#aioug
aioug
ALL INDIA ORACLE USERS GROUP
https://www.aioug.org/sangam21

#sangam21
sangam 21
.....meeting of minds

AutoUpgrade Master Class

More than upgrades

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AutoUpgrade Master Class

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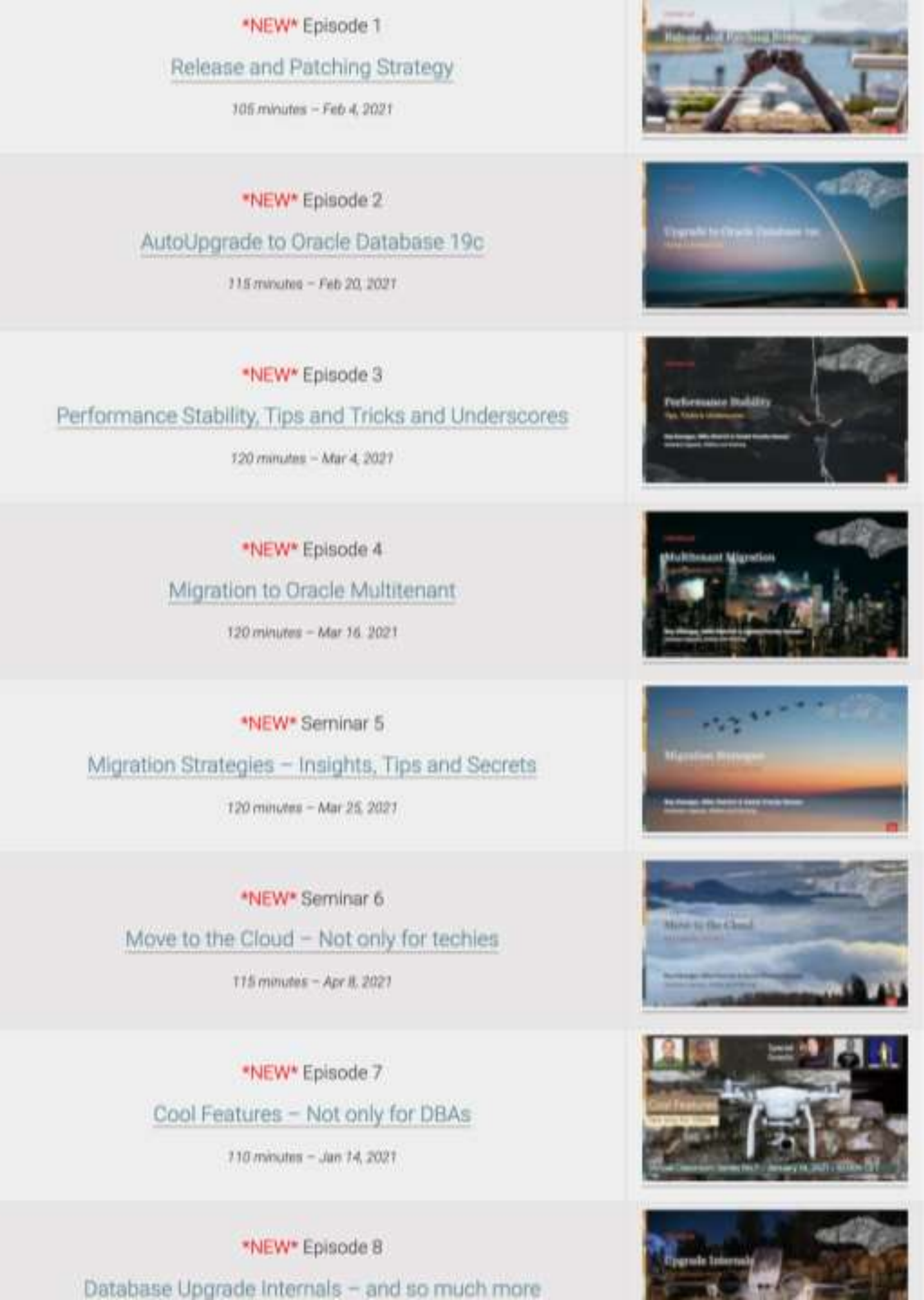
Recorded Web Seminars

https://MikeDietrichDE.com/videos



NEW Episode 1

Release and Patching Strategy

105 minutes – Feb 4, 2021

NEW Episode 2

AutoUpgrade to Oracle Database 19c

115 minutes – Feb 20, 2021

NEW Episode 3

Performance Stability, Tips and Tricks and Underscores

120 minutes – Mar 4, 2021

NEW Episode 4

Migration to Oracle Multitenant

120 minutes – Mar 16, 2021

NEW Seminar 5

Migration Strategies – Insights, Tips and Secrets

120 minutes – Mar 25, 2021

NEW Seminar 6

Move to the Cloud – Not only for techies

115 minutes – Apr 8, 2021

NEW Episode 7

Cool Features – Not only for DBAs

110 minutes – Jan 14, 2021

NEW Episode 8

Database Upgrade Internals – and so much more

Chapter 1

Release and Patching Strategy

Photo by Reid Naaykens on Unsplash

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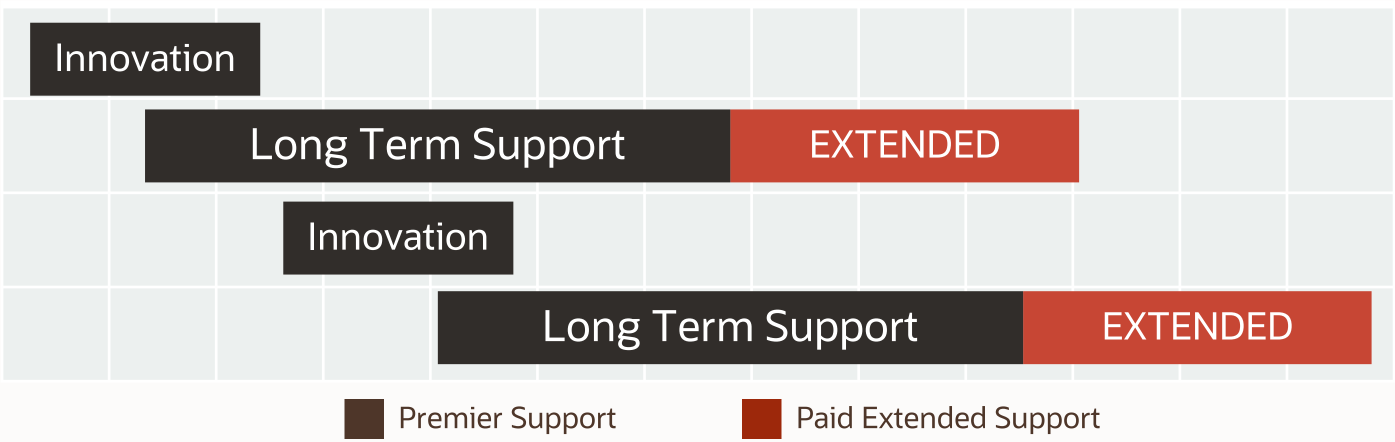
Release Types | Long Term Support vs Innovation Releases

Long Term Support Release

- 5 years of Premier Support followed by 3 years of Extended Support

Innovation Release

- 2 years of Premier Support, but there is no Extended Support



Recommendation: Production environments should go from LTS to LTS

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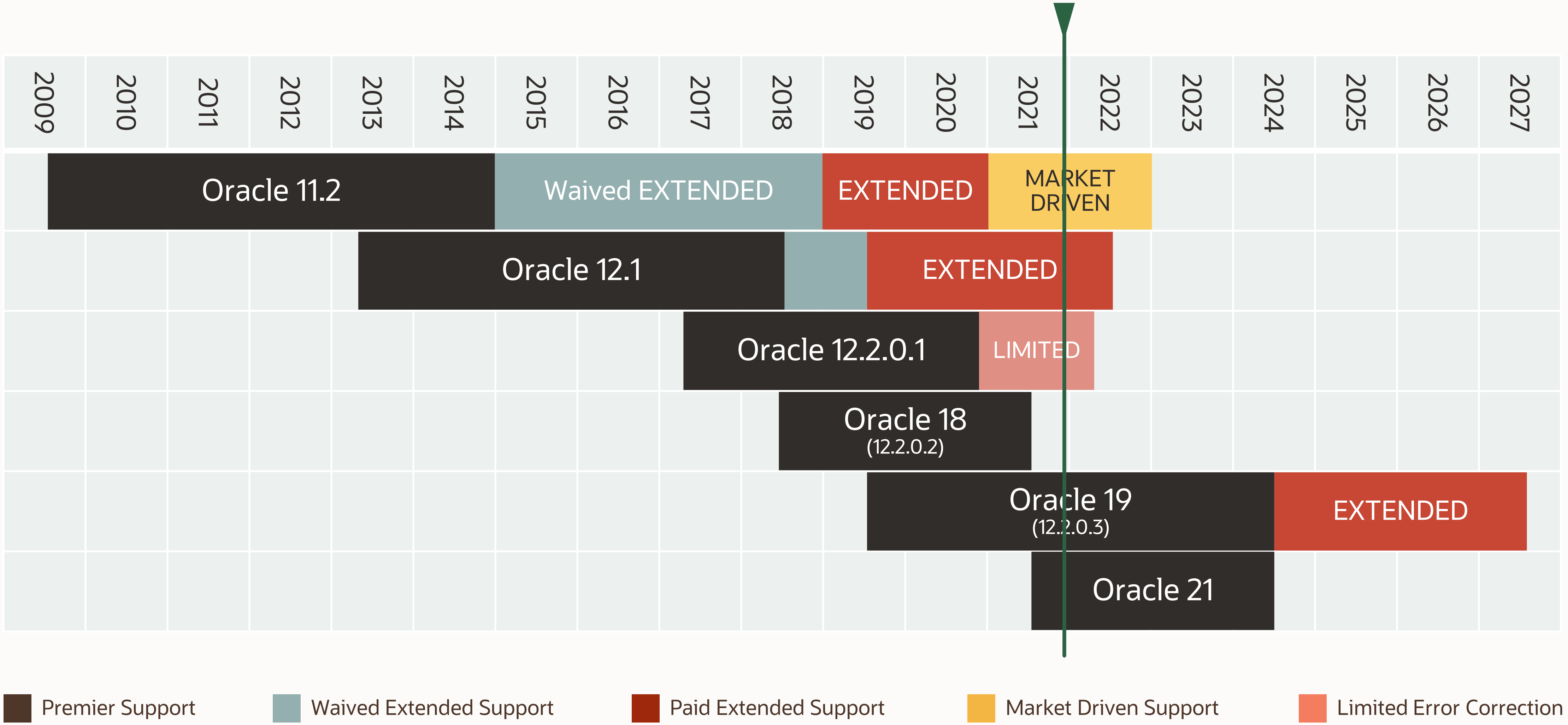
Move production databases from one Long Term Support release to the next

Lifetime Support Policy



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Lifetime Support Policy

Different Support Periods

🟫	Premier Support	Bug fixing support regardless of severity
🟥	Paid Extended Support	Extra cost extension, 10% / 20% extra cost Included in ULA/PULA contracts
🟦	Waived Extended Support	Extended support gets waived to everybody having a valid Support contract for the product
🟨	Market Driven Support	Extra cost extension after Extended Support Fixes done only for critical and security issues
🟧	Limited Error Correction	Extension for Oracle 12.2.0.1 at no extra cost Only applicable for Sev.1 and security issues
⬜	Sustaining Support	Oracle Support assists as long as the customer is using the product – but no new fixes will be delivered

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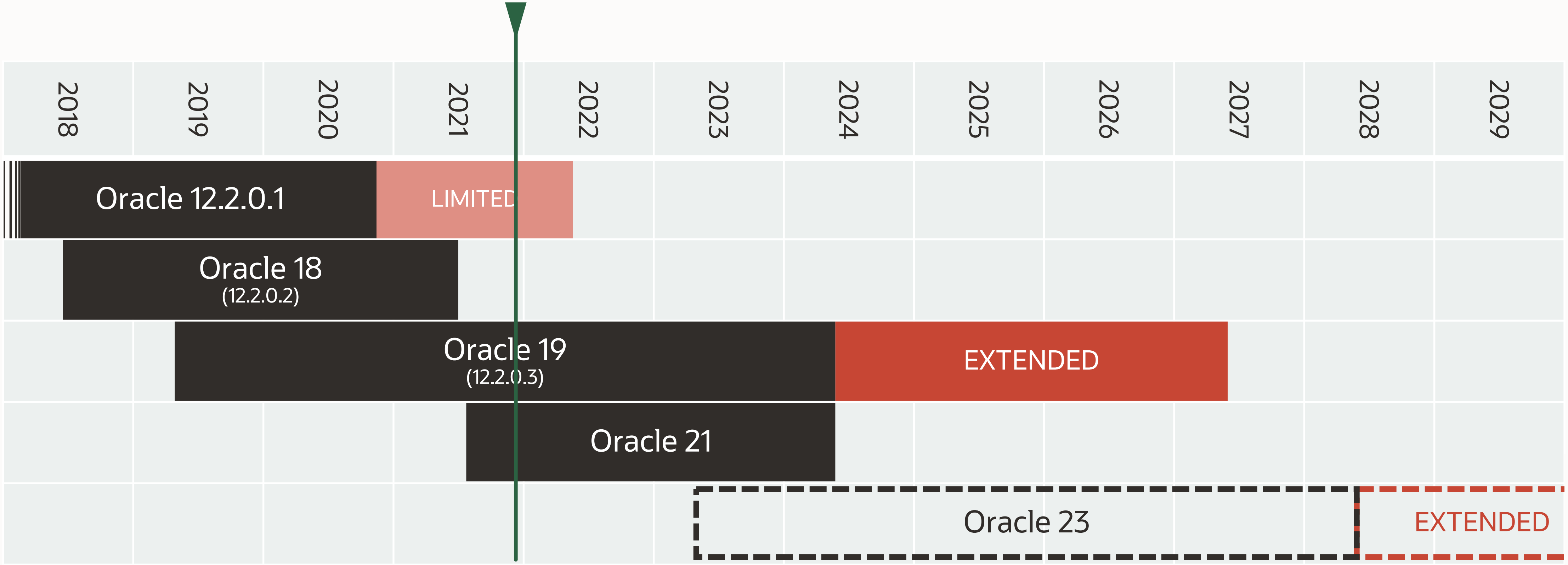
Oracle Database 12.2 and beyond



- MOS Note:742060.1 - The Single Source of Truth
- MOS Note:161818.1 - Releases Support Status Summary

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Chapter 2

Upgrade to Oracle Database 19c

Photo by SpaceX on Unsplash

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your key to

Successful Database Upgrades

Step 1
Download and install Oracle 19c
eDelivery.oracle.com

Step 2
Download and install newest RU
MOS Note: 2118136.2

Step 3
Download and use AutoUpgrade
MOS Note: 2485457.1

Step 4
Performance Stability with SPM, STA and RAT

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Get started | Quick Start Guide

Simple overview

Read it, try it

Download from oracle.com

ORACLE

Oracle Database Upgrade:
Quick Start Guide

A quick reference to a successful Oracle Database upgrade

Feb 20, 2020 | Version 1.0
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Public

Database Upgrade | Supported Releases

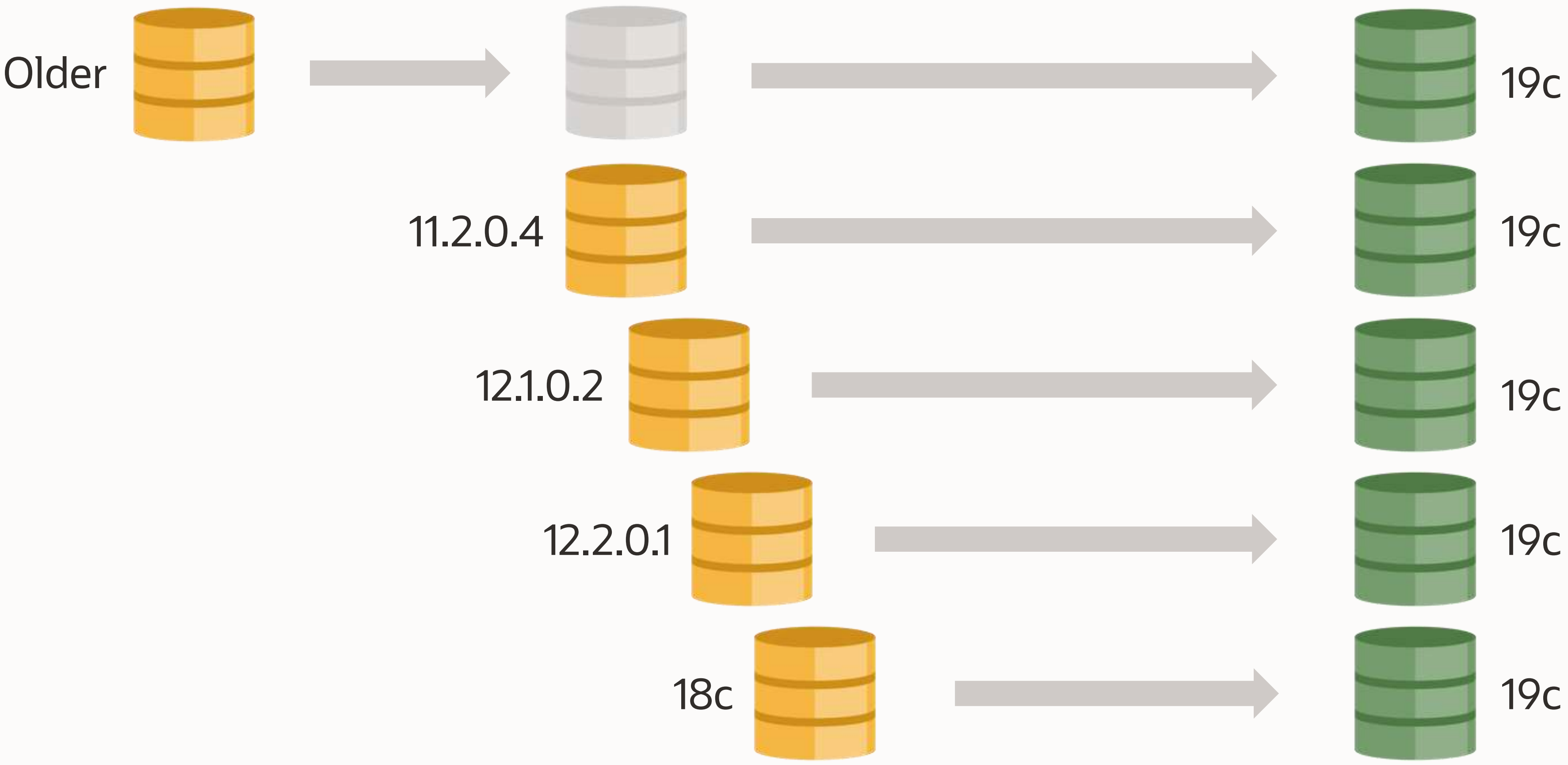


Photo by Joshua Sortino on Unsplash

AutoUpgrade

The ONLY recommended way to upgrade databases

Upgrade | AutoUpgrade - As Easy As 1-2-3

START

1. DOWNLOAD

2. CONFIG

3. DEPLOY

SUCCESS

Supported source releases

- 11.2.0.4
- 12.1.0.2
- 12.2.0.1
- 18
- 19

All architectures (CDB and non-CDB)
All supported operating systems
All editions (SE2, EE)
All types (single instance and RAC)

Upgrade | AutoUpgrade - As Easy As 1-2-3

START

1. DOWNLOAD

2. CONFIG

3. DEPLOY

SUCCESS

Download from My Oracle Support ID 2485457.1

Upgrade | AutoUpgrade - As Easy As 1-2-3

START
1. DOWNLOAD
2. CONFIG
3. DEPLOY
SUCCESS

Simple text file

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=CDB1
```

Upgrade | AutoUpgrade - As Easy As 1-2-3

START

1. DOWNLOAD

2. CONFIG

3. DEPLOY

SUCCESS

One command

```
$ java -jar autoupgrade.jar -config cdb1.cfg -mode deploy
```

Advanced monitoring and logging

Upgrade | AutoUpgrade - As Easy As 1-2-3

START

1. DOWNLOAD

2. CONFIG

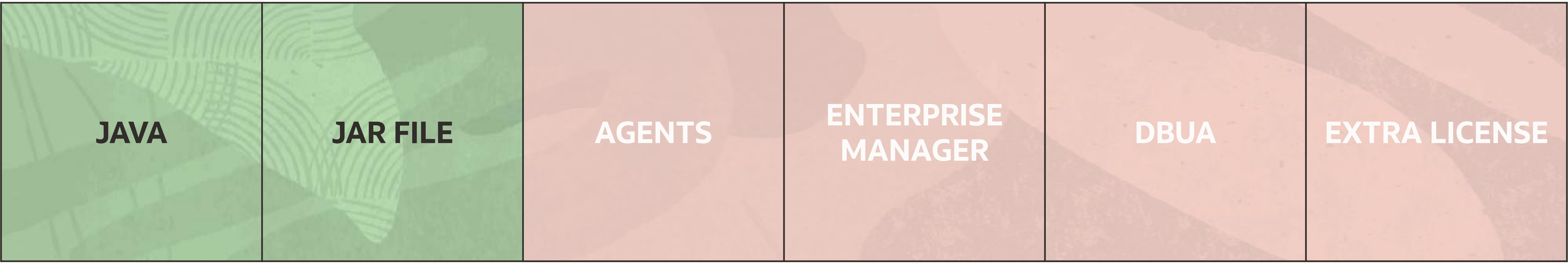
3. DEPLOY

SUCCESS

Supported target releases

- 12.2.0.1
- 18
- 19
- 21
- Any future release

AutoUpgrade | Need And Don't Need



JAVA

JAR FILE

AGENTS

ENTERPRISE MANAGER

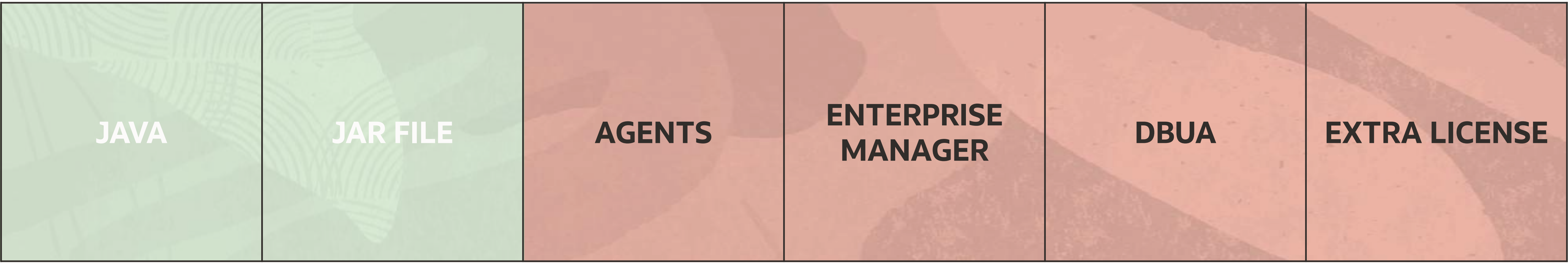
DBUA

EXTRA LICENSE

- Java 8 required
  - Part of Oracle Home since 12.1.0.2

- 3 MB jar file

AutoUpgrade | Need And Don't Need



JAVA

JAR FILE

AGENTS

ENTERPRISE MANAGER

DBUA

EXTRA LICENSE

- No agents to install
- Enterprise Manager not needed
- AutoUpgrade offers superior functionality
- No extra license

AutoUpgrade Essentials

Photo by Daniel Cheung on Unsplash

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AutoUpgrade | Essentials

Download

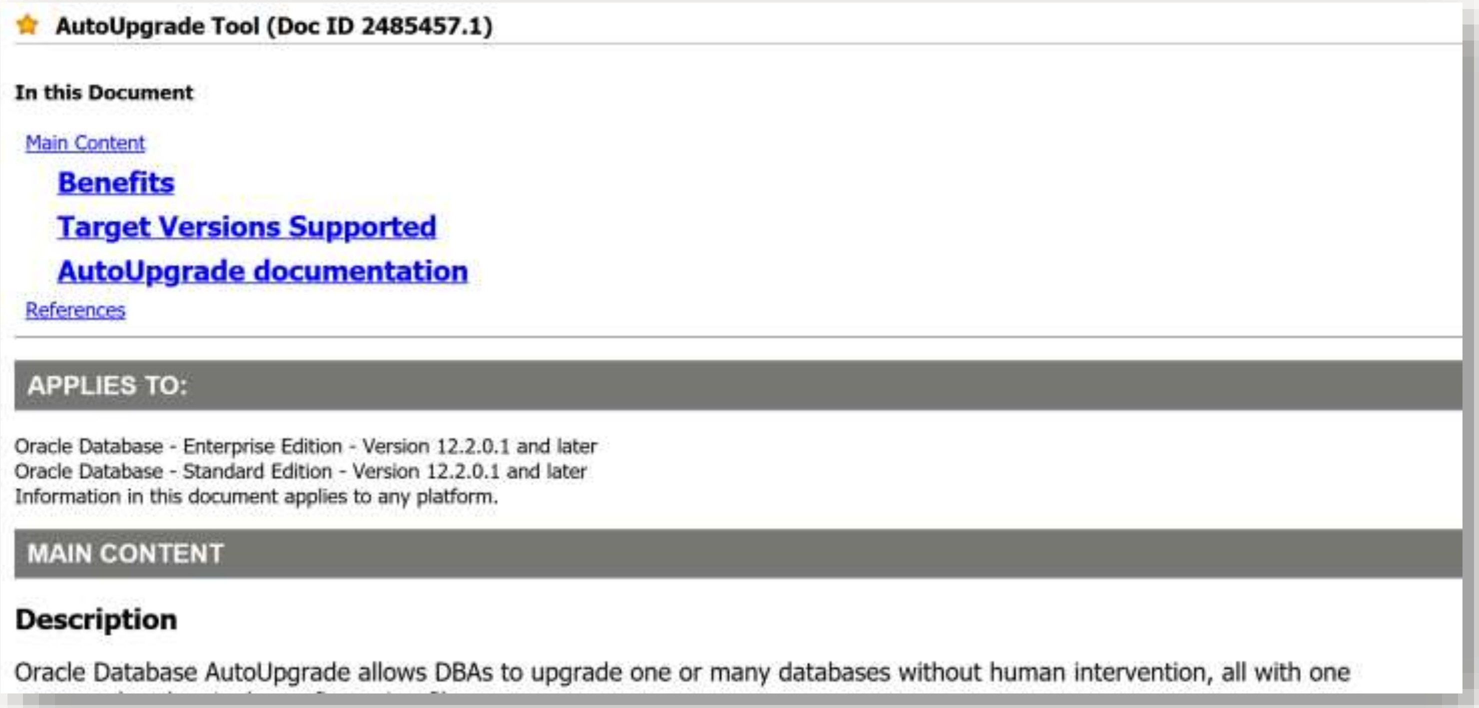
Configure

Analyze

Check

Upgrade

Always download latest version from MOS



AutoUpgrade Tool (Doc ID 2485457.1)

In this Document

- Main Content
  - **Benefits**
  - **Target Versions Supported**
  - **AutoUpgrade documentation**
- References

APPLIES TO:

Oracle Database - Enterprise Edition - Version 12.2.0.1 and later
Oracle Database - Standard Edition - Version 12.2.0.1 and later
Information in this document applies to any platform.

MAIN CONTENT

Description

Oracle Database AutoUpgrade allows DBAs to upgrade one or many databases without human intervention, all with one

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AutoUpgrade | Essentials

Download

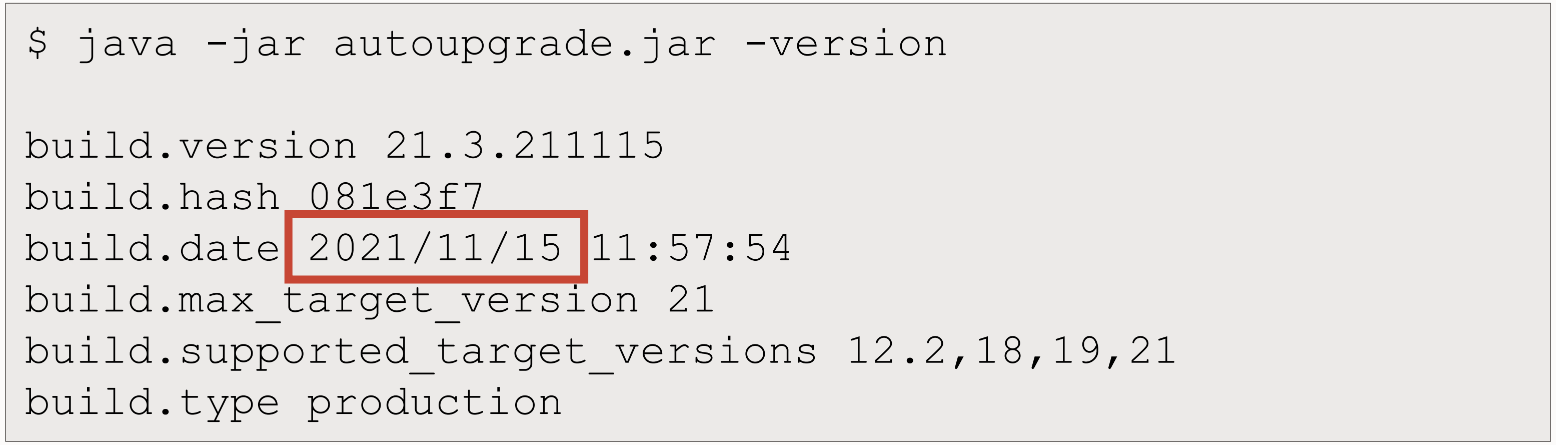
Configure

Analyze

Check

Upgrade

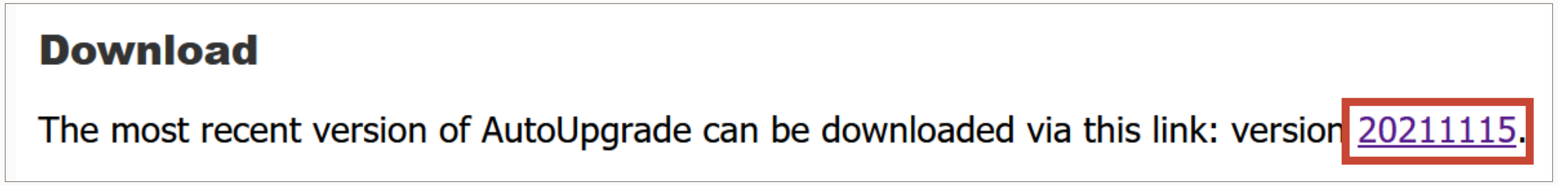
Check your version



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

build.version 21.3.211115
build.hash 081e3f7
build.date 2021/11/15 11:57:54
build.max_target_version 21
build.supported_target_versions 12.2,18,19,21
build.type production
```

Compare to latest version on MOS



Download

The most recent version of AutoUpgrade can be downloaded via this link: version 20211115.

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AutoUpgrade | Essentials

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Configure

Analyze

Check

Upgrade

AutoUpgrade handles older releases as well

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

build.version 21.3.211115
build.hash 081e3f7
build.date 2021/11/15 11:57:54
build.max_target_version 21
build.supported_target_versions 12.2,18,19,21
```

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AutoUpgrade | Essentials

- Download
- **Configure**
- Analyze
- Check
- Upgrade

Shortest possible config file version

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=CDB1
```

Or, generate a sample config file

```
$ java -jar autoupgrade.jar -create_sample_file config

Created sample configuration file /home/oracle/sample_config.cfg
```

Pro tip: `upg1` is a prefix that you decide.
Use it to define multiple databases

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Configure

Analyze

Check

Upgrade

Analyze your database

```
$ java -jar autoupgrade.jar -config CDB1.cfg -mode analyze

...

upg> Job 100 completed

Please check the summary report at:
/u01/app/oracle/cfgtoollogs/autoupgrade/cfgtoollogs/upgrade/auto/status/status.html
/u01/app/oracle/cfgtoollogs/autoupgrade/cfgtoollogs/upgrade/auto/status/status.log
```

Pro tip: Analyze is similar to running `preupgrade.jar`

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Configure
Analyze
Check
Upgrade

Summary report - text

```
==========================================
          Autoupgrade Summary Report
==========================================
[Date]           Tue Jan 12 10:26:19 CET 2021
[Number of Jobs] 1
==========================================
[Job ID] 100
==========================================
[DB Name]                CDB1
[Version Before Upgrade] 12.2.0.1.0
[Version After Upgrade]  19.9.0.0.0
------------------------------------------
[Stage Name]    PRECHECKS
[Status]        SUCCESS
[Start Time]    2021-01-12 10:25:58
[Duration]      0:00:20
[Log Directory] /u01/app/oracle/upg/CDB1/100/prechecks
[Detail]        /u01/app/oracle/upg/CDB1/100/prechecks/cdb1_preupgrade.log
                Precheck passed and no manual intervention needed
------------------------------------------
```

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AutoUpgrade | Essentials

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Configure

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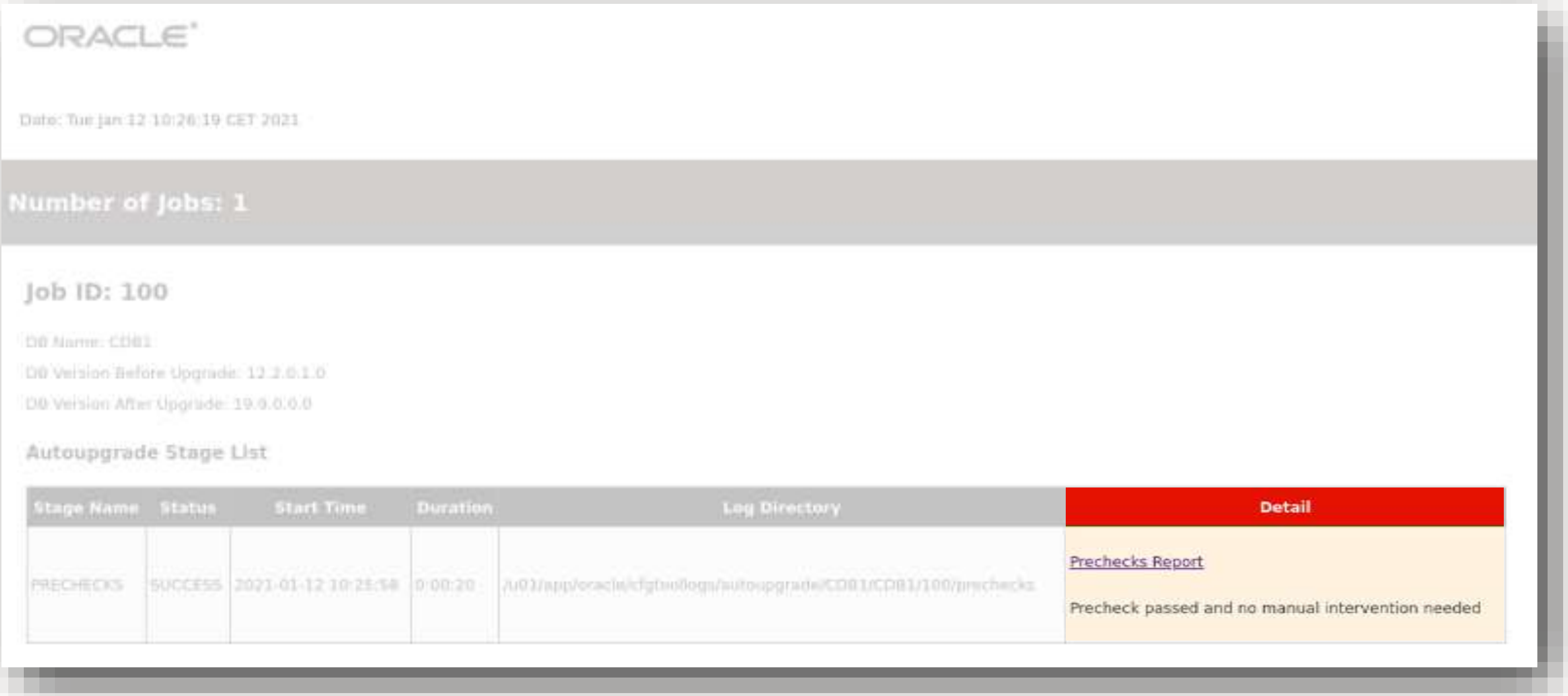
Summary report - HTML



Date: Tue Jan 12 10:26:19 CET 2021

Number of Jobs: 1

Job ID: 100

DB Name: CDB1

DB Version Before Upgrade: 12.2.0.1.0

DB Version After Upgrade: 19.0.0.0.0

Autoupgrade Stage List

Stage Name	Status	Start Time	Duration	Log Directory	Detail
PRECHECKS	SUCCESS	2021-01-12 10:25:58	0:00:20	/u01/app/oracle/cfgtoollogs/autoupgrade/CDB1/CDB1/100/prechecks	Prechecks Report Precheck passed and no manual intervention needed

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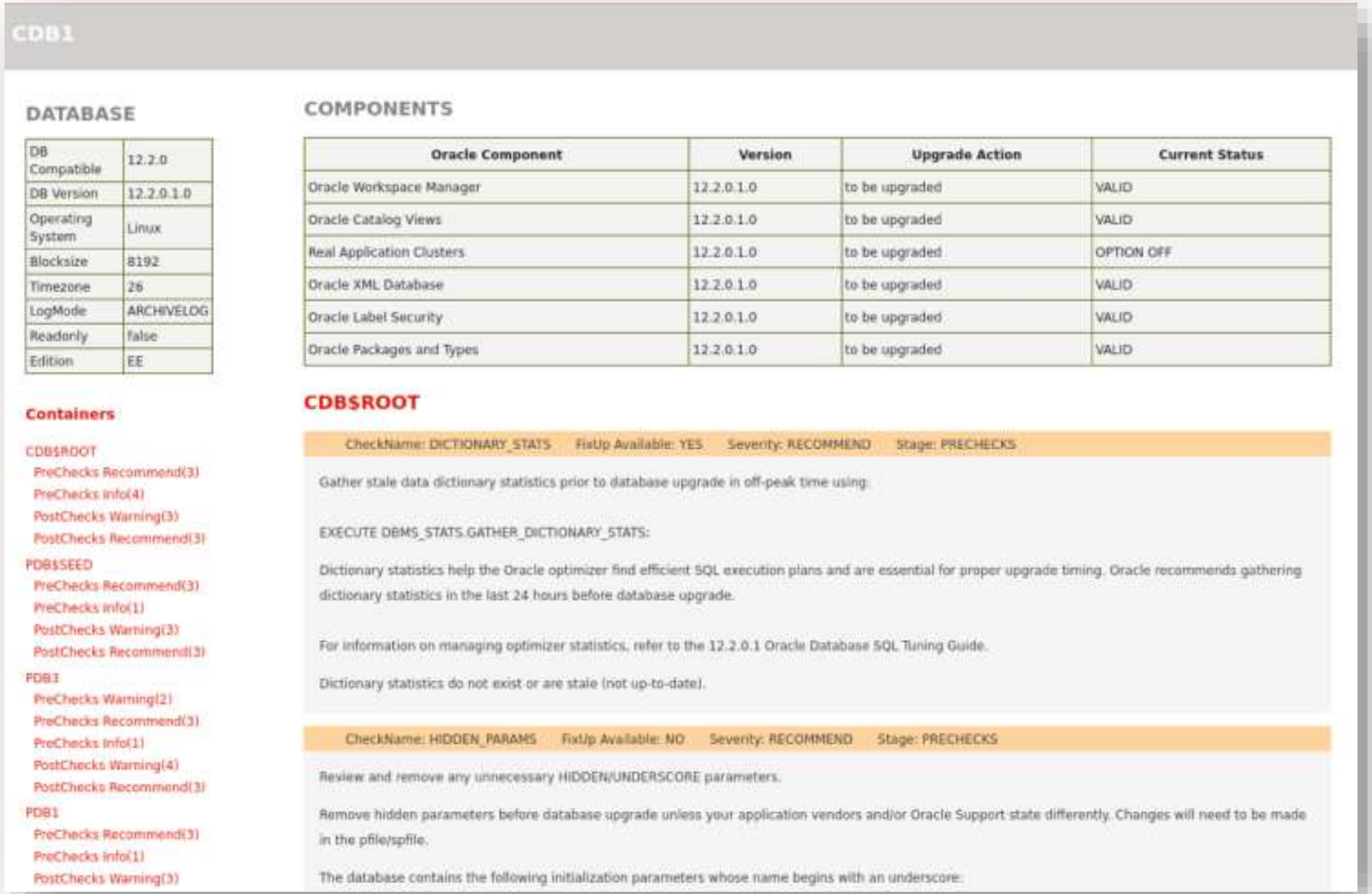
AutoUpgrade | Essentials

- Download
- Configure
- Analyze
- **Check**
- Upgrade



CDB1

DATABASE

DB Compatible	12.2.0
DB Version	12.2.0.1.0
Operating System	Linux
Blocksize	8192
Timezone	26
LogMode	ARCHIVELOG
Readonly	false
Edition	EE

Containers

- CDB$ROOT
  - PreChecks Recommend(3)
  - PreChecks Info(4)
  - PostChecks Warning(3)
  - PostChecks Recommend(3)
- PDB$SEED
  - PreChecks Recommend(3)
  - PreChecks Info(1)
  - PostChecks Warning(3)
  - PostChecks Recommend(3)
- PDB3
  - PreChecks Warning(2)
  - PreChecks Recommend(3)
  - PreChecks Info(1)
  - PostChecks Warning(4)
  - PostChecks Recommend(3)
- PDB1
  - PreChecks Recommend(3)
  - PreChecks Info(1)
  - PostChecks Warning(3)

COMPONENTS

Oracle Component	Version	Upgrade Action	Current Status
Oracle Workspace Manager	12.2.0.1.0	to be upgraded	VALID
Oracle Catalog Views	12.2.0.1.0	to be upgraded	VALID
Real Application Clusters	12.2.0.1.0	to be upgraded	OPTION OFF
Oracle XML Database	12.2.0.1.0	to be upgraded	VALID
Oracle Label Security	12.2.0.1.0	to be upgraded	VALID
Oracle Packages and Types	12.2.0.1.0	to be upgraded	VALID

CDB$ROOT

CheckName: DICTIONARY_STATS FixUp Available: YES Severity: RECOMMEND Stage: PRECHECKS

Gather stale data dictionary statistics prior to database upgrade in off-peak time using:

EXECUTE DBMS_STATS.GATHER_DICTIONARY_STATS;

Dictionary statistics help the Oracle optimizer find efficient SQL execution plans and are essential for proper upgrade timing. Oracle recommends gathering dictionary statistics in the last 24 hours before database upgrade.

For information on managing optimizer statistics, refer to the 12.2.0.1 Oracle Database SQL Tuning Guide.

Dictionary statistics do not exist or are stale (not up-to-date).

CheckName: HIDDEN_PARAMS FixUp Available: NO Severity: RECOMMEND Stage: PRECHECKS

Review and remove any unnecessary HIDDEN/UNDERSCORE parameters.

Remove hidden parameters before database upgrade unless your application vendors and/or Oracle Support state differently. Changes will need to be made in the pfile/spfile.

The database contains the following initialization parameters whose name begins with an underscore:

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Preupgrade report comes in:

- HTML
- Text
- JSON

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Upgrade

```
$ java -jar autoupgrade.jar -config CDB1.cfg -mode deploy
```

Have a cup of coffee and wait, or ...

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Check

Upgrade

Monitor

```
upg> lsj

+----+-------+---------+---------+-------+--------------+--------+---------------+
|Job#|DB_NAME|    STAGE|OPERATION| STATUS|    START_TIME| UPDATED|        MESSAGE|
+----+-------+---------+---------+-------+--------------+--------+---------------+
| 101|   CDB1|PREFIXUPS|EXECUTING|RUNNING|20/11/24 13:38|13:39:26|Remaining 12/13|
+----+-------+---------+---------+-------+--------------+--------+---------------+
```

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All the details

```
upg> status -job 101

Progress
-----------------------------------
Start time:      20/11/24 13:38
Elapsed (min):   13
Last update:     2020-11-24T13:48:52.139
Stage:           DBUPGRADE
Operation:       EXECUTING
Status:          RUNNING
Stage summary:
    SETUP                <1 min
    GRP                  <1 min
    PREUPGRADE           <1 min
    PRECHECKS            <1 min
    PREFIXUPS            8 min
    DRAIN                <1 min
    DBUPGRADE            3 min (IN PROGRESS)

Job Logs Locations
-----------------------------------
Logs Base:    /home/oracle/autoupg_default/CDB1/CDB1
Job logs:     /home/oracle/autoupg_default/CDB1/CDB1/101
Stage logs:   /home/oracle/autoupg_default/CDB1/CDB1/101/dbupgrade
TimeZone:     /home/oracle/autoupg_default/CDB1/CDB1/temp
```

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All the details - continued

```
...

Additional information
-----------------------------------
Details:
[Upgrading] is [0%] completed for [cdb1-cdb$root]
                 +---------+---------------+
                 |CONTAINER|     PERCENTAGE|
                 +---------+---------------+
                 | CDB$ROOT|   UPGRADE[12%]|
                 | PDB$SEED|UPGRADE PENDING|
                 |     PDB3|UPGRADE PENDING|
                 +---------+---------------+

Error Details:
None
```

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Configure

Analyze

Check

Upgrade

Success

```
upg> Job 101 completed
------------------- Final Summary --------------------
Number of databases            [ 1 ]

Jobs finished successfully     [1]
Jobs failed                    [0]
Jobs pending                   [0]
------------- JOBS FINISHED SUCCESSFULLY -------------
Job 101 for CDB1

---- Drop GRP at your convenience once you consider it is no longer needed ----
Drop GRP from CDB1: drop restore point AUTOUPGRADE_9212_CDB1122010
```

And it includes:

- Recompilation (utlrp.sql)
- Time zone file upgrade
- Postupgrade fixups
- … and so much more

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AutoUpgrade | Essentials

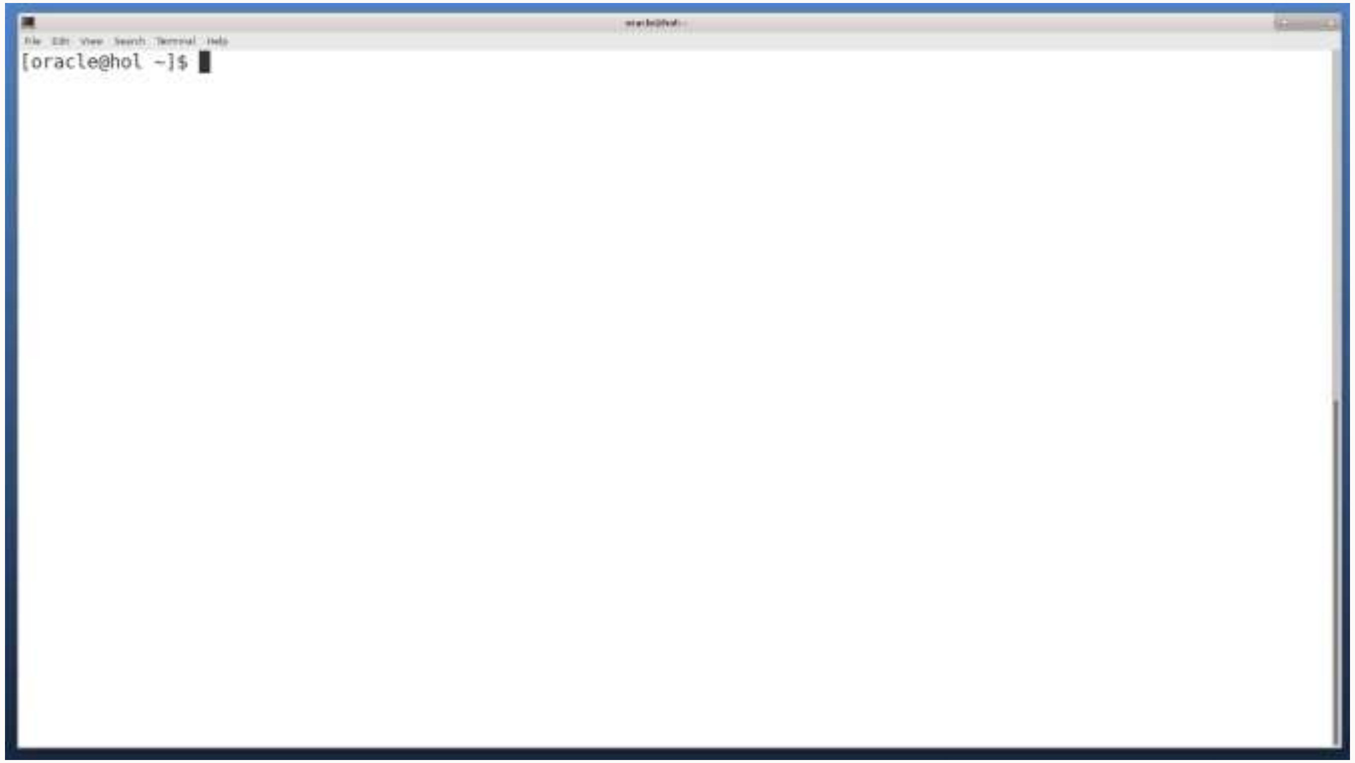
Download

Configure

Analyze

Check

Upgrade



```
[oracle@hol ~]$ 
```

Watch on YouTube

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AutoUpgrade Advanced Options

Photo by Ciprian Boiciuc on Unsplash

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AutoUpgrade | Advanced Options

Shell Scripts

Restore Point

Underscores

Time Zone

Monitoring

Execute your own scripts as part of the upgrade

You can:

- Before and after upgrade
- Halt or continue on error
- For a single or every database

Ideas:

- Enterprise Manager configuration
- Backup configuration
- Interact with apps using the database

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AutoUpgrade | Advanced Options

- **Shell Scripts**
- Restore Point
- Underscores
- Time Zone
- Monitoring

Shell script execution

```
global.before_action=/database/scripts/set_blackout.sh

upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=CDB1
upg1.after_action=/database/scripts/start_level0.sh
```

- Permitted extension options:
  - Unix shell (.sh)
  - Microsoft Windows batch (.bat, .cmd)
  - Microsoft Windows PowerShell (.ps1)

Pro tip: If you want script execution for all upgrades use `global.before_action` and `global.after_action`

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AutoUpgrade | Advanced Options

Shell Scripts

Restore Point

Underscores

Time Zone

Monitoring

Shell script execution

Default - AutoUpgrade does not react on return code

```
upg1.before_action=/database/scripts/run_this_on_UPG1_before.sh
```

Optionally - AutoUpgrade halts on non-zero return code

```
upg1.before_action=/database/scripts/run_this_on_UPG1_before.sh Y
```

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AutoUpgrade | Advanced Options

- Shell Scripts
- **Restore Point**
- Underscores
- Time Zone
- Monitoring

Guaranteed Restore Points

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=CDB1
upg1.restoration=no

upg2.source_home=/u01/app/oracle/product/12.2.0.1
upg2.target_home=/u01/app/oracle/product/19
upg2.sid=CDB2
upg2.drop_grp_after_upgrade=yes
```

- Default behavior:
  - AutoUpgrade creates GRP except for
    - Standard Edition 2
    - `restoration=no`
  - GRP will be kept
  - GRP needs to be removed manually except for
    - `drop_grp_after_upgrade=yes` will only remove it when upgrade completed successfully

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AutoUpgrade | Advanced Options

- Shell Scripts
- Restore Point
- **Underscores**
- Time Zone
- Monitoring

Underscore parameters and events

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=CDB1
upg1.remove_underscore_parameters=yes
```

- Default behavior:
  - Underscores and events will be kept

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AutoUpgrade | Advanced Options

- Shell Scripts
- Restore Point
- Underscores
- **Time Zone**
- Monitoring

Skip time zone upgrade

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=CDB1
upg1.timezone_upg=no
```

- Default behavior:
  - Time zone adjustment happens post upgrade
  - Database will be restarted several times
  - Important when you use "Downgrade" as fallback strategy as time zone can't be downgraded

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AutoUpgrade | Advanced Options

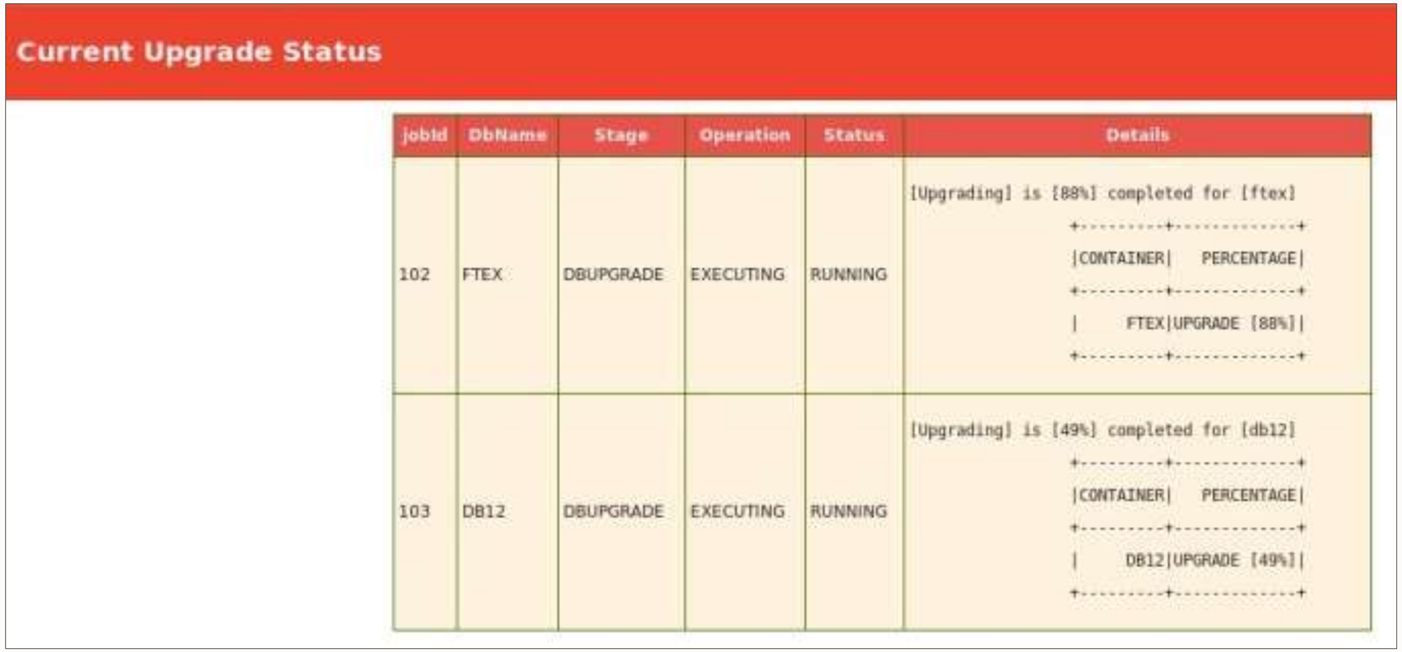
Shell Scripts

Restore Point

Underscores

Time Zone

Monitoring



Current Upgrade Status

<table>
<tr><th>jobId</th><th>DbName</th><th>Stage</th><th>Operation</th><th>Status</th><th>Details</th></tr>
<tr><td>102</td><td>FTEX</td><td>DBUPGRADE</td><td>EXECUTING</td><td>RUNNING</td><td>[Upgrading] is [88%] completed for [ftex]
+---------+------------+
|CONTAINER| PERCENTAGE|
+---------+------------+
| FTEX|UPGRADE [88%]|
+---------+------------+</td></tr>
<tr><td>103</td><td>DB12</td><td>DBUPGRADE</td><td>EXECUTING</td><td>RUNNING</td><td>[Upgrading] is [49%] completed for [db12]
+---------+------------+
|CONTAINER| PERCENTAGE|
+---------+------------+
| DB12|UPGRADE [49%]|
+---------+------------+</td></tr>
</table>

Monitor via browser:
`<au_global_log_dir>/cfgtoollogs/upgrade/auto/state.html`

Refreshes automatically every 3 minutes

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Photo by Adam Muise on Unsplash

AutoUpgrade with Data Guard

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👍 AutoUpgrade supports upgrading databases that are part of a Data Guard configuration

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AutoUpgrade | Data Guard

- Detected by AutoUpgrade automatically
- Works for broker-managed and manual Data Guard environments
- Primary database handled by AutoUpgrade
  Standby database handled manually

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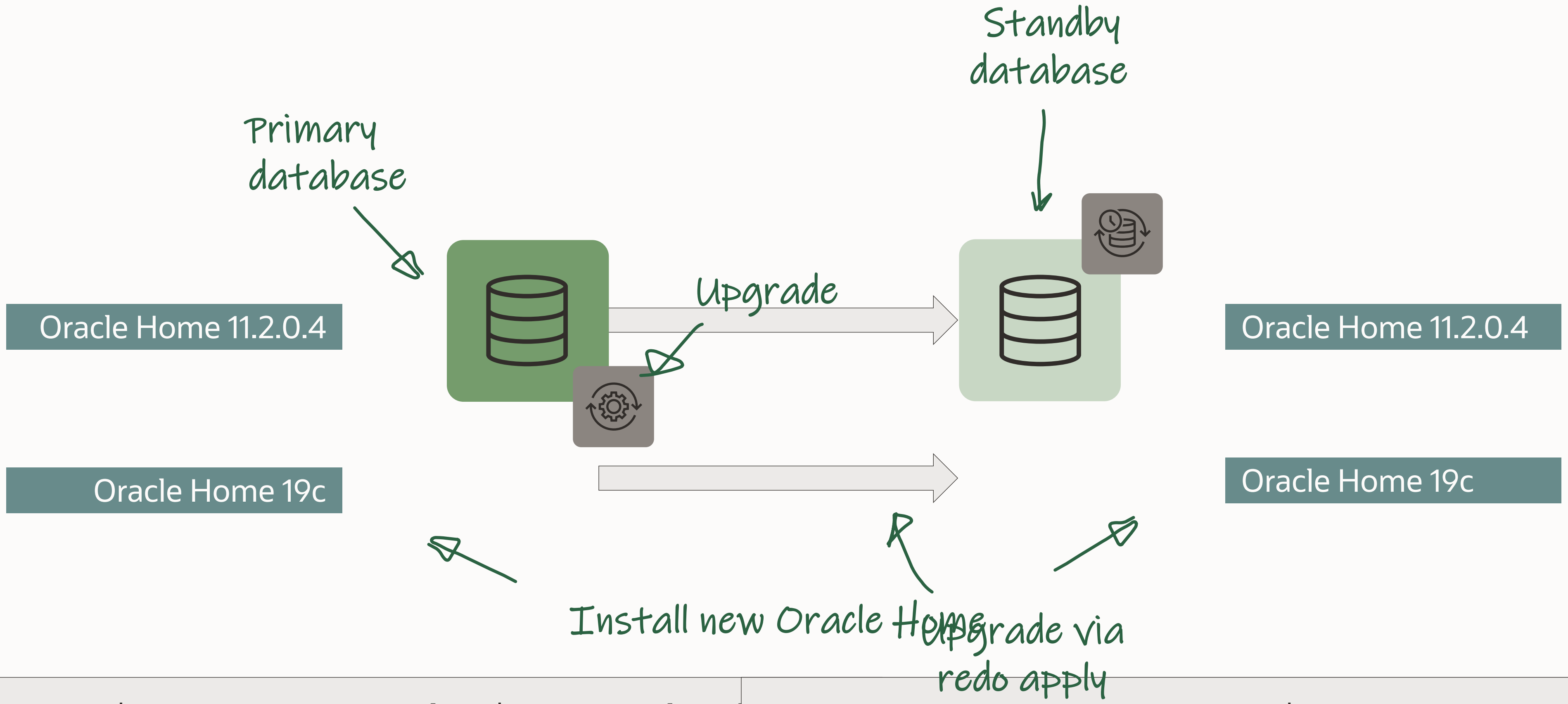
AutoUpgrade | Data Guard



Oracle Home 11.2.0.4

Oracle Home 19c

Oracle Home 11.2.0.4

Oracle Home 19c

```
$ java -jar autoupgrade.jar -mode d
```

Relea

```
SQL> create restore point ...
$ srvctl upgrade database ...
$ srvctl start database ...
```

AutoUpgrade | Data Guard

MAA Approach

- Keep standby online during upgrade
- Allows for faster go-live after upgrade
- Move standby database to new Oracle Home before upgrade
- Keep redo transport and redo apply on during upgrade

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AutoUpgrade | Data Guard

Our Approach

```
upg1.defer_standby_log_shipping=yes
```

- Keep standby offline during upgrade
- Downtime extended while standby applies redo
- Move standby database to new Oracle Home after upgrade
- Safer because is left untouched - but slower

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Photo by Philipp Katzenberger on Unsplash

AutoUpgrade and RAC

UPGRADE
RAC DATABASE

1

UPGRADE GRID INFRASTRUCTURE

- Not covered by AutoUpgrade
- Recommended to upgrade one week in advance

2

UPGRADE DATABASE

- Upgrade with AutoUpgrade
- Everything handled by AutoUpgrade

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AutoUpgrade | RAC

WHAT IS REQUIRED?

- Linux or Unix-based system
- Registered and managed through `srvctl`
- SPFile in ASM

WHAT DO YOU GET?

- Fully mananged upgrade
- Supports RAC and RAC One Node
- No extra configuration
- Just connect to one node and AutoUpgrade takes care of the rest
  - `CLUSTER_DATABASE=FALSE`
  - `srvctl` configuration

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It is recommended to keep Grid Infrastructure and database patch level in sync

Pro tip: Additional details can be found in blog post

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AutoUpgrade on Exadata

AutoUpgrade is the recommended utility to upgrade Oracle Databases to 19c

Source:
19c Grid Infrastructure and Database Upgrade steps for Exadata Database Machine running on Oracle Linux (Doc ID 2542082.1)

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AutoUpgrade | Exadata

Follow elaborate procedure in MOS note:

19c Grid Infrastructure and Database Upgrade steps
for Exadata Database Machine running on Oracle Linux (Doc ID 2542082.1)

AutoUpgrade version 21.1.3 or higher is required

- but always use the latest version of AutoUpgrade

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What about ExaCC and ExaCS?

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AutoUpgrade | ExaCC + ExaCS

Follow elaborate procedure in MOS note:

- Upgrading to 19c Oracle Database on Exadata Cloud Service (ExaCS) and Exadata Cloud at Customer Gen2 (ExaCC) (Doc ID 2628228.1)

Above mentioned procedure is the only support method

Currently, DBUA is utilized by cloud tooling

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Photo by Chris Briggs on Unsplash

What if ...

AutoUpgrade | What if ... AutoUpgrade fails

1. Create zip file

```
$ java -jar autoupgrade.jar -config config.cfg -zip
```

2. Optionally, add `opatch lsinventory`

```
$ $ORACLE_HOME/OPatch/opatch lsinventory > opatch.txt
$ zip -r AUPG_210419_0735_461.zip opatch.txt
```

3. Upload it to My Oracle Support

My Oracle Support

Welcome

Search our Knowledge base and engage Communities to learn about products, services, and to find help resolving issues

Daniel Overby Hansen

Lead Developer
SimCorp A/S - Denmark

"After qualifying the new AutoUpgrade tool on a representative portion of our database landscape we found that tool was doing a great job and is production-ready. In our automation tool we have removed a lot of "home-grown" code and replaced it with AutoUpgrade functionality.

Since August 2019 all upgrades at SimCorp have been executed using the AutoUpgrade tool."

#aioug

aioug

ALL INDIA ORACLE USERS GROUP

https://www.aioug.org/sangam21

#sangam21

sangam 21

.....meeting of minds

BREAK

05:00

Photo by Krzysztof Kotkowicz on Unsplash

Chapter 3

Multitenant Migration

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Multitenant | Support

> ***Desupport of Non-CDB Oracle Databases***
>
> *Starting with Oracle Database 21c, installation of non-CDB Oracle Database architecture is no longer supported.*
>
> *The non-CDB architecture was deprecated in Oracle Database 12c. It is desupported in Oracle Database 21c.*

Database 21c, Upgrade Guide, chapter 10

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Multitenant | Support

What does this mean?

1. Oracle Database 19c is the last release to support non-CDB architecture

2. Before upgrade to Oracle Database 21c or beyond,
you must convert to the mulititenant architecture

Pro tip: For further details see Release Schedule of Current Database Releases (Doc ID 742060.1)

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Multitenant | License

Included in all offerings (SE2/EE)

12.1.0.2
12.2.0.1
18c

Single tenant

Max. 1 PDB

19c
21c

Multitenant

Max. 3 PDB

```
SQL> alter system set max_pdbs=3;
```

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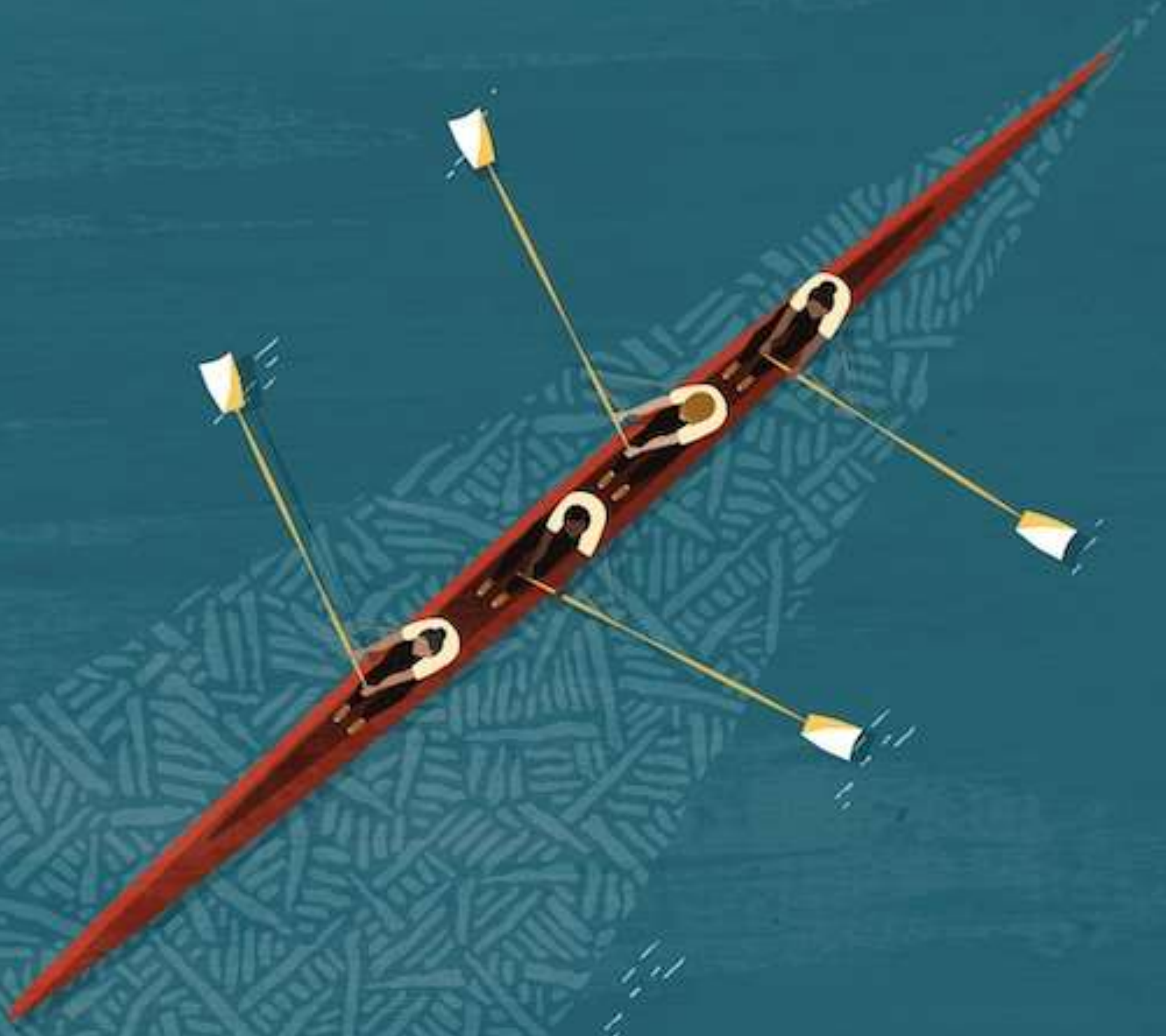
other

MIGRATION

options

Plug-in Copy

Plug-in NoCopy



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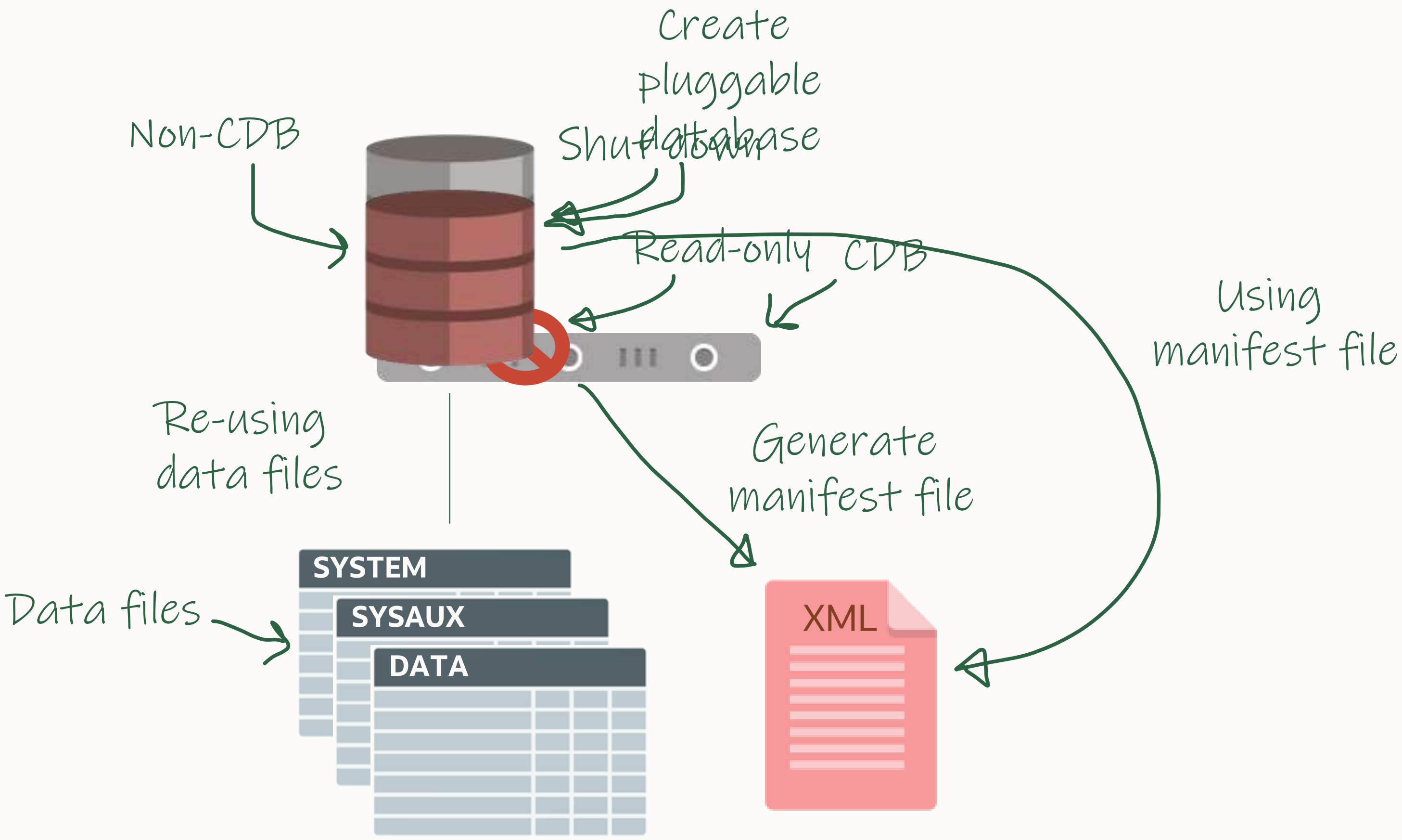
Plug-in NoCopy | Concept



Non-CDB

Create pluggable database

Shut down

Read-only

CDB

Using manifest file

Re-using data files

Generate manifest file

Data files

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Plug-in NoCopy | Create

Re-use existing data files

```
SQL> CREATE PLUGGABLE DATABASE DB19 ... NOCOPY ... ;
```

Move data files

```
SQL> CREATE PLUGGABLE DATABASE DB19 ... MOVE ... ;
```

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Plug-in NoCopy | AutoUpgrade

Fully automated plug-in

```
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=DB19
upg1.target_cdb=CDB2
```

Command

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

Pro tip: Always get latest version of AutoUpgrade from MOS 2485457.1

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Plug-in NoCopy | AutoUpgrade

Upgrade - and plug in

```
upg1.source_home=/u01/app/oracle/product/12.2.0.1
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=DB12
upg1.target_cdb=CDB2
#Optionally, rename PDB
#upg1.target_pdb_name=SALES
```

Command

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

Blog post: Oracle AutoUpgrade between two servers – and Plugin?

Pro tip: You can also plug in manually and upgrade PDB with `dbupgrade -c DB19`

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Plug-in NoCopy | Nice to know

No fallback

- Data files are re-used

Fast option

Cross-platform

- Potentially roll off patches before unplug
- But can't go across Endian format

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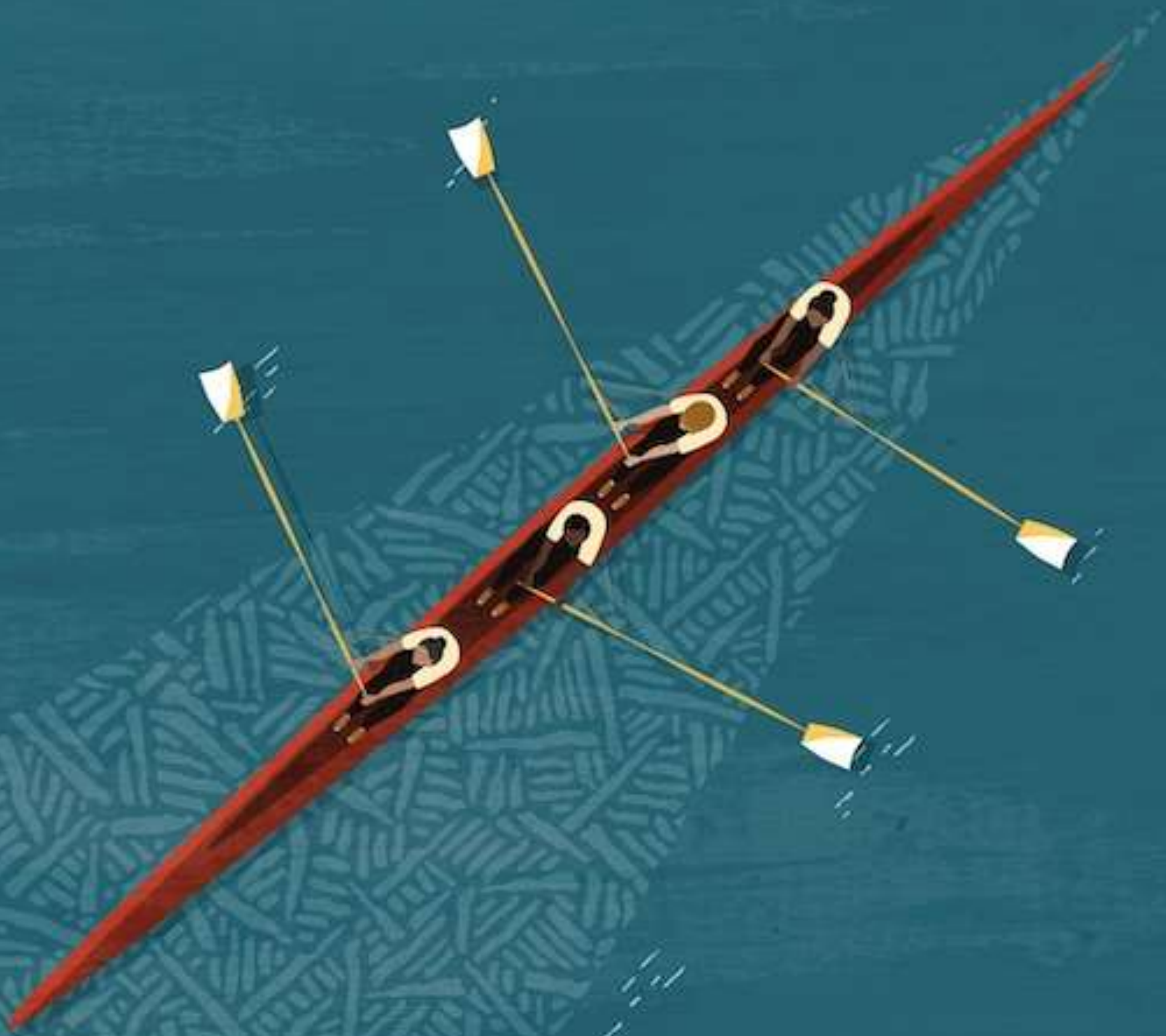
other

MIGRATION

options



Plug-in Copy

Plug-in NoCopy

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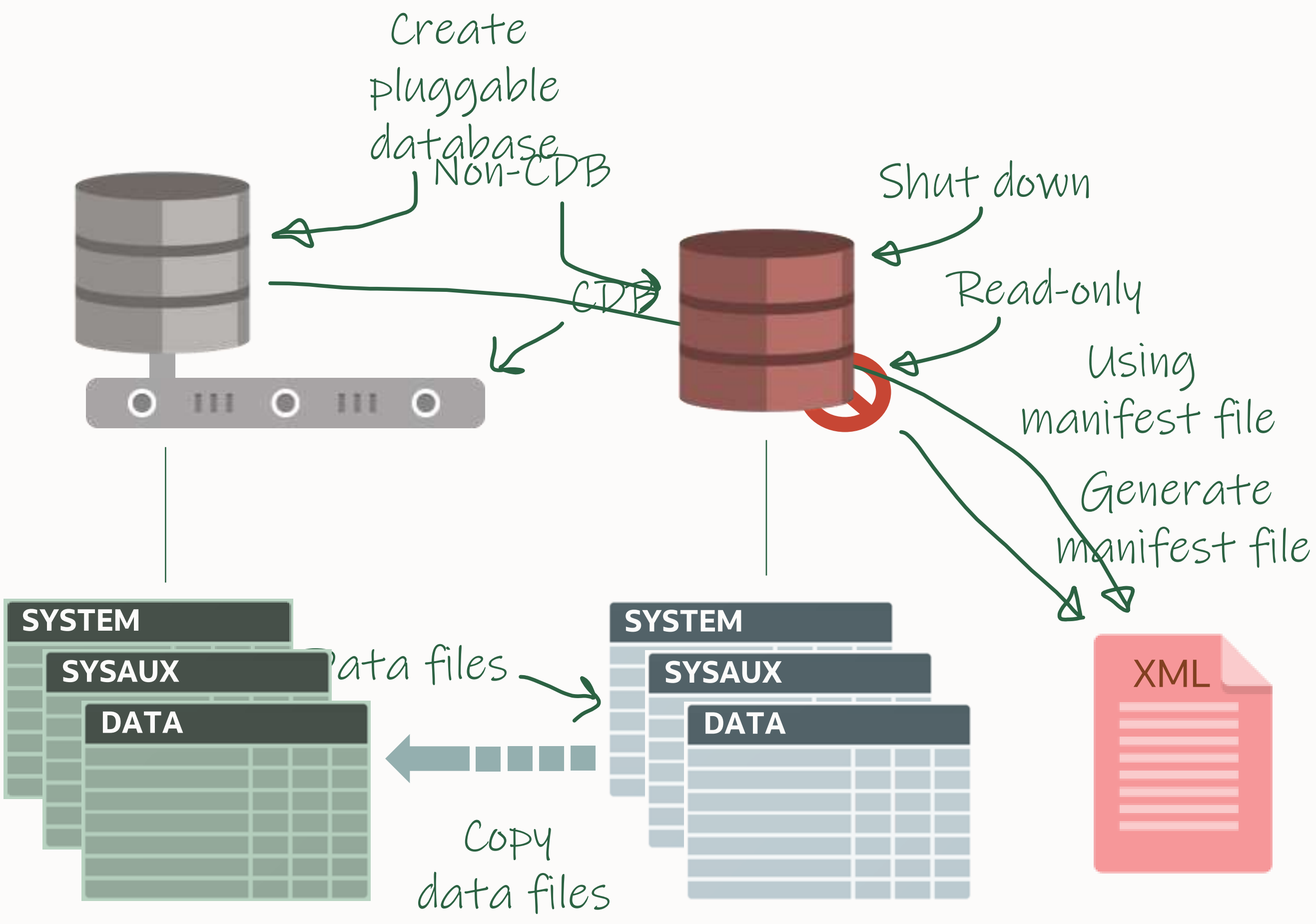
Plug-in Copy | Concept



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Plug-in Copy | Create

Copy data files

```
SQL> CREATE PLUGGABLE DATABASE DB19 ... COPY FILE_NAME_CONVERT= ... ;
```

Rename data files with `FILE_NAME_CONVERT`

- Regular search/replace
  ```
  FILE_NAME_CONVERT=('DB19', 'SALES')
  ```
- OMF
  ```
  FILE_NAME_CONVERT=NONE
  ```

Pro tip: Use the same `FILE_NAME_CONVERT` clause for plug-in with `MOVE` keyword

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Plug-in Copy | Clone non-CDB

Plug in and copy data files over network link

```
SQL> CREATE DATABASE LINK CLONELNK ... ;
SQL> CREATE PLUGGABLE DATABASE DB19 FROM NON$CDB@CLONELNK ... ;
```

Prerequisites:

- Source must be 12.1.0.2 or newer
- Block size must match
- Blog post

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Plug-in Copy | AutoUpgrade

Fully automated plug-in

```
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/19
upg1.sid=DB19
upg1.target_cdb=CDB2
upg1.target_pdb_name=SALES
#Copy files and perform search/replace on file names
upg1.target_pdb_copy_option=file_name_convert=('DB19','SALES')
#Copy files and generate new OMF file names
#upg1.target_pdb_copy_option=file_name_convert=none
```

Command

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

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Plug-in Copy | Nice to know

Fallback option

- Original data files are preserved

Slow and requires additional disk space

Cross-platform

- Potentially roll off patches before unplug
- But can't go across Endian format

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Photo by Adam Muise on Unsplash

Multitenant and Data Guard

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Data Guard | Migration Options

It is possible to preserve the standby database when you migrate from non-CDB to PDB

Special attention is needed

You don't have to rebuild your standby database, but you might find it is the easiest solution

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Data Guard | Migration Options

If you CDB has a standby database,
you must follow these guidelines

If you don't, you will crash the MRP process
and redo apply stops

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Data Guard | Plug-in

Three options

1. **Re-use data files**
    - **PDB is immediately protected**

2. Defer creation of PDB on standby
    - PDB is protected as soon as data files are restored on standby

3. Create or recreate standby database
    - CDB is protected when standby database is ready

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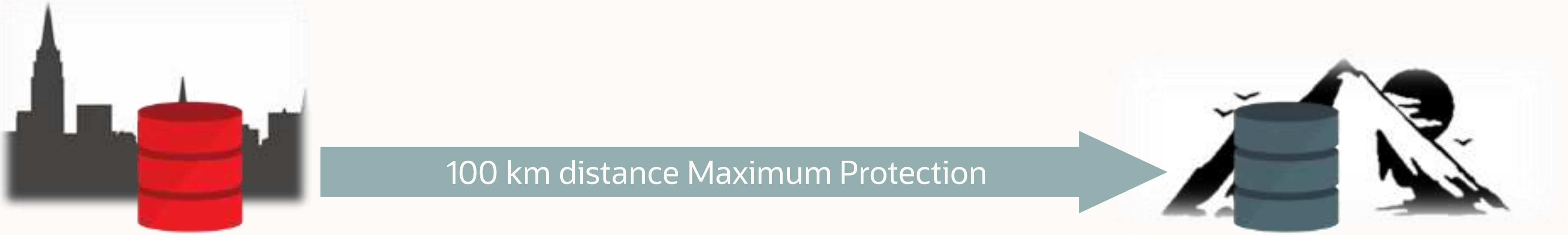
Data Guard Example | Initial Setup



100 km distance Maximum Protection

Oracle 12.1.0.2
PROD
10 TB size

Oracle 12.1.0.2
STBDY
10 TB size

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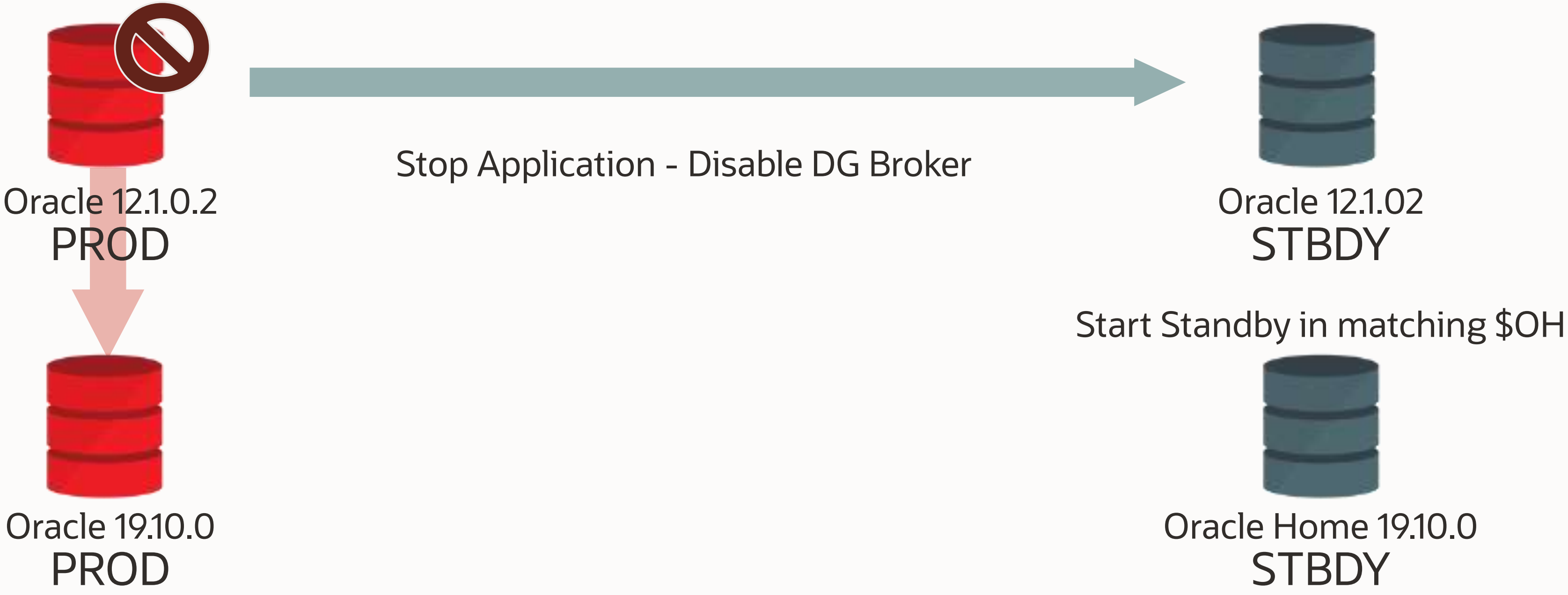
Data Guard Example | AutoUpgrade

>> DOWNTIME <<



Stop Application - Disable DG Broker

Oracle 12.1.0.2
PROD

Oracle 19.10.0
PROD

Oracle 12.1.02
STBDY

Start Standby in matching $OH

Oracle Home 19.10.0
STBDY

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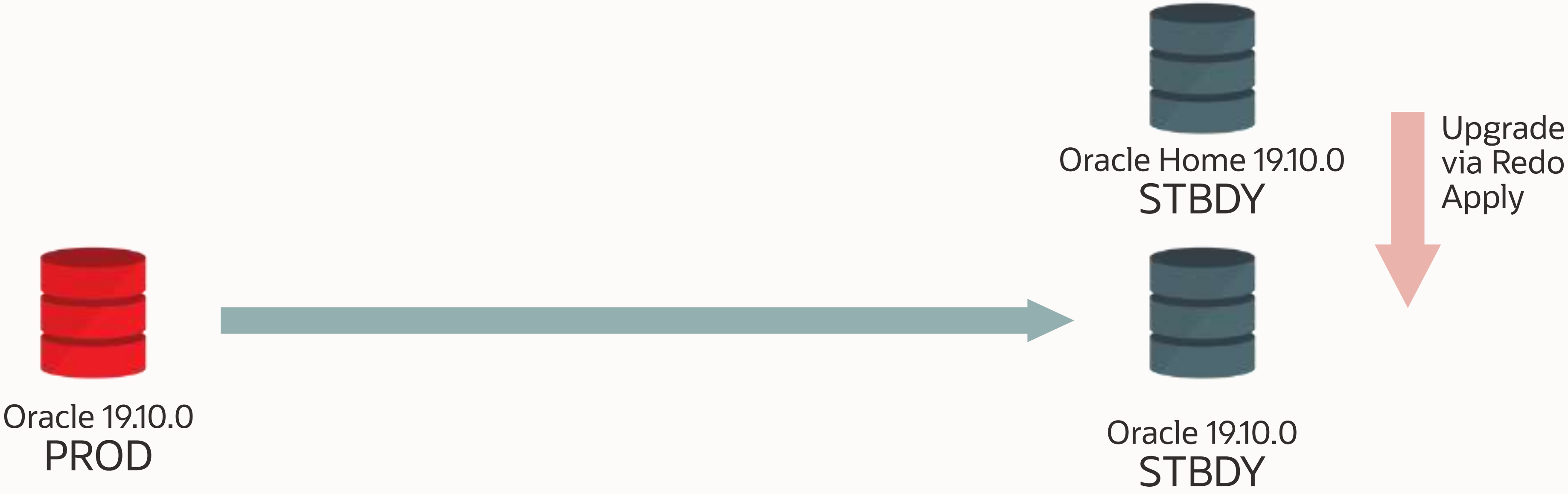
Data Guard Example | Implicit Standby Upgrade



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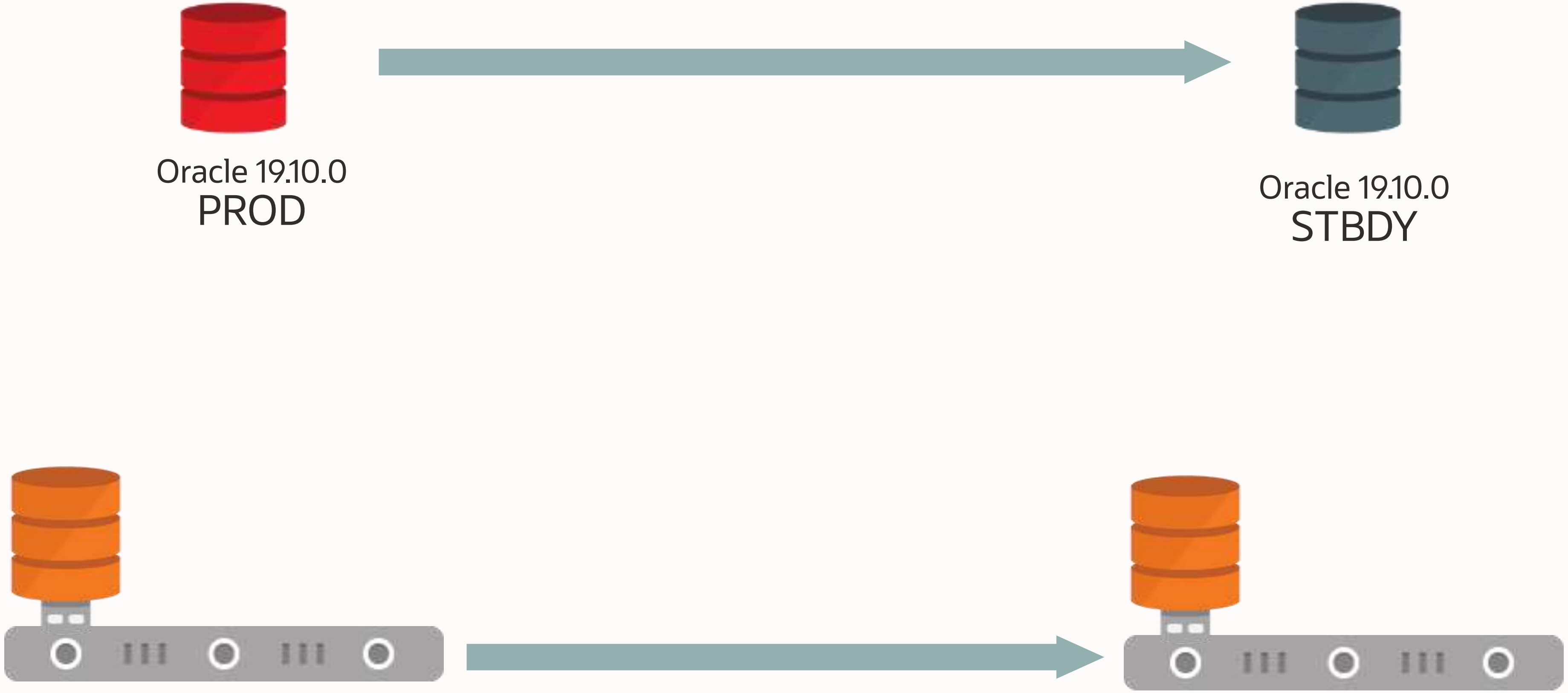
Data Guard Example | Create CDBs



Oracle 19.10.0
PROD

Oracle 19.10.0
STBDY

Oracle 19.10.0
CDB - PROD

Oracle 19.10.0
CDB - STBDY

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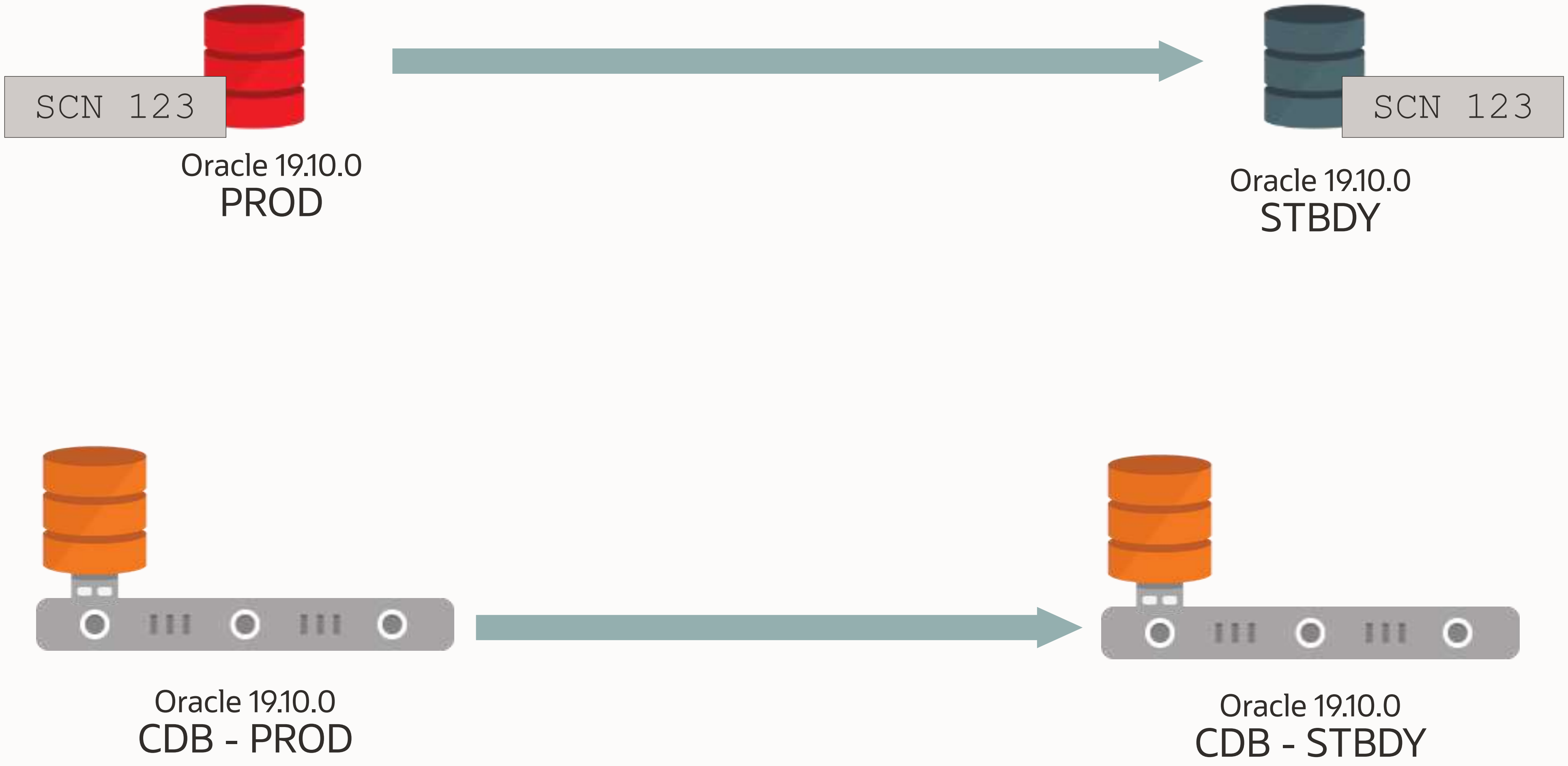
Data Guard Example | Synchronize



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Data Guard Example | Synchronize

MOS Doc ID 2273304.1

Primary

```
SQL> shutdown immediate
SQL> startup mount
SQL> alter system
     flush redo to stdby no confirm apply;
SQL> alter database open read only;
SQL> select checkpoint_change#
     from v$datafile_header where file#=1;
```

MUST MATCH!

```
SQL> execdbms_pdb.describe('/home/oracle/prmy.xml');
SQL> shutdown immediate
```

Standby

```
DGMGRL> edit database stdby set state='APPLY-OFF';
SQL> shutdown immediate
SQL> startup
SQL> alter database
     recover managed standby database cancel;
```

Replace with checkpoint_change#

```
SQL> alter database recover managed standby database
     until change 2319950;
SQL> select checkpoint_change#
     from v$datafile_header where file#=1;
```

```
SQL> shutdown immediate
```

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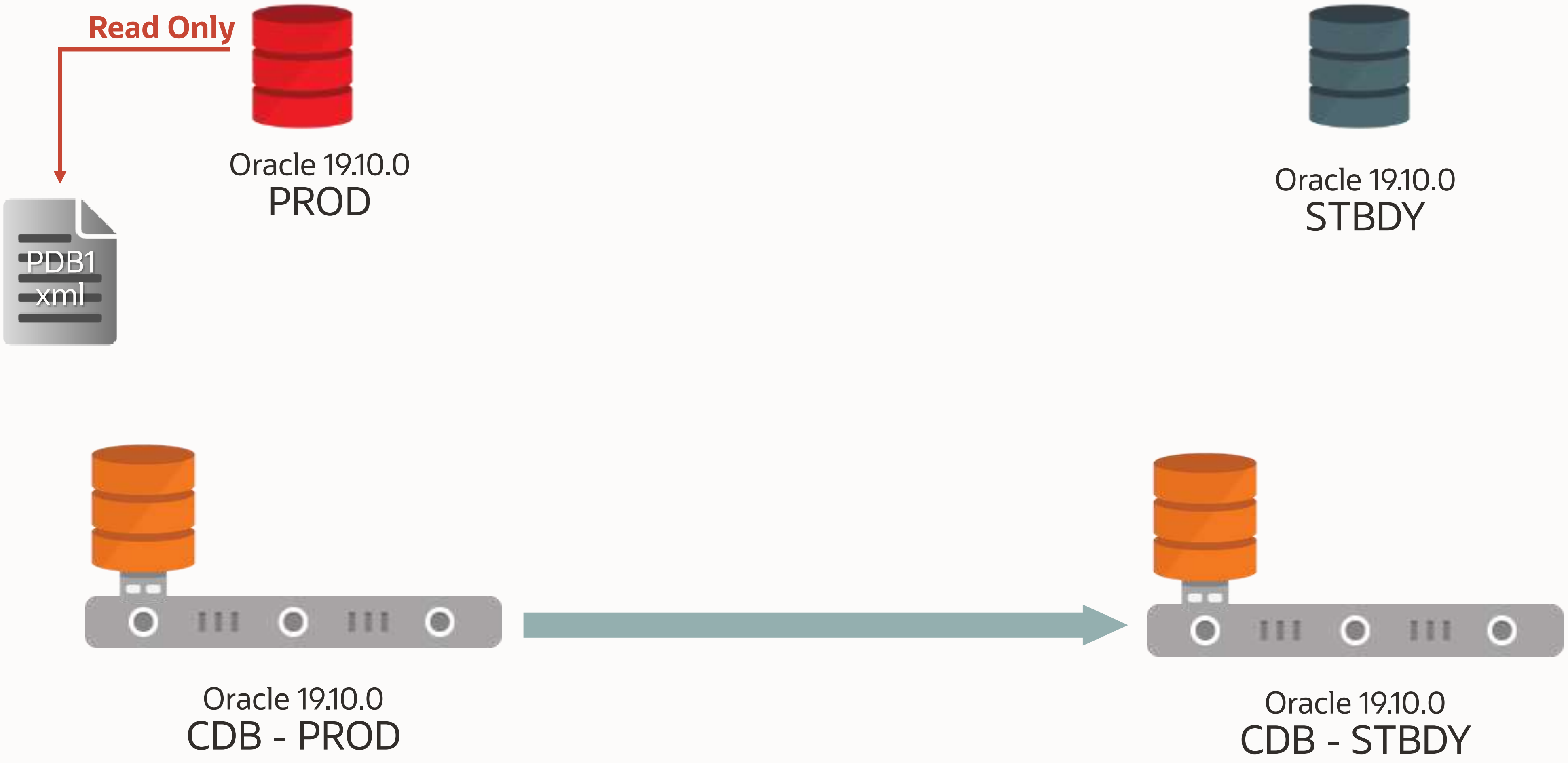
Data Guard Example | Read Only Phase



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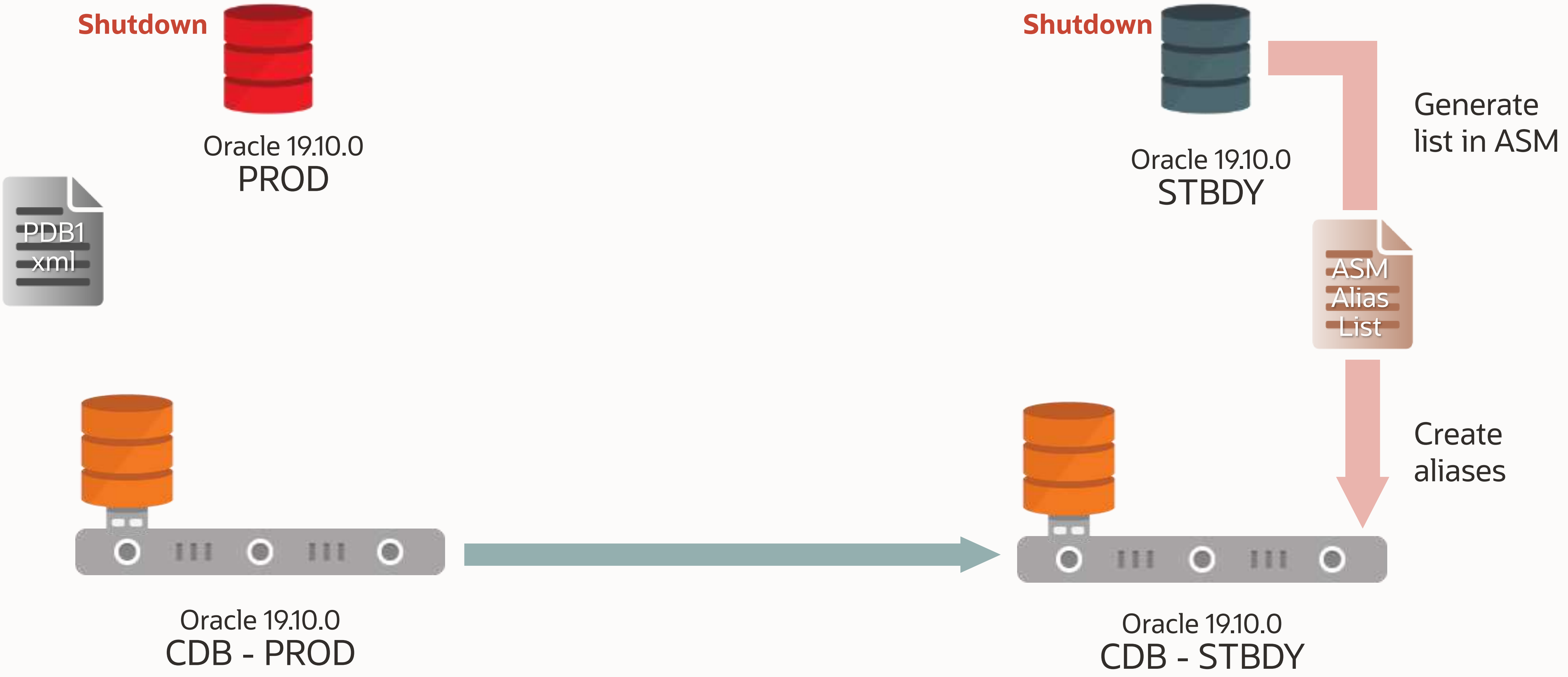
Data Guard Example | ASM Alias File



Shutdown

Oracle 19.10.0
PROD

PDB1
xml

Shutdown

Oracle 19.10.0
STBDY

Generate list in ASM

ASM
Alias
List

Create aliases

Oracle 19.10.0
CDB - PROD

Oracle 19.10.0
CDB - STBDY

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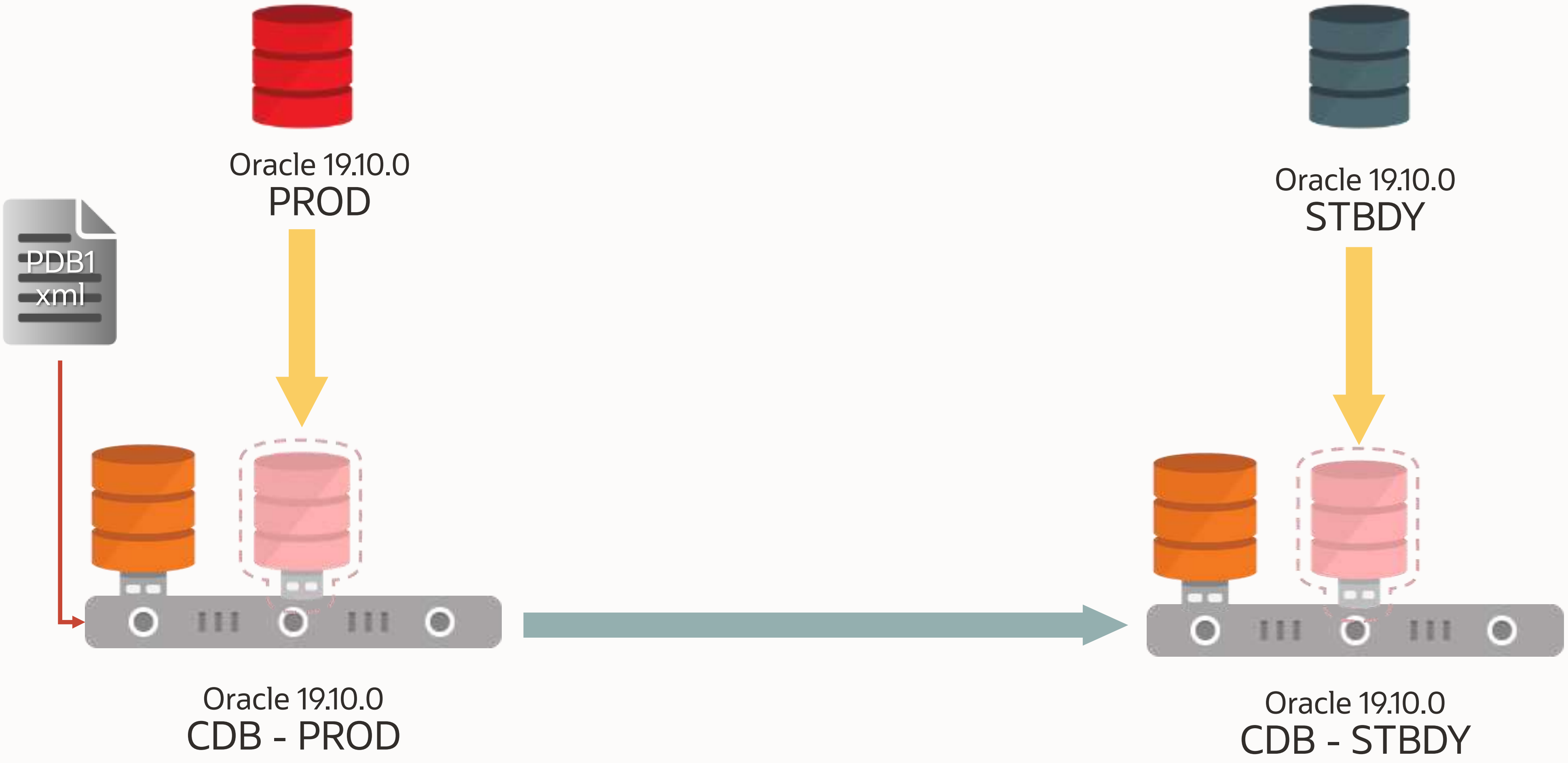
Data Guard Example | Plugin



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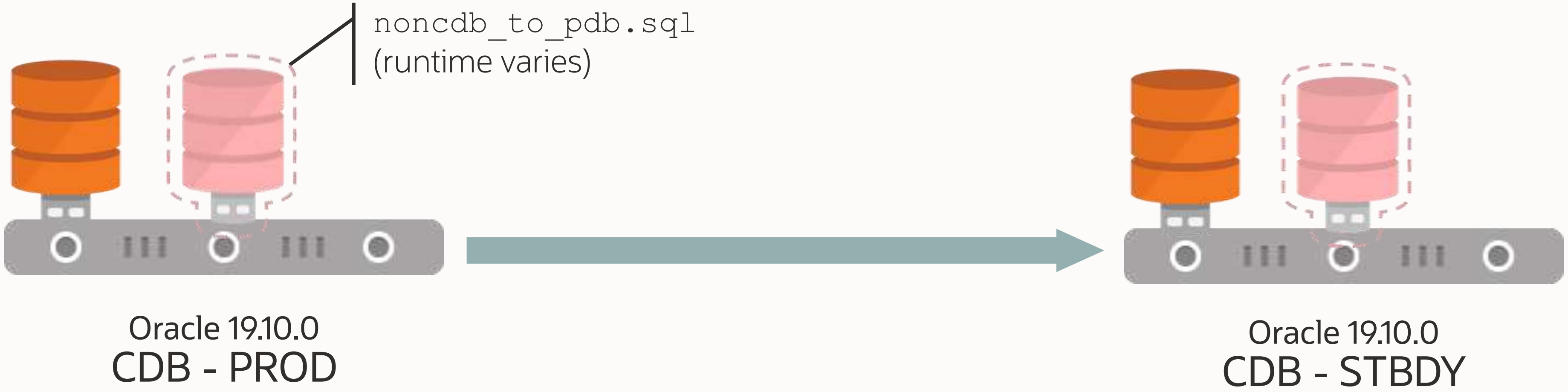
Data Guard Example | Convert non-CDB to PDB



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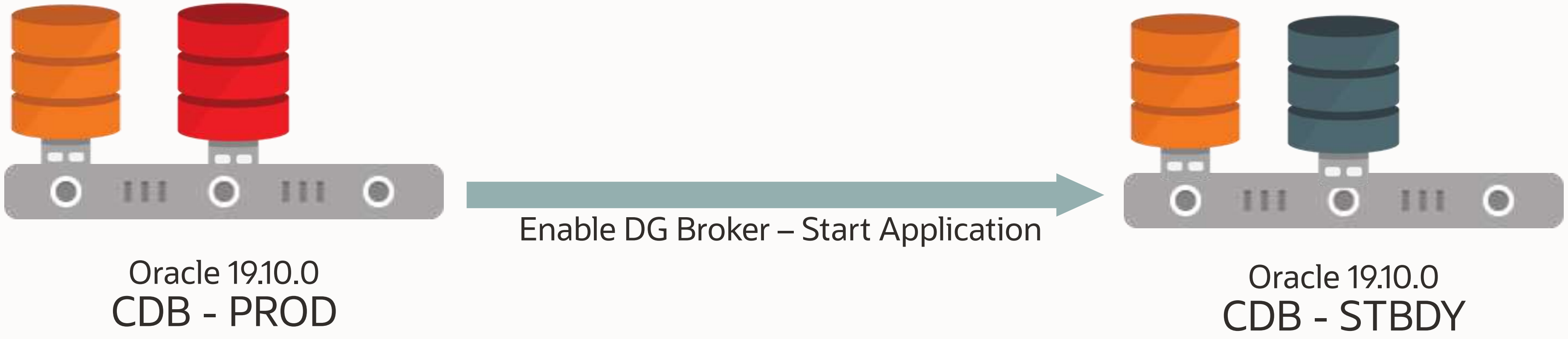
Data Guard Example | Plugin Completed!



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Data Guard | Preserve Data Files

- Data Guard PM - Pieter van Puymbroeck:
  https://vanpupi.stepi.net/2019/06/to-cdb-or-not-to-cdb-thats-the-question/

- MAA Team:
  MOS Note: 2273304.1
  Reusing the Source Standby Database Files When Plugging a non-CDB as a PDB into the Primary Database of a Data Guard Configuration

- Explanation and troubleshooting
  https://dohdatabase.com/2020/12/03/upgrade-plug-in-with-asm-data-guard-tde-and-no-keystore-password/

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Data Guard | Plug-in

Three options

1. Re-use data files
   - PDB is immediately protected
2. **Defer creation of PDB on standby**
   - **PDB is protected as soon as data files are restored on standby**
3. Create or recreate standby database
   - CDB is protected when standby database is ready

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AutoUpgrade supports this approach

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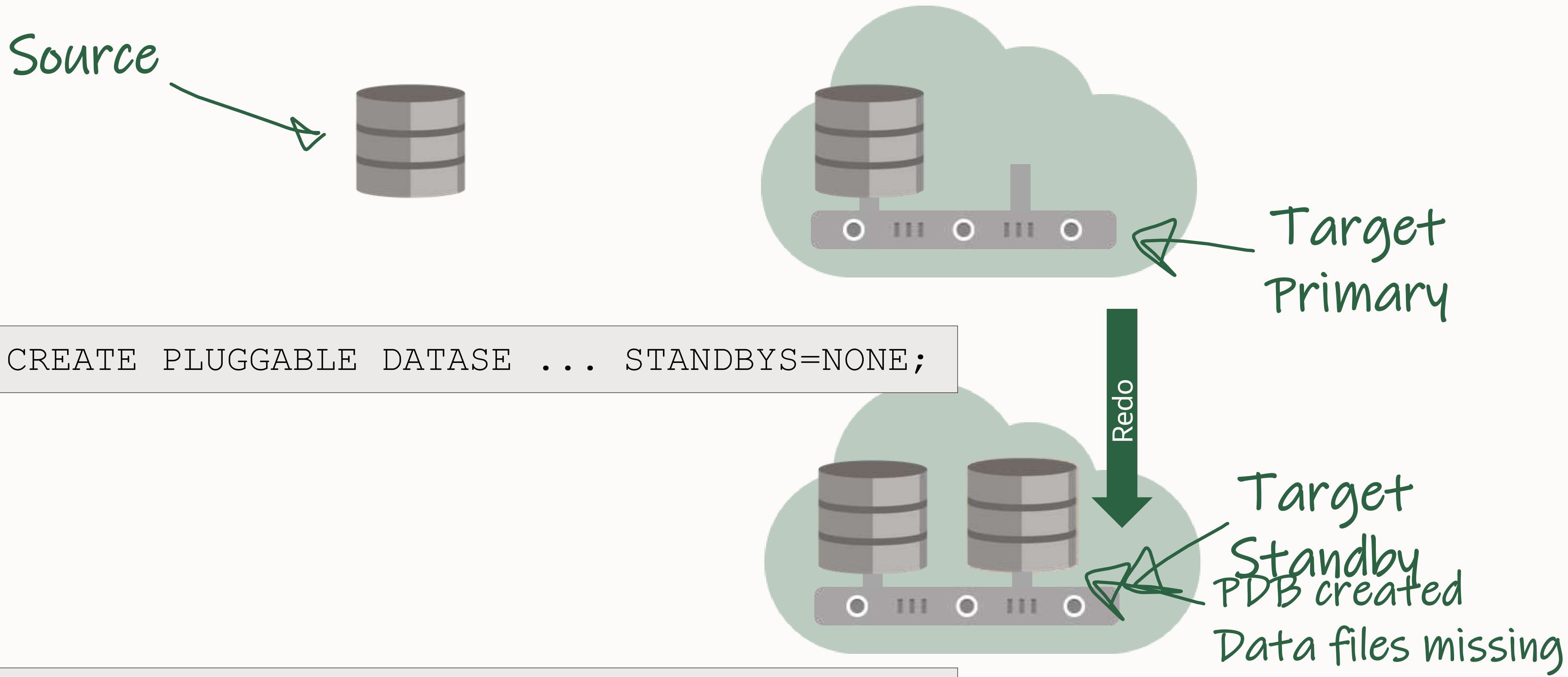
Data Guard | Plug-in



```
SQL> CREATE PLUGGABLE DATASE ... STANDBYS=NONE;
```

```
RMAN> restore pluggable database ... from service ... ;
...
SQL> alter pluggable database enable recovery;
```

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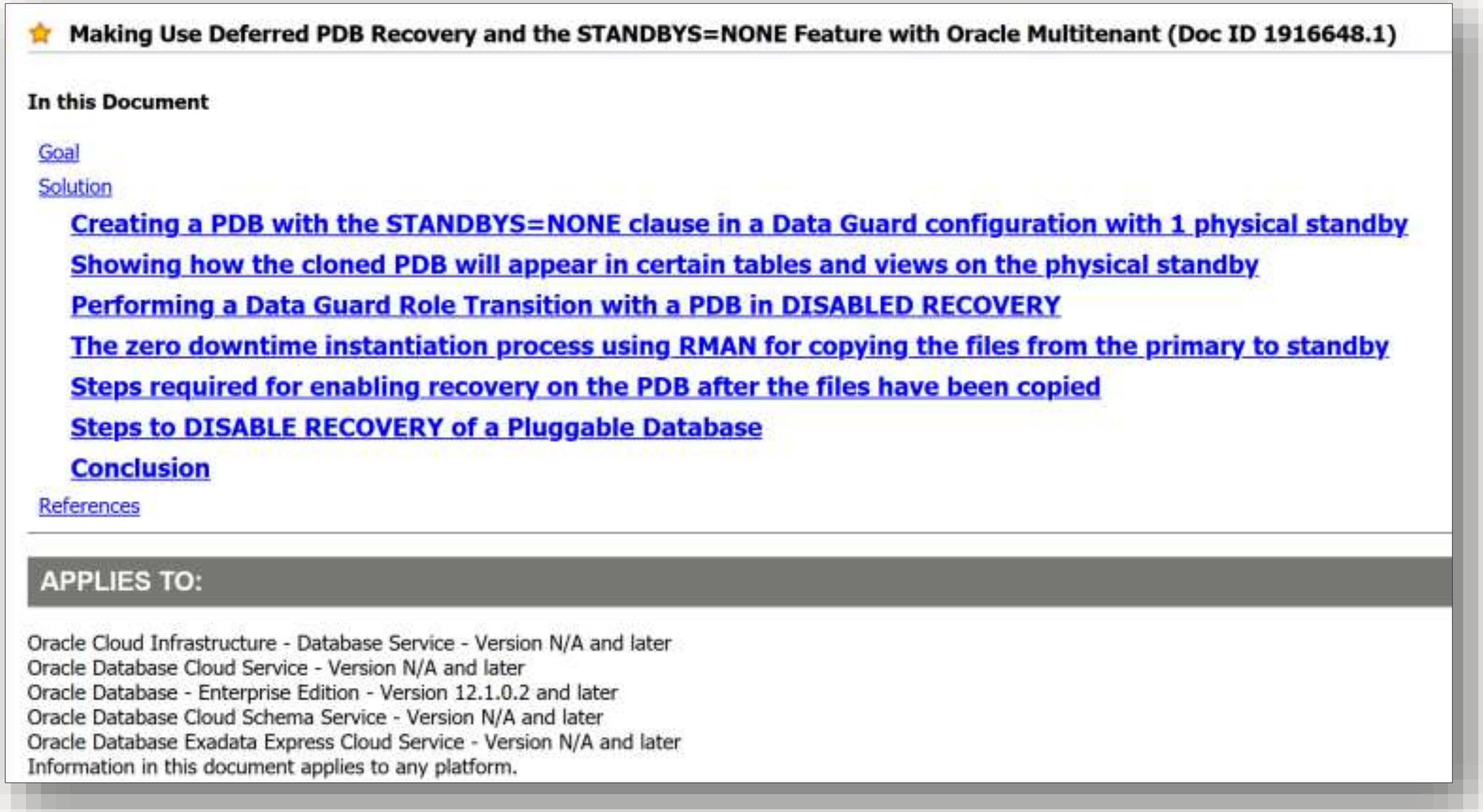
Data Guard | Plug-in



☆ **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.

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

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Data Guard | Plug-in

Three options

1. Re-use data files
   - PDB is immediately protected

2. Defer creation of PDB on standby
   - PDB is protected as soon as data files are restored on standby

3. **Create or recreate standby database**
   - **CDB is protected when standby database is ready**

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Migration | Last Words

Every migration

- Is an architectural change
- Requires downtime
- Requires a fallback
- Ends with a backup

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Chapter 4

Performance Stability

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your key to

Successful Database Upgrades

Step 1
Download and install Oracle 19c
eDelivery.oracle.com

Step 2
Download and install newest RU
MOS Note: 2118136.2

Step 3
Download and use AutoUpgrade
MOS Note: 2485457.1

Step 4
Performance Stability with SPM, STA and RAT

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Statistics | Refresh?

Should you refresh object statistics when you upgrade to Oracle 19c?

- It is not required

- But especially when you upgrade from 11.2, histograms can change
  - Avoid gradual change of plans when stats become stale
  - Better regather object statistics as soon as possible

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Statistics | Refresh?

Want to gather statistics fast?

```
SQL> exec dbms_stats.set_global_prefs('CONCURRENT','AUTOMATIC');
```

Even faster (if you have CPU available)?

```
SQL> exec dbms_stats.set_global_prefs('DEGREE', DBMS_STATS.AUTO_DEGREE);
```

Fastest (if you have a lot of CPU available)?

```
SQL> exec dbms_stats.set_global_prefs('CONCURRENT','AUTOMATIC');
SQL> exec dbms_stats.set_global_prefs('DEGREE', DBMS_STATS.AUTO_DEGREE);
```

Or import fresh statistics from a matching test system

Pro tip: Read Nigel Bayliss' blog on
How to Gather Optimizer Statistics Fast!

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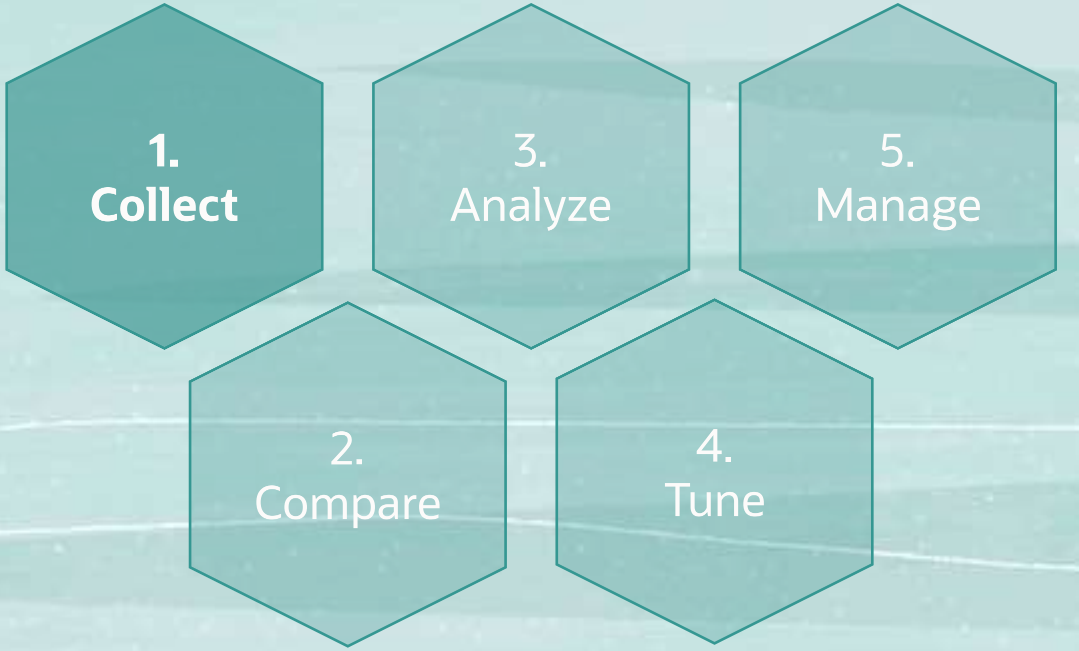
Performance Stability Prescription



1. Collect

2. Compare

3. Analyze

4. Tune

5. Manage

SQL Tuning Set | Definition

> ”
>
> *An SQL Tuning Set (STS) enables you to group SQL statements and related metadata in a single database object, which you can use to meet your tuning goals.*
>
> *Specifically, SQL tuning sets achieve the following goals:*
>
> - *Providing input to the performance tuning advisors*
> - *Transporting SQL between databases*

Database 19c SQL Tuning Guide, chapter 23

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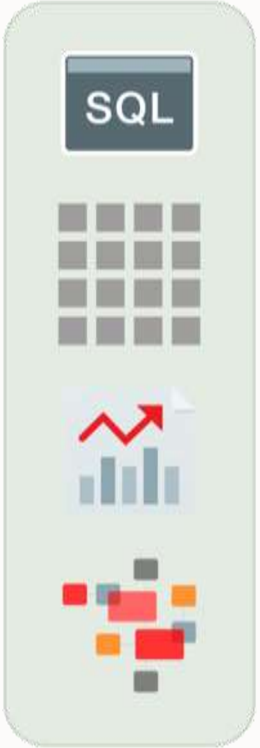
SQL Tuning Set | Definition



SQL statement

Context

Statistics

Plans

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SQL Tuning Set | Create

First, create a SQL Tuning Set

```
SQL> BEGIN
  DBMS_SQLSET.CREATE_SQLSET (
    sqlset_name  => 'UPG_STS_1',
    description  => 'For upgrade - from source'
  );
END;
/
```

Pro tip: You can also use DBMS_SQLTUNE to create a SQL Tuning Set

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SQL Tuning Set | Capture

Next, capture statements from AWR

```
SQL> DECLARE
   begin_id number;
   end_id number;
   cur sys_refcursor;
BEGIN
   SELECT min(snap_id), max(snap_id) INTO begin_id, end_id
   FROM dba_hist_snapshot;

open cur for
  select value(p) from table(dbms_sqltune.select_workload_repository(
       begin_snap       => begin_id,
       end_snap         => end_id,
       basic_filter     => 'parsing_schema_name not in (''SYS'')',
       ranking_measure1 => 'elapsed_time',
       result_limit     => 5000,
       attribute_list   => 'ALL')) p;

  dbms_sqltune.load_sqlset('UPG_STS_1', cur);

close cur;

END;
/
```

Pro tip: Consider excluding other internal schemas like *DBSNMP*, *ORACLE_OCM*, *LBACSYS*, *WMSYS*, *XDB*, *SYSTEM*

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SQL Tuning Set | Capture

Optionally, capture statements from cursor cache

```
SQL> BEGIN
   DBMS_SQLSET.CAPTURE_CURSOR_CACHE_SQLSET(
      sqlset_name     => 'UPG_STS_1',
      time_limit      => 900,
      repeat_interval => 60,
      capture_option  => 'MERGE',
      capture_mode    => DBMS_SQLTUNE.MODE_ACCUMULATE_STATS,
      basic_filter    => 'parsing_schema_name not in (''SYS'')',
      sqlset_owner    => NULL,
      recursive_sql   => 'HAS_RECURSIVE_SQL');
   END;
/
```

Careful - puts load on your system

Pro tip: SQL Tuning Guide shows how to load all statements from a given schema

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SQL Tuning Set | License

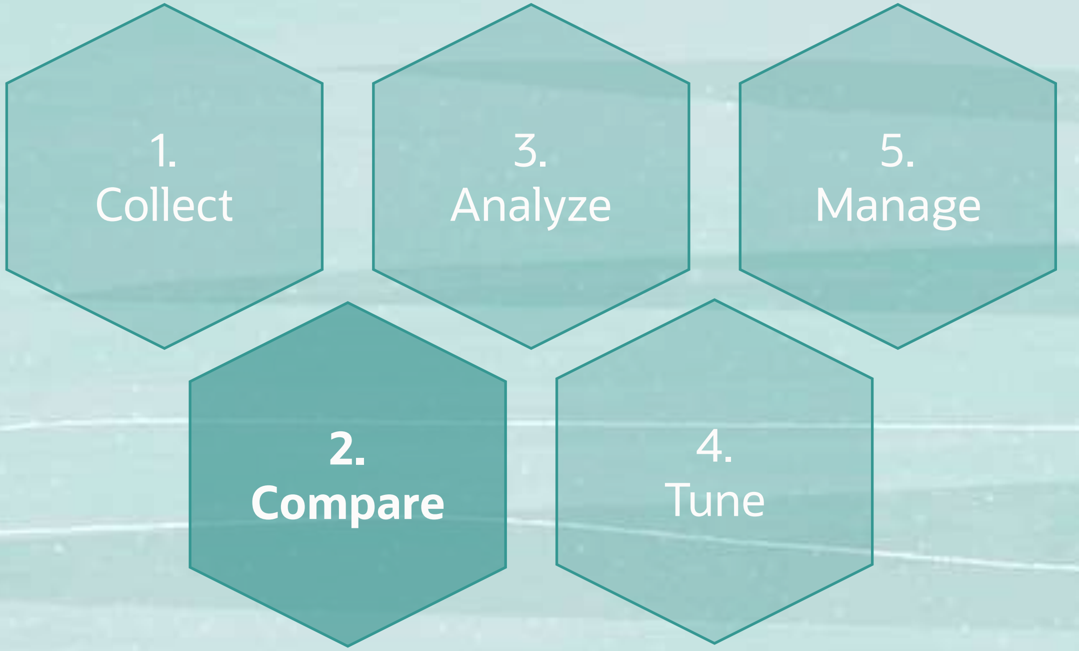
> *SQL Tuning Sets can also be accessed by way of database server APIs and command-line interfaces. Usage of any subprograms in the DBMS_SQLSET package to manage SQL Tuning Sets is part of the EE and EE-ES offerings.*
>
> *In addition, the following subprograms, part of the DBMS_SQLTUNE package, provide an older interface to manage SQL Tuning Sets and are also part of the EE and EE-ES offerings:*
>
> *ADD_SQLSET_REFERENCE*
> *CAPTURE_CURSOR_CACHE_SQLSET*
> *CREATE_SQLSET*
> *CREATE_STGTAB_SQLSET*
> *DELETE_SQLSET*
> *DROP_SQLSET*
> *LOAD_SQLSET*
> *PACK_STGTAB_SQLSET*
> *REMOVE_SQLSET_REFERENCE*
> *SELECT_CURSOR_CACHE*
> *SELECT_SQLSET*
> *SELECT_WORKLOAD_REPOSITORY*
> *UNPACK_STGTAB_SQLSET*
> *UPDATE_SQLSET*

Database 19c Database Licensing Information User Manual

SQL Tuning Set | Recommendation

Always capture workload data into SQL Tuning Sets

Performance Stability Prescription



1. Collect

2. Compare

3. Analyze

4. Tune

5. Manage

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AWR | Diff Report

Compare AWR report
from two different periods

1. AWR snapshot
2. Execute workload
3. AWR snapshot

4. Upgrade

5. AWR snapshot
6. Execute workload
7. AWR snapshot

8. Compare

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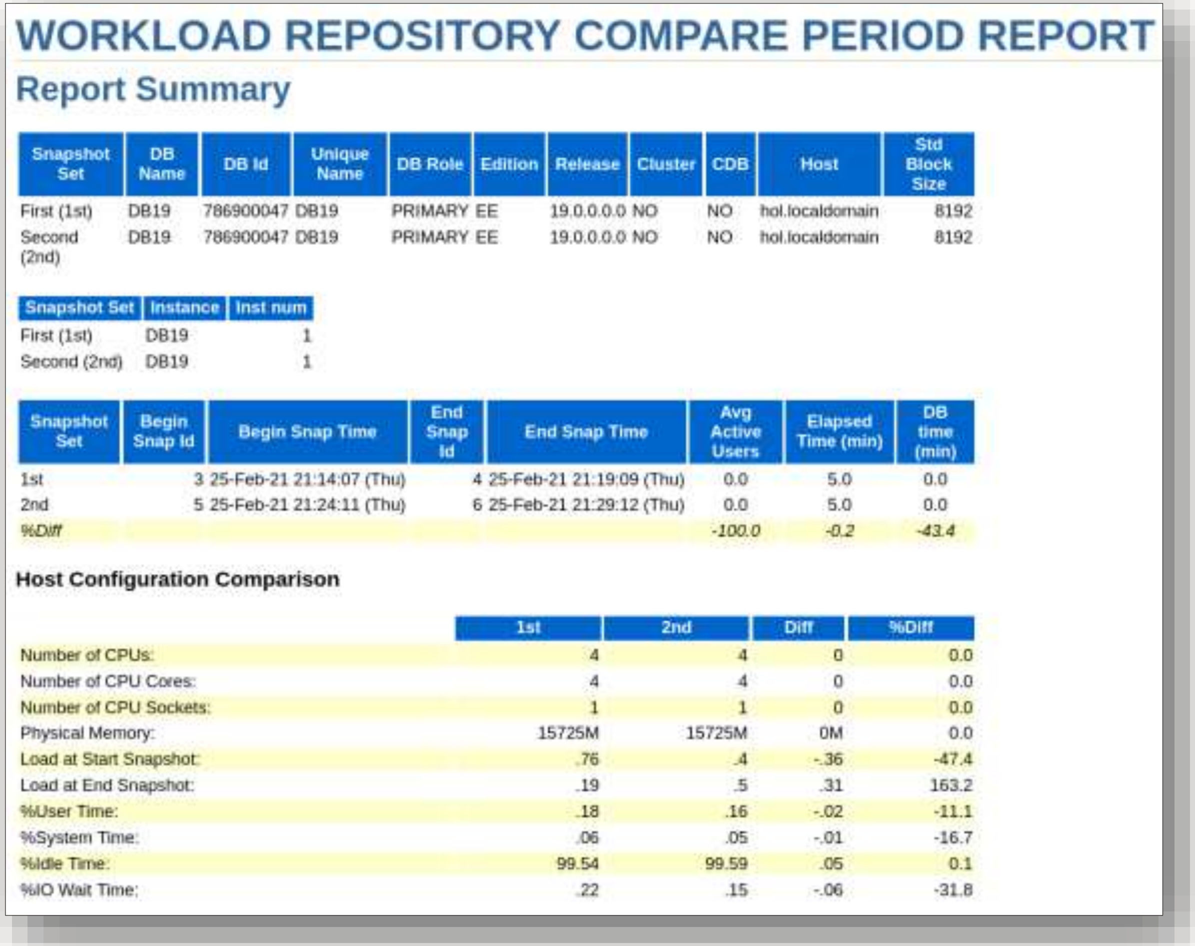
AWR | Diff Report

Use script `awrddrpt.sql`



WORKLOAD REPOSITORY COMPARE PERIOD REPORT

Report Summary

Snapshot Set	DB Name	DB Id	Unique Name	DB Role	Edition	Release	Cluster	CDB	Host	Std Block Size
First (1st)	DB19	786900047	DB19	PRIMARY	EE	19.0.0.0.0	NO	NO	hol.localdomain	8192
Second (2nd)	DB19	786900047	DB19	PRIMARY	EE	19.0.0.0.0	NO	NO	hol.localdomain	8192

Snapshot Set	Instance	Inst num
First (1st)	DB19	1
Second (2nd)	DB19	1

Snapshot Set	Begin Snap Id	Begin Snap Time	End Snap Id	End Snap Time	Avg Active Users	Elapsed Time (min)	DB time (min)
1st	3	25-Feb-21 21:14:07 (Thu)	4	25-Feb-21 21:19:09 (Thu)	0.0	5.0	0.0
2nd	5	25-Feb-21 21:24:11 (Thu)	6	25-Feb-21 21:29:12 (Thu)	0.0	5.0	0.0
%Diff					*-100.0*	*-0.2*	*-43.4*

Host Configuration Comparison

	1st	2nd	Diff	%Diff
Number of CPUs:	4	4	0	0.0
Number of CPU Cores:	4	4	0	0.0
Number of CPU Sockets:	1	1	0	0.0
Physical Memory:	15725M	15725M	0M	0.0
Load at Start Snapshot:	.76	.4	-.36	-47.4
Load at End Snapshot:	.19	.5	.31	163.2
%User Time:	.18	.16	-.02	-11.1
%System Time:	.06	.05	-.01	-16.7
%Idle Time:	99.54	99.59	.05	0.1
%IO Wait Time:	.22	.15	-.06	-31.8

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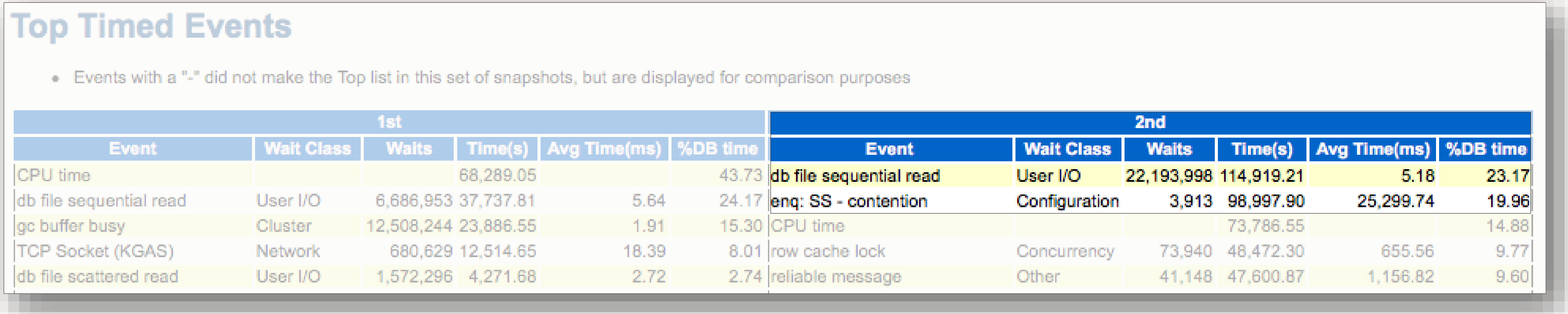
AWR | Diff Report

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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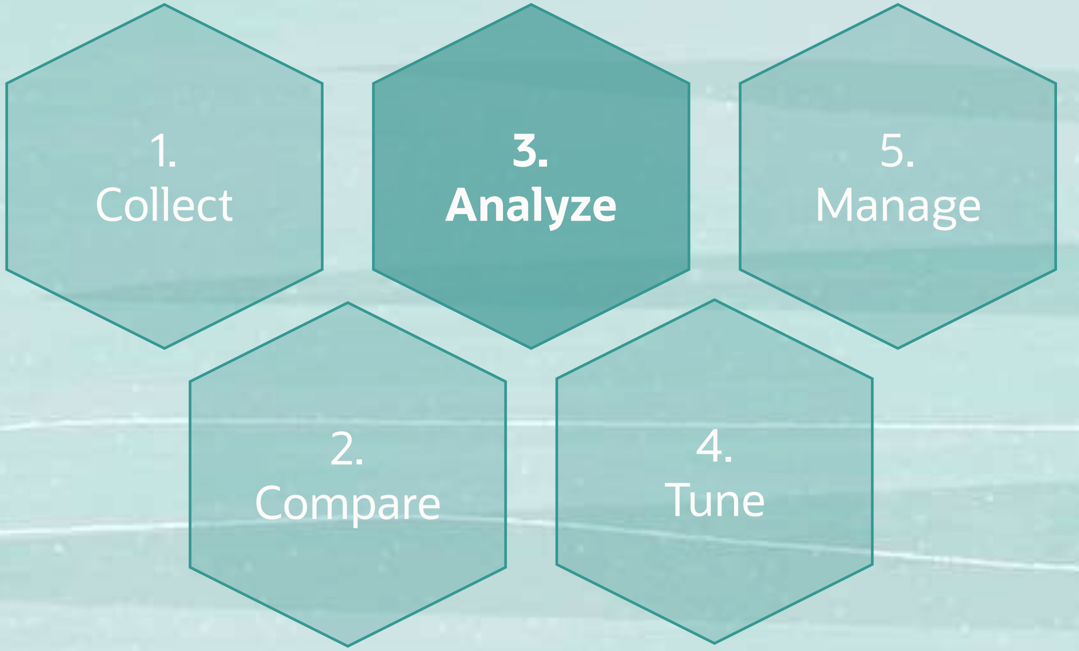
Performance Stability Prescription



1. Collect

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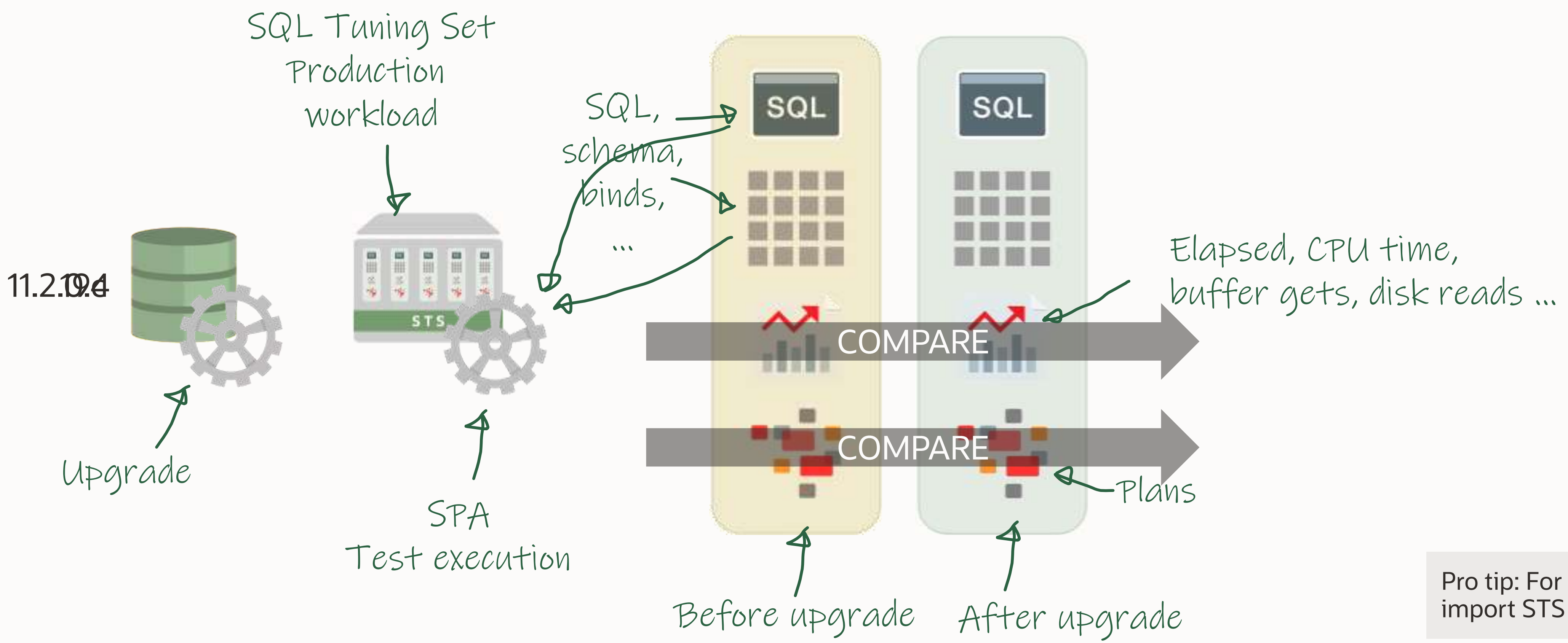
SQL Performance Analyzer | SPA

> *SPA provides fine-grained assessment of environment changes on SQL execution plans and statistics by running the SQL statements both in isolation and serially manner in before-change and after-change environments.*
>
> *SPA functionality is well integrated with existing SQL Tuning Set (STS), SQL Tuning Advisor, and SQL Plan Management functionality.*

Oracle Database Real Application Testing Data Sheet

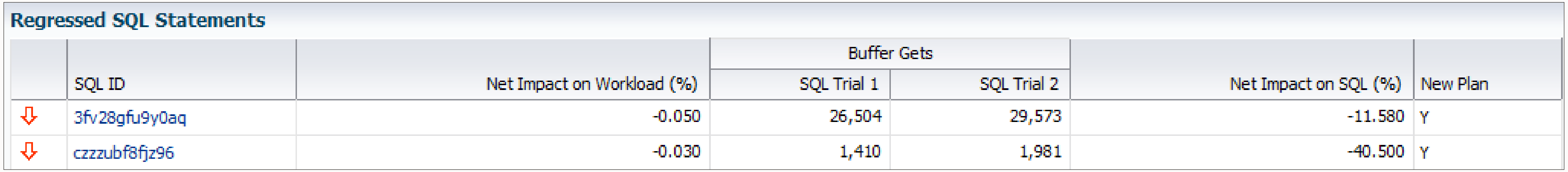
Requires Enterprise Edition + Real Application Testing

SPA | Concept



Pro tip: For migrations,
import STS into target database

SPA | Regressed Report



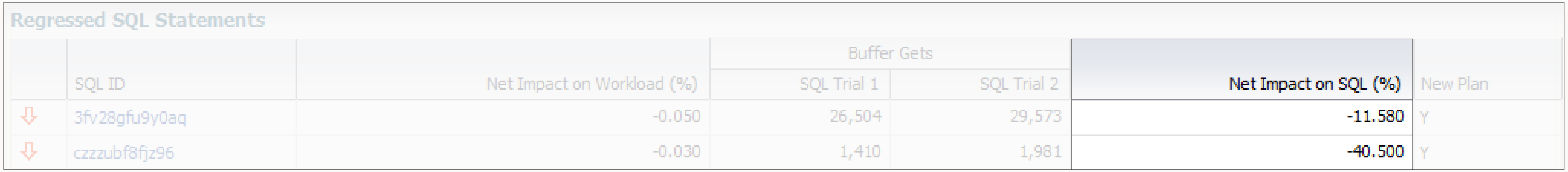
Regressed SQL Statements

			Buffer Gets			
	SQL ID	Net Impact on Workload (%)	SQL Trial 1	SQL Trial 2	Net Impact on SQL (%)	New Plan
⇩	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

SPA | Regressed Report



Regressed SQL Statements

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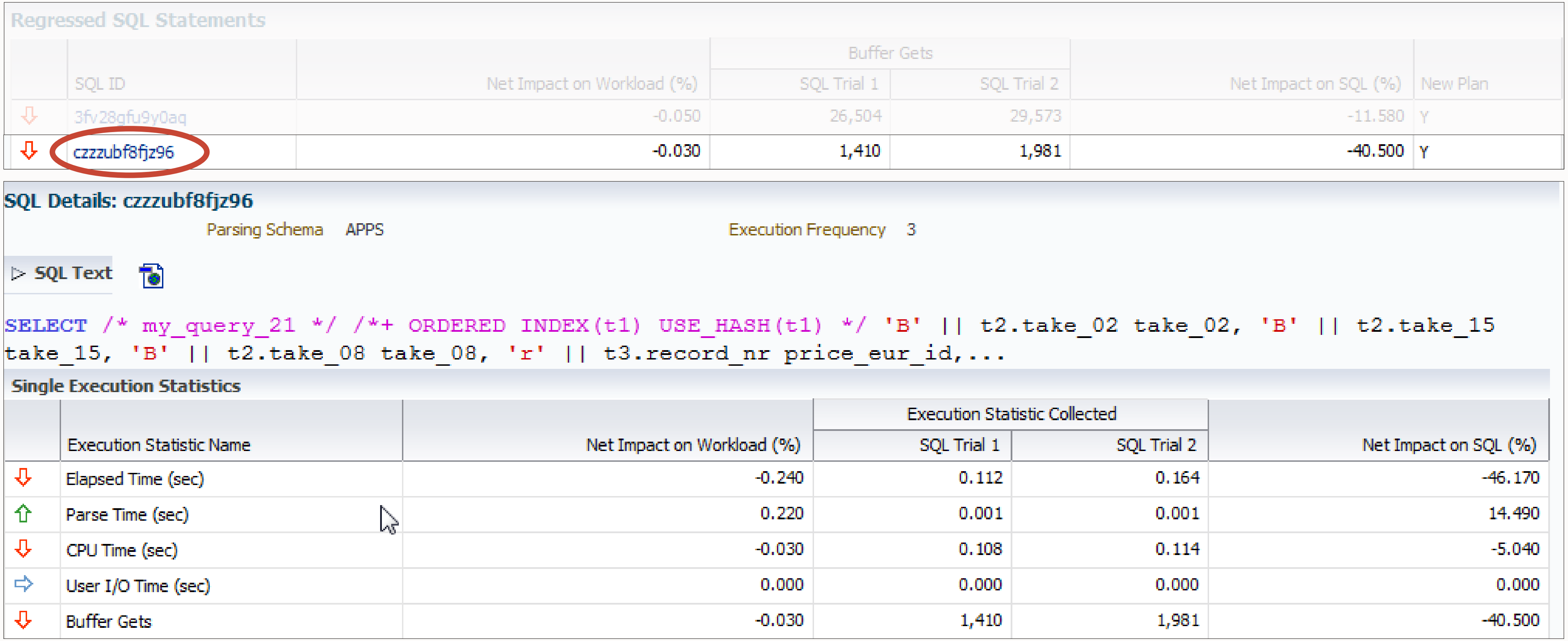
SPA | Regressed Report



Regressed SQL Statements

	SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
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⇩	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

SQL Details: czzzubf8fjz96

Parsing Schema APPS

Execution Frequency 3

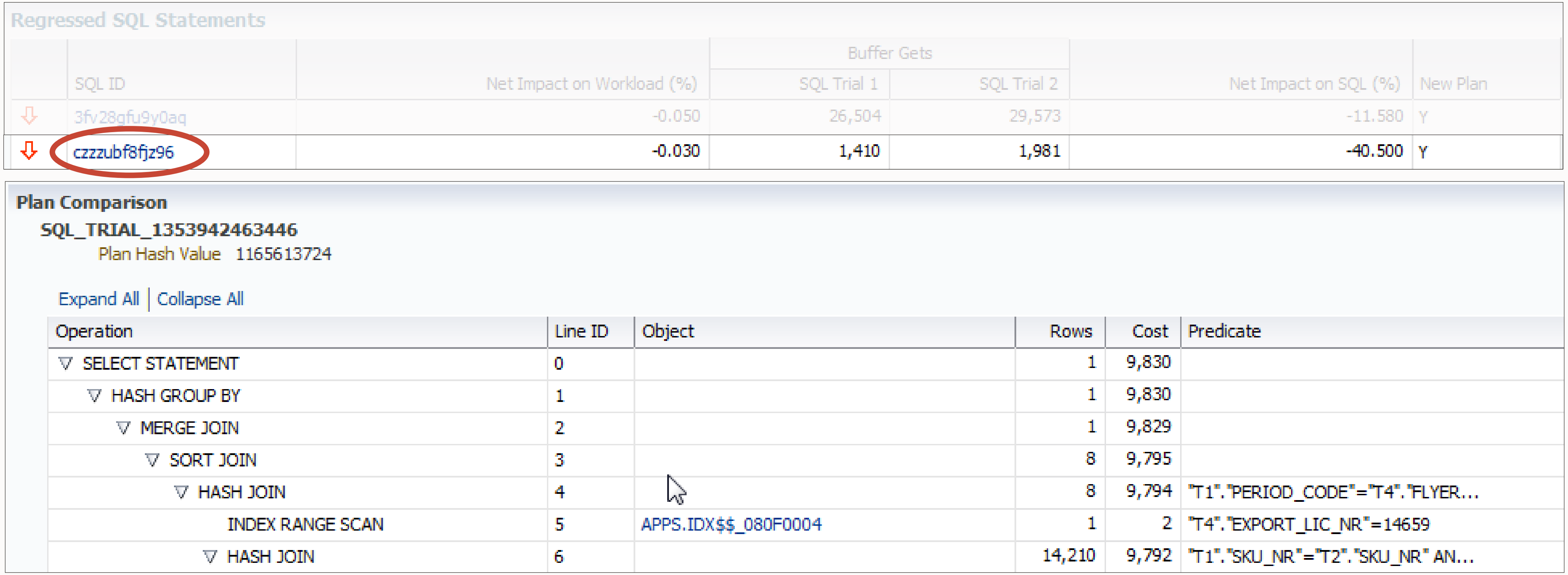
▷ SQL Text

```
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

SPA | Regressed Report



Regressed SQL Statements

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Plan Comparison

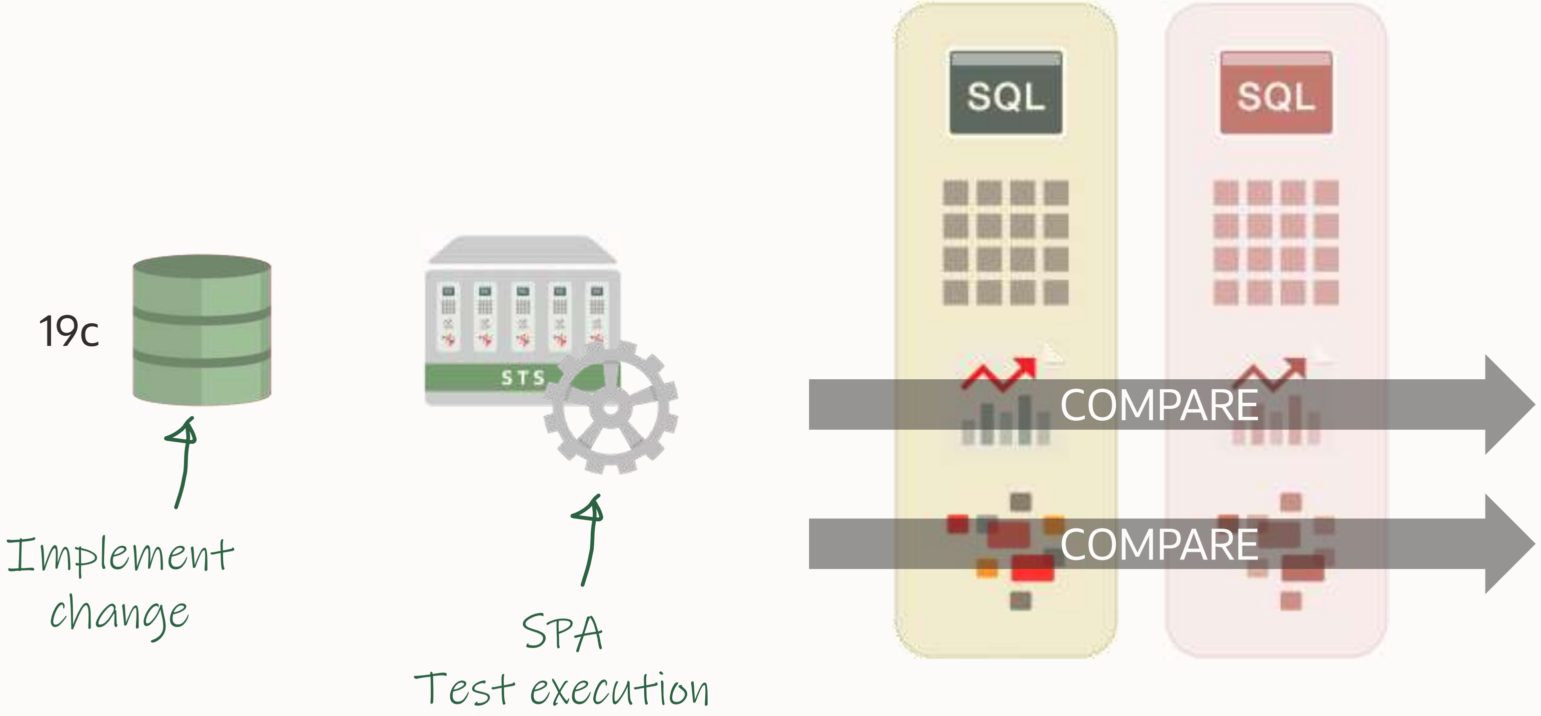
SQL_TRIAL_1353942463446

Plan Hash Value 1165613724

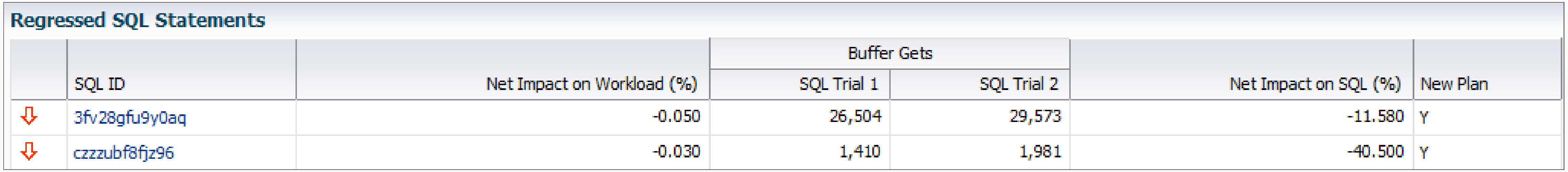
Expand All | Collapse All

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...

SPA | Continuous Improvement



SPA | Regressed Report



Regressed SQL Statements

			Buffer Gets			
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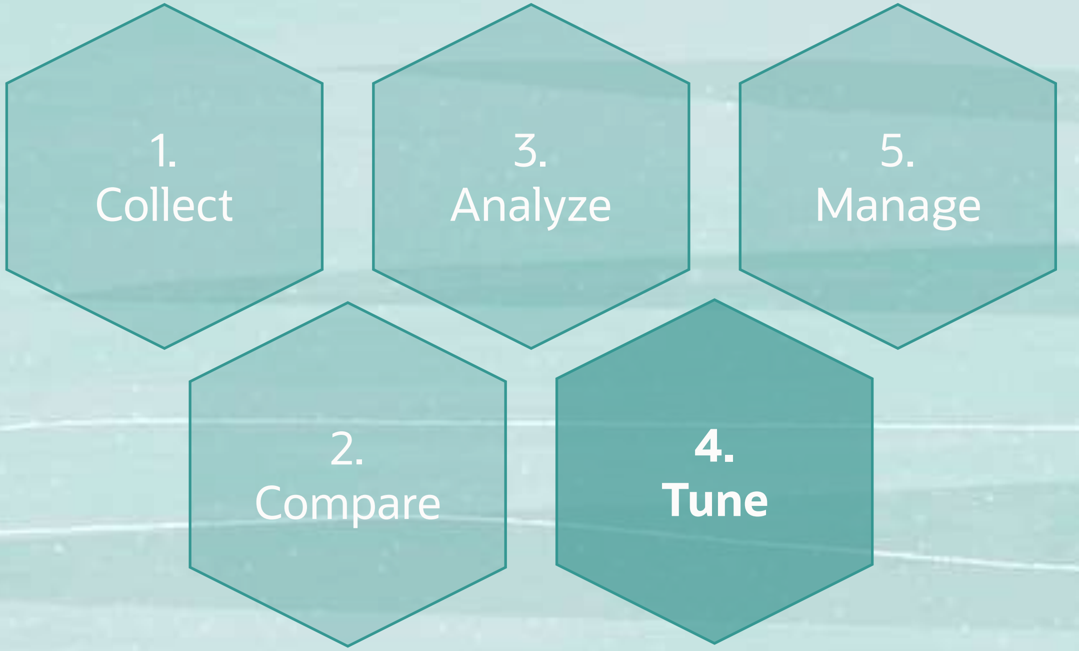
Performance Stability Prescription



1. Collect

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5. Manage

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SQL Tuning Advisor

> *SQL Tuning Advisor is SQL diagnostic software in the Oracle Database Tuning Pack.*
>
> …
>
> *SQL Tuning Advisor is a mechanism for resolving problems related to suboptimally performing SQL statements.*

Database 19c SQL Tuning Guide, chapter 24

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SQL Tuning Advisor | Findings

Types of findings:

1. Collection of object statistics
2. Creation of indexes
3. Rewriting SQL statements
4. Creation of SQL profiles

.... and more

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

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SQL Profiles

> *A SQL profile is a database object that contains auxiliary statistics specific to a SQL statement.*
>
> …
>
> *The corrected statistics in a SQL profile can improve optimizer cardinality estimates, which in turn leads the optimizer to select better plans.*

Database 19c SQL Tuning Guide, chapter 26

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SQL Profiles | Facts

1. Part of Tuning Pack
   - Included in some cloud offerings

2. Stores a set of hints that causes the optimizer to select a plan

3. Affects one statement only

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SQL Profiles | Facts

4. You can enable/disable a profile

5. Transparent to application
   - Does not require application changes

6. Persistent and transportable
   - Documentation

7. Useful with literals using `FORCE_MATCH=TRUE`

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SQL Profile | Testing

1. Enable profile for selected environments only

```
SQL> exec :p_name := dbms_sqltune.accept_sql_profile(
   task_name=>'TASK_21944',
   name=>'XT_PROFILE',
   category=>'TEST_ENV');
```

2. Verify the profile – it doesn't get used by the optimizer in the live environment

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

3. Accept and make visible to all sessions (`'DEFAULT'`)

```
SQL> exec dbms_sqltune.alter_sql_profile(
   name=>'XT_PROFILE',
   attribute_name=>'CATEGORY',
   value=>'DEFAULT');
```

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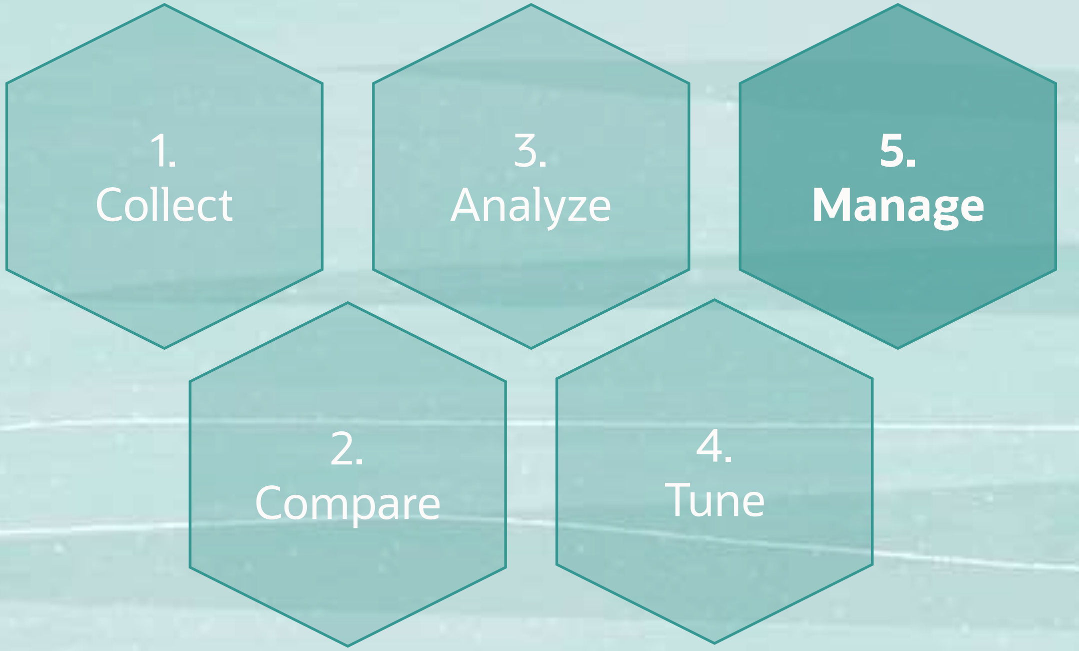
Performance Stability Prescription



1. Collect

2. Compare

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SQL Plan Management | SPM

> *SQL plan management uses a mechanism called a* ***SQL plan baseline****, which is a set of accepted plans that the optimizer is allowed to use for a SQL statement.*
>
> …
>
> *SQL plan management prevents performance regressions caused by plan changes.*

Database 19c SQL Tuning Guide, chapter 27

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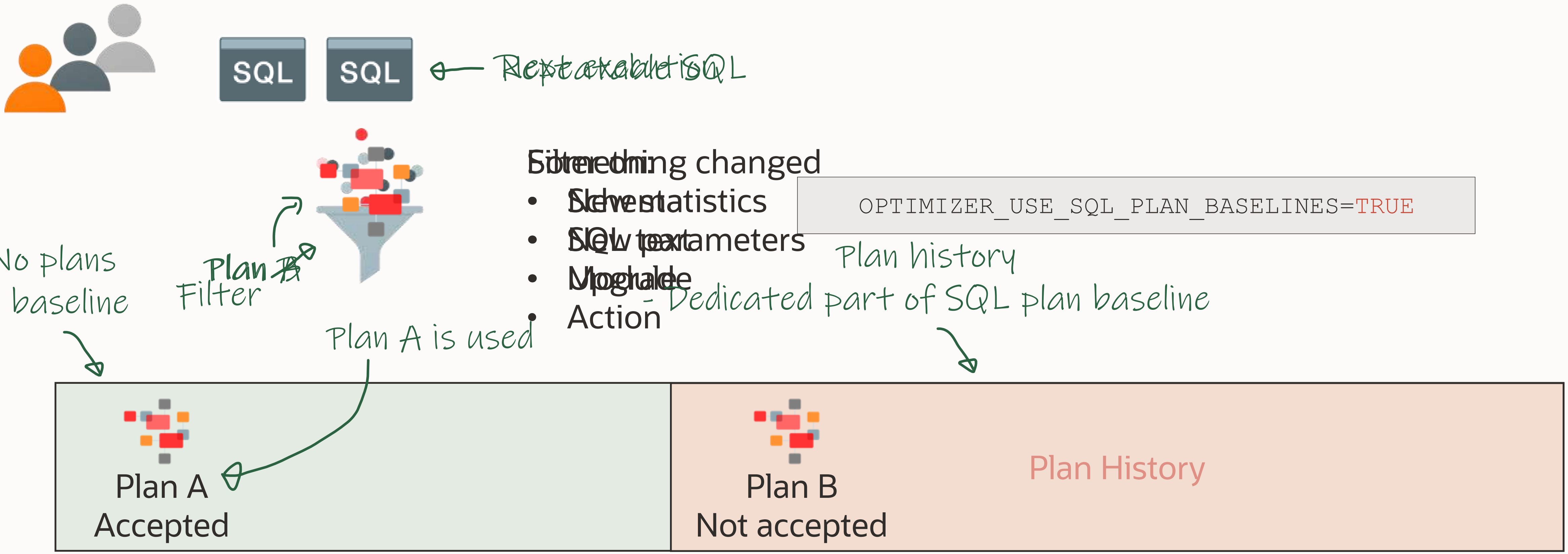
SPM | **Concept**



Repeatable SQL

Next execution

Something changed

Filter on:

- New statistics
- Schema
- New parameters
- SQL text
- Upgrade
- Module
- Action

```
OPTIMIZER_USE_SQL_PLAN_BASELINES=TRUE
```

Plan history - Dedicated part of SQL plan baseline

No plans in baseline

Plan B

Plan A

Filter

Plan A is used

Plan A
Accepted

Plan B
Not accepted

Plan History

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SPM | Plans

The plans in a SQL plan baseline can be:

- Enabled
- Accepted
- Fixed

To change status use `DBMS_SPM.ALTER_SQL_PLAN_BASELINE`

You can also prevent plans from getting purged by setting the `autopurge` property.

Pro tip: The *Accepted* attribute can only be set by a test execution

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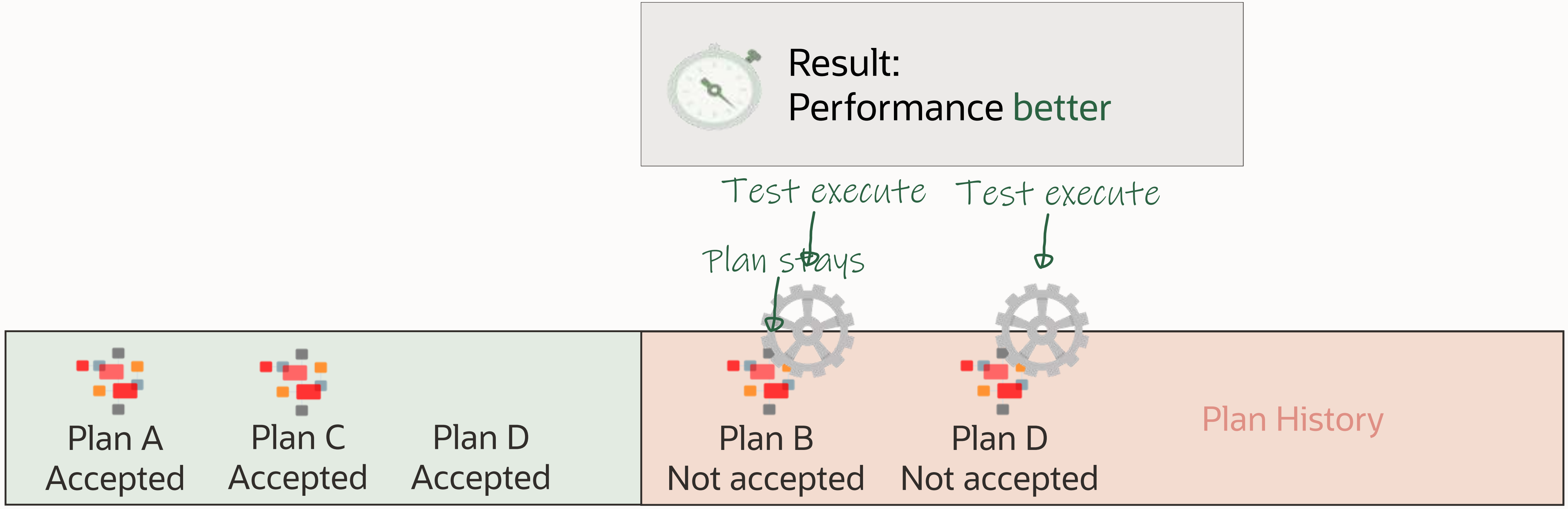
SPM | Evolve



Result:
Performance better

Test execute

Test execute

Plan stays

Plan A
Accepted

Plan C
Accepted

Plan D
Accepted

Plan B
Not accepted

Plan D
Not accepted

Plan History

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SPM | Evolve

Evolving happens in maintenance task SYS_AUTO_SPM_EVOLVE_TASK

- Part of Automatic SQL Tuning Task

You decide whether recommendations are implemented automatically

```
SQL> BEGIN
   DBMS_SPM.SET_EVOLVE_TASK_PARAMETER(
      parameter => 'accept_plans',
      value     => 'true');
   END;
/
```

You can evolve plans manually

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SPM | Management Base

- SQL Management Base is stored in SYSAUX tablespace
- Plans are stored in a LOB
- Unused plans are deleted after 53 weeks
- Space budget is 10 %

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SPM | Management Base

Check your settings

```
SQL> select parameter_name, parameter_value from dba_sql_management_config;

PARAMETER_NAME                       PARAMETER_VALUE
___________________________________ __________________
AUTO_CAPTURE_ACTION
```

```
SQL> exec DBMS_SPM.CONFIGURE('plan_retention_weeks', 5);
```

```
AUTO_CAPTURE_PARSING_SCHEMA_NAME
AUTO_CAPTURE_SQL_TEXT
AUTO_SPM_EVOLVE_TASK                OFF
AUTO_SPM_EVOLVE_TASK_INTERVAL       3600
```

```
SQL> exec DBMS_SPM.CONFIGURE('space_budget_percent', 5);
```

```
PLAN_RETENTION_WEEKS                53
SPACE_BUDGET_PERCENT                10
```

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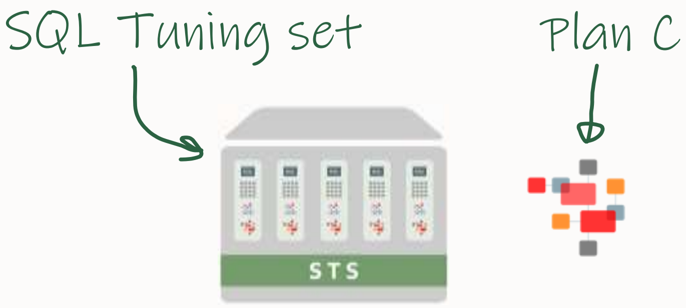
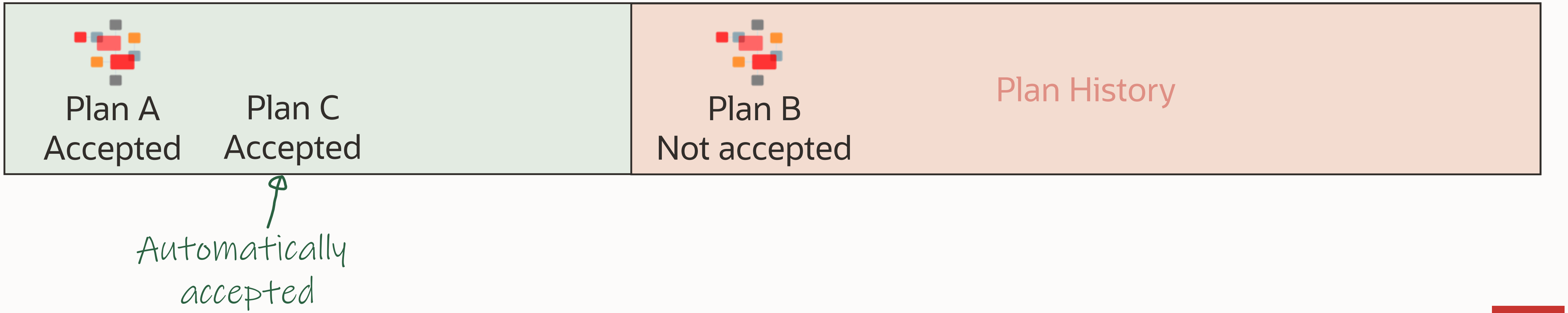
SPM | Load from STS



SQL Tuning set

Plan C

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



Plan A
Accepted

Plan C
Accepted

Automatically
accepted

Plan B
Not accepted

Plan History

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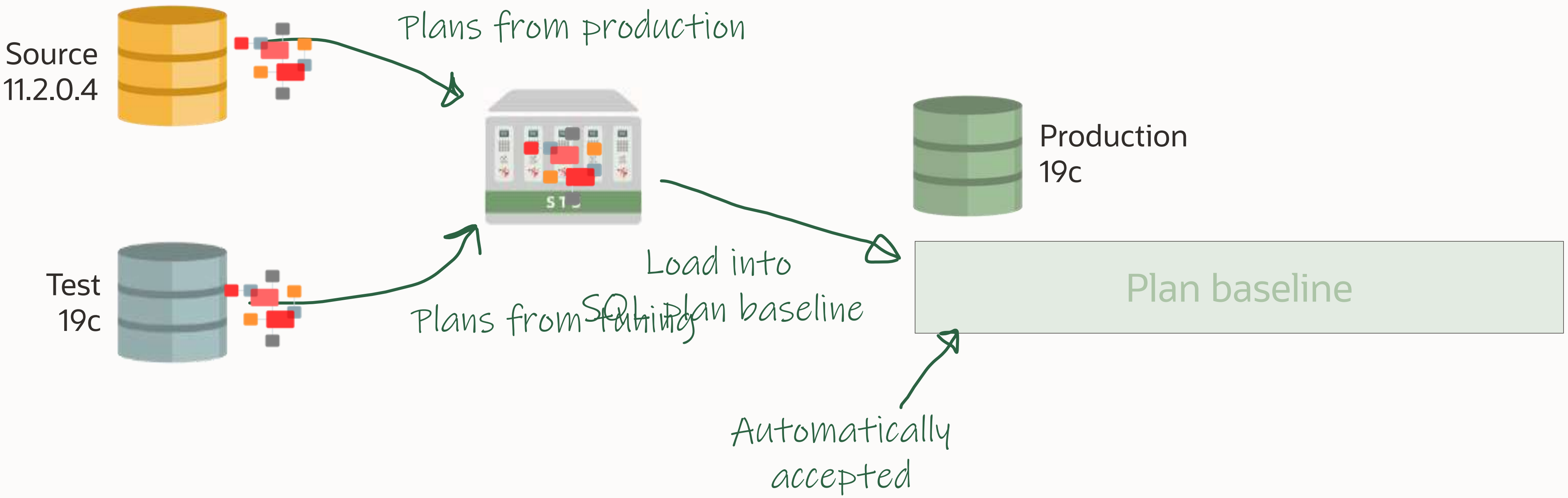
SPM | Use Case



Source 11.2.0.4

Test 19c

Production 19c

Plan baseline

Plans from production

Plans from tuning

Load into SQL plan baseline

Automatically accepted

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SPM | Use Case

STS
Plan baseline

```
SQL> DECLARE
  plans_loaded NUMBER;
  filter VARCHAR2(255);
BEGIN
  filter := 'sql_id=''czzzubf8fjz96'' AND plan_hash_value=''1165613724''';

  plans_loaded := DBMS_SPM.LOAD_PLANS_FROM_SQLSET (
    sqlset_name  => 'UPG_STS_1',
    basic_filter => filter
  );
END;
/
```

Pro tip: The function `LOAD_PLANS_FROM_SQLSET` can also *fix* the plans

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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!
- SQL profiles can do force matching

Optimal solution: Change your application to use bind variables

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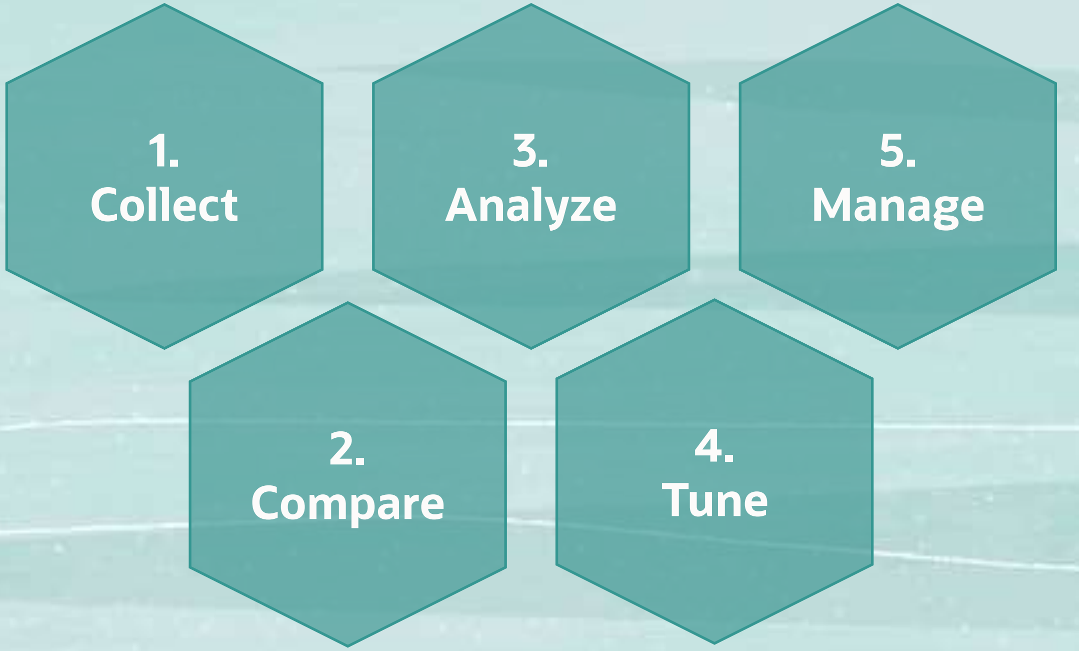
Performance Stability Prescription



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Secrets, Surprises, Underscores

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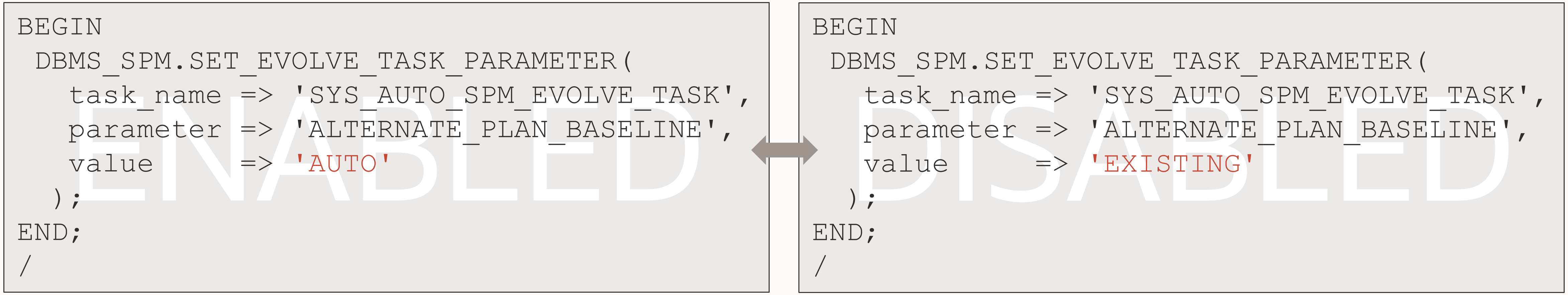
Surprise | Automatic SQL Plan Management

Enabled by default in Oracle 19.3.0

Disabled by default since Oracle 19.4.0, but only on non-Exadata systems

- Scans AWR
- Verifies and enables SQL Plan Baselines without DBA intervention
- Exadata-only feature



ENABLED

```
BEGIN
 DBMS_SPM.SET_EVOLVE_TASK_PARAMETER(
   task_name => 'SYS_AUTO_SPM_EVOLVE_TASK',
   parameter => 'ALTERNATE_PLAN_BASELINE',
   value     => 'AUTO'
  );
END;
/
```

DISABLED

```
BEGIN
 DBMS_SPM.SET_EVOLVE_TASK_PARAMETER(
   task_name => 'SYS_AUTO_SPM_EVOLVE_TASK',
   parameter => 'ALTERNATE_PLAN_BASELINE',
   value     => 'EXISTING'
  );
END;
/
```

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Underscores | optimizer_adaptive_*

Parameter `optimizer_adaptive_plans`

- Default: `TRUE`
- Adjust join methods, bitmap pruning and parallel distribution methods during runtime after parsing

Parameter `optimizer_adaptive_statistics`

- Default: `FALSE`
- Create dynamic statistics, SQL Plan Directives and do automatic reoptimization

Recommendation

- Leave the defaults
- For Oracle 12.2.0.1 and newer

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Underscores | `_sql_plan_directive_mgmt_control`

Parameter `_sql_plan_directive_mgmt_control`

- SQL Plan Directives get collected in the background
- Even when `optimizer_adaptive_statistics=false` (default)
- But SPDs won't be used
- MOS Note: 2209560.1 - How To Disable SQL Plan Directive (SPD)

Recommendation

- Set `_sql_plan_directive_mgmt_control=0` always everywhere
- For Oracle 12.2.0.1 and newer

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Underscores | `_cursor_obsolete_threshold`

Parameter `_cursor_obsolete_threshold`

- Parent cursors not getting obsoleted
- Thus, the child cursors under the parent are getting extended beyond 1024 (default in 12.1)
- Massive concurrency issues with cursor mutexes
- MOS Note: 2431353.1
  High Version Counts For SQL (>1024) Post Upgrade To 12.2 and Above Causing Slow Performance

Recommendation

- Set `_cursor_obsolete_threshold=1024` always everywhere
- For Oracle 12.2.0.1 and newer

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Underscores | optimizer_real_time_statistics

Parameter

optimizer_real_time_statistics

- Real time and high frequency statistics gathering on DML operations
- Exadata-only feature
- ON by default until 19.9.0
- OFF by default since 19.10.0
- Documentation, Optimizer Blog and Upgrade Blog

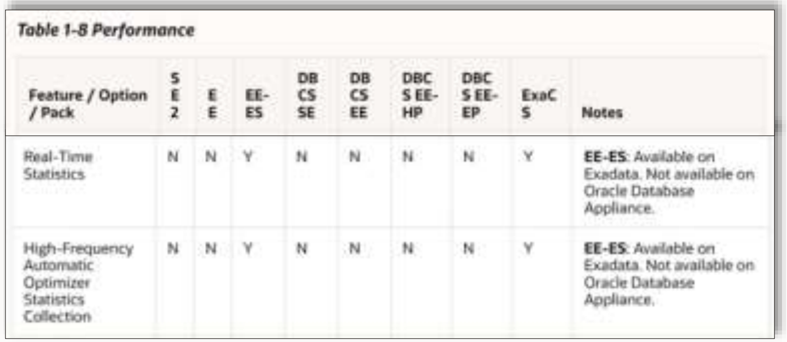

Table 1-8 Performance

Feature / Option / Pack	SE2	EE	EE-ES	DBCS SE	DBCS EE	DBCS EE-HP	DBCS EE-EP	ExaCS	Notes
Real-Time Statistics	N	N	Y	N	N	N	N	Y	**EE-ES**: Available on Exadata. Not available on Oracle Database Appliance.
High-Frequency Automatic Optimizer Statistics Collection	N	N	Y	N	N	N	N	Y	**EE-ES**: Available on Exadata. Not available on Oracle Database Appliance.

Recommendation

- Until 19.9.0
  - `_optimizer_gather_stats_on_conventional_dml=FALSE`
  - `_optimizer_use_stats_on_conventional_dml=FALSE`
- From 19.10.0 on: `optimizer_real_time_statistics=FALSE`

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Underscores | `deferred_segment_creation`

Parameter `deferred_segment_creation`

- Table/index created but no row inserted? No space used
- But performance penalty when first row gets inserted
- Only useful in environments where objects get created and dropped massively
- Several corruption bugs, contention issues and more
  - See: MOS Note 1216282.1 - Parameter "DEFERRED_SEGMENT_CREATION"

Recommendation

- Set `deferred_segment_creation=false` unless you really need this feature
- For Oracle 11.2 and newer

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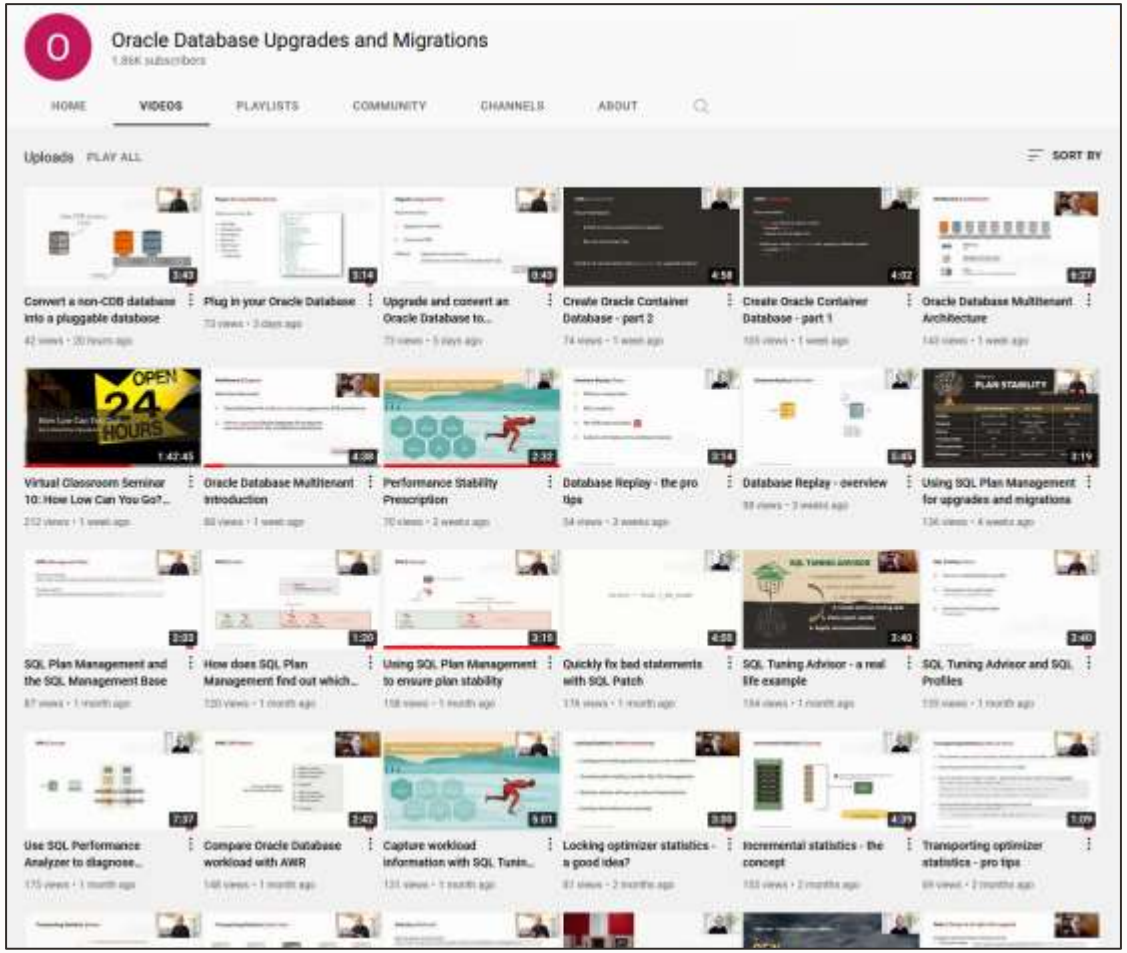
YouTube | Oracle Database Upgrades and Migrations



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