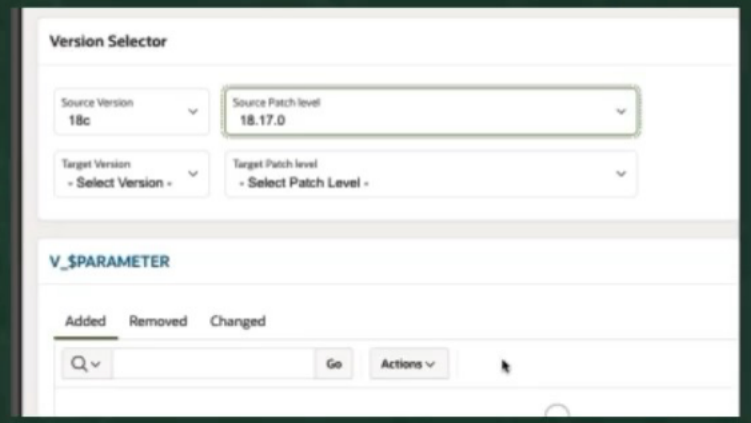
ORAdiff

ORAdiff - Find the differences between two Oracle Database releases

ORAdiff allows you to compare two database releases to each other - with or without patch bundles on top.

Get Started

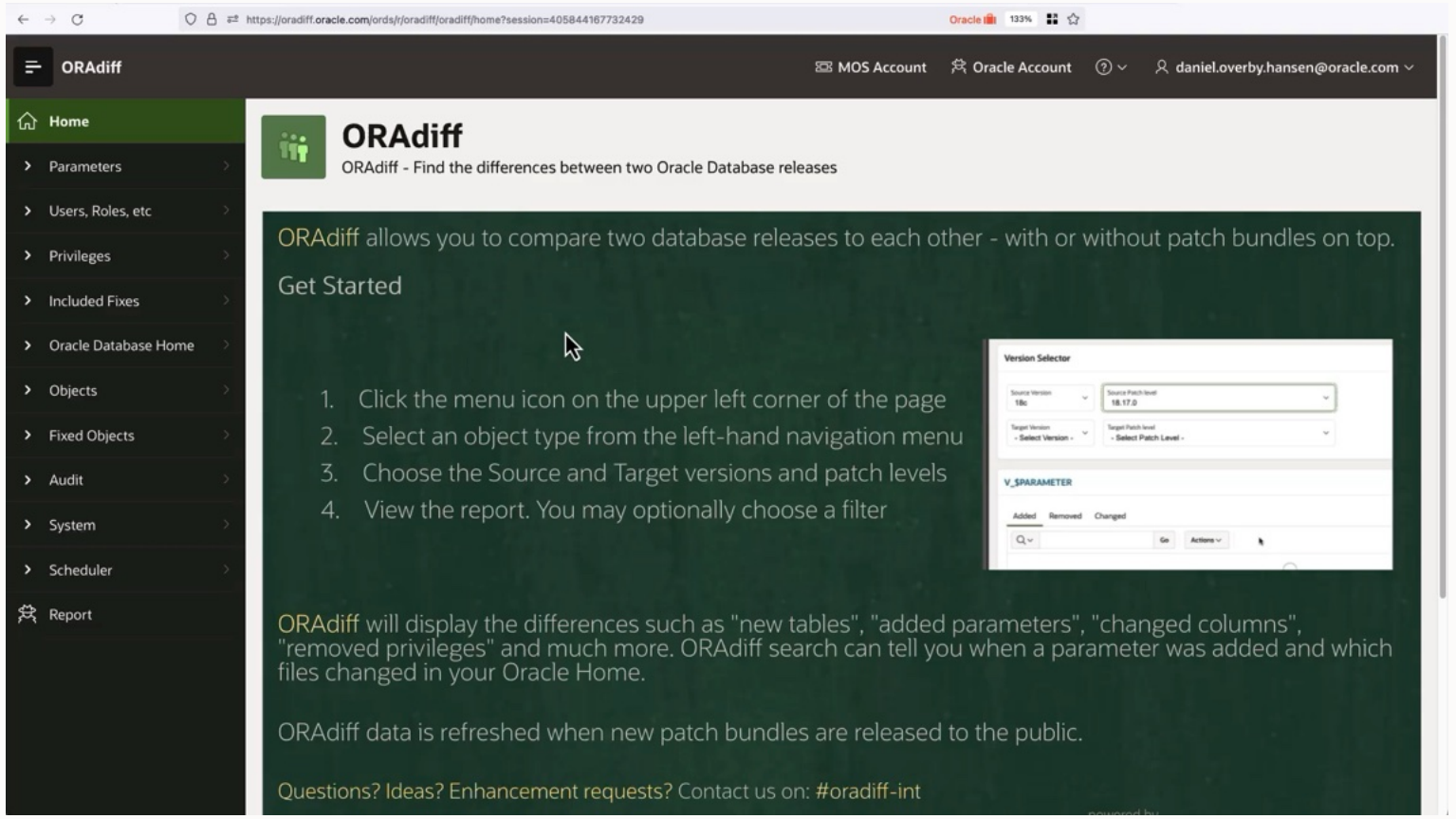
1. Click the menu icon on the upper left corner of the page
2. Select an object type from the left-hand navigation menu
3. Choose the Source and Target versions and patch levels
4. View the report. You may optionally choose a filter



ORAdiff will display the differences such as "new tables", "added parameters", "changed columns", "removed privileges" and much more. ORAdiff search can tell you when a parameter was added and which files changed in your Oracle Home.

ORAdiff data is refreshed when new patch bundles are released to the public.

Questions? Ideas? Enhancement requests? Contact us on: #oradiff-int



[Watch on YouTube]

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Oracle Autonomous Database speaks *human*

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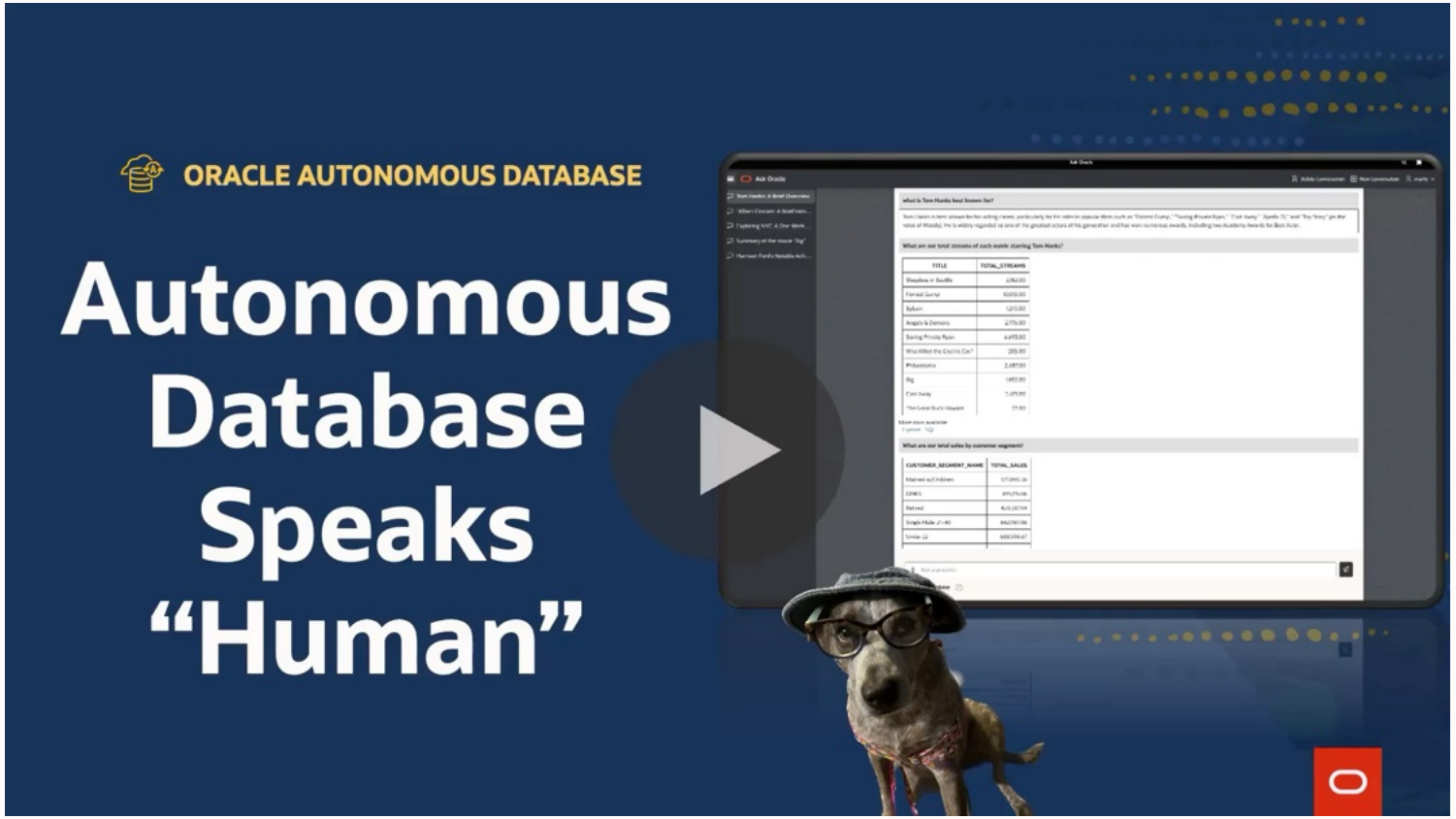

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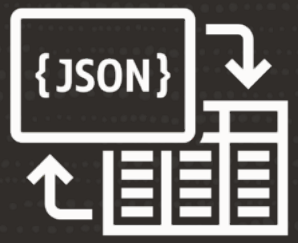

Get the best of both worlds with JSON Duality Views

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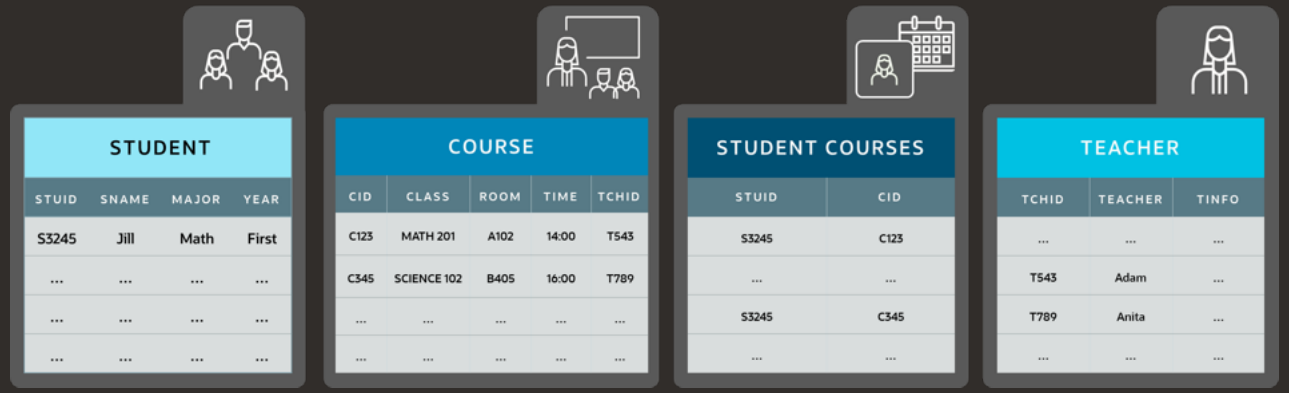

SCHEDULE FOR: JILL

```
"student"     : "S3245",
"name"        : "Jill",
"major"       : "Math",
"schedule"    :
  [  {
       "time"    : "14:00",
       "course"  : "Math 201",
       "room"    : "A102",
       "teacher" : "Adam"
     },
     {
       "time"    : "16:00",
       "course"  : "Science 102",
       "room"    : "B405",
       "teacher" : "Anita"
     }
  ]
}
```

A single database can now support both relational and document data providing the benefits of both

Oracle Database
secures your data

Data Guard

RAC

RMAN

TDE Tablespace Encryption

Network Encryption

Auditing

SQL Firewall

ACID

No data duplication

... and so much more

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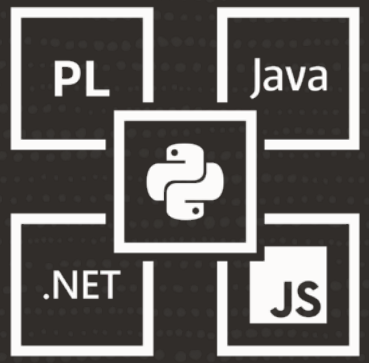

Easily convert your existing application with Oracle Database API for MongoDB

- Using Oracle Database API for MongoDB

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Quickly resolve poor performance caused by change in execution plan

- Simplified use of SQL Plan Management

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```
--Loads all known plans from cursor cache, AWR,
--and automatic SQL tuning sets into a SQL plan baseline.
--Use Evolve Advisor to find the best plan and mark that as accepted.

select dbms_spm.add_verified_sql_plan_baseline('<sql_id>');
```

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Allow the database to fix regressing plans automatically

- Automatic SQL Plan Management
- Real-time SQL Plan Management

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Automatically recover from certain **ORA-00600** errors

- Automatic Error Mitigation

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```
SQL> select ... from ...
ERROR at line 1:
ORA-00600: internal error code, arguments: [...]
```


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```
SQL> select ... from ...
ERROR at line 1:
ORA-00600: internal error code, arguments: [...]

SQL> alter session set sql_error_mitigation = 'on';

SQL> select ... from ...
n rows returned
```


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Automatically rollback sessions blocking high-priority sessions

- Automatic Transaction Rollback

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Session 1

```
alter session set txn_priority=low;
```

Session 2

```
alter session set txn_priority=high;
```


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Session 1

```
alter session set txn_priority=low;


--Updates row and goes to lunch
update t1 set c1 = 1000 where id = 1;
```

Session 2

```
alter session set txn_priority=high;
```


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Session 1

```
alter session set txn_priority=low;


--Updates row and goes to lunch
update t1 set c1 = 1000 where id = 1;
```

Session 2

```
alter session set txn_priority=high;


--Session waits for row lock
update t1 set c1 = 2000 where id = 1;
```


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Session 1

```
alter session set txn_priority=low;


--Updates row and goes to lunch
update t1 set c1 = 1000 where id = 1;




--After wait time session is killed
ERROR at line 1:
ORA-03113: end-of-file on communication
channel
```

Session 2

```
alter session set txn_priority=high;


--Session waits for row lock
update t1 set c1 = 2000 where id = 1;
```


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Session 1

```
alter session set txn_priority=low;

--Updates row and goes to lunch
update t1 set c1 = 1000 where id = 1;

--After wait time session is killed
ERROR at line 1:
ORA-03113: end-of-file on communication
channel
```

Session 2

```
alter session set txn_priority=high;

--Session waits for row lock
update t1 set c1 = 2000 where id = 1;

--Row lock acquired
--Update completes
1 row updated.
```


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Even wider tables

- Up to 4096 columns

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```
SQL> alter system set max_columns=extended scope=spfile;
```


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Ensure your database clients are updated

- Older clients do not support more than 1000 columns

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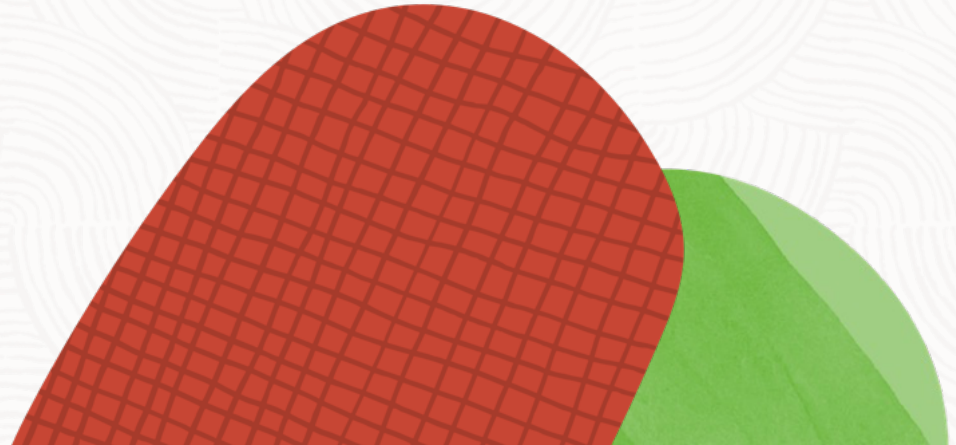
Oracle Database 23c

Even More Secure



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No more insecure case insensitive password

- 10G password verifies are no longer accepted

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Even stronger passwords

- Up to 1024 bytes

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Get started quickly and securely using new developer role

- `DB_DEVELOPER_ROLE`

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Grant privileges to an entire schema in one command

- `grant ... on schema ...`

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By default even stronger encryption algorithms are used

- RMAN backups
- TDE Tablespace Encryption

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Tighten security with SQL Firewall

- Prevent SQL injection attacks and unauthorized queries

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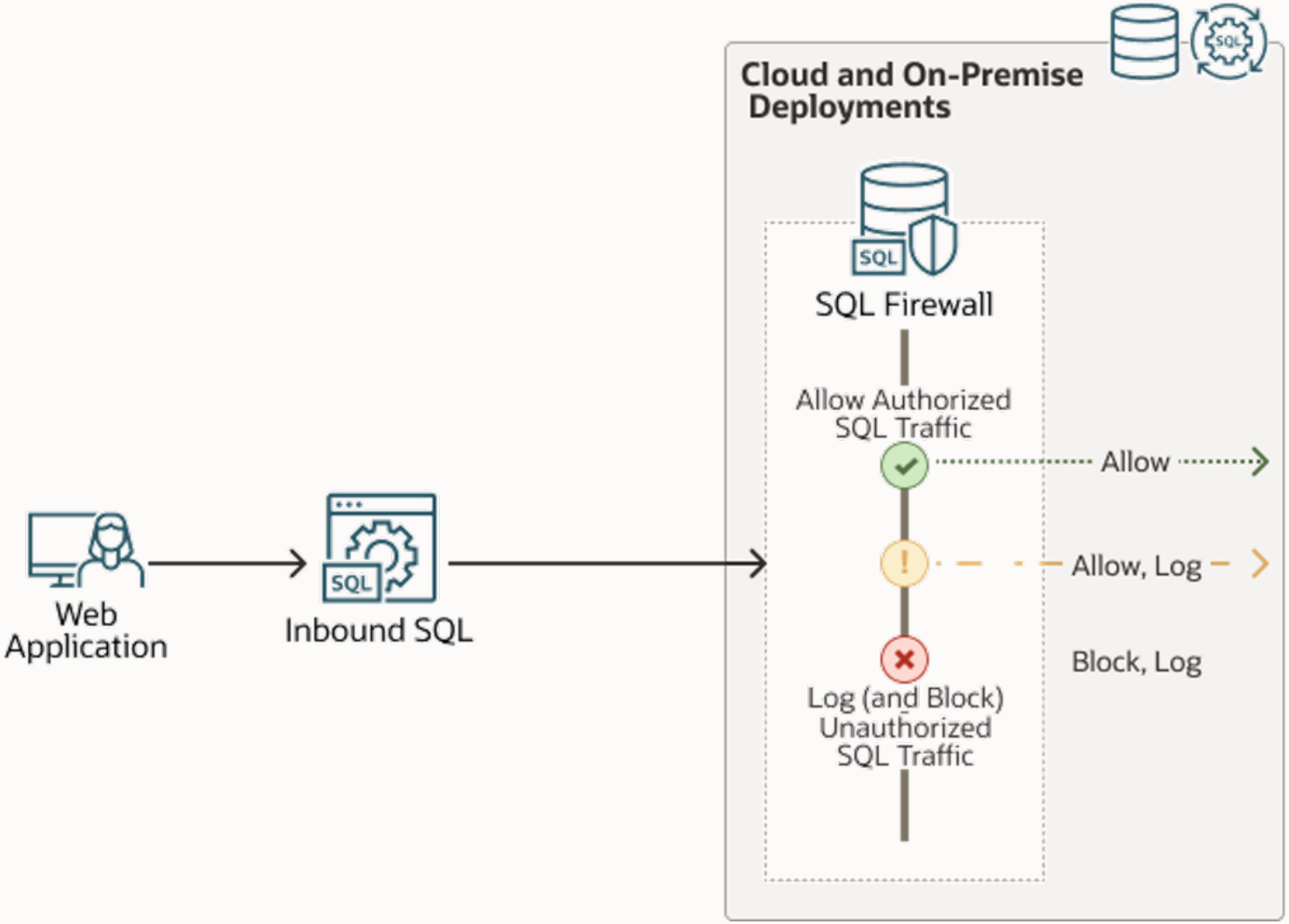
SQL Firewall



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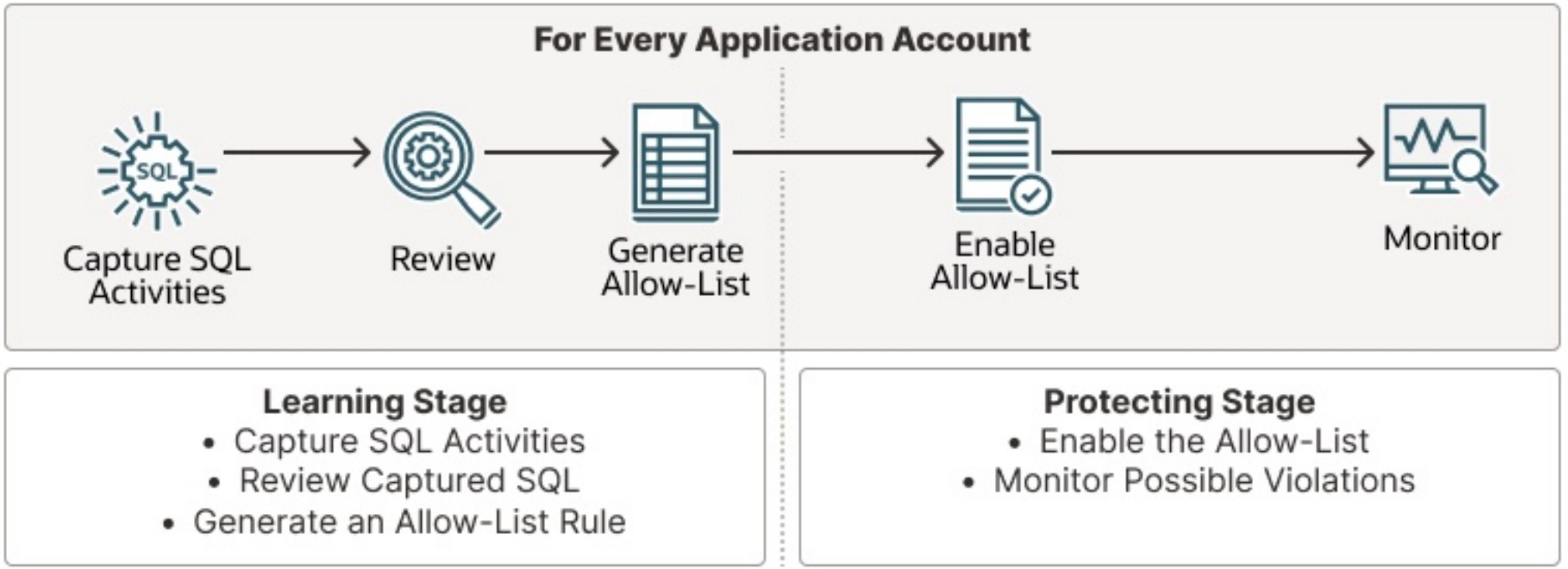
SQL Firewall



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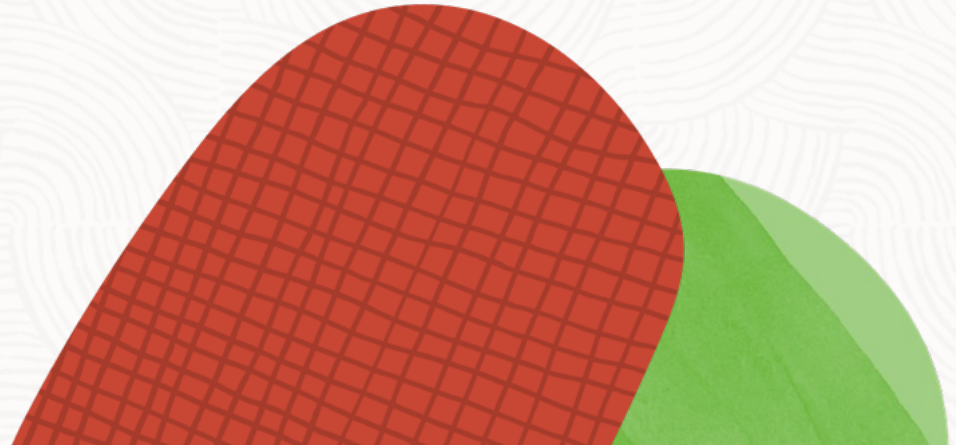
Oracle Database 23c

Small, but useful



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```
--Regardless of whether the object exists or not,
--the DROP command don't produce an error


SQL> drop table t1;

ERROR at line 1:
ORA-00942: table or view does not exist

SQL> drop table if exists t1 ... ;

Table dropped
```


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```
--Regardless of whether the object exists or not,
--the CREATE command don't produce an error


SQL> create table t1 ( ... );

ERROR at line 1:
ORA-00955: name is already used by an existing object

SQL> create table if not exists t1 (c1 number);

Table created
```


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```
--Group by expression must be written in full
--Works for HAVING clause as well
```

```
select   owner, to_char(created, 'YYYYMM'), count(*)
from     dba_objects
group by owner, to_char(created, 'YYYYMM');
```


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```
--Group by expression must be written in full
--Works for HAVING clause as well

alter session set group_by_position_enabled=true;

select   owner, to_char(created, 'YYYYMM'), count(*)
from     dba_objects
group by 1, 2;
```


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```
sqlplus appuser@alias_does_not_exist

ERROR:
ORA-12154: Cannot connect to database. Could not find alias
alias_does_not_exist in
/opt/oracle/product/23c/dbhome_1/network/admin/tnsnames.ora.
Help: https://docs.oracle.com/error-help/db/ora-12154/
```


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```
sqlplus appuser@alias_does_not_exist

ERROR:
ORA-12154: Cannot connect to database. Could not find alias
alias_does_not_exist in
/opt/oracle/product/23c/dbhome_1/network/admin/tnsnames.ora.
Help: https://docs.oracle.com/error-help/db/ora-12154/
```


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```
SQL> oerr ORA-12154

Message: "Cannot connect to database. Could not find alias %s in %s."
Help: https://docs.oracle.com/error-help/db/ora-12154/
Cause:  A connection to a database or other service was requested using a
        connection alias but the alias specified could not be resolved into
        a connect descriptor using one of the configured naming methods.
Action: Do the following:
        - Check for mistakes in the connection string that you used.
        - If you have a sqlnet.ora file containing a NAMES.DIRECTORY_PATH
          parameter, then ensure that the parameter contains valid values.
        - If you are using an alias from a tnsnames.ora file:
          * Verify that the tnsnames.ora file exists, is in the proper
            directory, and is accessible.
          * Ensure that the alias exists in one of the tnsnames.ora files.
          * Ensure that there are no syntax errors anywhere in the
            tnsnames.ora file or files. Look for unmatched parentheses or
            stray characters. Ensure that magic quotes are not used.

        ...
```


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```
SQL> ping salesgold

Network service name mapping file:
/opt/oracle/product/23c/dbhome_1/network/admin/tnsnames.ora
Attempting to contact: (DESCRIPTION = (CONNECT_TIMEOUT=5) (RETRY_COUNT=2) (RETRY_DELAY=3)
(TRANSPORT_CONNECT_TIMEOUT=3) (ADDRESS_LIST = (LOAD_BALANCE=on) (ADDRESS = (PROTOCOL =
TCP)(HOST=localhost)(PORT=1521))) (CONNECT_DATA= (SERVICE_NAME = pdb1)))

Ok (1.177 msec)
```


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```
--Examines a bigfile tablespace to find objects that can be moved
--to the start of the data files. In the end, shrink the data file
--to release the space.
--Tablespace MUST be ASSM managed. Does not work in SYSTEM and SYSAUX.


exec dbms_space.tablespace_shrink('USERS');
```


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Tablespace Shrink

- Dependent objects and cursors might be invalidated
- Objects are moved in an online manner
- Purges recycle bin

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the most

important change

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```
--No longer need to select from dual

select sysdate from dual;

select sysdate;
```


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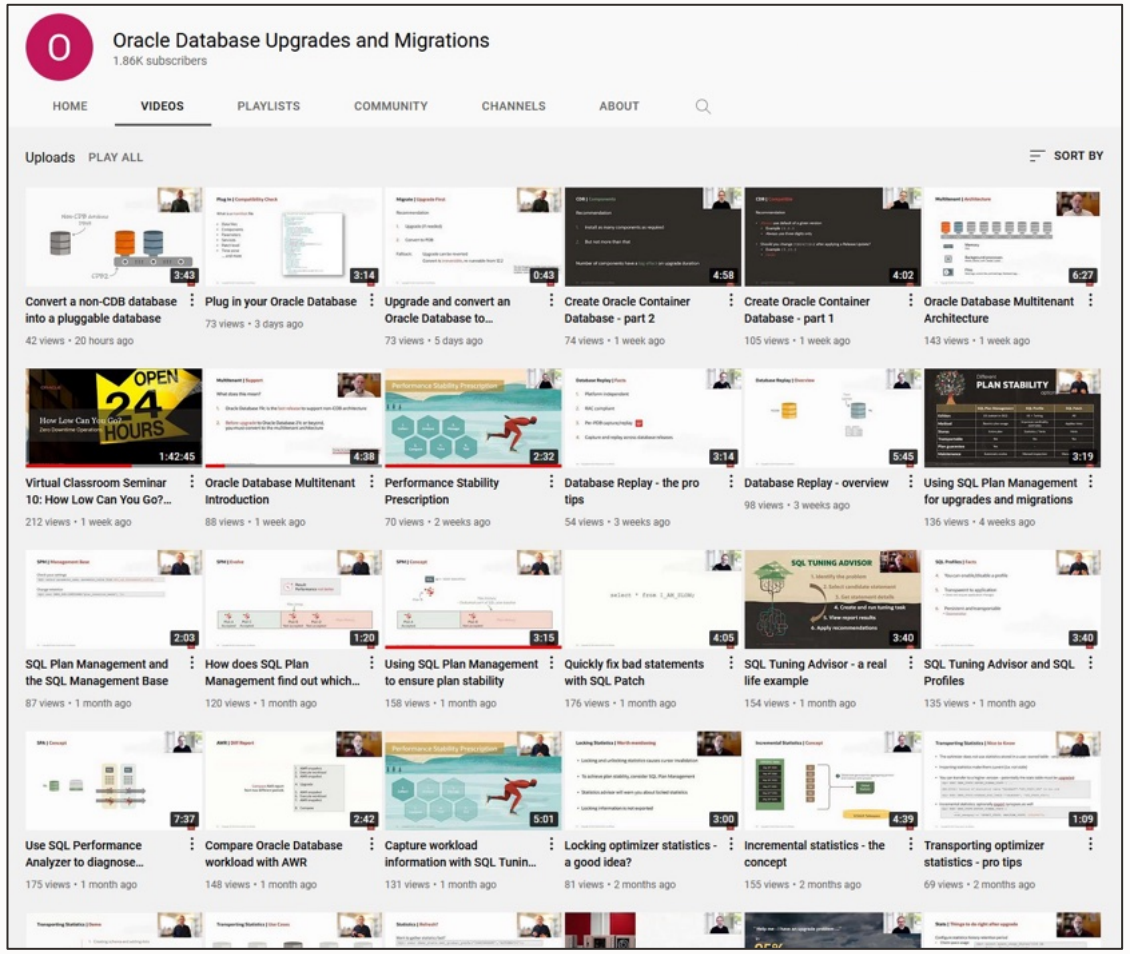

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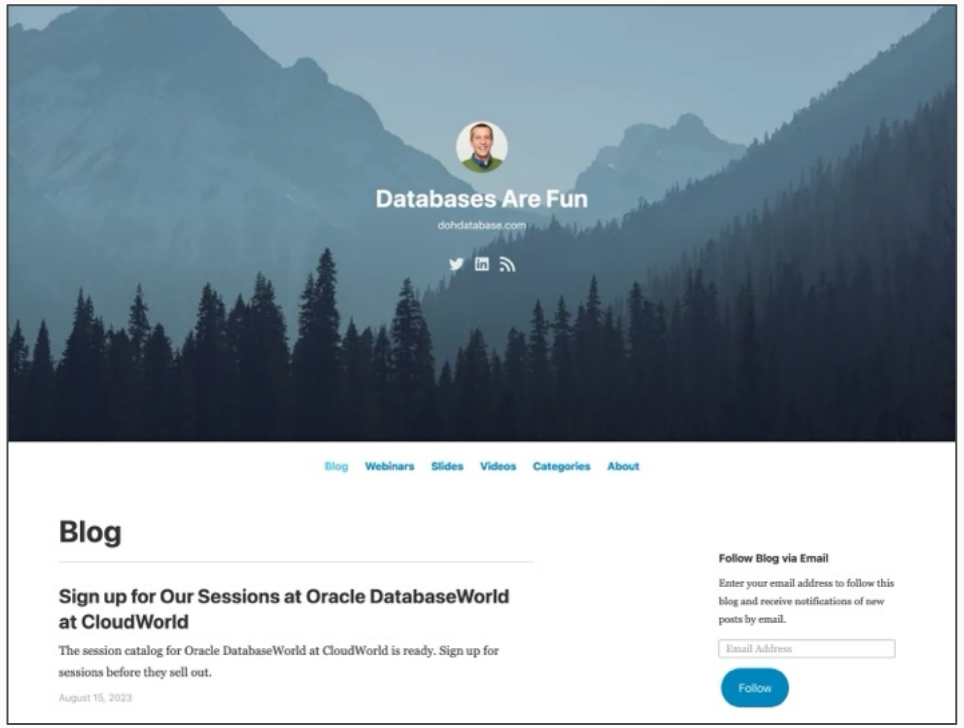
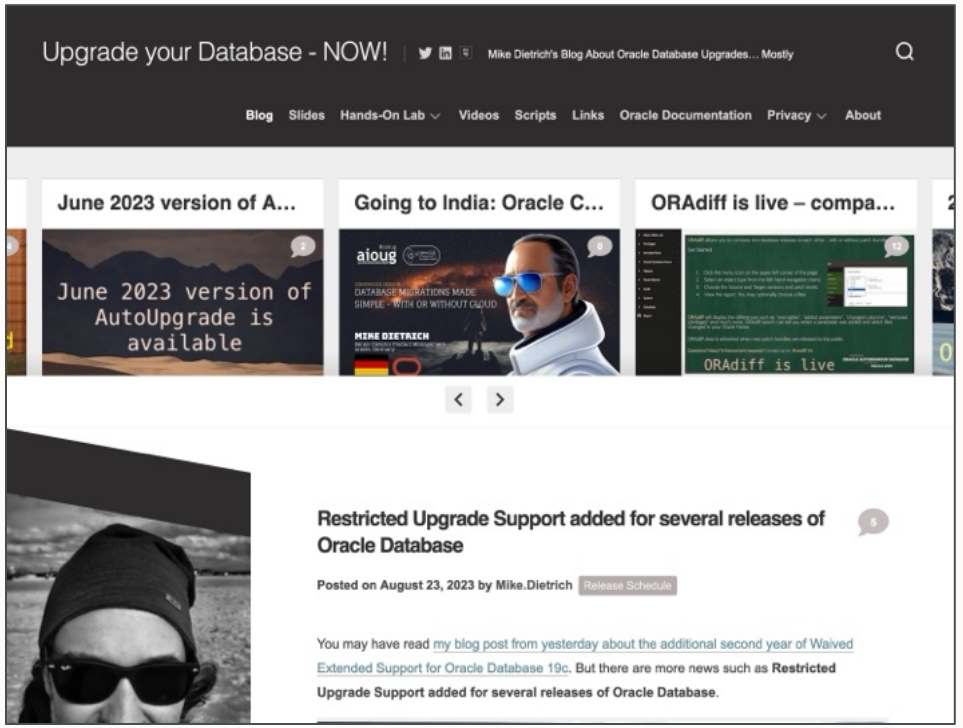


MikeDietrichDE.com



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Thank You

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