

ORACLE

CRIBAN ALEXANDRU = JON = CUZA ALEXAN

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

Bucharest, January 2025

Oracle

DBAs

run the world





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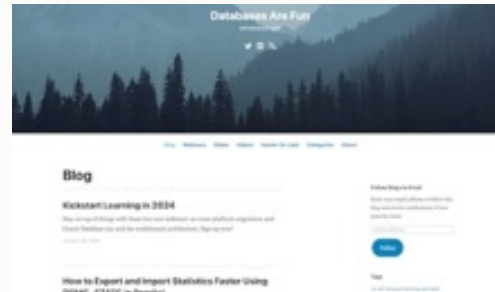
 <https://dohdatabase.com>

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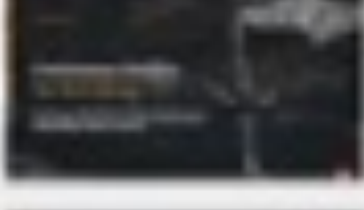
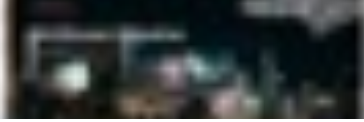
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Web Seminar	Video
Episode 10 Improving Clouds in Real Time (2016) Clouds for Data Science and Analytics (2016) November 19, 2016	
Episode 11 Clouds for Data Science and Analytics (2016) November 19, 2016	
Episode 12 Clouds for Data Science and Analytics (2016) November 19, 2016	
Episode 13 Clouds for Data Science and Analytics (2016) November 19, 2016	
Episode 14 Clouds for Data Science and Analytics (2016) November 19, 2016	
Episode 15 Clouds for Data Science and Analytics (2016) November 19, 2016	

Recorded Web Seminars

<https://MikeDietrichDE.com/videos>

More than 35 hours of technical content,
on-demand, anytime, anywhere

AGENDA

09:30

Welcome
Release Strategy
Patching

11:00

Upgrade
Multitenant

13:00

Data Pump
Performance Stability
Insights into development

15:15

Autonomous Database
Oracle Database 23ai
What's New, What's Coming

10:45

Coffee break

12:00

Lunch

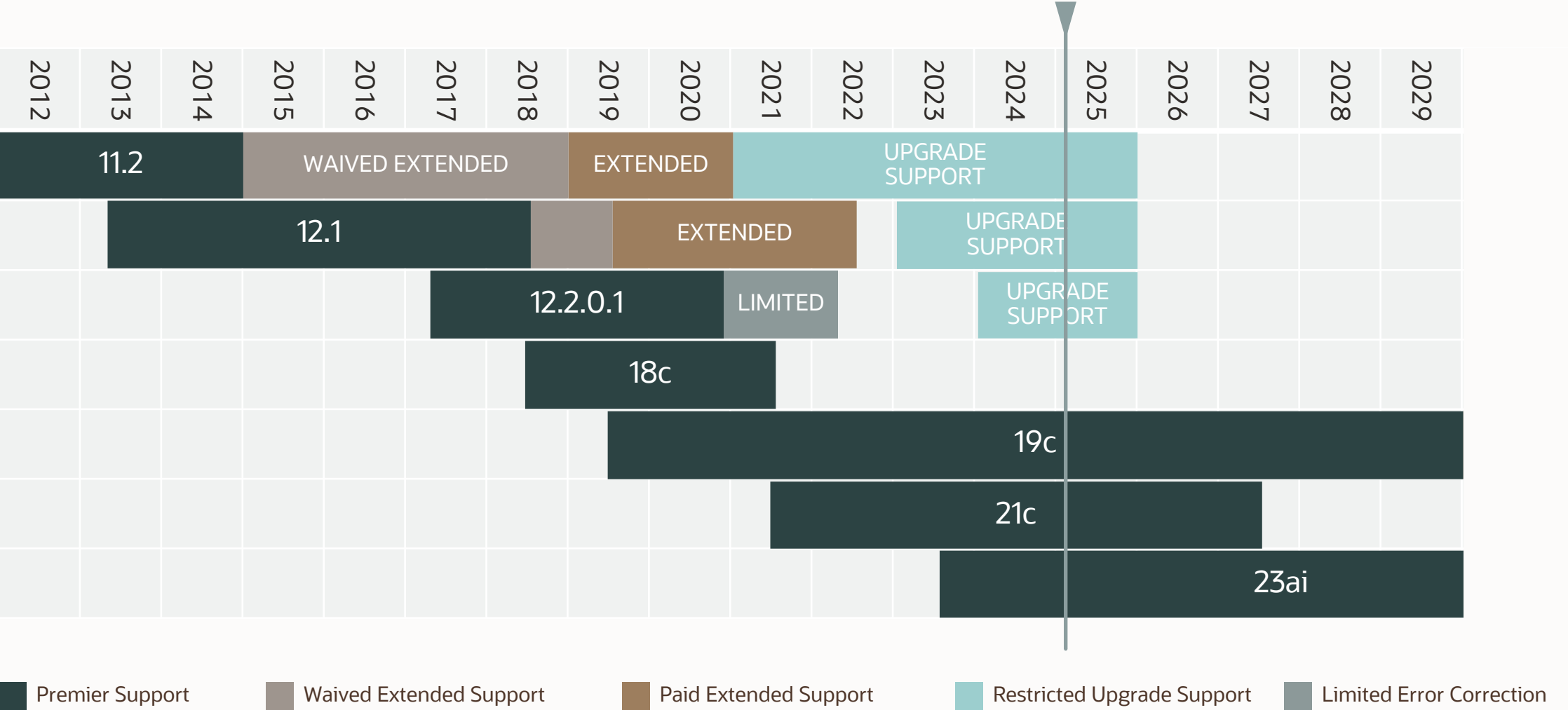
15:00

Coffee break

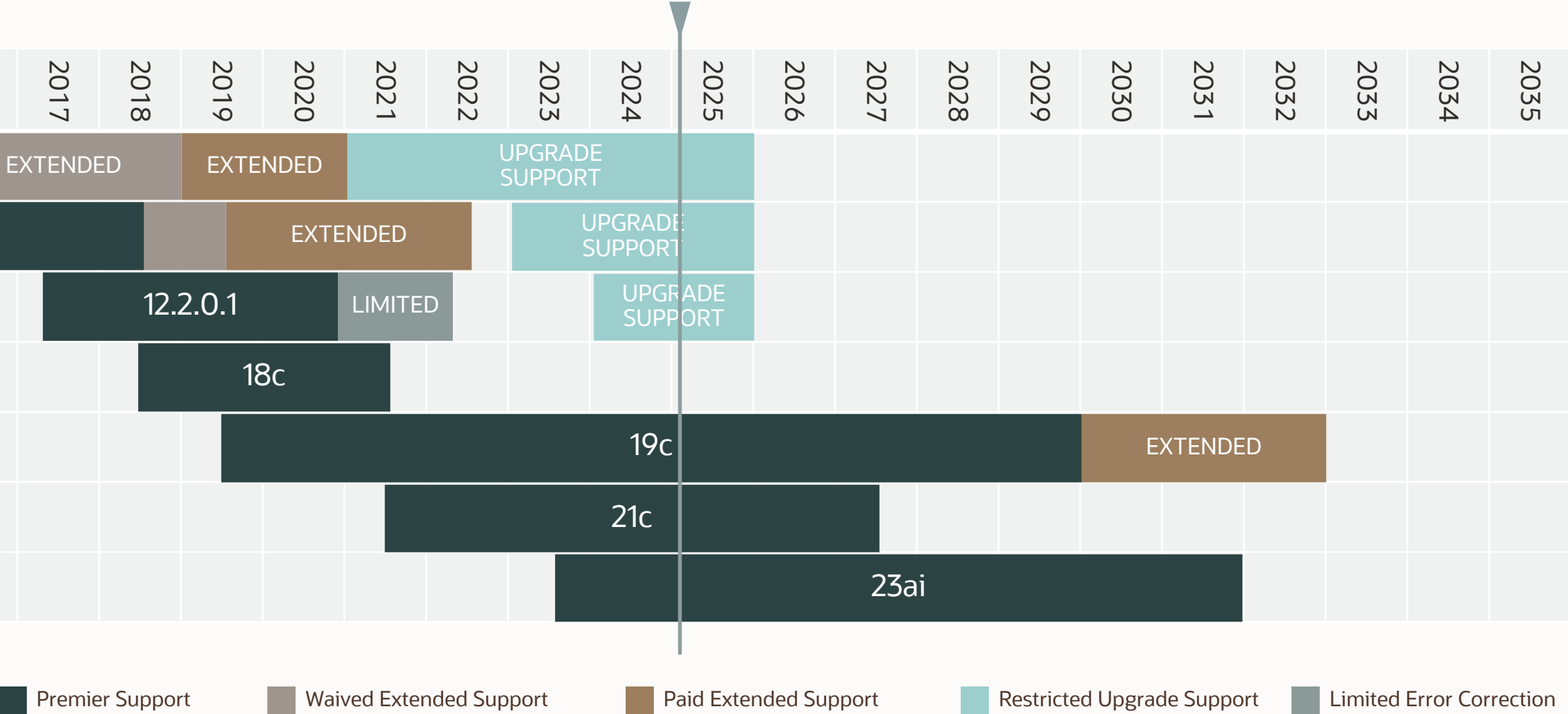


Release Strategy

Lifetime Support Policy



Lifetime Support Policy





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

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

Next Long Term Support release

Oracle Database 23ai

Upgrade possible only from:

- Oracle Database 19c
- Oracle Database 21c

Database and Grid Infrastructure Patching

Patching Best Practices

Installation

Basics

Methods

Grid Infrastructure

Datapatch

AutoUpgrade





Until **Oracle Database 19c**, you
always start with the base release

- Oracle Database 19.3.0



From **Oracle Database 23ai** onwards,
you download a Gold Image

- Updated with latest Release Update

Always Apply the Most Recent RU

Use the Patch Download Assistant [MOS Note: 2118136.2](#)

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

Visibility: EXTERNAL

(96)

Selection(s)

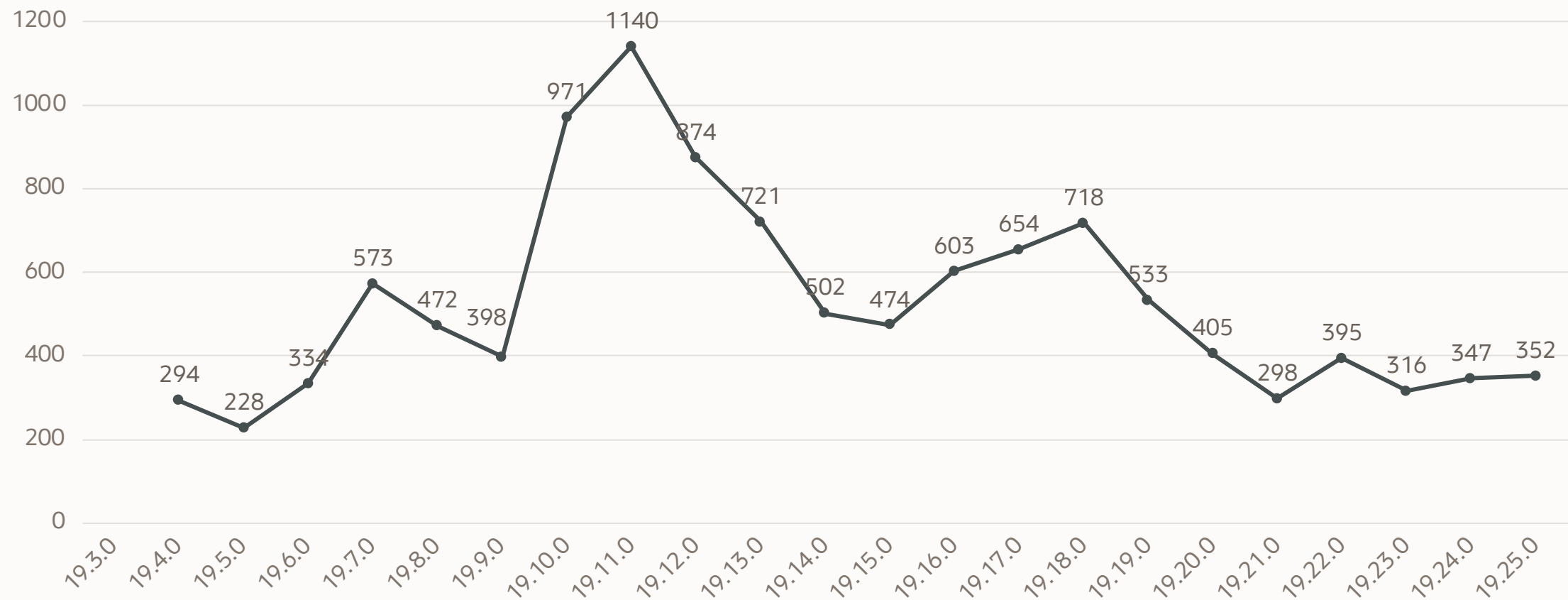
What would you like to download?

- ☐ 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 will appear once you make your selection.

Release Update Contents



[Database 19 Release Updates and Revisions Bugs Fixed Lists \(Doc ID 2523220.1\)](#)





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

- More than 11k fixes with 19.25.0
- More than 300 security fixes

Apply the Most Important Patches

Always use Important Recommended One-Off Patches: [MOS Note: 555.1](#)

Recommended Patches for 19.23 DB Home							
Below is the list of important patches to consider applying on top of 19.23. 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
36587533	19.24	DBMRP 19.22.0.0.240618 DBMRP 19.23.0.0.240618	[SQL EXECUTION] Result Cache: Global Flush Should Always Clear Bypass Flag even if the Result Cache is Uninitialized	[list: patches]	YES	YES	27-SEP-2024
32781163			[QRY OPTIMIZER] Deadlock on library cache lock on MV refresh and dbms_stats gathering the same object	[list: patches]	YES		27-SEP-2024
36908826 (replaces 33539779)			[RMAN] ORA-600[krbr1sf_no_dc_record] during RMAN Restore	[list: patches]	YES		24-SEP-2024
35398148			[VOS HEAP MGMT] SHARED POOL not shrinking during shrink of SGA	[list: patches]	YES	YES	19-SEP-2024



Monthly Recommended Patches

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

Quarterly Release Updates

	2023				2024				2025				2026		
	January	April	July	October	January	April	July	October	January	April	July	October	January	April	July
19c	19.18.0	19.19.0	19.20.0	19.21.0	19.22.0	19.23.0	19.24.0	19.25.0	19.26.0	19.27.0	19.28.0	19.29.0	19.30.0	19.31.0	19.32.0
21c	21.9.0	21.10.0	21.11.0	21.12.0	21.13.0	21.14.0	21.15.0	21.16.0	21.17.0	21.18.0					
23ai							23.5.0	23.6.0	23.7.0	23.8.0	23.9.0	23.10.0	23.11.0	23.12.0	23.13.0



Monthly Recommended Patches

	2023			2024										
	October	November	December	January	February	March	April	May	June	July	August	September	October	November
19.21.0	19.21.0	MRP1	MRP2	MRP3	MRP4	MRP5	MRP6							
19.22.0				19.22.0	MRP1	MRP2	MRP3	MRP4	MRP5	MRP6				
19.23.0							19.23.0	MRP1	MRP2	MRP3	MRP4	MRP5	MRP6	
19.24.0										19.24.0	MRP1	MRP2	MRP3	MRP4
19.25.0													19.25.0	MRP1





Sorry, but there is more to talk about ...

Apply Additional Important Fixes and Bundles

★ **Oracle Database Patches to Consider for 19c (Doc ID 2781612.2)** To Bottom

Visibility: EXTERNAL

Getting Started Performance GoldenGate Oracle Text Platform Specific HA DNFS Data Pump Partitioning Multitenant General Oracle Spatial

Search This Document Print

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



Always use the latest OPatch

- [Patch 6880880](#)



Patching Oracle home is faster
when you use a brand new home

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

Patching Best Practices

Installation

Basics

Methods

Grid Infrastructure

Datapatch

AutoUpgrade



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 ...`

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

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;
```

Patching Best Practices

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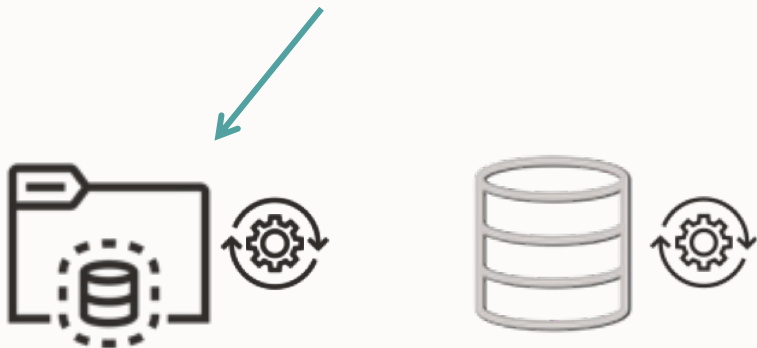
Datapatch

AutoUpgrade



In-Place Patching

Oracle Home, 19.24.0



```
$ORACLE_HOME/OPatch/opatch rollback -id ...
```

Out-of-Place Patching

Oracle Home, 19.24.0



```
SQL> SHUTDOWN IMMEDIATE
```



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

New Oracle Home
Oracle Home, 19.25.0



Tim Hall ∞ 🧑 + ∞ 🗨️
@oraclebase



When patching your production Oracle GI/DB installations, which method do you use?

In-Place = Current ORACLE_HOME
Out-Of-Place = New ORACLE_HOME

If you don't look after have production kit, then don't answer.





Always patch Out-of-Place

- Don't argue with us 😊



Reduce downtime to the time it takes to perform a switchover

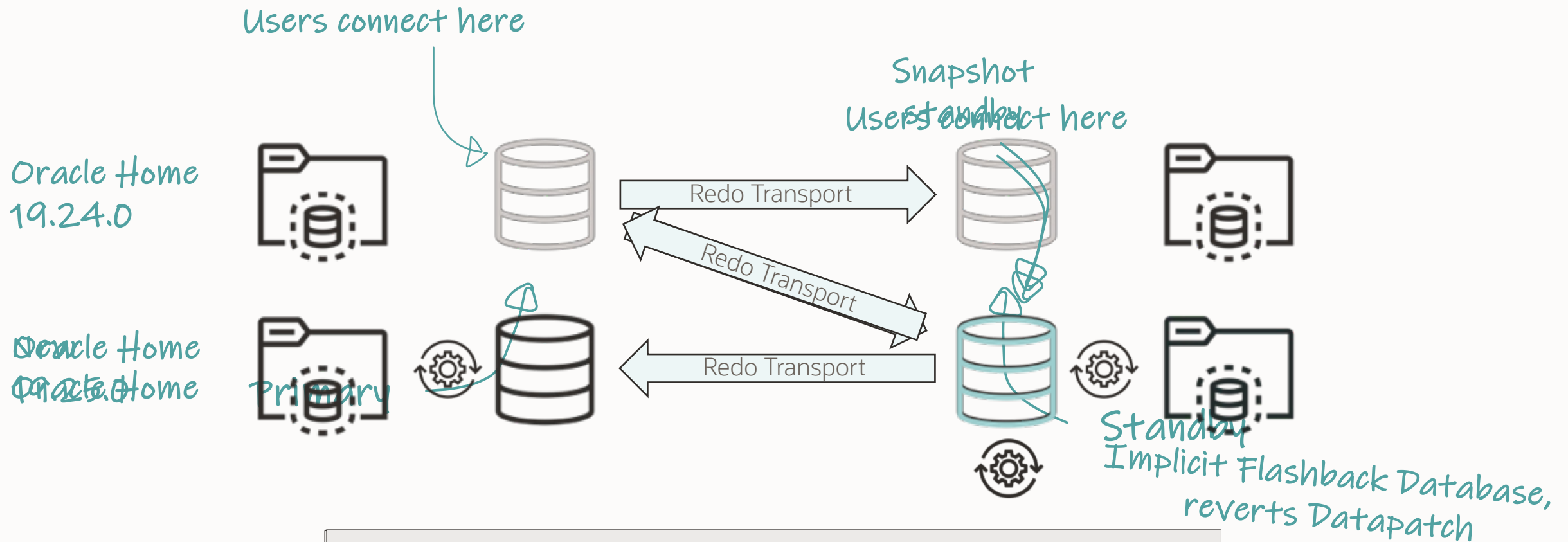
- [Data Guard Standby-First Patch Apply \(Doc ID 1265700.1\)](#)



Safely test and verify patches with Standby-First Patch Apply

- [Data Guard Standby-First Patch Apply \(Doc ID 1265700.1\)](#)

Standby-First Patching



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



Patch must Standby-First installable

- Check the patch readme



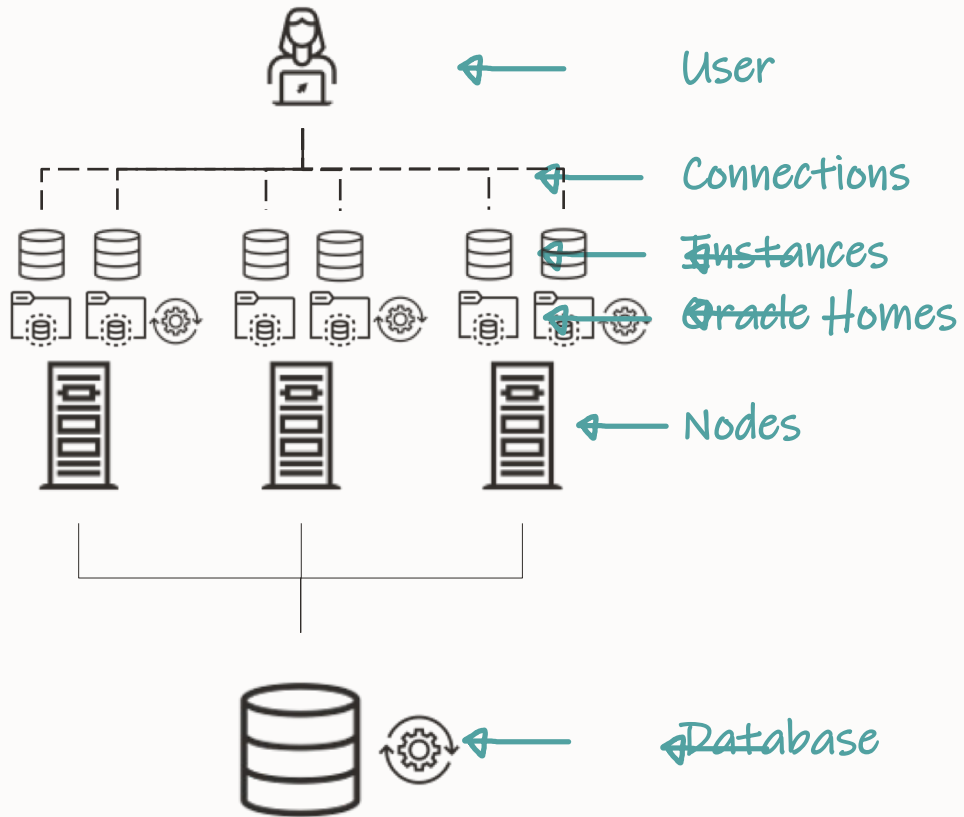
Execute datapatch on the primary database

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



Avoid database downtime with RAC Rolling Patch Apply

RAC Rolling Patching



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

Release updates are **always:**



Standby-First installable



RAC Rolling installable

Patching Best Practices

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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

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 SwitchGridHome

Demo

Patch a 2-node RAC system
GI and database

Watch on [YouTube](#)



23ai GI home disk space greatly reduced to 3 GB

- 12 GB in 19c



Use golden images

- [Blog post](#)
- Also for database homes

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

Patching GI and DB together?

Option 1

TOGETHER

One maintenance window

Longer, single patching window

Several changes

When draining is a problem

Option 2

SEPARATELY

Two maintenance windows

Shorter window, but longer overall patching

One change at a time

For well-behaving applications



Keep GI and DB patch levels in synch

- This is what we test and run in our Cloud



GI and DB Patch Levels

Method	Status	Example
In sync	Recommended, best practice	GI 19.26 + DB 19.26
Within two Release Updates	Supported, good practice	GI 19.26 + DB 19.24 GI 19.24 + DB 19.26
Within three or more Release Updates	Supported, not recommended	GI 19.26 + DB 19.23 GI 19.23 + DB 19.26
Different releases	Supported, use only for upgrades	GI 23.7 + DB 19.26





Complete a rolling patching operation
always as **quickly as possible**

- [RAC: Frequently Asked Questions \(Doc ID 220970.1\)](#)



Unusual combinations are supported, but we **strongly advice against it**

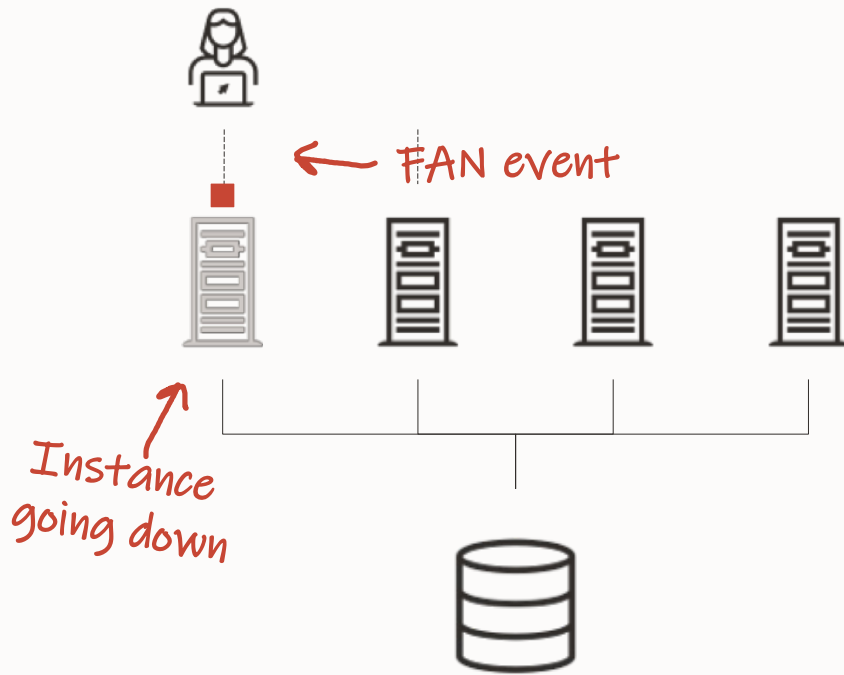
- Node 1 with GI 19.16.0, node 2 with GI 19.18.0
- Patching node 1 on Monday, node 2 on Tuesday ...
- Mix of GI and DB versions on various nodes



Rolling patching requires efficient draining

- Optionally, consider a *batched* approach

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`

Drain Timeout



Setting drain_timeout
very low?

- This may cause login storms
 - Be cautious 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

Patching Best Practices

Installation

Basics

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AutoUpgrade



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 \(Doc ID 2680521.1\)](#)



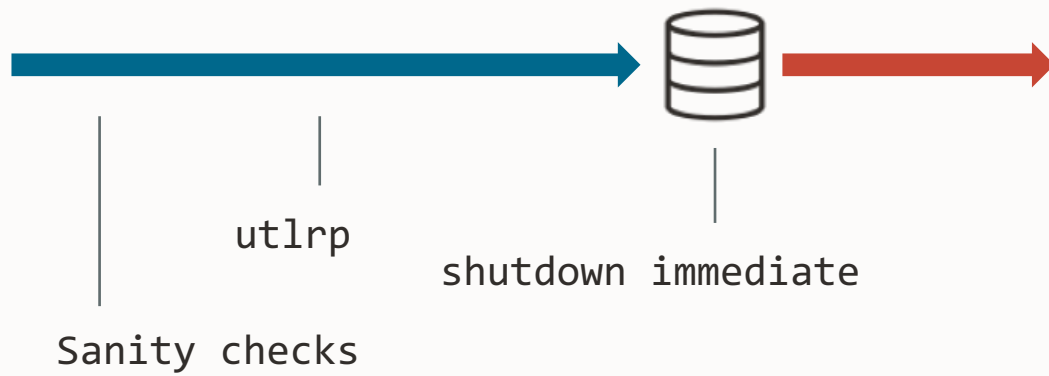
Analyze the database for patching readiness using Datapatch Sanity Checks

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



Recompile invalid objects
before invoking datapatch

Patching Timeline

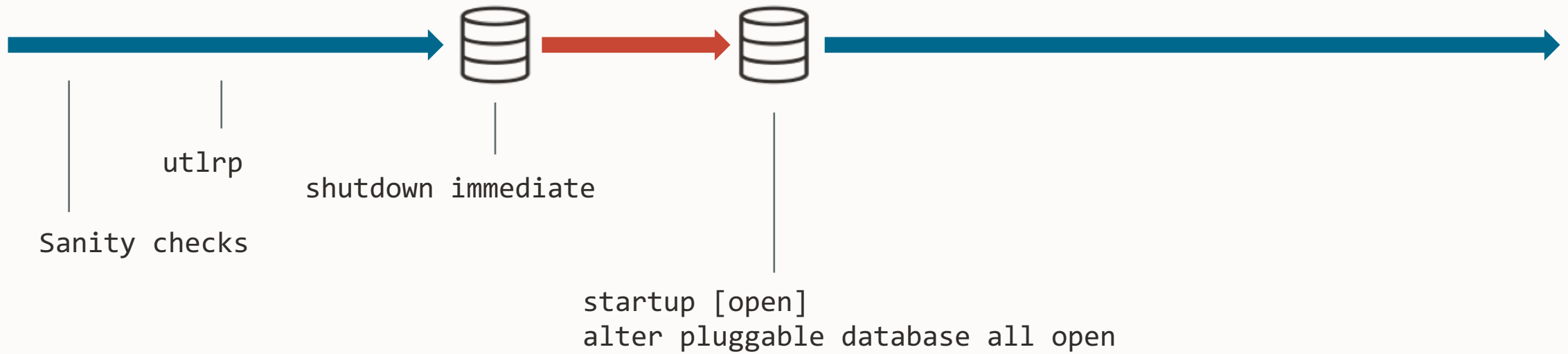




The database must be open
Only open PDBs are patched

- Upgrade mode or restricted session is **not** needed

Patching Timeline

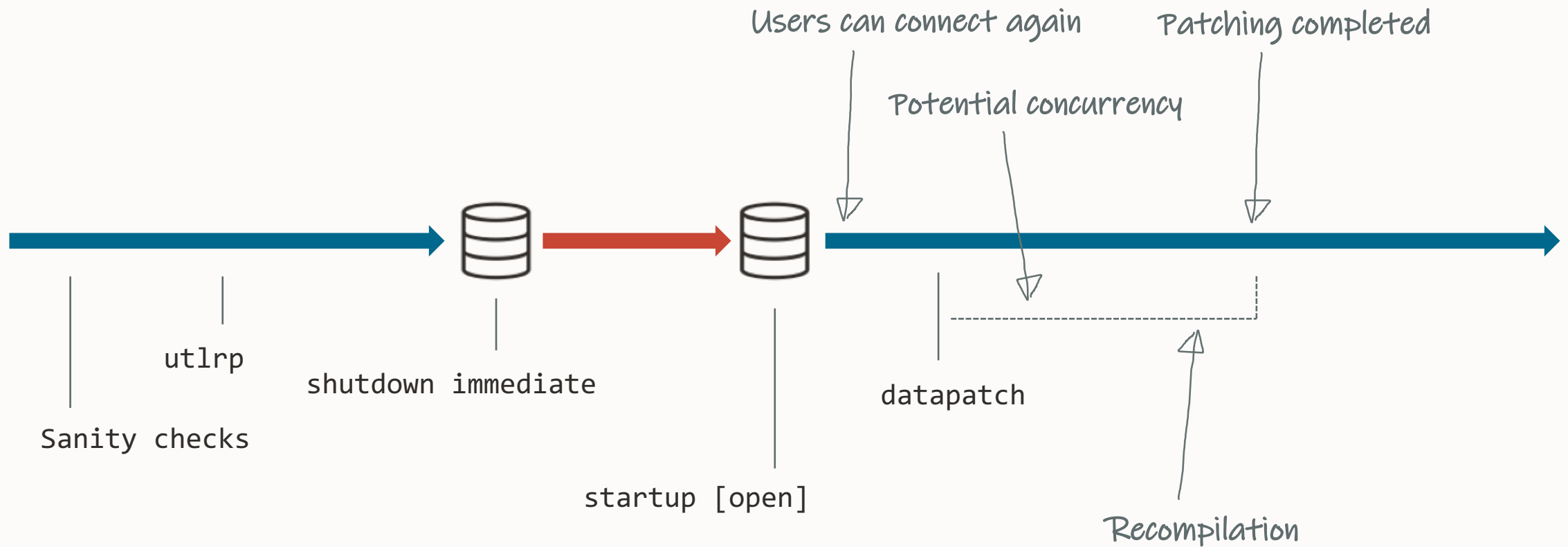




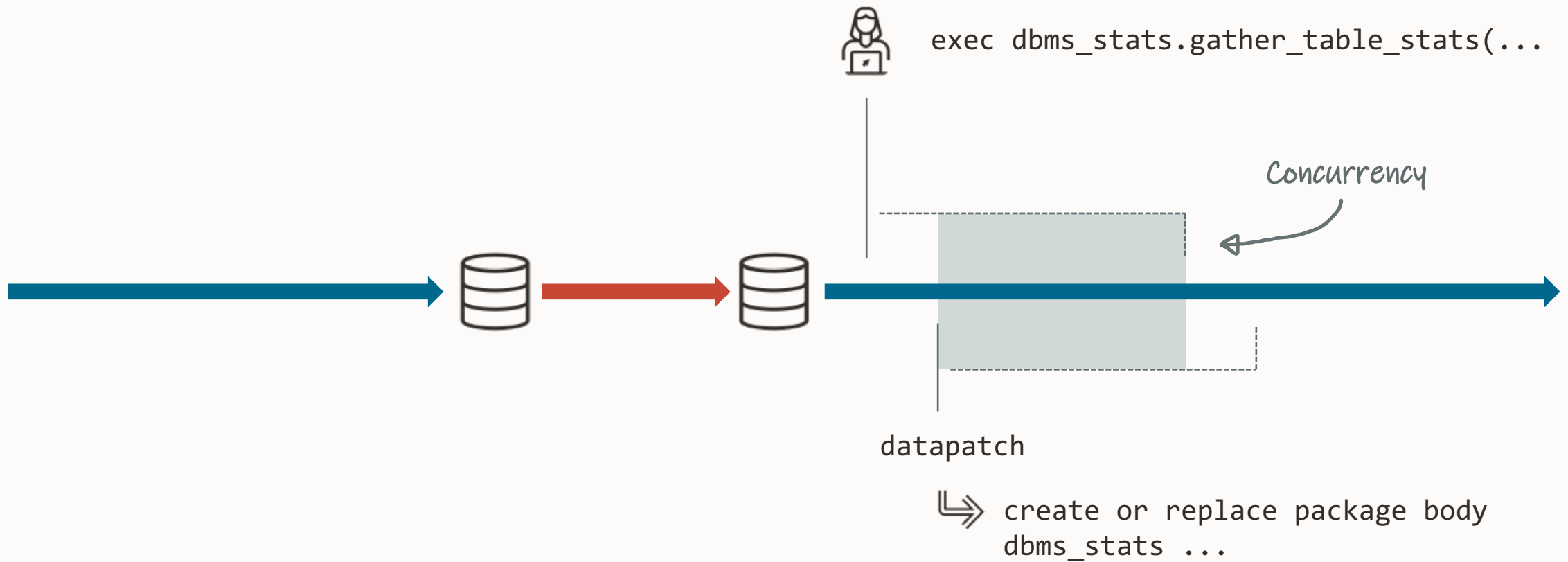
You can run **datapatch** while users are connected to the database

- Details in [blog post](#)

Patching Timeline



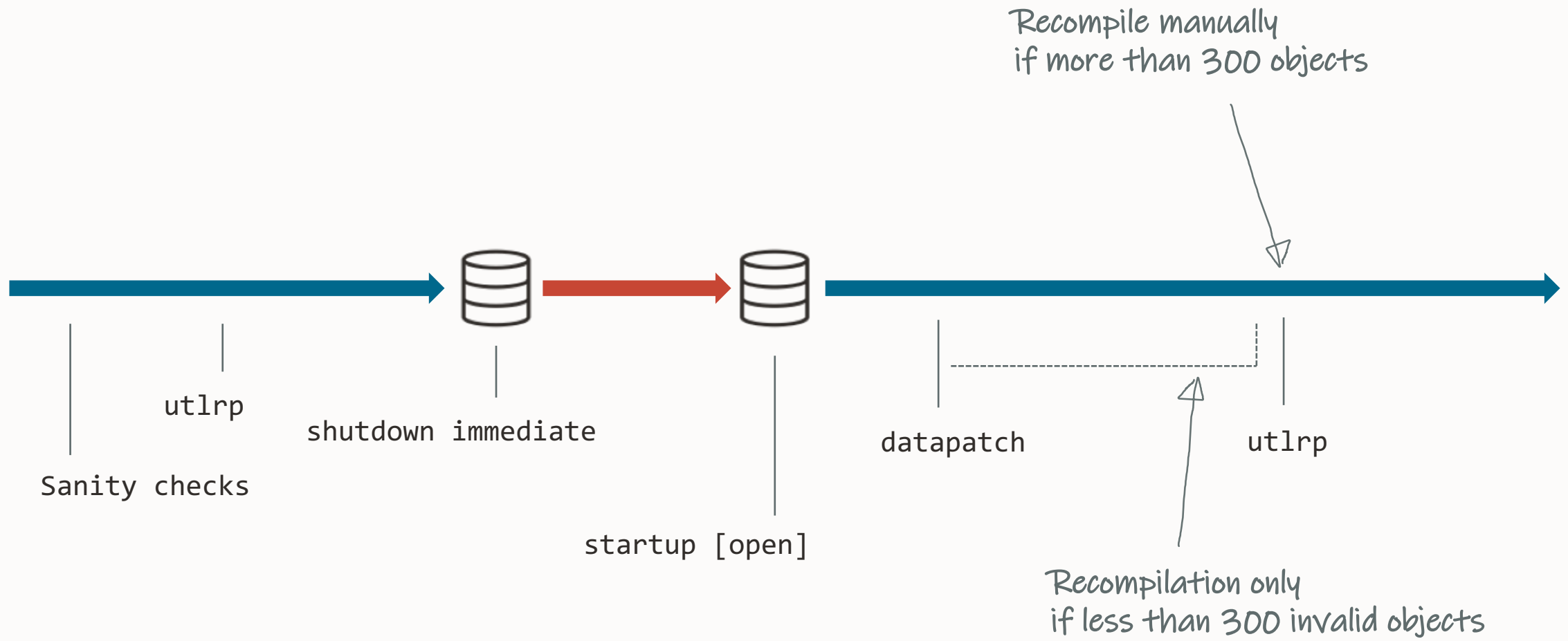
Patching Timeline



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>*

Patching Timeline




```
$ ./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





Datapatch uses
REGISTRY\$SQLPATCH_RU_INFO to
control the patching operations



If in doubt run **datapatch** again

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

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
```



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

- AutoUpgrade executes the script



Patching Best Practices

Installation

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Datapatch

AutoUpgrade

AutoUpgrade and Patching



Download

- Find the right patch numbers
- For the right platform
- Get latest OPatch



Install

- Install brand-new Oracle home
- Update OPatch
- Apply all patches



Patch

- Datapatch Sanity Check
- Move instances and files
- Datapatch
- Recompilation
- Post-tasks

AutoUpgrade and Patching



Download

- Find the right patch numbers
- For the right platform
- Get latest OPatch



Install

- Install brand-new Oracle home
- Update OPatch
- Apply all patches



Patch

- Datapatch Sanity Check
- Move instances and files
- Datapatch
- Recompilation
- Post-tasks

```
$ cat DB19.cfg
```

```
global.keystore=/home/oracle/autoupgrade-patching/keystore  
patch1.source_home=/u01/app/oracle/product/19/dbhome_19_24_0  
patch1.target_home=/u01/app/oracle/product/19/dbhome_19_25_0  
patch1.sid=DB19  
patch1.folder=/home/oracle/autoupgrade-patching/patch  
patch1.patch=RU,OPATCH,OJVM,DPBP
```



```
$ cat DB19.cfg
```

```
global.keystore=/home/oracle/autoupgrade-patching/keystore  
patch1.source_home=/u01/app/oracle/product/19/dbhome_19_24_0  
patch1.target_home=/u01/app/oracle/product/19/dbhome_19_25_0  
patch1.sid=DB19  
patch1.folder=/home/oracle/autoupgrade-patching/patch  
patch1.patch=RU,OPATCH,OJVM,DPBP
```

```
$ java -jar autoupgrade.jar -config DB23.cfg -patch -mode deploy
```

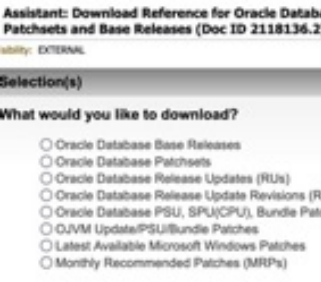

Demo

One-Button Patching

- Download patches
- Install Oracle home
- Patch database

Watch on [YouTube](#)

Important MOS Notes



Download Assistant

MOS Note: 2118136.2

Download Release Update, OJVM, Bundles

Recommended Patches for 19.25 DB Home

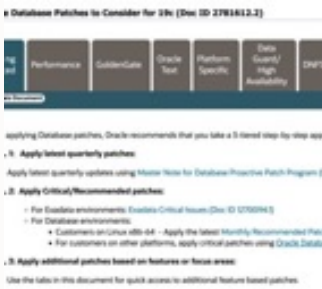
is the list of important patches to consider applying on top of 19.25. In addition to the info also review patches in Database Patchset Update Review - Known Issues Primary Note/Op for Patches to Consider for 19c (Doc ID 2781612.2) which contains patches to consider for Golden Gate etc.

Bug	Patch Fixed in in 19c MRPs	Description	Doc Patches Available	State
34213767 (Implement 34213767)		[TYP] HIGH LOCAL ORA-01761: invalid block computed on tempfile after 20040000 34213767	34213767 34213767	YES
34612008 (Implement 34612008)	Not Applicable	[VOR] ORA-00014: ORA-00014 internal error, arguments [not priority fixed], [later] [fixed]	34612008 34612008	YES
34776867		[AG] ORA-1461 in Pump Cluster Table / High CPU usage in OJVM Service	34776867 34776867	
25113953	Not Applicable	[OJVM] OJVM-1461 Error (ORA-1461) when Gathering Stats for User's Table	25113953 25113953	

Important One-Offs

MOS Note: 555.1

Add critical fixes on top
for known issues



Additional Fixes

MOS Note: 2781612.2

Important fixes such as
GoldenGate, Spatial, Data
Pump Bundle, Text and
more



SQL Performance

MOS Note: 2773715.1

Avoid SQL performance
problems. Has links to
"wrong results", "SPM"
and more included



MOS Note: 555.1

Recommended Patches for 19.25 DB Home

Below is the list of important patches to consider applying on top of 19.25. 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
36760879	19.26		[OSS SRV LAYER] Exadata: Warm up flash cache for disks that are being synced	[list patches]	YES		11-JAN-2025
36006239	19.26		[VOS] Exadata: Flash Cache Space Pressure After Cell Goes Down	[list patches]	YES		11-JAN-2025
37166484	19.26	DBMRP 19.24.0.0.241217 , DBMRP 19.25.0.0.241217	[SPACE LOB] To defer foreground materialize(chunks movement ufs->cfs)	[list patches]	YES	YES	28-NOV-2024
35197819	19.26	DBMRP 19.24.0.0.241119 , DBMRP 19.25.0.0.241119 , GIMRP 19.24.0.0.241119 , GIMRP 19.25.0.0.241119	[ASM] CSSD Leaking Memory When There Are Voting File Add/Drops	[list patches]	YES	YES	19-OCT-2024
34672698 (replaces 34286265)		Not Applicable	[VOS] DB50: ORA-800: soft external error, arguments: [set priority failed], [vktm] , dism(16)	[list patches]	YES		22-FEB-2024
34774667			[AQ] ORA-7445 in Purge Queue Table / High CPU usage in SVCB Service	[list patches]			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

Version DB 19.25_555.1: 36760879,36006239,37166484,35197819,34672698,34774667,29213893

This list may not be conflict-free!



```
$ cat DB19.cfg
```

```
global.keystore=/home/oracle/autoupgrade-patching/keystore  
patch1.source_home=/u01/app/oracle/product/19/dbhome_19_24_0  
patch1.target_home=/u01/app/oracle/product/19/dbhome_19_25_0  
patch1.sid=DB19  
patch1.folder=/home/oracle/autoupgrade-patching/patch  
patch1.patch=RECOMMENDED,36006910,36908826,35398148,36916250,  
36273767,34672698,34774667,29213893
```


Demo

Applying recommended patches

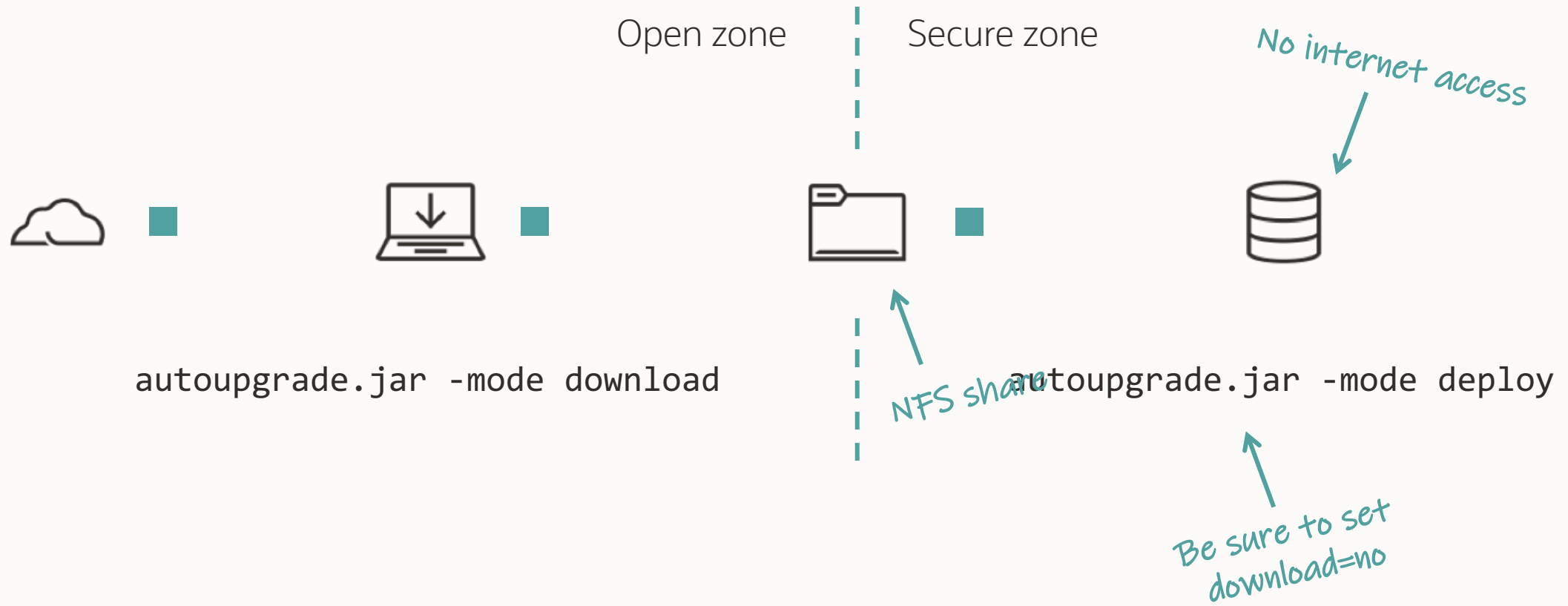
- Specifying patches
- Patch database

Watch on [YouTube](#)



Your database host
doesn't have internet access?

Using Download Mode





Without internet, AutoUpgrade applies the recent-most RU found in *patch* folder

- Unless you explicit specify a different RU

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

AutoUpgrade functionality extended to patching

Hands-on Lab

Patch Me If You Can

It's better to fail in our lab, than in production



[Access lab on Oracle Live Labs](#)

Key Learnings



- 1 Patch your Oracle Database regularly
- 2 Patch out-of-place
- 3 Use AutoUpgrade Patching



Break

We start again at 11:00

Before upgrade

How to upgrade and convert

After upgrade



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

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 23ai**



Oracle Database 23ai supports the multitenant architecture only

- You must convert your database to a PDB



Generally, you don't need to change your application to use a pluggable database

Single vs. Multitenant



Single Tenant

One PDB
No extra license



Multitenant

Multiple PDBs
Extra license if **more** than 3 PDBs

- 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_pdb=3;
```




Update Exadata System Software to the latest version, minimum 24.1.6

- Exadata Database Machine and Exadata Storage Server Supported Versions (Doc ID [888828.1](#))



Upgrade to Oracle Grid Infrastructure 23ai

- Manages Oracle Database 19c and newer
- Upgrade older databases in advance



Raise ASM disk group compatibility

- Set `compatible.rdbms` to `19.0.0.0.0`



Ensure your clients can connect to Oracle Database 23ai

- Upgrade your clients well in advance of the upgrade

Client / Server Interoperability

Client Version		Server Version					
	23ai	21c	19c	18c	12.2.0	12.1.0	11.2.0
23ai#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#9
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#9	Was	Yes#12	Yes#9

MOS Note: [207303.1 - Client / Server Interoperability Support Matrix](#)



Client / Server Interoperability

Client Version				Server Version			
	23ai	21c	19c	18c	12.2.0	12.1.0	11.2.0
23ai#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#9
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#9	Was	Yes#12	Yes#9

MOS Note: [207303.1 - Client / Server Interoperability Support Matrix](#)




```
--List current connections and their driver details  
--Join to gv$session for more details.  
--https://dohdatabase.com/2024/03/19/are-your-oracle-database-clients-ready-for-the-next-database-upgrade/
```

```
select * from gv$session_connect_info;
```



On important databases,
execute a dictionary check before upgrade

- Formerly known as *Health Check*
- MOS Doc ID [136697.1](#)


```
upg1.sid=DB19
```

```
upg1.source_home=/opt/oracle/product/19c
```

```
upg1.target_home=/opt/oracle/product/23ai
```

```
upg1.target_cdb=CDB1
```

```
upg1.run_dictionary_health=full
```

```
#To run only the critical checks
```

```
#upg1.run_dictionary_health=critical
```



Ensure dictionary and fixed objects statistics are accurate

- Save downtime by gathering in advance


```
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;
/
```


Before upgrade

How to upgrade and convert

After upgrade



How Do You Start?



Installation

Download and install
Oracle Database 23ai



Container Database



AutoUpgrade



Installation of Oracle Home is simpler

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



Simplified Installation

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



Simplified Installation

1 Download software

2 ~~Download patches~~

3 Unzip

4 ~~Update OPatch~~

5 Install

6 ~~Apply patches~~

Simplified Installation

1 Download software

2 Unzip

3 Install



Fully updated
Oracle Home



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

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

How Do You Start?



Installation



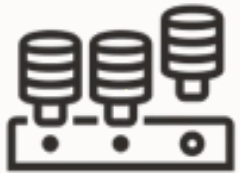
Container Database

Create a new CDB in
Oracle Database 23ai



AutoUpgrade

Create Container Database



1 Character set

2 Components

3 COMPATIBLE

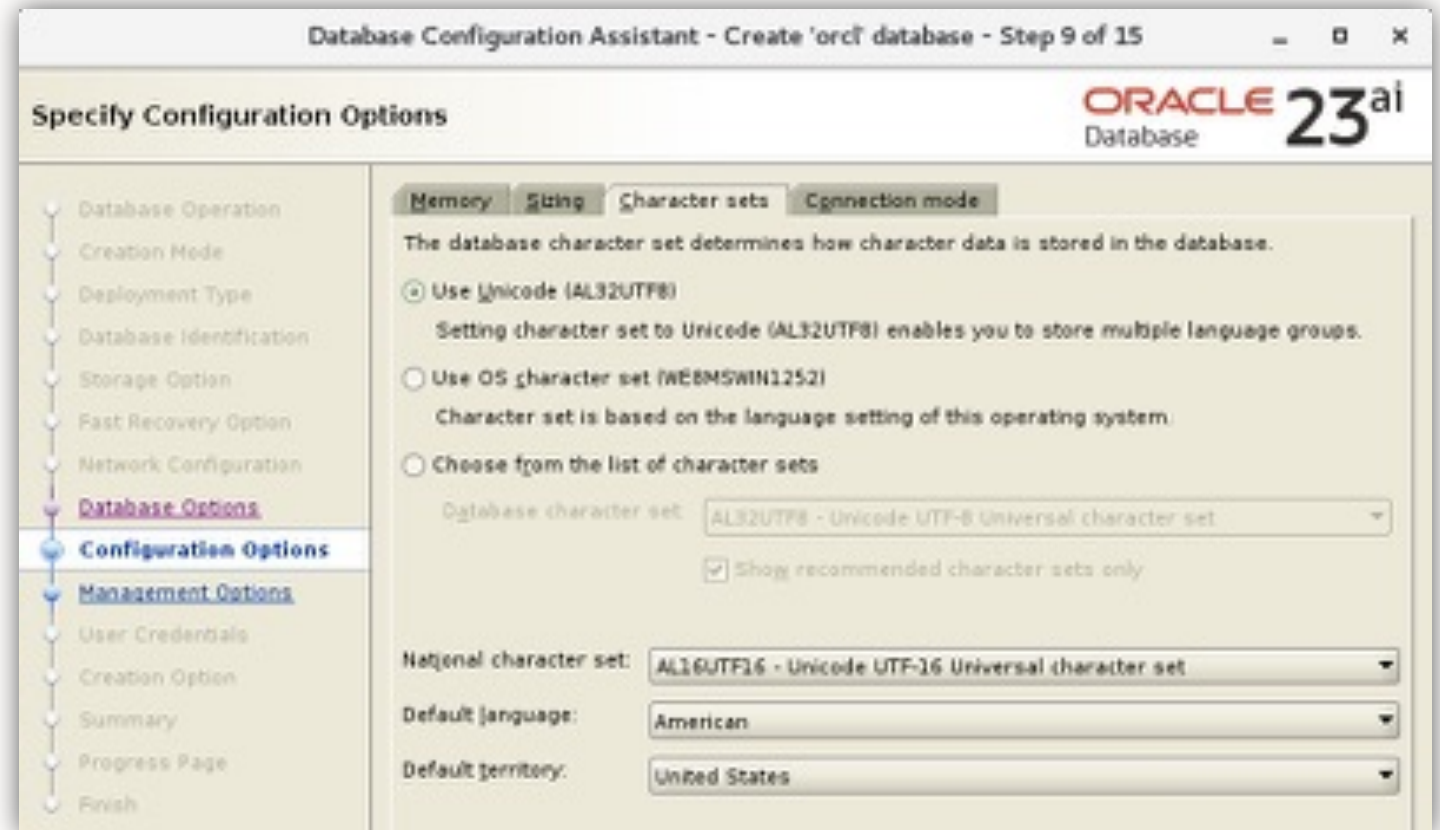
Create Container Database

1 Character set

- Always choose AL32UTF8
- Allows PDBs with any character set

2 Components

3 COMPATIBLE



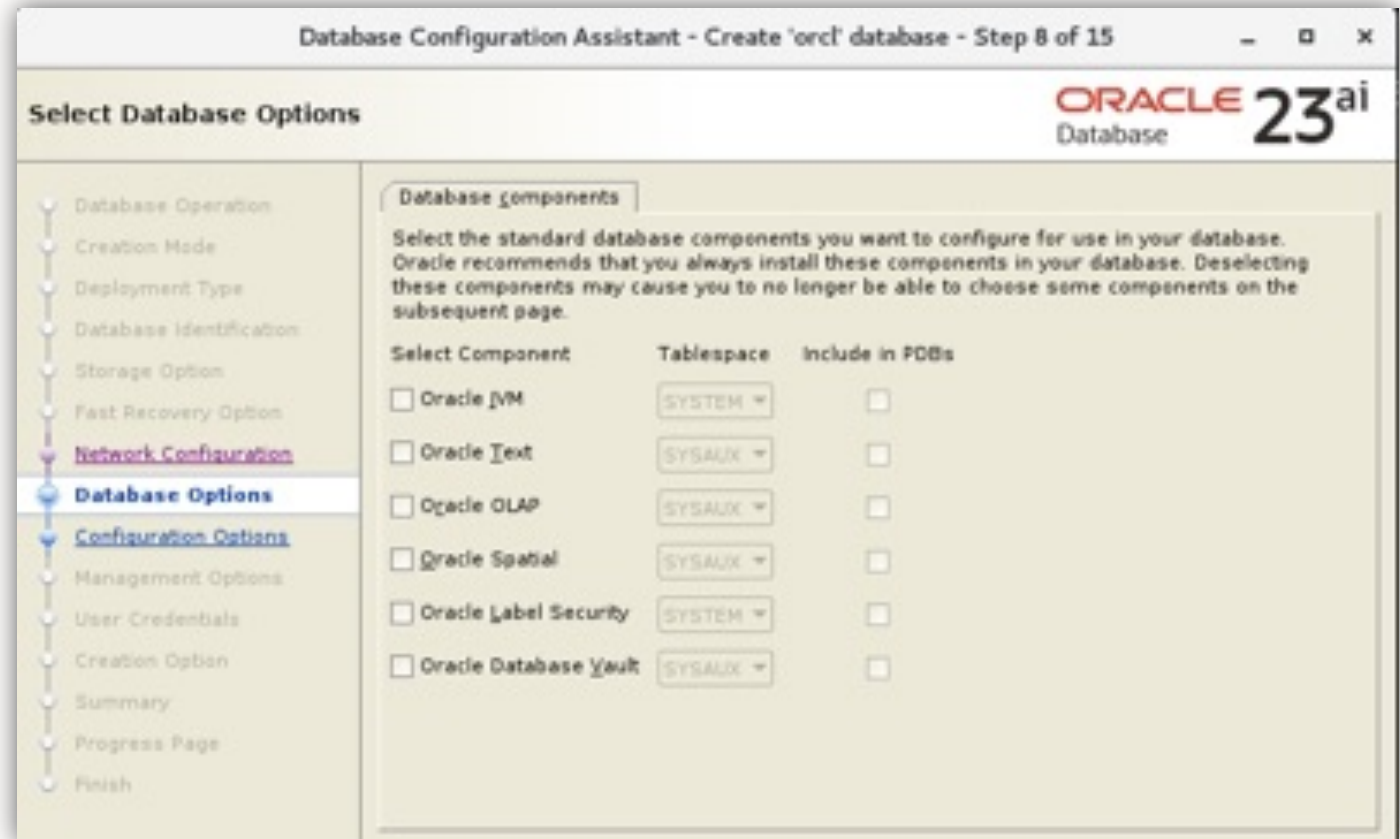
Create Container Database

1 Character set

2 Components

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

3 COMPATIBLE



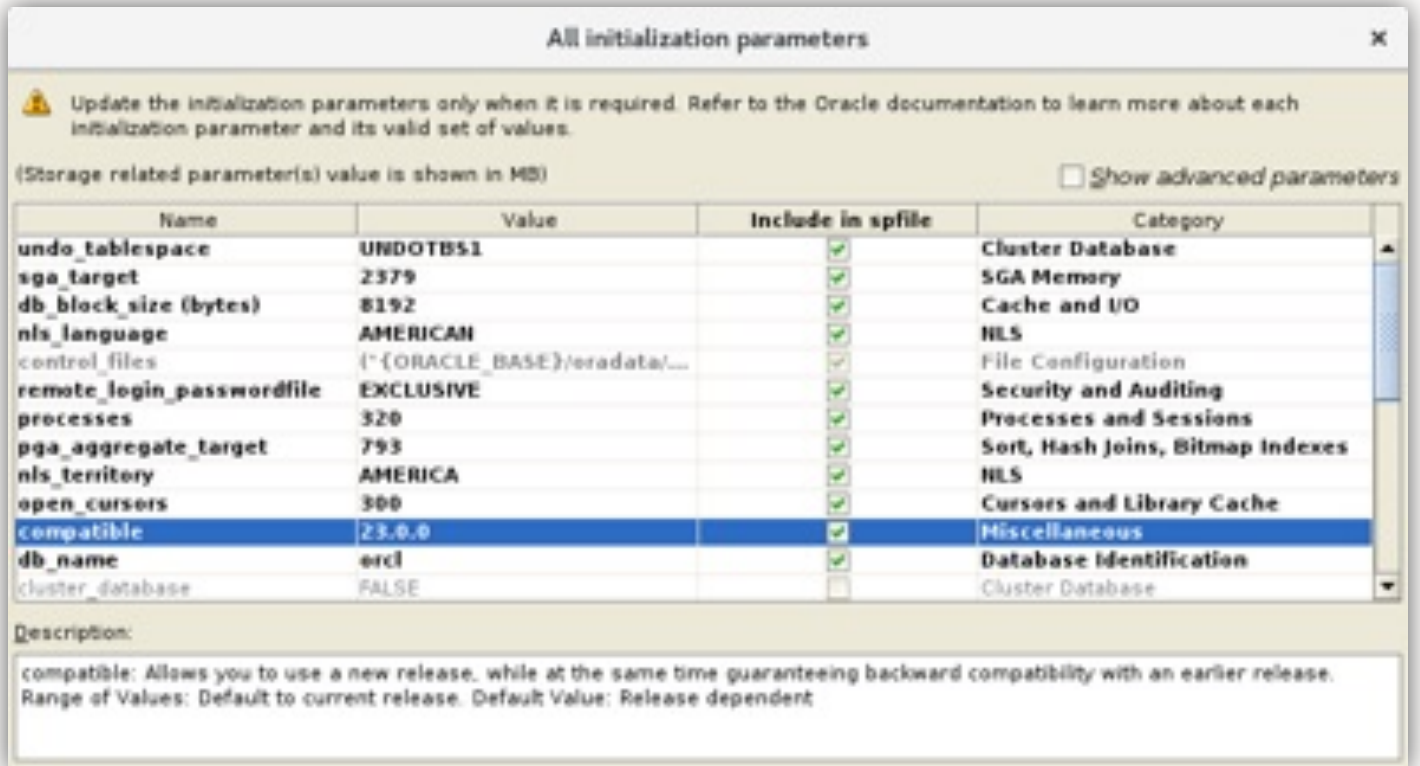
Create Container Database

1 Character set

2 Components

3 COMPATIBLE

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



All initialization parameters

Update the initialization parameters only when it is required. Refer to the Oracle documentation to learn more about each initialization parameter and its valid set of values.

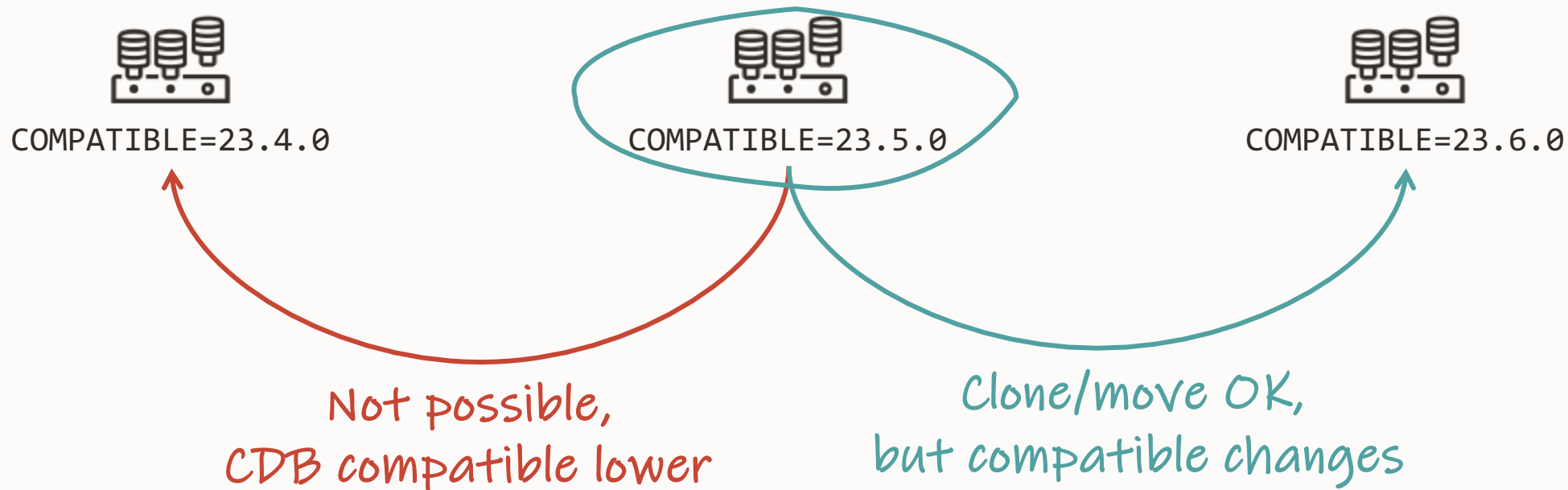
(Storage related parameter(s) value is shown in MB) ☐ Show advanced parameters

Name	Value	Include in spfile	Category
undo_tablespace	UNDOTBS1	☒	Cluster Database
sga_target	2379	☒	SGA Memory
db_block_size (bytes)	8192	☒	Cache and I/O
nls_language	AMERICAN	☒	NLS
control_files	{*{ORACLE_BASE}/oradata/...	☒	File Configuration
remote_login_passwordfile	EXCLUSIVE	☒	Security and Auditing
processes	320	☒	Processes and Sessions
pga_aggregate_target	793	☒	Sort, Hash Joins, Bitmap Indexes
nls_territory	AMERICA	☒	NLS
open_cursors	300	☒	Cursors and Library Cache
compatible	23.0.0	☒	Miscellaneous
db_name	orcl	☒	Database Identification
cluster_database	FALSE	☐	Cluster Database

Description:

compatible: Allows you to use a new release, while at the same time guaranteeing backward compatibility with an earlier release. Range of Values: Default to current release. Default Value: Release dependent

Compatible



--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;
```

How Do You Start?



Installation



Container Database



AutoUpgrade

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



Always download the latest version of AutoUpgrade

- My Oracle Support Doc ID 24854571


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

```
build.version 24.7.241021
```

```
build.date 2024/10/21 11:16:20 -0400
```

```
build.hash babf5a631
```

```
build.hash_date 2024/10/18 18:36:27 -0400
```

```
build.supported_target_versions 12.2,18,19,21,23
```

```
build.type production
```

```
build.label (HEAD, tag: v24.7)
```

```
build.MOS_NOTE 2485457.1
```

```
build.MOS_LINK https://support.oracle.com/.../?id=2485457.1
```

```
--Download the latest version of AutoUpgrade directly from oracle.com  
--No authentication needed
```

```
wget https://download.oracle.com/otn-pub/otn_software/autoupgrade.jar
```




Flow

1

Plug in

2

Upgrade

3

Convert



23^{ai}

*Irreversible!
Flashback no good*

Demo

Upgrade to Oracle Database 23ai

- Using AutoUpgrade
- Including PDB conversion

[Watch on YouTube](#)

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

```
VERSION_FULL
```

```
-----
```

```
23.5.0.24.07
```

Non-CDB to PDB conversion is irreversible

What are your rollback options?

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

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

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

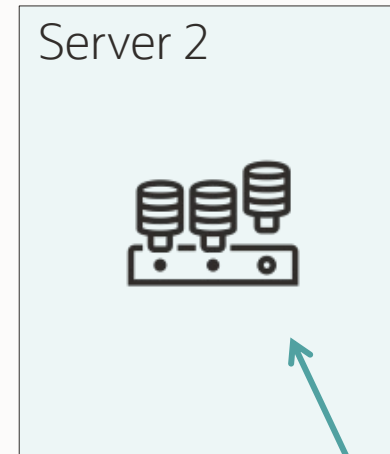
To become a proper PDB, it must be converted

Refreshable Clone

system01.dbf
sysaux01.dbf
users01.dbf
undo01.dbf
...



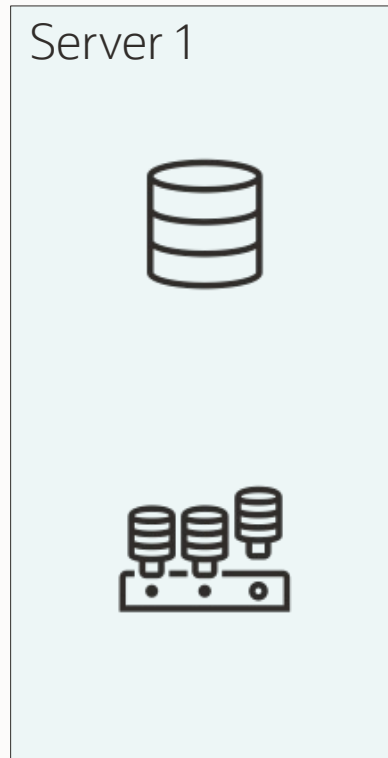
Source
non-CDB



Target
CDB

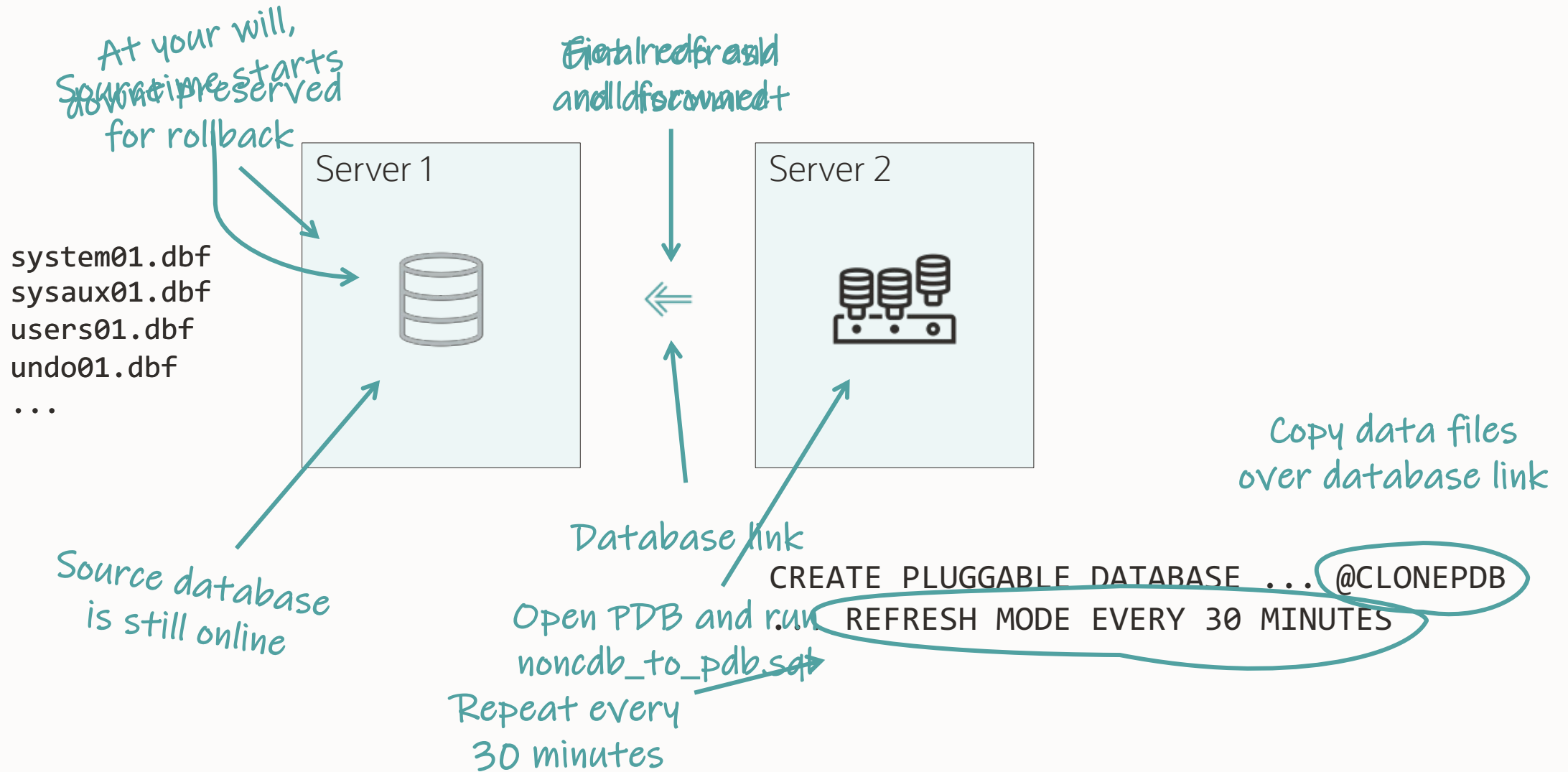
Refreshable Clone

system01.dbf
sysaux01.dbf
users01.dbf
undo01.dbf
...



*Could be same
server as well*

Refreshable Clone



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';
```



You can drop user and database link
after migration

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
```

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
```

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=25/01/2025 02:00:00
--Specify relative start time
--upg1.start_time=+1h30m
```

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=25/01/2025 02:00:00
upg1.parallel_pdb_creation_clause=4
```



Refreshable Clone

1

Run on source

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

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

2

Run on target

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




Refreshable Clone



`autoupgrade.jar ... -mode deploy`

`upg1.start_time=25/01/2025 02:00:00`



Works for unplug-plug upgrades as well



The source non-CDB stays intact
to allow rollback



Refreshable clone works only with deferred recovery on standby database

- You must restore the PDB on standby database after disconnect from non-CDB

Refreshable Clone PDB

- After creating the refreshable clone PDB, don't restart the source database
- In the source database, refreshable clone PDB supports:
 - Creating new tablespaces
 - Extending existing data files
 - Adding new data files



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



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

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



Customer Case | Zürcher Kantonalbank

Customer

Cloning user

Project

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

Constraints

Permissions

Preparation

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

Migration

Success?

Database link

Remarks

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


Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

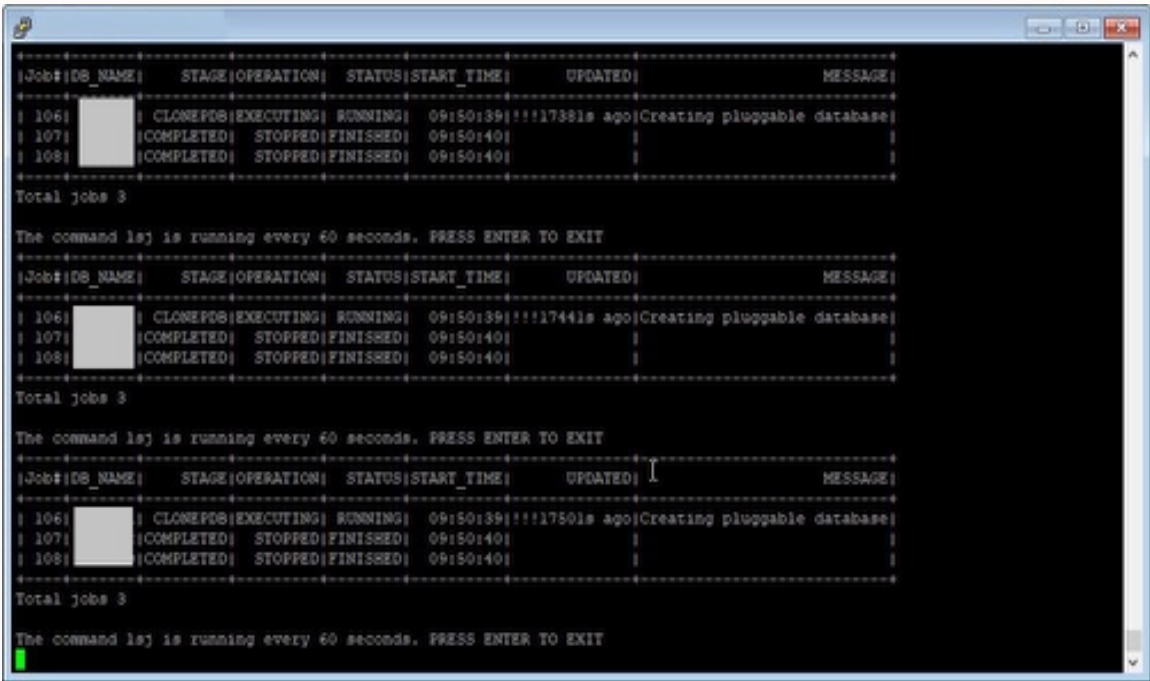
Preparation

Migration

Success?

Remarks

Migration in progress



```
Job# DB_NAME STAGE/OPERATION STATUS START_TIME UPDATED MESSAGE
-----
106 | CLONEPDB/EXECUTING RUNNING 09:50:39 17381s ago Creating pluggable database
107 | COMPLETED STOPPED/FINISHED 09:50:40 17381s ago Creating pluggable database
108 | COMPLETED STOPPED/FINISHED 09:50:40 17381s ago Creating pluggable database
Total jobs 3
The command is running every 60 seconds. PRESS ENTER TO EXIT
```

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



Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

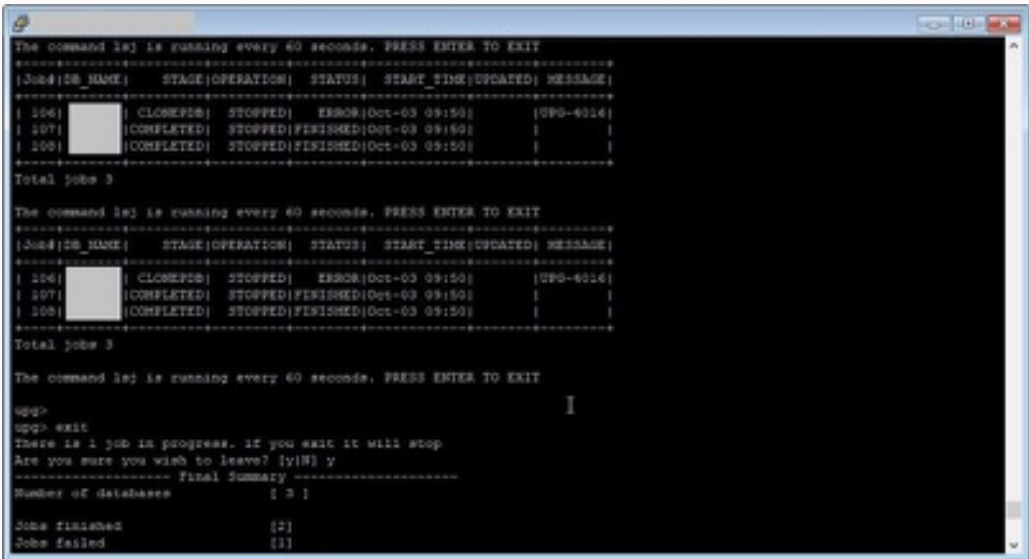
Preparation

Migration

Success?

Remarks

Migration completed



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



Customer Case | Zürcher Kantonalbank

Customer

First non-CDBs migrated successfully

Project

- Project is ongoing

Constraints

Preparation

Migration

Success?

Remarks

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

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



Christian Marquardt
Database Specialist Expert & Solution Architect



In OCI, upgrade individual PDBs using AutoUpgrade and refreshable clones

- See [blog post](#) for details



In OCI, upgrade entire CDBs using cloud tooling

- Be sure to update cloud tooling beforehand



You can also migrate with Data Pump or Transportable Tablespaces

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

Before upgrade

How to upgrade and convert

After upgrade



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 23ai CDB



Backup your database after migration

- Level 0
- Practice restore with pre-plugin backups



Check your standby databases

- Special attention is needed for standby databases

Data Guard



*Plug-in on primary propagates
to standby database via redo*

1 Enabled recovery

2 Deferred recovery





Enabled Recovery

1

Enabled recovery

create pluggable database ... `standbys=all`

Standby records PDB creation

Standby locates data files

MRP applies redo to PDB

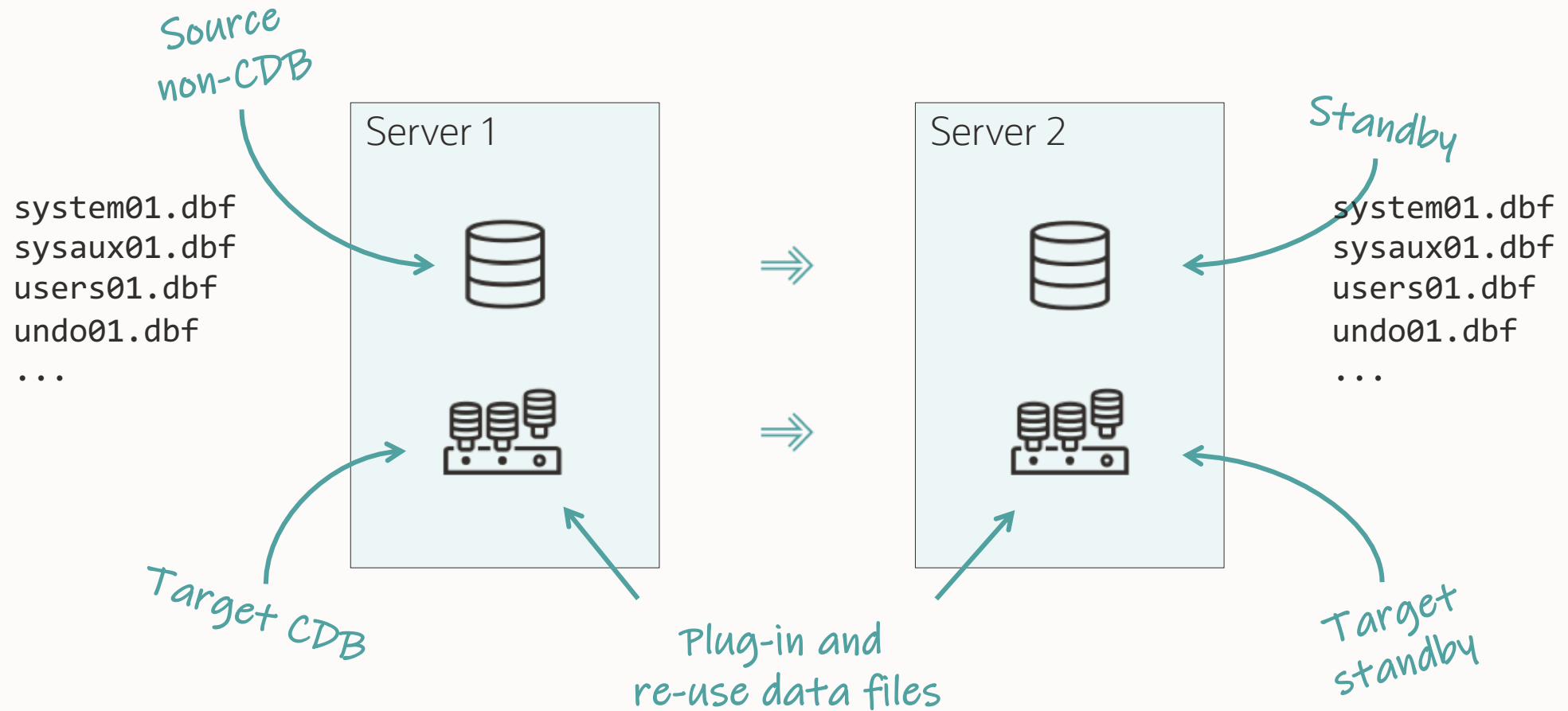
PDB is immediately protected

Default

2

Deferred recovery

Enabled Recovery





All data files on primary and standby
must be at the same SCN

Enabled Recovery

- The plug-in happens on the primary database
- The plug-in uses the manifest file
- The manifest file contains information on data files from the primary database only

How does the standby database know which files to plug in?

Enabled Recovery

How does the standby database know which files to plug in?

- 1 Regular files
- 2 OMF in regular file system
- 3 ASM

Enabled Recovery

1 Regular files

- Standby search for data files at the same location as the primary
- Override with `DB_FILE_NAME_CONVERT`
- Or, override with `STANDBY_PDB_SOURCE_FILE_DIRECTORY`

Enabled Recovery

2 OMF in regular file system

- Standby search for data files at the OMF location (`DB_CREATE_FILE_DEST`)
- Move data files from non-CDB location into OMF location
- Or, create soft links in OMF location pointing to data file location

Enabled Recovery

3 ASM

- Standby search for data files at the OMF location (`DB_CREATE_FILE_DEST`)
- Use ASM aliases to find data files at non-CDB OMF location

Enabled Recovery | ASM

Primary



Standby



```
SQL> select name from v$datafile;
```

NAME

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

```
SQL> select name from v$datafile;
```

NAME

```
-----  
+DATA/DB_CHICAGO/DATAFILE/system.265.1103050007  
+DATA/DB_CHICAGO/DATAFILE/sysaux.266.1103050007  
+DATA/DB_CHICAGO/DATAFILE/users.269.1103050009
```

Same file,
but different name

```
SQL> alter diskgroup data add alias  
      '+DATA/DB_CHICAGO/DATAFILE/users.269.1103050009'  
for  
      '+DATA/CDB1_CHICAGO/⟨PDB_GUID⟩/DATAFILE/users.269.1103050009':
```

Data Guard | Re-use Data Files

Primary



Standby



Looking for file like on primary



```
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_CHICAGO/DATAFILE/users.269.1103050009
```



Follows alias and finds the real file

Enabled Recovery | AutoUpgrade

The current version (24.1) does not support plugging in with enabled recovery

- Enabled recovery requires work on both primary and standby hosts
- You must execute commands at specific times
- It's complicated - but we're working on it



Deferred Recovery

1

Enabled recovery

`create pluggable database ... standbys=all`

Standby records PDB creation

Standby locates data files

MRP applies redo to PDB

PDB is immediately protected

2

Deferred recovery

`create pluggable database ... standbys=none`

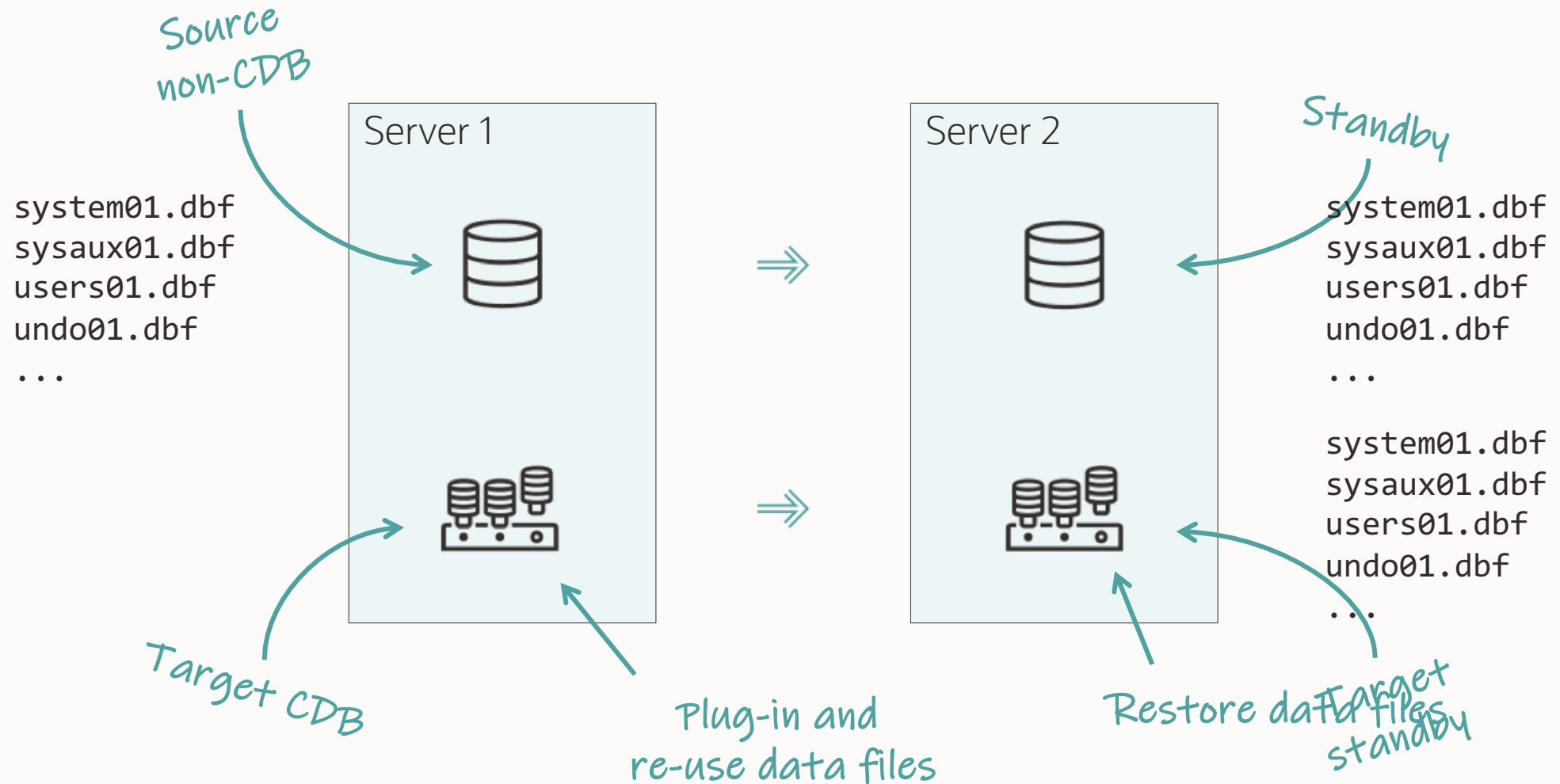
Standby records PDB creation

Standby ignores data files

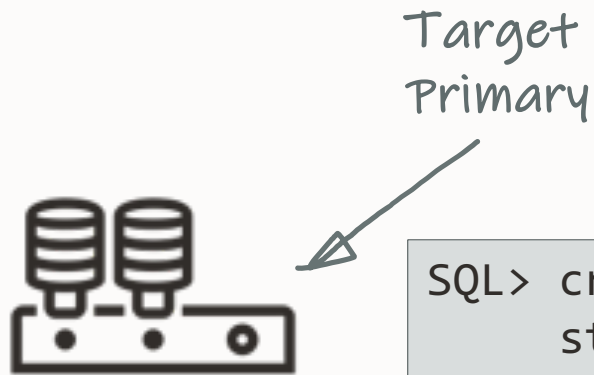
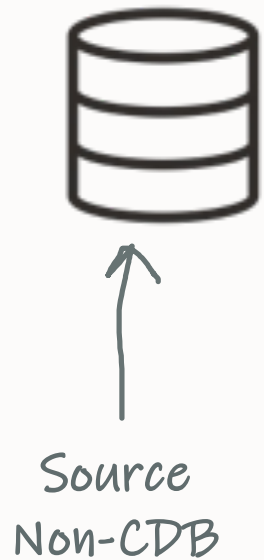
MRP skips redo

PDB protected after restore

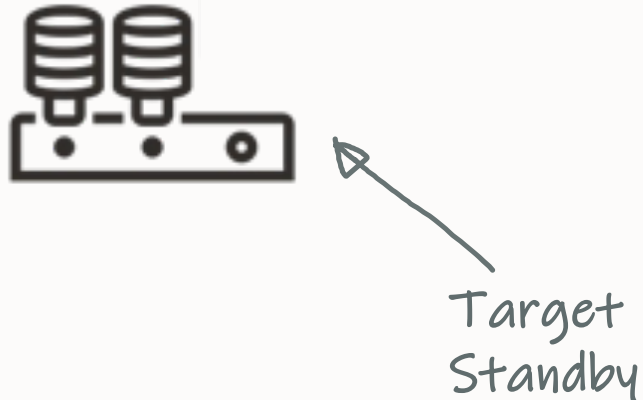
Deferred Recovery



Deferred Recovery



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



Deferred Recovery



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



PDB created
Data files missing



Deferred Recovery



```
SQL> show pdba
```

CON_NAME	OPEN	MODE
PDB1	READ	WRITE

```
SQL> show pdba
```

CON_NAME	OPEN	MODE
PDB1	MOUNTED	

Deferred Recovery



```
SQL> select name, recovery_status  
       from v$pdb;
```

NAME	RECOVERY_STATUS
PDB1	DISABLED



Deferred Recovery



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

```
SQL> alter pluggable database  
enable recovery;
```

```
SQL> alter database datafile  
... online;
```

Deferred Recovery



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

```
SQL> alter pluggable database  
enable recovery;
```

```
SQL> alter database datafile  
... online;
```

- Automated process in Oracle Database 21c
- PDB Recovery Isolation
- Requires Active Data Guard

Further Details

Webinar:

[Move to Oracle Database 23ai –
Everything you need to know about Oracle Multitenant – Part 1](#)



Don't jeopardize your Data Guard

- Test the procedure and verify your environment

--Default value is for CDBs with lots of PDBs
--In other cases it leads to concurrency issues
--Reset back to 12.1 default as described in MOS 2431353.1

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

```
--Default value is for CDBs with lots of PDBs  
--In other cases it leads to concurrency issues  
--Reset back to 12.1 default as described in MOS 2431353.1
```

```
alter system set "_cursor_obsolete_threshold"=1024  
comment="Added 2024-03-25 - Advice from MOS Note: 2431353.1";
```



```
--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;
```

```
--Database collects expression statistics for  
--SQL Plan Directives and Auto-Indexing.  
--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$  
--Doc ID 2674400.1, Value of "0" fully disables tracking.
```

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




We need real-world experience with 23ai

- We are looking for reference customers

Key Learnings



- 1 Start preparing today
- 2 Use AutoUpgrade
- 3 Data Guard and Multitenant conversion

Lunch Break

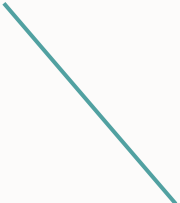
We start again at 13:00

Data Pump Top Tips

—
Supercharge data loading/unloading



Always use
Data Pump Bundle Patch





More than 200 functional and performance fixes

- Data Pump Recommended Proactive Patches For 19.10 and Above (Doc ID [2819284.1](#))



*Importing a complete application with data drops from almost 2.5 hours to **48 minutes** – by just applying the Data Pump bundle patch*

A global provider of financial services



Always ensure dictionary
and fixed objects statistics are accurate





Ensure dictionary and fixed objects statistics are accurate

- Before export
- Before import
- Immediately after import

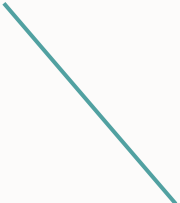

```
begin
  --dbms_stats.gather_dictionary_stats;
  dbms_stats.gather_schema_stats('SYS');
  dbms_stats.gather_schema_stats('SYSTEM');
  dbms_stats.gather_fixed_objects_stats;
end;
/
```

```
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;
/
```

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



Use parallel and
multiple dump files



--Apply parallelism by simply specifying a degree

```
expdp ... parallel=8
```

--Use different parallel degree on import

```
impdp ... parallel=32
```



Oracle Cloud Infrastructure

Number of OCPUs

Number of ECPUs / 4



On-prem (x86-64)

2 x physical cores



On-prem (other)

Depends

--Use %L to allow multiple dump files
expdp ... parallel=8 dumpfile=exp%L.dmp

--Split dump files into minor files for easier transport
expdp ... parallel=8 dumpfile=exp%L.dmp **filesize=10G**

- After export, store a checksum in the dump file.
- Detects in-flight corruption or alteration.
- Specify other algorithms using checksum_algorithm parameter.

```
expdp ... checksum=yes
```

```
impdp ... verify_checksum=yes  
         verify_only=yes
```



Transportable jobs can use parallel
in Oracle Database 21c




```
-- Any transportable jobs can now run in parallel  
-- Parallel unload/load of metadata provide a significant performance boost
```

```
expdp ... full=y transportable=always parallel=16
```

```
expdp ... tablespace=<list> parallel=16
```

```
impdp ... parallel=16
```

Parallel Transportable | Benchmark

Oracle E-Business Suite database
600.000+ objects

Export parallel 1	2h 2m
Import parallel 1	6h 44m
Total	8h 46m

Export parallel 16	1h 8m
Import parallel 16	1h 23m
Total	2h 31m





Always convert to
SecureFile LOBs





If exporting SecureFile LOBs is slow,
apply 19.23.0 Data Pump Bundle Patch

- Alternatively, trick Data Pump with [fake stats](#)



Do you still have BasicFile LOBs?

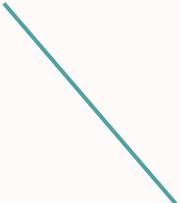
- Use [DIY parallelism](#) during export

```
--Converting a BasicFile LOB to SecureFile during import,  
--is faster than not converting it.  
--Overview of Oracle LOBs (Doc ID: 1490228.1)
```

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



Speed up imports by using NOVALIDATE constraints





A Constraint Can Be

VALIDATED

All data in the table obeys the constraint.
The database guarantees that data is good.

NOT VALIDATED

All data in the table **may** obey the constraint.
The database **does not know** if data is good.



Most constraints are **VALIDATED**



On import, Data Pump creates constraints
in the same state as in the source

--Example of which commands Data Pump import might execute as part of an import

```
create table sales ( .... );
```

```
insert into sales as select ... ;
```

```
alter table sales add constraint c_sales_1 check (c1 in (0,1)) enable validate;  
alter table sales add constraint c_sales_2 check (c2 in ('A','B')) enable validate;  
alter table sales add constraint c_sales_3 check (c3 > 0) enable validate;
```

Recursive full table scan

Recursive full table scan

Recursive full table scan

```
-- Add constraints with NOVALIDATE keyword regardless of state in source database  
-- Significantly speeds up add constraints for larger tables
```

```
impdp ... transform=constr_novalidate
```


--Transforming constraints to NOVALIDATE to speed up import

```
alter table sales add constraint c_sales_1 check (c1 in (0,1)) enable novalidate;  
alter table sales add constraint c_sales_2 check (c2 in ('A','B')) enable novalidate;  
alter table sales add constraint c_sales_3 check (c3 > 0) enable novalidate;
```


No full table scan

--Transforming constraints to NOVALIDATE to speed up import

```
alter table sales add constraint c_sales_1 check (c1 in (0,1)) enable novalidate;  
alter table sales add constraint c_sales_2 check (c2 in ('A','B')) enable novalidate;  
alter table sales add constraint c_sales_3 check (c3 > 0) enable novalidate;
```

Database validates new rows



Benchmark, 1 billion rows

Importing VALIDATE constraints

```
10-AUG-24 00:32:28.716: W-1 Processing object type TABLE_EXPORT/TABLE/TABLE_DATA
10-AUG-24 00:36:42.762: W-1 . . imported "FUSION"."hwr_topic_t1" 151.2 GB 1044625000 rows in 254 seconds using external_table
10-AUG-24 00:45:41.226: W-1 Processing object type TABLE_EXPORT/TABLE/CONSTRAINT/CONSTRAINT
10-AUG-24 00:55:35.787: W-1      Completed 7 CONSTRAINT objects in 594 seconds
```

Importing NOVALIDATE constraints

```
10-AUG-24 00:14:56.050: W-1 Processing object type TABLE_EXPORT/TABLE/TABLE_DATA
10-AUG-24 00:19:10.311: W-1 . . imported "FUSION"."hwr_topic_t1" 151.2 GB 1044625000 rows in 254 seconds using external_table
10-AUG-24 00:29:20.841: W-1 Processing object type TABLE_EXPORT/TABLE/CONSTRAINT/CONSTRAINT
10-AUG-24 00:29:21.101: W-1      Completed 7 CONSTRAINT objects in 1 seconds
```



NOVALIDATE constraints prevent the optimizer from certain **query** rewrites

- Check QUERY_REWRITE_INTEGRITY



Validate constraints after import, or even **after go-live**

- Still requires a full scan of the table
- But can use parallel query
- And **no** table lock!

Exceptions

Data Pump always validates certain constraints:

1. On DEFAULT ON NULL columns
2. Used by a reference partitioned table
3. Used by a reference partitioned child table
4. Table with Primary key OID
5. Used as clustering key on a clustered table



Use with care if
you are transforming data on import



Also available in Oracle Database 19c
via 19.23.0 Data Pump Bundle Patch

- Doc ID [2819284.1](#)

Even faster index imports





Use index size to determine parallel degree on index creation

- Coming in future 23ai Data Pump Bundle Patch

Index Creation

Before 12.1

Worker 1 `CREATE INDEX .... PARALLEL 16`

Really good for few big indexes

From 12.1

Worker 1 `CREATE INDEX .... PARALLEL 1`

Worker 2 `CREATE INDEX .... PARALLEL 1`

... `CREATE INDEX .... PARALLEL 1`

Worker 16 `CREATE INDEX .... PARALLEL 1`

Really good for many small indexes



Index Creation

From 23

Worker 1	CREATE INDEX PARALLEL 1
Worker 2	CREATE INDEX PARALLEL 8
Worker 3	CREATE INDEX PARALLEL 4
Worker 4	CREATE INDEX PARALLEL 3

The best of both worlds





How Data Pump Create Indexes

- 1 Calculate the optimal parallel degree
- 2 Create indexes



How Data Pump Create Indexes

1 Calculate the optimal parallel degree

- Always parallel 1 when a table is less than 150 MB
- Customizable via `INDEX_THRESHOLD`
- Get optimal parallel degree using `EXPLAIN PLAN`

```
SQL> explain plan for create index i1 on t1(c1) parallel;
```

Explained.


```
SQL> explain plan for create index i1 on t1(c1) parallel;
```

Explained.

```
SQL> select * from table(dbms_xplan.display(format => 'ALL'));
```

...

Note

- **automatic DOP: Computed Degree of Parallelism is 4** because of degree limit
- estimated index size: 655K bytes



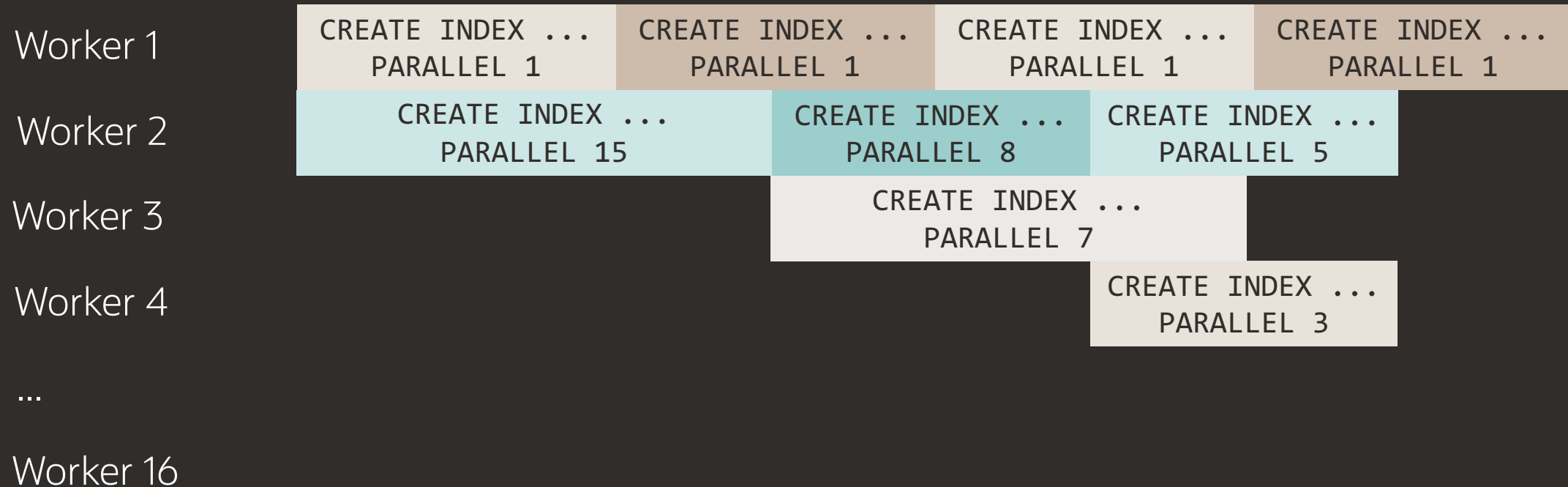
How Data Pump Create Indexes

2 Create indexes

- One worker creates small indexes (parallel 1) in large batches
- The next worker starts with the biggest index (measured by optimal parallel degree)

How Data Pump Create Indexes

impdp ... parallel=16





Benchmark, 1 billion rows

Importing with 19c settings constraints

10-AUG-24 00:55:35.830: Job "SYSTEM"."SYS_IMPORT_TABLE_01" successfully completed at Sat Aug 10 00:55:35 2024 elapsed 0 00:23:09

Importing NOVALIDATE constraints + new index method

10-AUG-24 01:48:38.844: Job "SYSTEM"."SYS_IMPORT_TABLE_01" successfully completed at Sat Aug 10 01:48:38 2024 elapsed 0 00:10:40



We expect much better result
with more complex schemas



We'd love to see this feature
in Oracle Database 19c

- Planned for future Data Pump Bundle Patch

Performance Stability Prescription

A person is standing in the middle of the ocean, their back to the camera, looking out at a vast, dark sea under a heavy, cloudy sky. The person's silhouette is visible against the horizon. The overall mood is contemplative and somewhat somber.

what's your

biggest fear

when making changes?



A hammock is strung between two palm trees on a sandy beach. The sun is setting in the background, creating a warm orange and yellow glow in the sky. The hammock is empty and hangs in a gentle curve. The ocean waves are visible in the distance, and a piece of driftwood lies on the sand in the foreground.

Performance Stability Prescription

Performance Stability Prescription



Collect workload information

- Sample from cursor cache
- Gather from AWR

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);
```

SQL Tuning Set | Definition

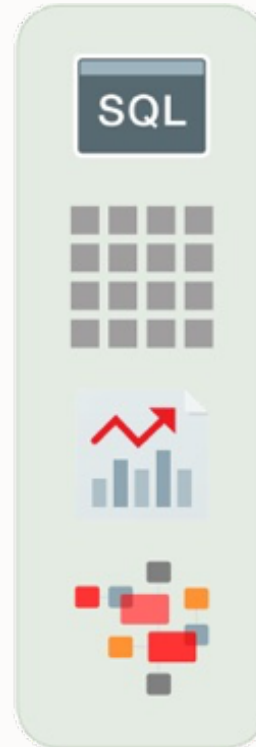
SQL statement

SQL

Context

Statistics

Plans





Gather at least a full month of workload data

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

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



Performance Stability Prescription



Upgrade test database

Load workload data
(SQL Tuning Set)

Performance Stability Prescription



AWR Diff Report

SQL Performance Analyzer tests your workload

Report with all regressing statements

AWR | Diff Report

Use script `awrddrpt.sql`

Top Timed Events

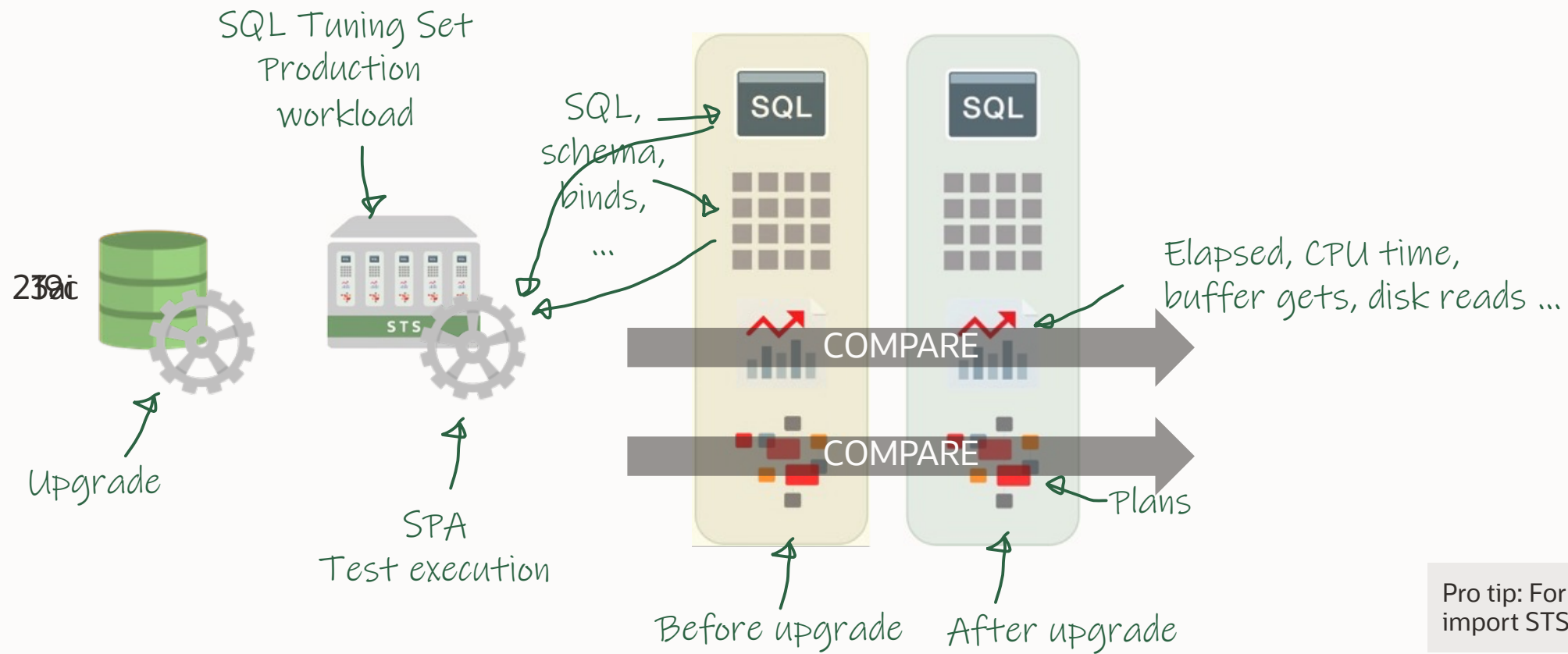
- Events with a "-" did not make the Top list in this set of snapshots, but are displayed for comparison purposes

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](#)

SQL Performance Analyzer | Concept



Pro tip: For migrations, import STS into target database

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	88fggncchy6wg	-.41%	325424	6.00316202861498	8	-33.26%	n
57	g5u7xuchhfu62	.39%	32790	26.6833180847819	8	70.02%	n



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

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

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



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

SQL Details: czzzubf8fjz96

Parsing Schema APPSExecution 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, 'x' || 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	0.364	-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



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

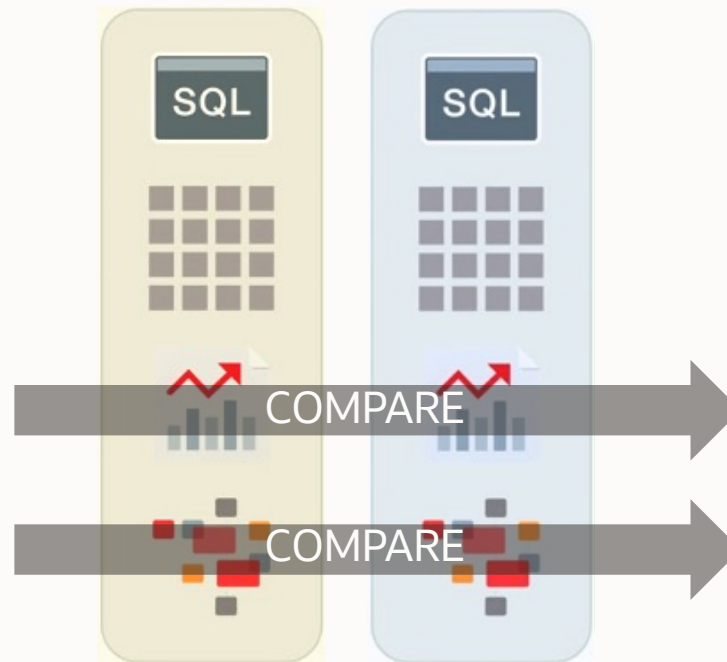
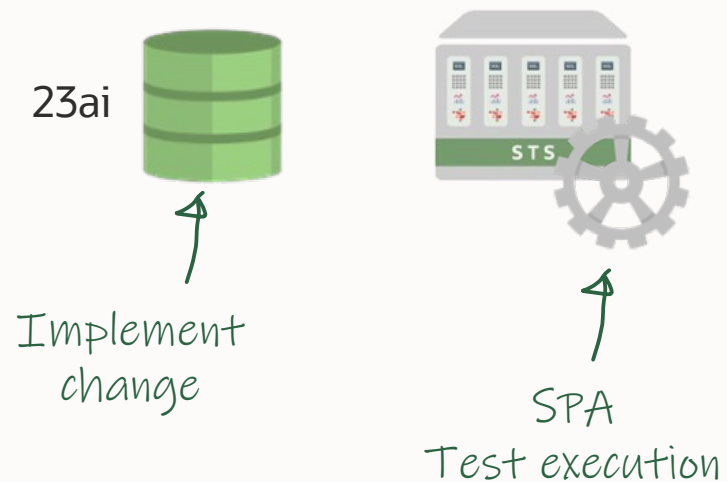
Plan Hash Value: 1165613724

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...



SPA | Continuous Improvement



--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;
```

Performance Stability Prescription



Tune SQLs with regressed plans

Create SQL Plan Baselines

Transport to production database

```
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;
/
```


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.

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.

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.

6- SQL Profile Finding	
A potentially better	
Recommendation (est	
1- Statistics Finding	- Consider acceptin
Optimizer statistics for s	execute dbms_sqlt
Recommendation	task_ownd
- Consider collecting appr	
execute dbms_stats.gather	
"TSPARTS", method_opt => 'f	
Rationale	
The optimizer requires a	
select a good execution p	
Validation results	
The SQL profile was	
and measuring their	
only partially exec	



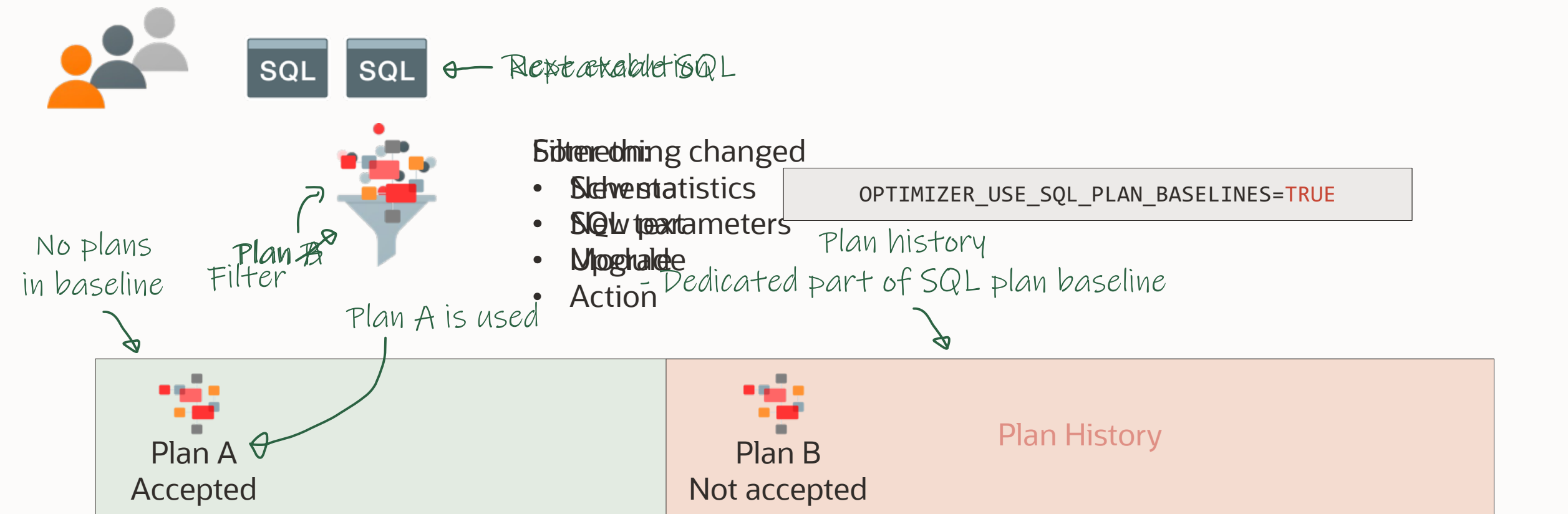
SQL Tuning Advisor | Findings

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

SQL Plan Management | Concept

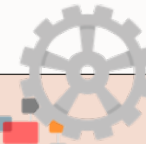
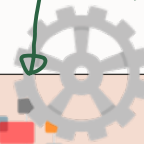


SPM | Evolve



Result:
Performance **better**

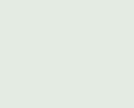
Test execute Test execute
Plan stays



Plan A
Accepted



Plan C
Accepted



Plan D
Accepted



Plan B
Not accepted



Plan D
Not accepted

Plan History

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

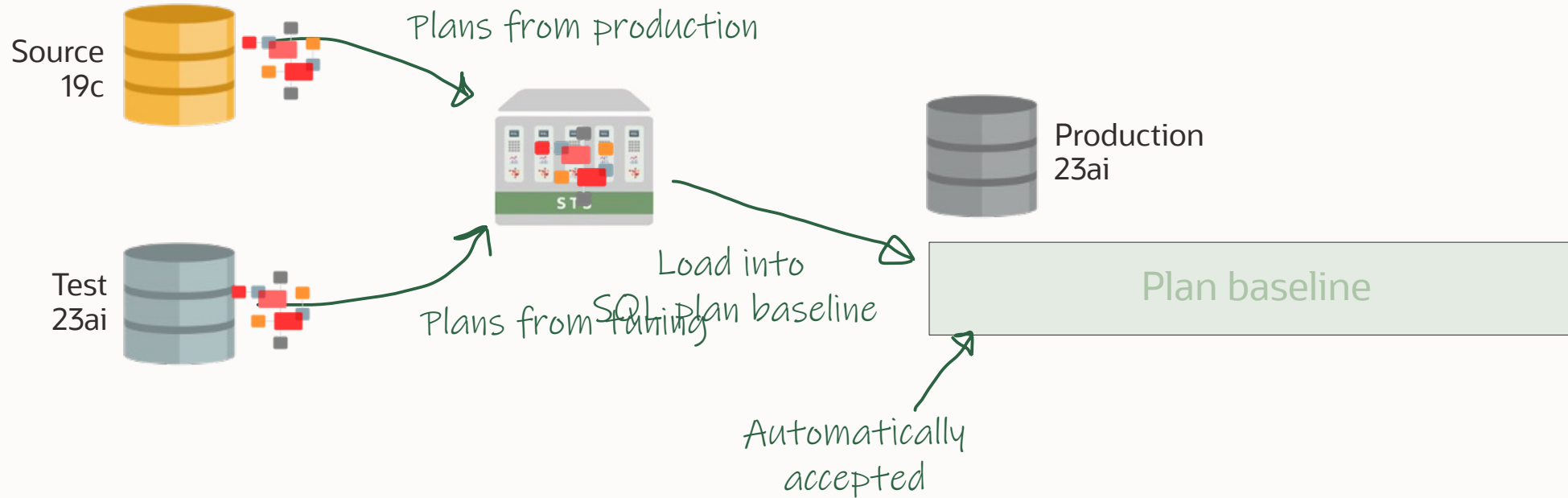
Automatically
accepted



Plan B
Not accepted

Plan History

SPM | Use Case



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



Use SQL Profiles for statements with literals

- Part of Tuning Pack

```
dbms_sqltune.accept_sql_profile(..., category=>'TEST_ENV');  
  
alter session set sqltune_category='TEST_ENV';
```



```
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');
```


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

There is only one tool to ensure plan stability:

SQL Plan Management

Don't use

- OPTIMIZER_FEATURES_ENABLE
- COMPATIBLE

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



Hitchhiker's Guide to Upgrade to Oracle Database 23ai

try it out for free

IT'S EASY





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

- Relevant options and packs included in most cloud offerings



Use OCI for Performance Testing



Performance Tips & Tricks



Use as few initialization parameters as possible

- Stick to the defaults
- Stick to vendor recommendations



Only use underscores and events to solve specific situations

- Only under guidance of Oracle Support



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](#))



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`

Should You Enable Optimizer Fixes?

oradiff.oracle.com

The screenshot shows the Oracle Release Analyzer Diff Utility web interface. The left sidebar contains navigation links: Home, Parameters, Users, Roles, etc., Privileges, Included Fixes (highlighted), List of Fixes, Total Fixes, Search Fixes, List of CVEs, CPU Experts, and Fix Control. The main content area is titled 'Version Selector' and includes dropdowns for Source Release (TBC), Source Patch Level (19.2.0 (Base Release)), Target Release (TBC), and Target Patch Level (19.24.0). A 'Load Fixes' button is on the right. Below this is a section for 'V_SYSTEM_FIX_CONTROL' with tabs for Added, Removed, and Modified. A search bar and a 'Go' button are present. A table lists fixes with columns: BUGNO, VALUE, SQL_FEATURE, DESCRIPTION, OPTIMIZER_FEATURE_ENABLE, EVENT, and IS_MULT. A red arrow points to the pagination control '1 - 50 of 235' with a right arrow button.

BUGNO	VALUE	SQL_FEATURE	DESCRIPTION	OPTIMIZER_FEATURE_ENABLE	EVENT	IS_MULT
33636280	0	QKSFM_EXTTAB_33636280	fix for serializable transaction		0	1
33649782	0	QKSFM_OR_EXPAND_33649782	Try LORE after ORE rejected due to LOB structure		0	1
33667505	0	QKSFM_OR_EXPAND_33667505	enhance index check in presence of NLSSORT function based index		0	1

1 - 50 of 235 >



Should You Enable Optimizer Fixes?

Upgrade
New database

Enable optimizer fixes using `DBMS_OPTIM_BUNDLE`

Patching

Do proper testing before enabling
optimizer fixes using `DBMS_OPTIM_BUNDLE`



Don't gather new optimizer statistics after upgrade

- Upgrades from 11.2.0.4 might be different



Don't gather system statistics

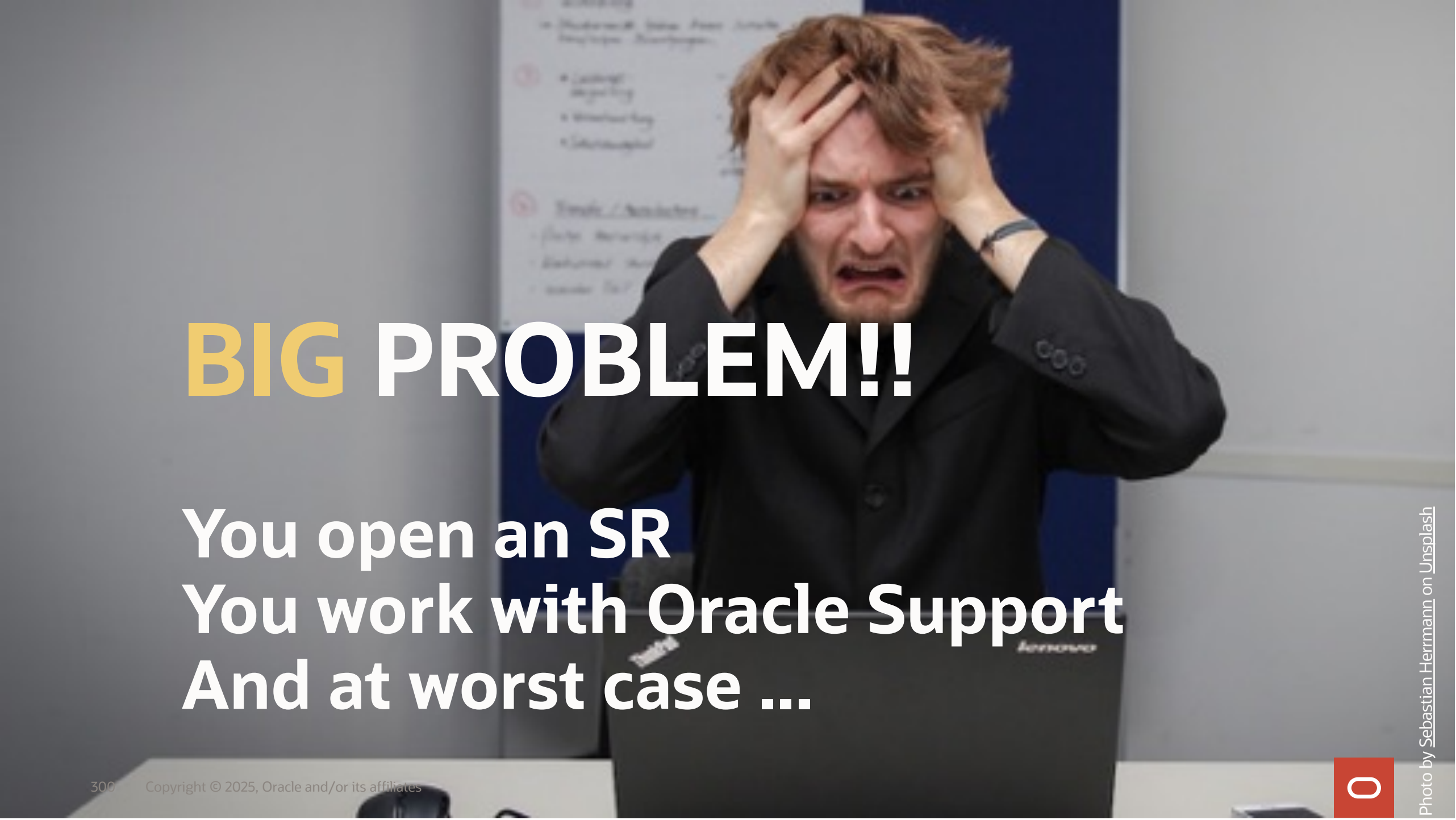
- In most cases, the defaults are fine
- Might be a good idea on Exadata Database Machine
- [Optimizer blog](#)

Insights into the Oracle Database Development Process



REALITY CHECK

A true customer story

A man with brown hair and a beard, wearing a black suit, is holding his head in both hands with a frustrated or stressed expression. He is standing in front of a whiteboard that has some text on it, though it is out of focus. The text on the whiteboard includes "in the morning", "in the afternoon", "in the evening", "in the night", "in the morning", "in the afternoon", "in the evening", "in the night", "in the morning", "in the afternoon", "in the evening", "in the night".

BIG PROBLEM!!

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

... you hit a bug!!



A photograph of two men laughing heartily while holding a large, inflatable character. The character is wearing a yellow long-sleeved shirt, red pants, and a red belt with a large red bow. The man on the left has blonde hair and is wearing a yellow shirt. The man on the right has dark hair and is wearing a plaid shirt. They are standing in front of a stone wall and a building with many windows. The background is slightly blurred, showing other people and structures.

But ... don't worry!
It is fixed! In Oracle 25ai!



Hmm??

You mean in
2025?

THREE PARTIES

- You
- Oracle Support
- Oracle Development

Insights into the Patching Process



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



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



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

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



▼ Bug Attributes

Type	B - Defect	Fixed in Product Version	25.1
Severity	2 - Severe Loss of Service	Product Version	23.1
Status	80 - Development to QA/ Fix Delivered Internal	Platform	226 - Linux x86-64
Created	Nov 7, 2022	Platform Version	ORACLE LINUX GENERIC
Updated	Apr 30, 2024	Base Bug	33786319
Database Version	23.1	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: 34774667 : 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](#)

Insights into the Patching Process



- Developer creates a fix
- Always in MAIN branch first

Insights into the Patching Process



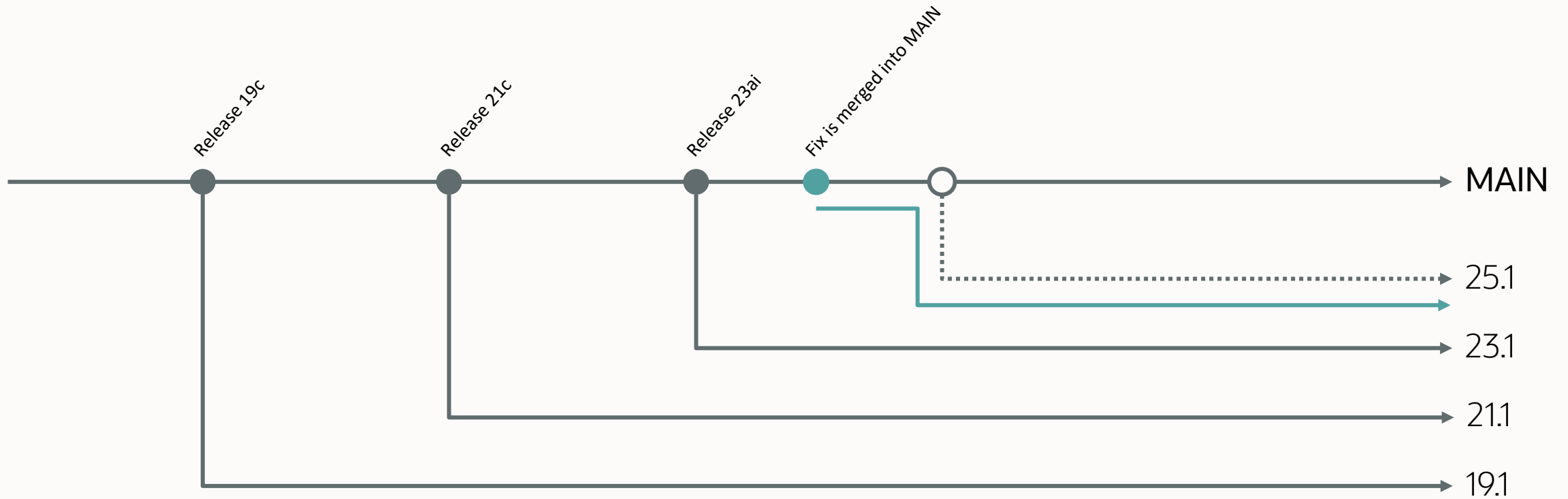
- Developer creates a fix
- Always in MAIN branch first
- Regression tests on Farm in OCI
 - Subset of tests before merge
 - All tests run daily, ~1 million functional tests (runtime ~25.000 hours)

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

Branches



▼ Bug Attributes

Type	B - Defect	Fixed in Product Version	25.1
Severity	2 - Severe Loss of Service	Product Version	23.1
Status	80 - Development to QA/ Fix Delivered Internal	Platform	226 - Linux x86-64
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▼ Related Products

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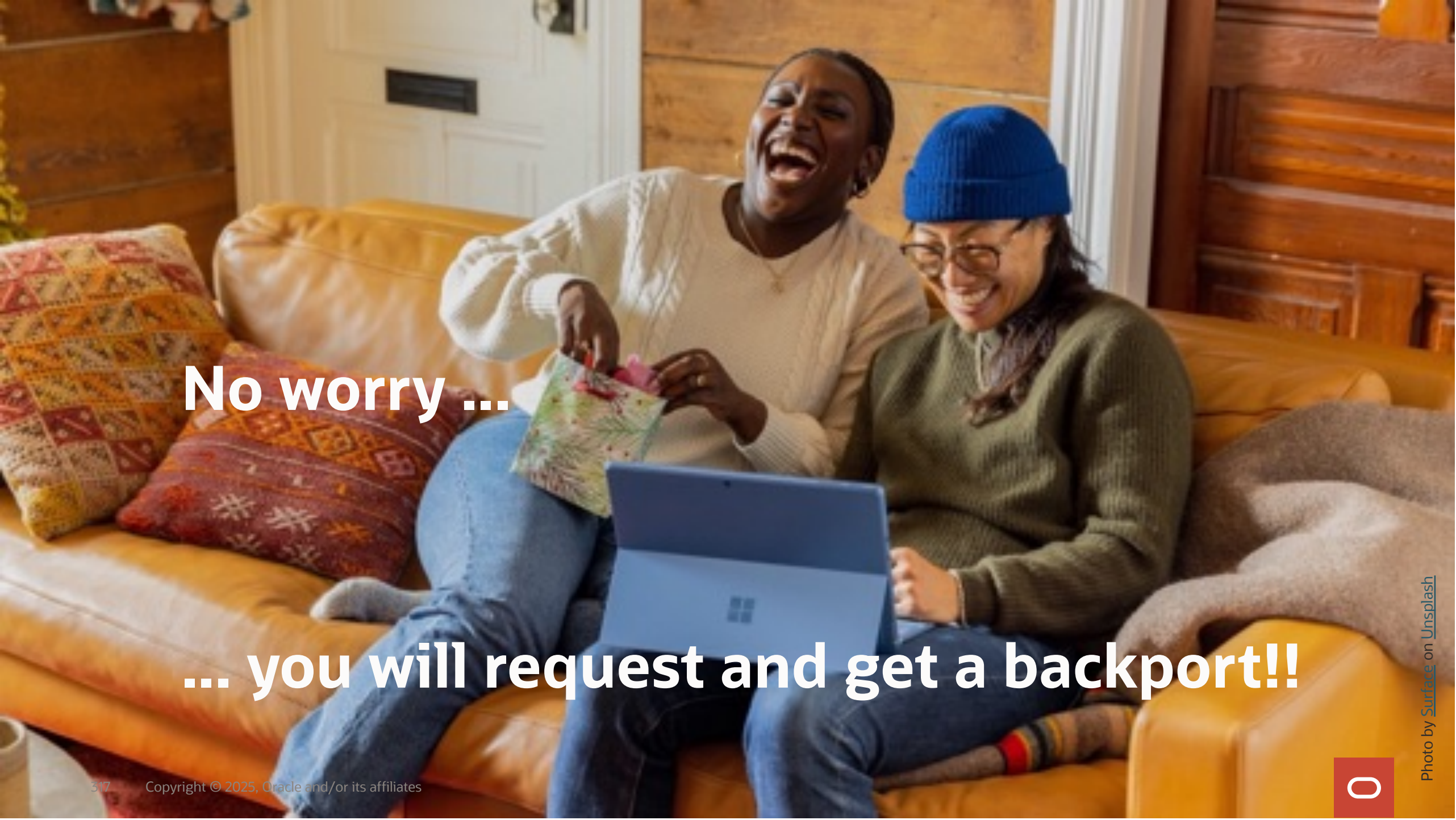
Hdr: 34774667 : ORA-600 [happens_on_mondays_only] before java is brewed
Abstract: Happens on most important sales table. Sales are yelling ... loudly





**Should I
upgrade to
Oracle Database 25ai now?**

But you just released 23ai???

A photograph of two women sitting on a mustard-colored leather sofa in a cozy living room. The woman on the left, with dark skin and wearing a white cable-knit sweater and blue jeans, is laughing heartily while opening a small, wrapped gift. The woman on the right, with light skin, glasses, a blue beanie, and a green sweater, is smiling and looking at a blue laptop. The sofa is decorated with patterned cushions, and a white door is visible in the background.

No worry ...

... you will request and get a backport!!

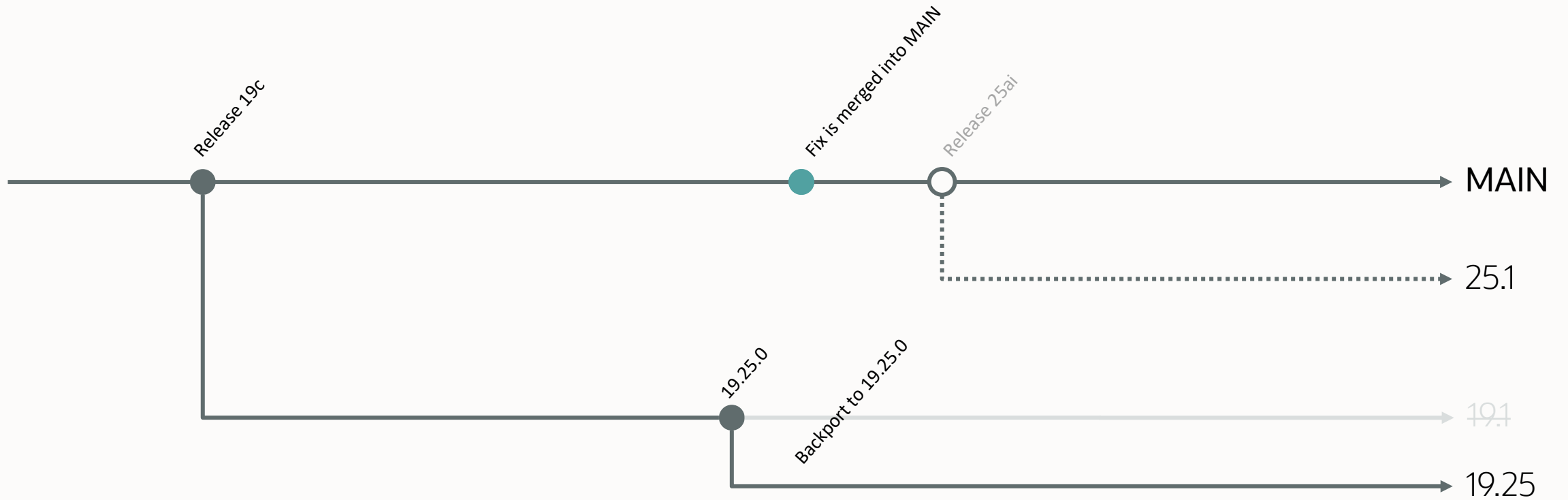
Insights into the Patching Process



- Backport created mostly on request
- Around 2.500 backports created proactively
- Backports are specific for a release and usually also for a patch level, e.g., on top of 19.25.0
- `opatch lsinventory`



Branches



Insights into the Patching Process



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

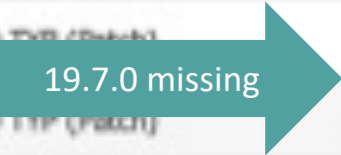
Patch Simple Search Results

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

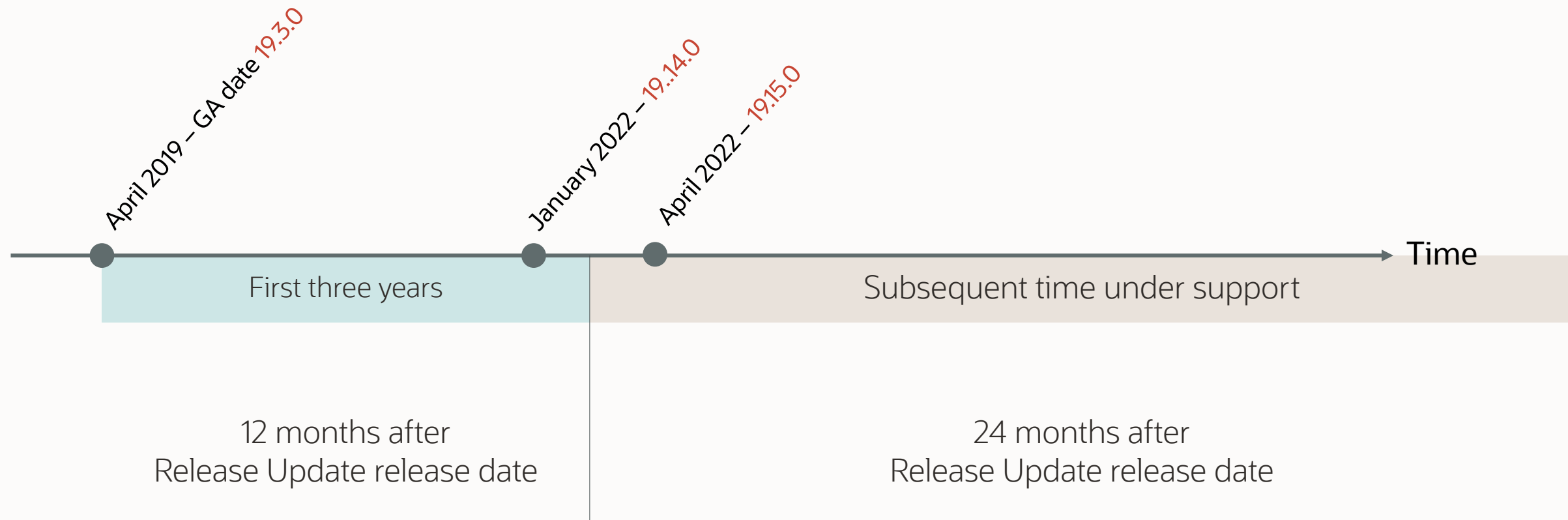
Edit Search

Table ▾ View ▾  Detach  Share Link

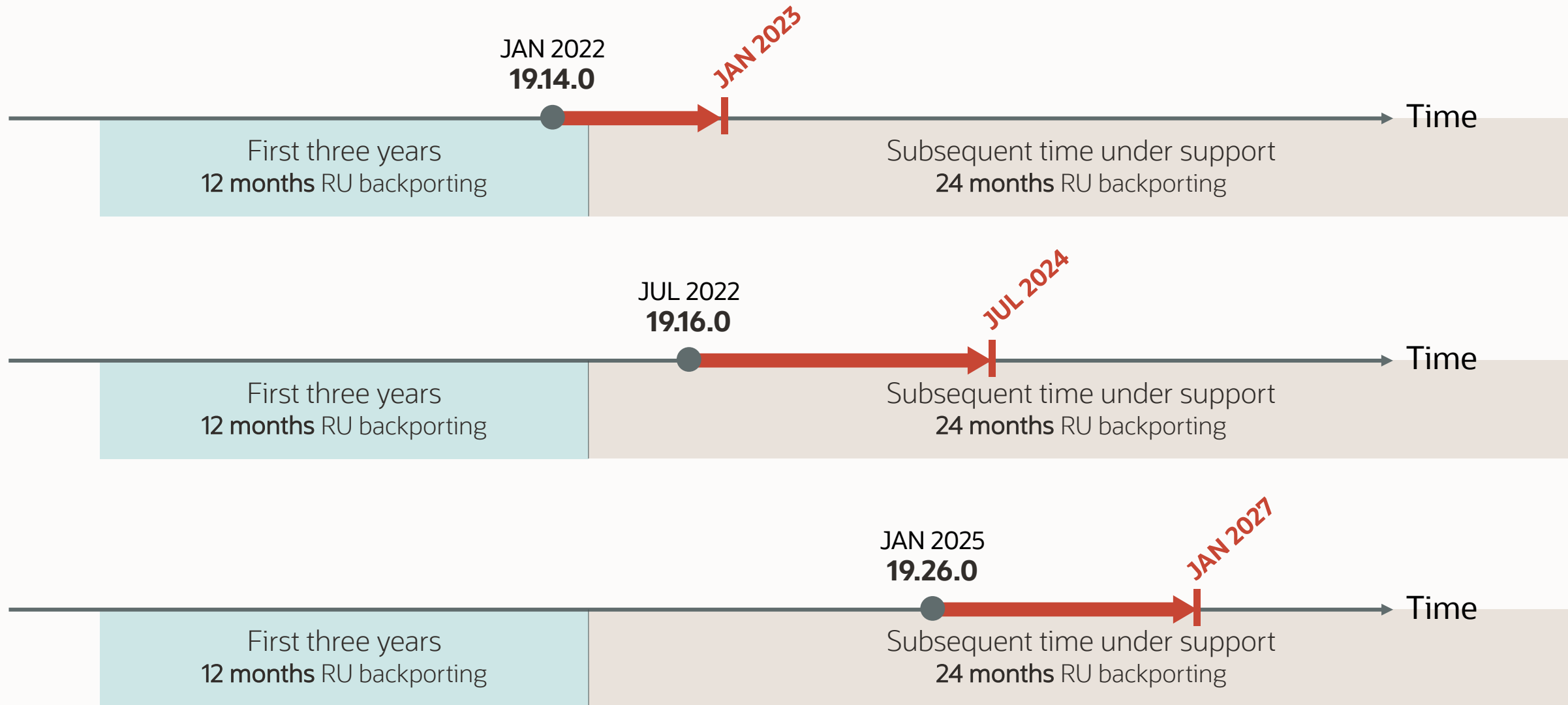
Patch Name	Description	Release	Platform (Language)
31517417	CRA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.16.0.0.0DBRU	Generic Platform (American English)
31517417	CRA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.15.0.0.0DBRU	Generic Platform (American English)
31517417	CRA-22308: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



Can I Request a Backport?



Can I Request a Backport? Examples





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

Request for Inclusion

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
36273767 (replaces 35733946)			ORA-1578: oracle data block corrupted on tempfile even after 35904282, 35733946	[list-patches]	YES	YES	30-APR-2024
35286895	19.23		[KPDB] Switchover/Failover Failing for Backup-Based Cadg : ORA-1113: File 3013 Needs Media Recovery	[list-patches]	YES	YES	29-APR-2024
36480774			[RECOVERY] Slow Opening of database in RAC database for other instance	[list-patches]	YES	YES	27-APR-2024
36366069	19.23	DBMRP 19.21.0.0.240319 , DBMRP 19.22.0.0.240319	CPU spinning on CTWR and reports ORA-32701 / instance crash post 19.21 DBRU on standby	[list-patches]	YES	YES	28-MAR-2024
35998116 (replaces 35037877)	19.23	DBMRP 19.21.0.0.240319 , DBMRP 19.22.0.0.240319	[DBSEC_PRIVS] PLS-00801: internal error [pgm.c:pgmrcm 4] from internal trigger compilation	[list-patches]	YES	YES	27-MAR-2024



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

Insights into the Patching Process



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

Inclusion Evaluation and Criteria

Close

  **Patch 30978304: ORA-20000 DURING IMPDP WITH STATS AND THE UNIQUE INDEX FOR THE PK IS NOT CREATED**

Last Updated Jun 2, 2021 2:04 PM (2+ months ago)

Product	Oracle Database - Enterprise Edition (More...)	Size	1.3 MB
Release	Oracle Database 19.12.0.0.0 DBRU	Download Access	Software
Platform	Generic Platform	Classification	General
		Patch Tag	

Prerequisite Patches

32904851	DATABASE RELEASE UPDATE 19.12.0.0.0

Bugs Resolved by This Patch

30978304	ORA-20000 DURING IMPDP WITH STATS AND THE UNIQUE INDEX FOR THE PK IS NOT CREATED

[View Related Knowledge to this Patch](#)

Release

Platform

Language

[Read Me](#) [Download](#) [Add to Plan](#) 

[Analyze with OPatch...](#)

[Discuss this patch in the community](#)

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
```

```
-----
```

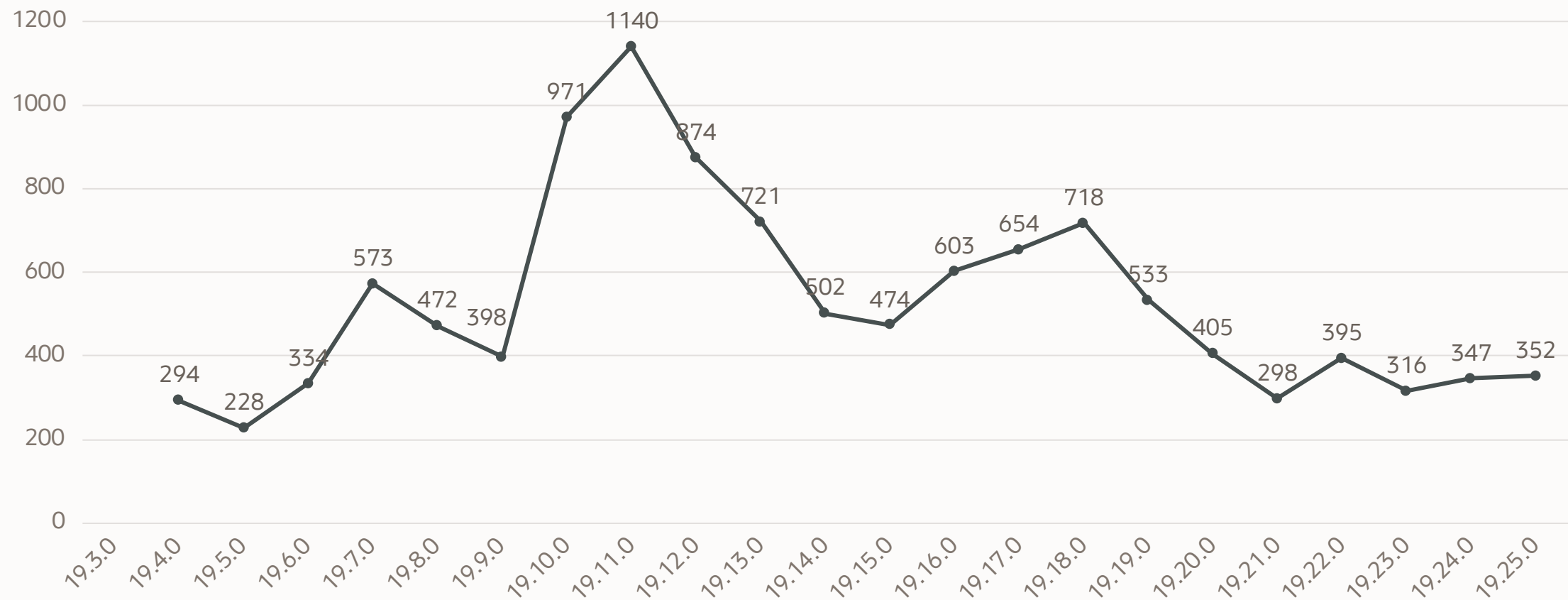
```
Before you install or deinstall the patch, ensure that you meet the following requirements:
```

Insights into the Patching Process



- Limited number of fixes per Release Update
- Release Update regression tests

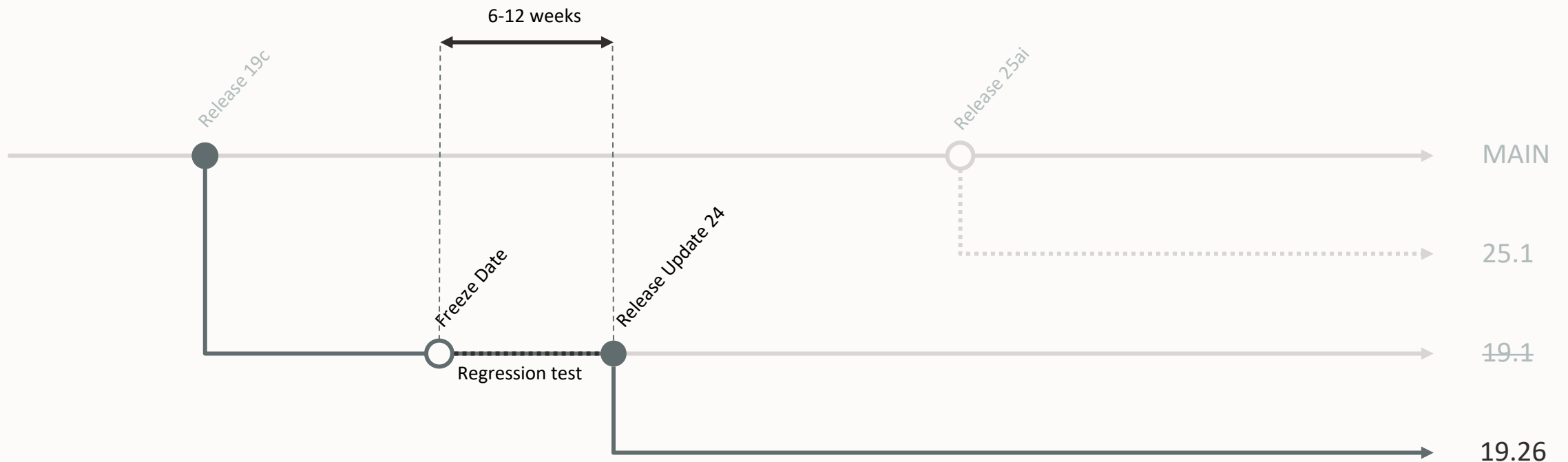
Release Update Contents



[Database 19 Release Updates and Revisions Bugs Fixed Lists \(Doc ID 2523220.1\)](#)



Limitation



WHY DO YOU ALWAYS ASK FOR

OPATCH Isinventory



TO AVOID **CONFLICTS**



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

Invoking prereq “checkconflictagainsthwithdetail”

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

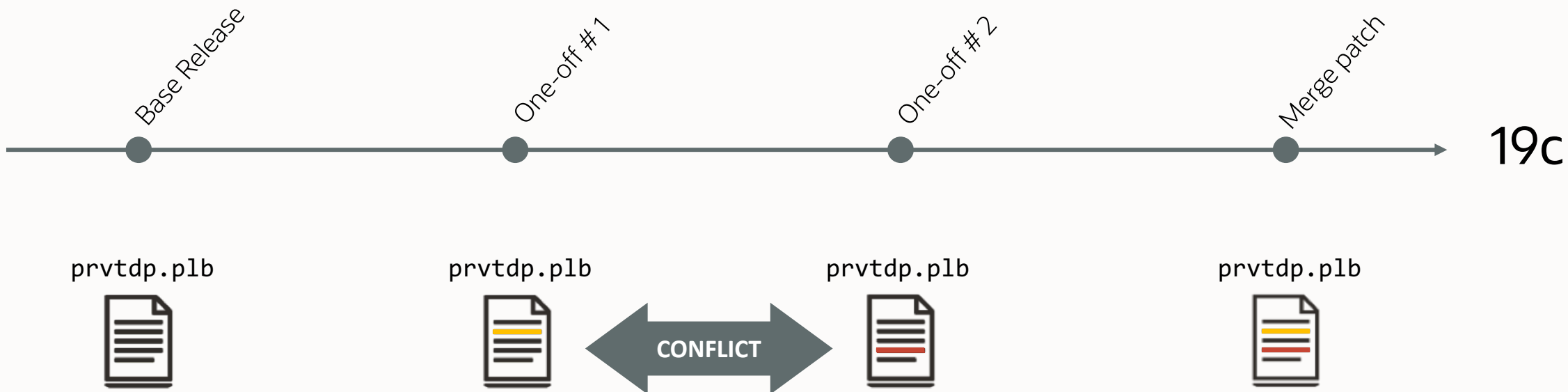
Conflict with 35012562

Conflict details:

/u01/app/oracle/product/19.19.0/db_1/lib/libserver19.a:kko.o

OPatch succeeded.

Basic Facts | Conflicts





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



Don't name it

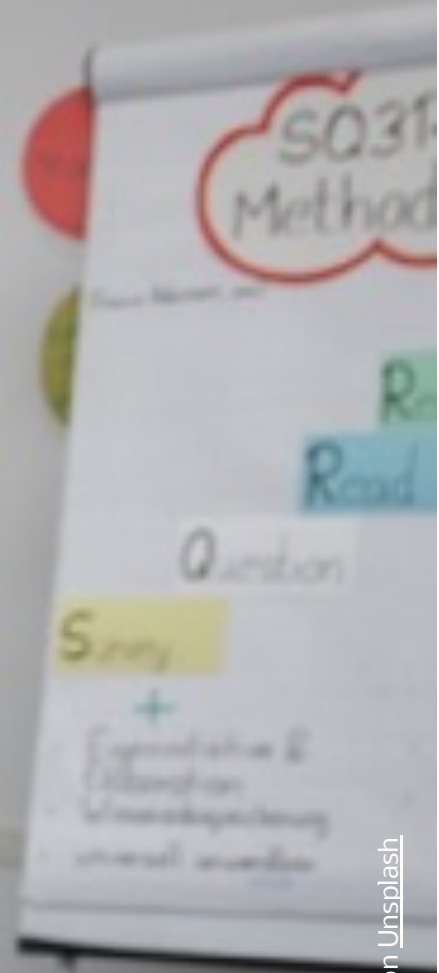
- `optch_lsinvt.txt`
- `tekst_fra_opatch.txt`
- `alle_meine_patches.txt`
- `textodeopatch.txt`



Just name it `opatch_lsinventory.txt`



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



Windows is different ...





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



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

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



Where do I find
the Windows Bundle Patches?

Knowledge

RCA

DWB

Customer Exceptions

CMS

More...



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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

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)

Related Information

19.0.0.0

Description	Bundle Patch	OJVM
19.23.0.0.240416	36219938	36199232
19.22.0.0.240116	35962832	35926646
19.21.0.0.231017	35681552	35648110
19.20.0.0.230718	35348034	35354406
19.19.0.0.230418	35046439	35050341

Patch Details

Details for Patch 36219938 not found.



Basic Facts | Patch Availability

Critical Patch Update Program Apr 2024 Patch Availability Document (DB-only)

My Oracle Support [Note 3000005.1](#)

Released April 16, 2024

This document contains the following sections:

- [Critical Patch Update April 2024 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 2024](#)
 - [2.1 "Final CPU Information \(Error Correction Policies\)"](#)
 - [2.2 "Post Release Patches"](#)
 - [2.3 "Separate PADs for Separate Products"](#)

Basic Facts | Patch Availability

2.2 Post Release Patches

Oracle strives to complete preparations and testing of each Quarterly Security Patch for each platform by the quarterly release date. Occasionally, circumstances beyond Oracle's control can require that a particular patch must be released a few days after the quarterly release date. The following table lists any current patch delays and the estimated date of availability.

Patch	Patch Number	Platform	Availability
21.14.0.0.240416 DB RU	Patch 36352352	Linux x86-64	Available
		HP-UX Itanium	07-May
21.14.0.0.240416 GI RU	Patch 36352207	Linux x86-64	Available
		HP-UX Itanium	07-May
21.14.0.0.240416 WIN BP	Patch 36219877	WINDOWS x64, NT	Available
19.23.0.0.240416 DB RU (& assoc. COMBO)	Patch 36233263 (& Patch 36209492)	Linux x86-64, Solaris.x64, Solaris SPARC 64-Bit, and AIX.PPC64	Available
		HP-UX Itanium, LINUX.ZSERIES64, and LINUX.ARM64	07-May
19.23.0.0.240416 GI RU (& assoc. COMBO)	Patch 36233126 (& Patch 36209493)	Linux x86-64, Solaris.x64, Solaris SPARC 64-Bit, and AIX.PPC64	Available
		HP-UX Itanium, LINUX.ZSERIES64, and LINUX.ARM64	07-May
19.23.0.0.240416 WIN BP	Patch 36219938	WINDOWS.X64	23-Apr
		WINDOWS NT	07-May
19.23.0.0.240416 OJVM	Patch 36199232	All except Linux x86-64	07-May



... Oracle on Windows is different

A photograph of a penguin standing on a large, jagged ice floe in a cold, snowy environment. The penguin is facing away from the camera, looking out over a vast, white landscape. The ice floe is a prominent feature, with sharp edges and a textured surface. The background is a soft, hazy expanse of snow and ice, suggesting a remote, polar location.

Oracle Linux Development Platform

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

Some of the **platforms** from our bug tracking system

Blast from the past

Blast from the Past | Platforms

Microsoft Windows Phone	Tekelec	Netra X3-2 for Acme Packet	Novell NetWare
Oracle JRockit Virtual Edition x86	Qualcomm Brew MP	Oracle Solaris on SPARC (64-bit)	Linux on IBM Z
SunOS	Netra Server X5-2 for Communications	IBM S/390 Based Linux (31-bit)	Data General
Monta Vista x86	HP NonStop S-series (Guardian)	Acme Packet 3900	Pyramid
Acme Packet 1100	HP OpenVMS Itanium	SPARC	Talari
iTron	Monta Vista x86-64	Fujitsu MSP-EX	Palm Computing
Embedded Linux on cnMIPS	OpenSolaris	Trusted Solaris	HP NonStop (OSS) on x86
Embedded Linux SH4	SCO Unix	Net-Net 4250	Unisys OS 2200
HP NonStop Itanium (OSS)	Net-Net 9200	HP OpenVMS VAX	HP OpenVMS Alpha
QNX Unix	Symbian EPOC	HP-UX PA-RISC (32-bit)	Acme Packet 3820
Acme Packet 6100	Linux ARM 32-bit VFP HardFP ABI	Acme Packet 6300	FreeBSDx86
Linux MIPS 64-bit	SGI Irix	Microsoft Windows CE	Oracle Solaris Express
Fujitsu BS2000/OSD (SQ series)	ia64	IBM z/OS on System z	VxWorks
Mediatek MTZ	Linux SPARC	StorageTek Hardware	Microsoft Windows (32-bit)
HP NonStop (Guardian) on x86	Oracle Solaris on SPARC (32-bit)	Oracle Solaris on x86 (32-bit)	Sequent
Fujitsu BS2000	HP NonStop Itanium (Guardian)	Fujitsu BS2000/OSD (SX series)	Windows NT
HP Tru64 UNIX	RIM BlackBerry	Linux ARM 64-bit	nCube

Key Learnings



- 1 Use Data Pump Bundle Patch
- 2 Save workload into SQL Tuning Sets
- 3 Use SQL Plan Management



Break

We start again at 15:15

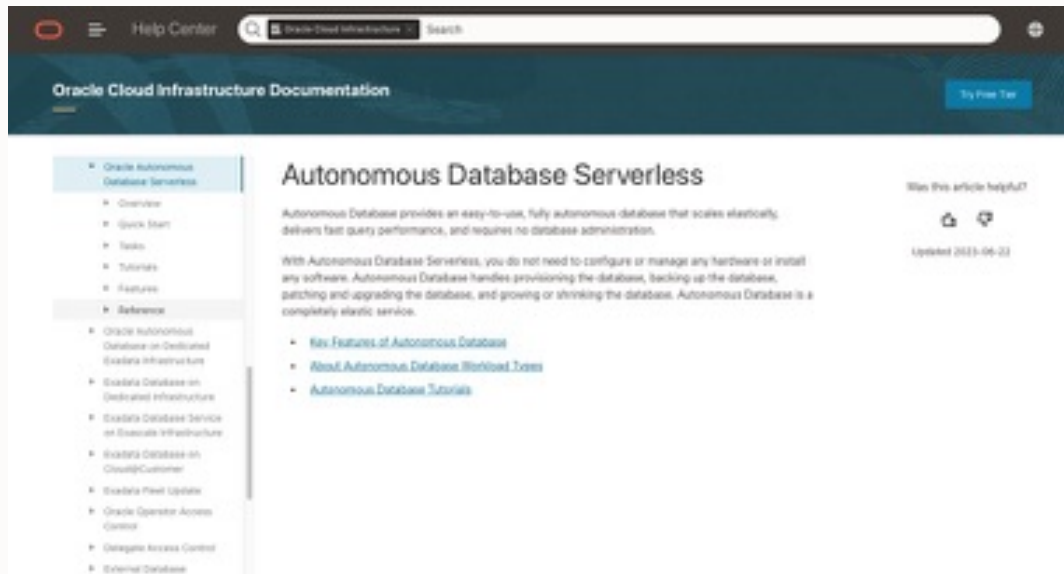
Autonomous Database

—
A migration story



Migration to Autonomous Database is a logical migration

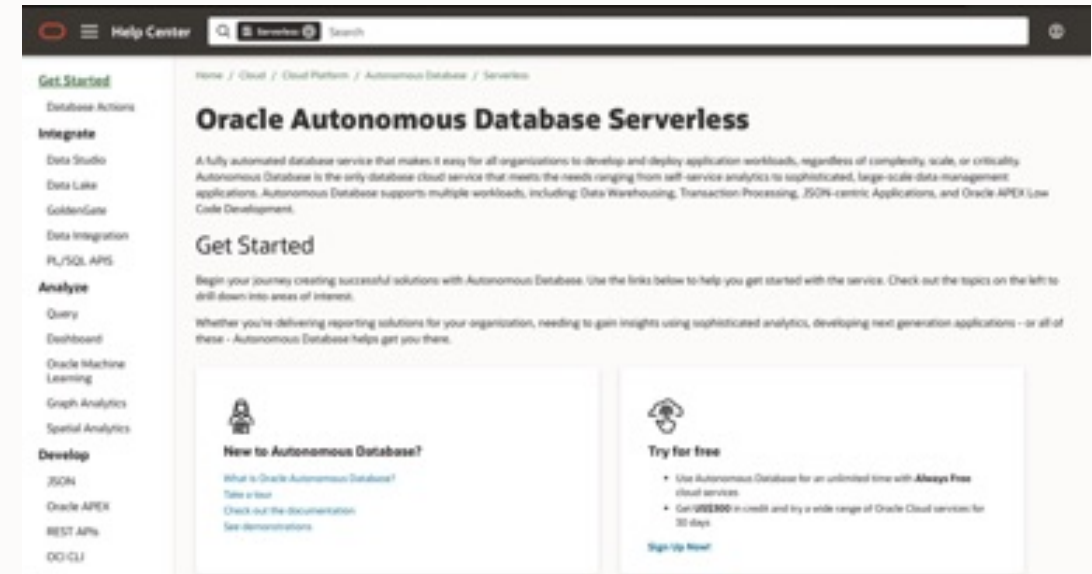
Autonomous Database Essentials



OCI Documentation for everything
“**outside**” the database

i.e deploy, start-stop, manage through the console

<https://docs.oracle.com/en-us/iaas/autonomous-database-serverless/index.html>



Database Documentation for everything
“**inside**” the database

i.e. schema, capabilities, using the database through a connection

<https://docs.oracle.com/en/cloud/paas/autonomous-database/serverless/index.html>

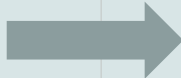
Move to Autonomous Database



Estate Explorer

Identify and map potential targets for the migration to Oracle ADB.

[Click for more information](#)

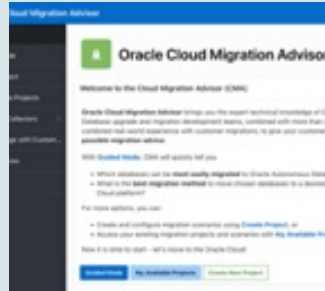
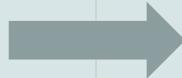


Source Database	
Action Required	4
Review Required	0
Review Suggested	2
Passed	7

CPAT

Cloud Pre-Migration Advisor Tool – download from MOS Note: [2758371.1](#)

[Click for more information](#)



CMA

Cloud Migration Advisor, GUI landscape overview.

The tool gives you technical advice on the various migration options.

[Click for more information](#)



DMS

Database Migration Service

[Click for more information](#)

ZDM

Zero Downtime Migration

[Click for more information](#)

AMA

Oracle Autonomous DB Migration Automation

In beta status currently.

[Contact me](#)



Do you plan to migrate to Autonomous Database?

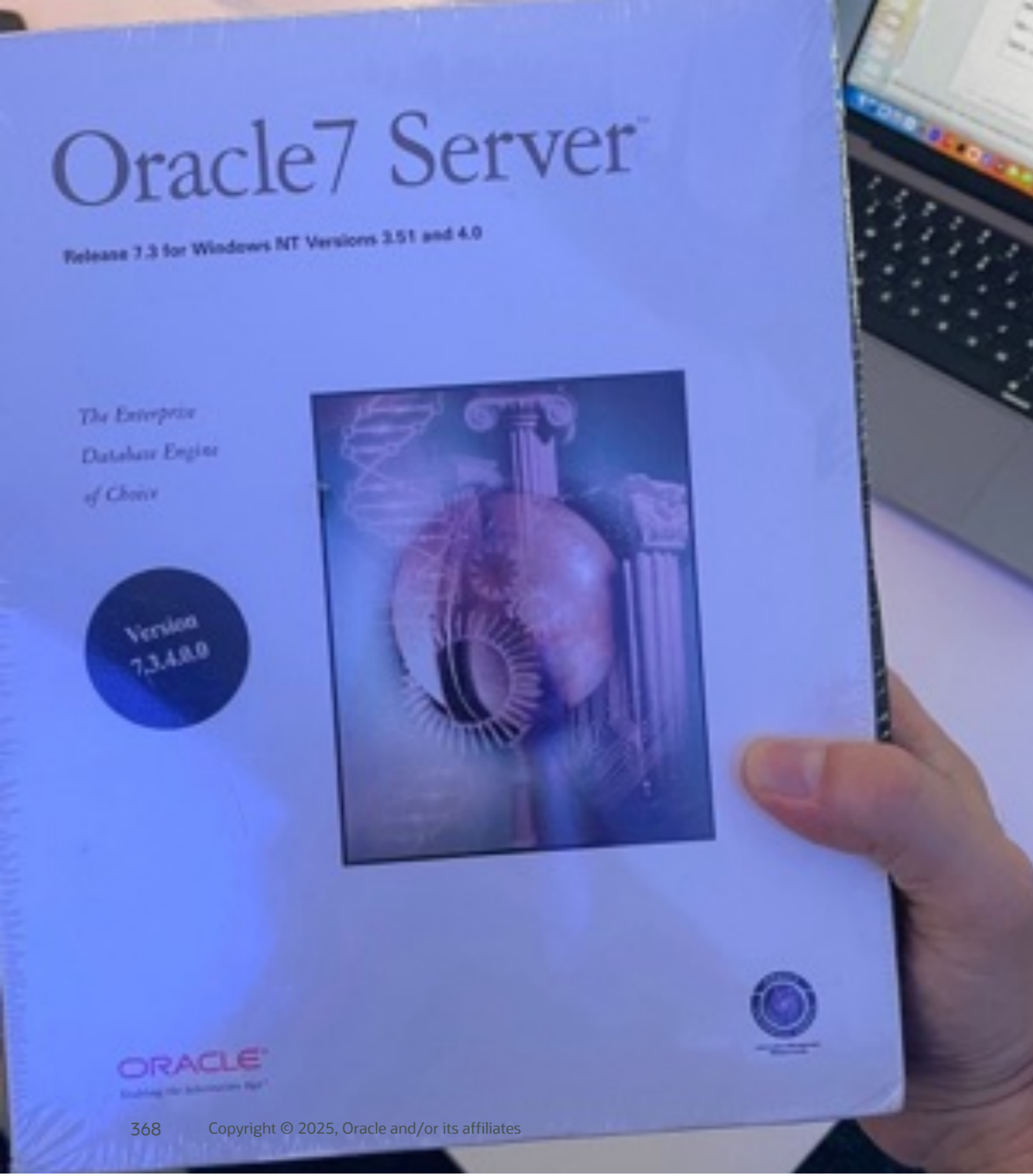
Then talk to us – we will guide you!

Oracle Database 23ai



What's Changing







Consult the [Upgrade Guide](#) for changes, desupports, and deprecations



Traditional Auditing is desupported in Oracle Database 23ai

- Migrate your policies to Unified Auditing



TRADITIONAL AUDITING

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

UNIFIED AUDITING

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





AutoUpgrade is **the only supported tool to upgrade** your Oracle Database

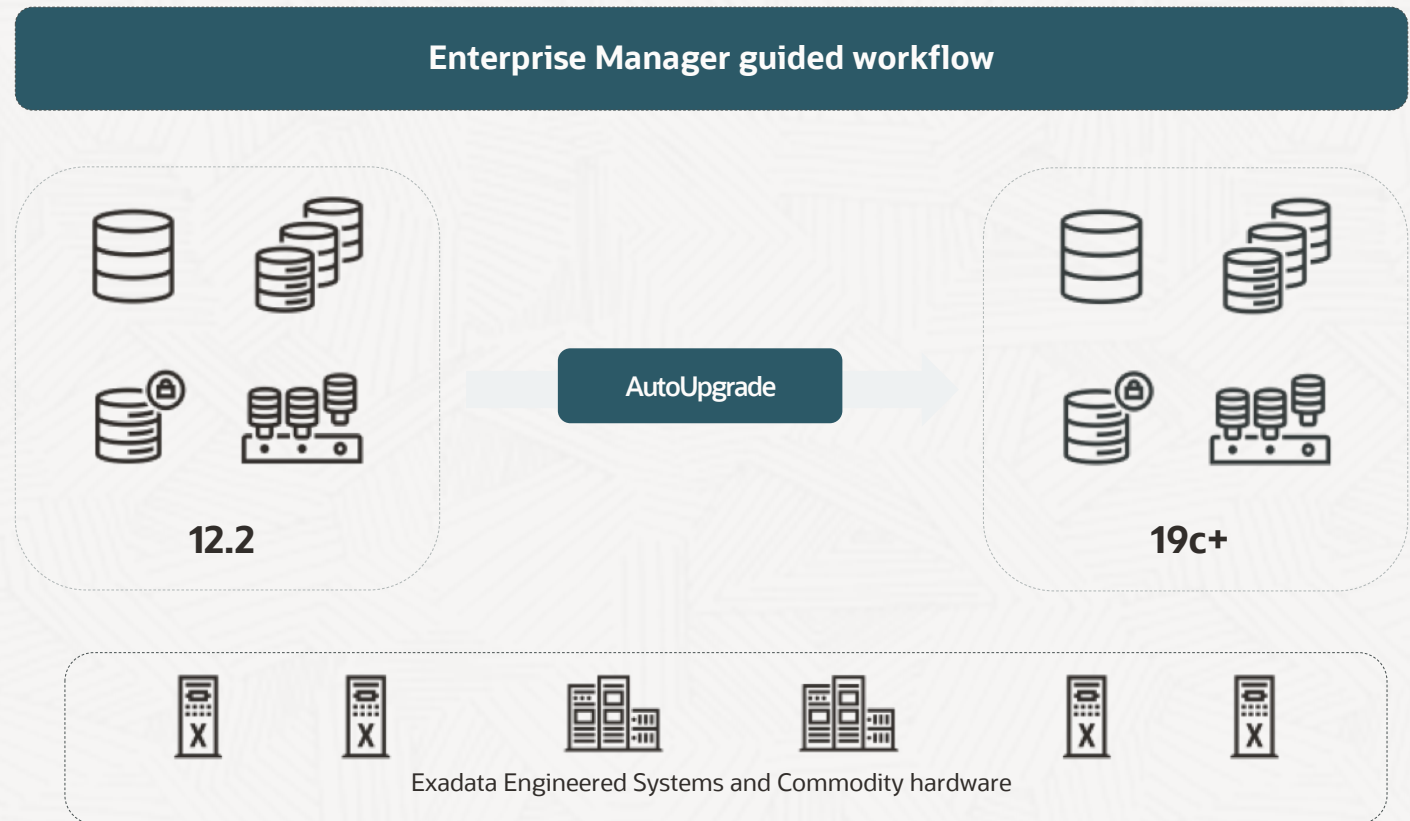
- DBUA is **desupported**

Enterprise Manager

AutoUpgrade integration into EM CC

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

- [MOS Note: 2978593.1](#)
[EM 13c: Is Agent 13.5](#)
[Certified on RHEL 9/OL9?](#)



Oracle Database 23ai



What's New





Examine Oracle Database changes using ORAdiff

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

ORAdiff

Home

Parameters

Users, Roles, etc

Privileges

Included Fixes

Oracle Database Home

Objects

Fixed Objects

Audit

System

Scheduler

Report

MOS Account

Oracle Account

daniel.loveby.hansen@oracle.com



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

Version Selector

Source Version

19c

Target Version

Select Version

Source Patch Level

19.0.0

Target Patch Level

Select Patch Level

v_PARAMETER

Added

Removed

Changed

1

2

3

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

ORAdiff

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Version Selector

Source Version: 19c
Target Version: 21c
Patch Level: 19.0.0.0.0
Patch Level: 21.0.0.0.0

Added	Removed	Changed

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.

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[Watch on YouTube](#)

Filter



Year ▼

Genre ▼

Nominations

Awards

Question

Message

Motivational movies about athletics

Search Type



Text Search



Vector Search

Search

Results

1 - 10 of 10

	Title	Awards	Year	Nominations	Genre
	Goodbye Columbus	NONE	1969	Academy Award for Best Writing, Adapted Screenplay	Romance, Comedy, Family
	The Formula	NONE	2002	NONE	Unknown
	Batman Returns	NONE	1992	Academy Award for Best Makeup and Hairstyling, Academy Award for Best Visual Effects, MTV Movie Award for Best Villain	Film-Noir, Action, Family, Fantasy

Why *Batman Returns*?

“Motivational Movies about Athletics”

NJQ15253, *Batman Returns*, 1992, https://upload.wikimedia.org/wikipedia/en/8/83/Batman_returns_poster2.jpg, 'Film-Noir, Action, Family, Fantasy', 'Academy Award for Best Makeup and Hairstyling, Academy Award for Best Visual Effects, MTV Movie Award for Best Villain', , *Batman Returns* is a 1992 American superhero film directed by Tim Burton and produced by Denise Di Novi and Burton, based on the DC Comics character Batman. The sequel to the 1989 film *Batman* , it is the second installment of Warner Bros. initial *Batman* film series, and stars Michael Keaton as Bruce Wayne / Batman, alongside Danny DeVito, Michelle Pfeiffer, Christopher Walken, Michael Gough, Pat Hingle and Michael Murphy. In *Batman Returns* , Batman faces the Penguin, who plots to kill all of Gotham City's firstborn sons, while dealing with Catwoman, who seeks vengeance against Max Shreck, a corrupt tycoon who allies with the Penguin to bring Gotham City under his control. Burton originally did not want to direct another *Batman* film. Warner Bros. developed a script with Sam Hamm which had the Penguin and Catwoman going after hidden treasure. Burton agreed to return after they granted him more creative control and replaced Hamm with Daniel Waters. Wesley Strick was later chosen to do an uncredited rewrite shortly before filming. This included normalizing dialogue, fleshing out the Penguin's motivations and master plan, and removing scenes due to budget concerns. Strick continued working as the on-set writer through filming. Annette Bening was originally cast as Catwoman, but became pregnant and was replaced with Pfeiffer. *Batman Returns* was released on June 19, 1992. It grossed \$266.8 million worldwide on a total budget of \$80 million and received positive reviews. Critics praised its action sequences, performances, Danny Elfman's score, effects and villains, although its dark tone and high level of violence for a PG-13 film, was criticized. The film was nominated for two Academy Awards: Best Visual Effects and Best Makeup, as well as two BAFTA awards. A stand- alone sequel, *Batman Forever* , was released in 1995, with Val Kilmer replacing Keaton as Batman. An alternate comic book continuation, which ignores the events of the subsequent films, will be published by DC Comics starting in July 2021. Keaton is also set to reprise the role of Batman in the DC Extended Universe beginning with *The Flash* (2022).

Filter



Year ▼

Genre ▼

Nominations

Awards

Question

Message

Motivational movies about athletics

is

Search Type

☐ Text Search

☒ Vector Search

Search

Results

1 - 10 of 10

	Title	Awards	Year	Nominations	Genre
	The Do-Deca-Pentathlon	NONE	2012	NONE	Comedy
	Champions	NONE	2025	NONE	Comedy,Sport
	Across the Tracks	NONE	1991	NONE	Drama,Action
	Hustle	NONE	2022	NONE	Sport

Filter



Year
2023



Genre
Sport



Nominations

Awards

Question

Message

Motivational movies about athletics

or

Search Type

☐ Text Search ☒ Vector Search

Search

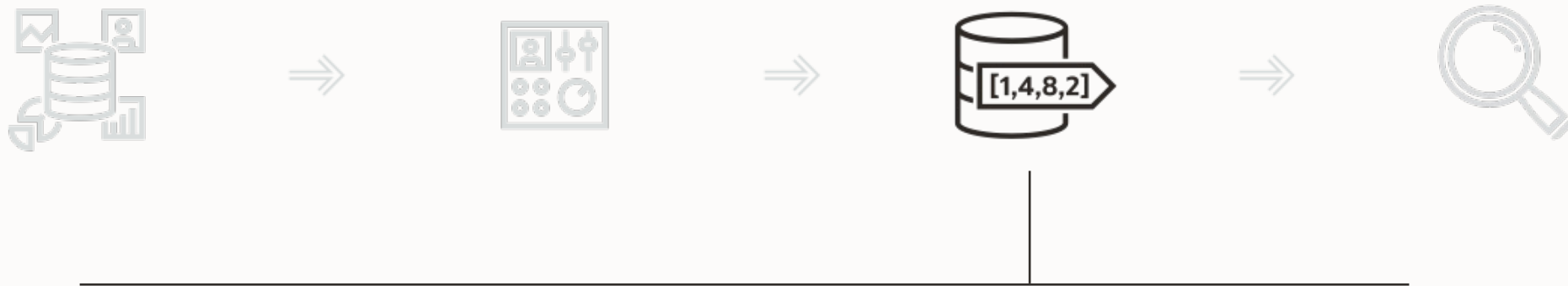
Results

1 - 3 of 3

	Title	Awards	Year	Nominations	Genre
	Champions	NONE	2023	NONE	Comedy,Sport
	Sweetwater	NONE	2023	NONE	Biography,Sport
	80 for Brady	NONE	2023	NONE	Sport,Comedy

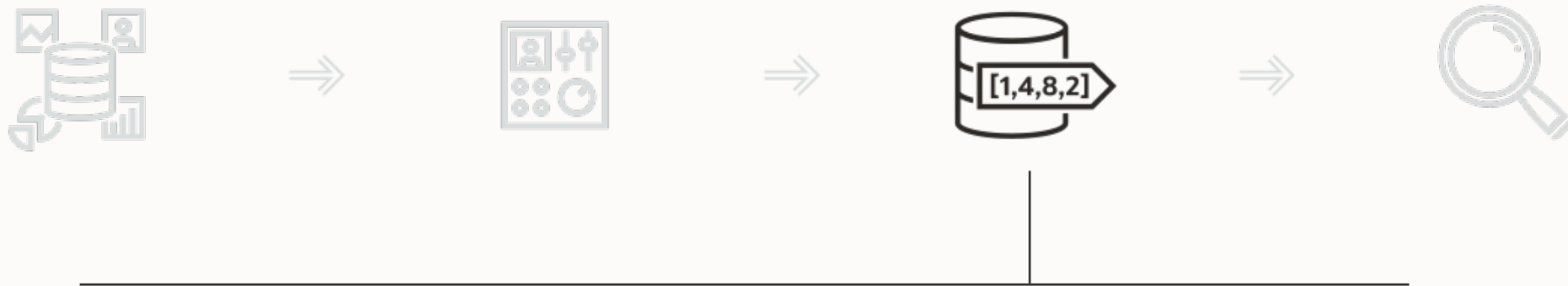
1 - 3 of 3

Vector Database



- New data type: **VECTOR**
- A vector is
*a numerical representation of data
that captures key features and relationships of the data*

Vector Database



```
CREATE TABLE movies (  
    id          NUMBER,  
    description CLOB,  
    photo       BLOB,  
    my_vector    VECTOR(768, FLOAT32));
```


It's just an array ...

50 21 16 42 33

The dimension is
"how many numbers"

Vector Database

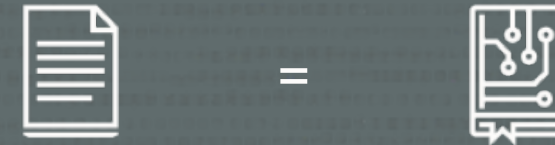


-
- Your data is already in the database
 - How do you perform a semantic search instead of a literal search?

Comparing numbers is trivial

$100 > 50 = \text{true}$

How to compare complex data types?



How to search for search complex data types?



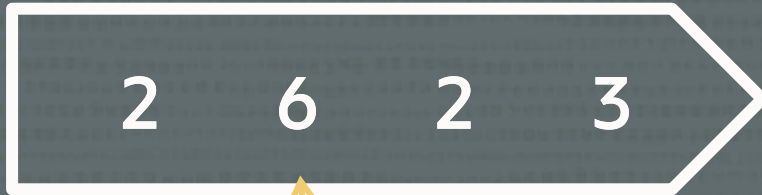
Vector Database



- Search vector data using vector indexes
- Calculate the vector distance



Type of movie



Genre



Mood

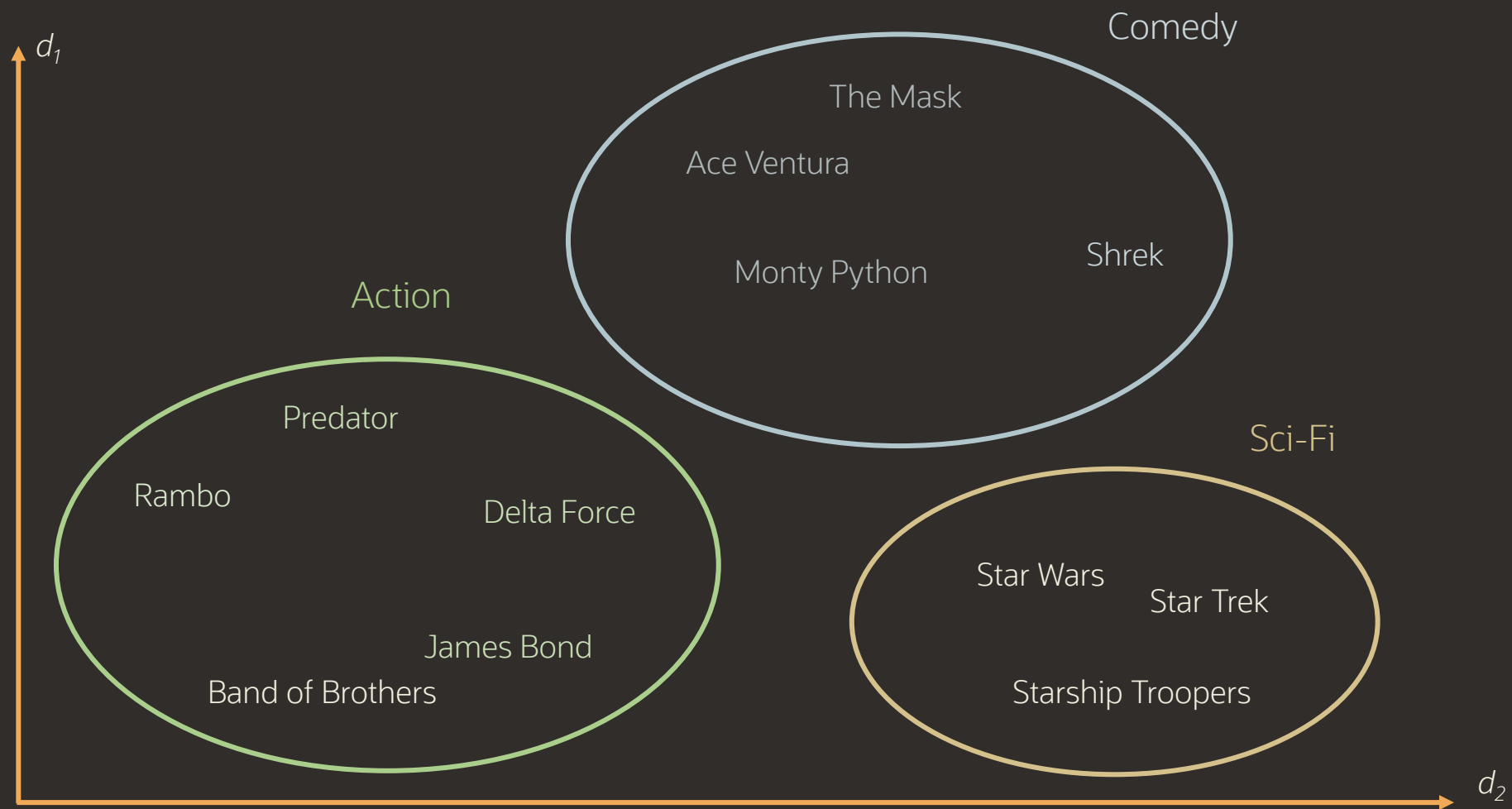


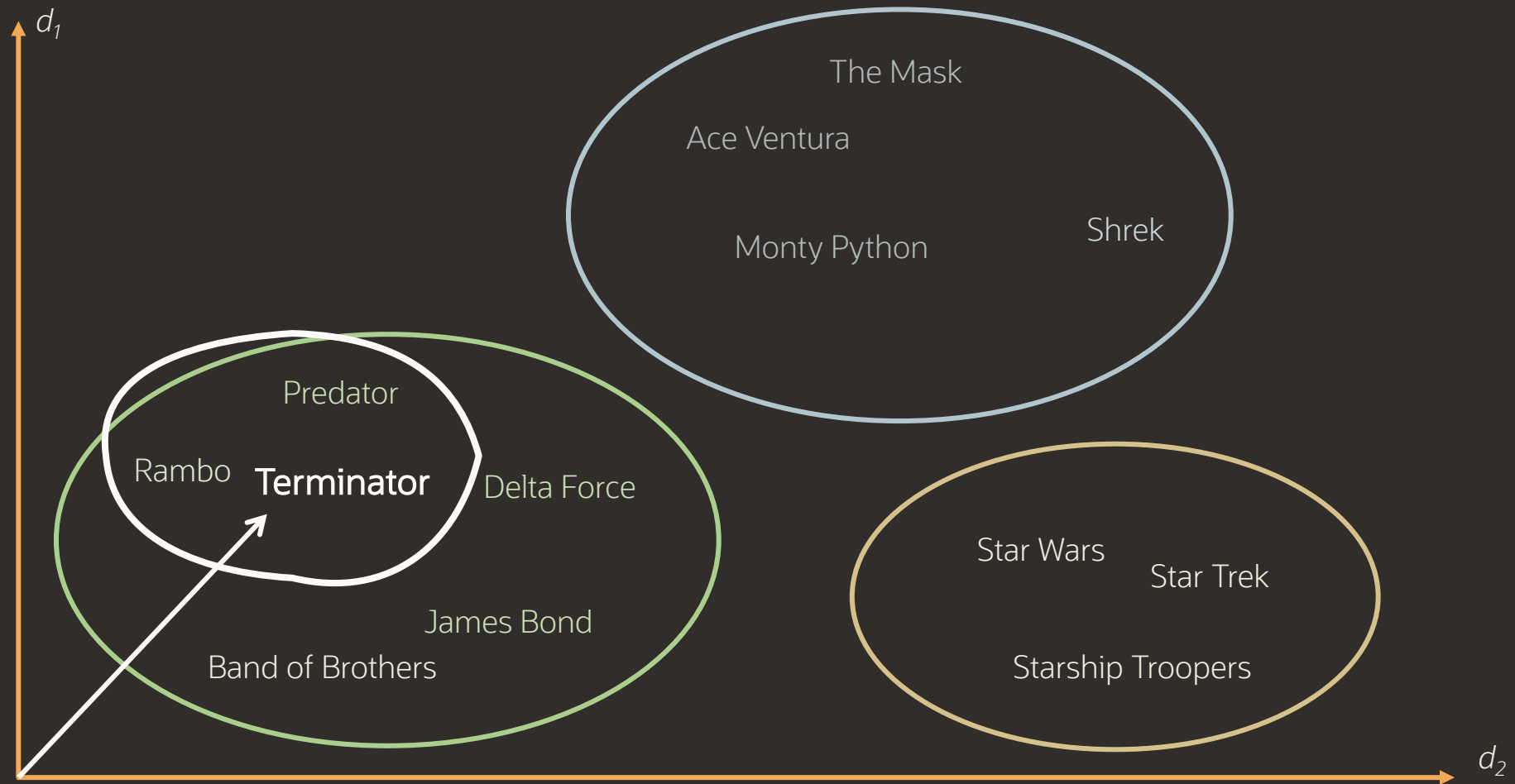
$$\begin{aligned} &\text{Distance (Euclidean Squared)} \\ &= (3-2)^2 + (1-6)^2 + (2-2)^2 + (8-3)^2 \end{aligned}$$

Vector Database



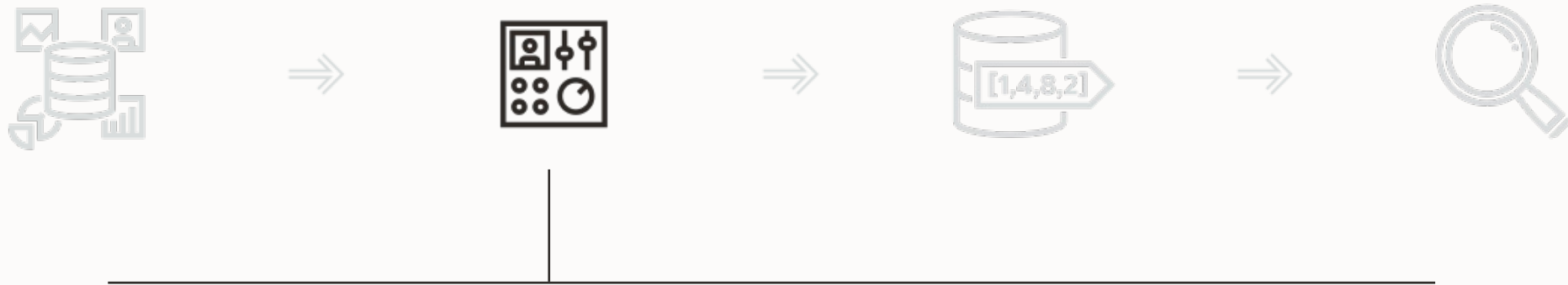
```
SELECT    ...  
FROM      movies  
ORDER BY  vector_distance(movie1, movie2, EUCLIDEAN_SQUARED);
```



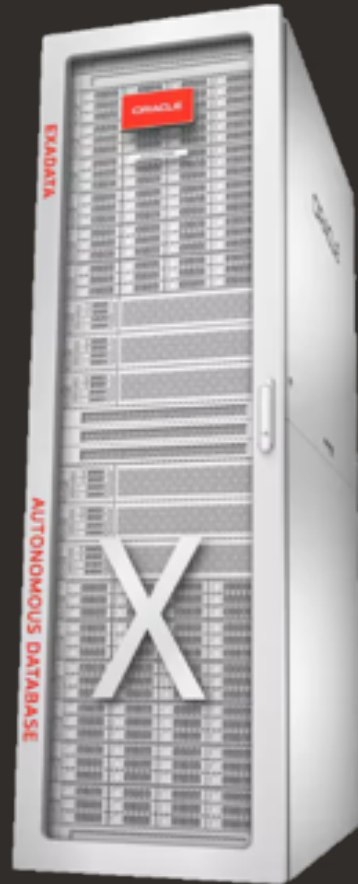


How do you convert your data into vectors?

Vector Database



- Embedding models transform your data into a vector



10,000 GPU ?

```
DBMS_DATA_MINING.import_onnx_model(  
    model_name => 'All-MiniLM-L6-v2',  
    model_data => 'All-MiniLM-L6-v2.onnx'  
    ...  
);
```

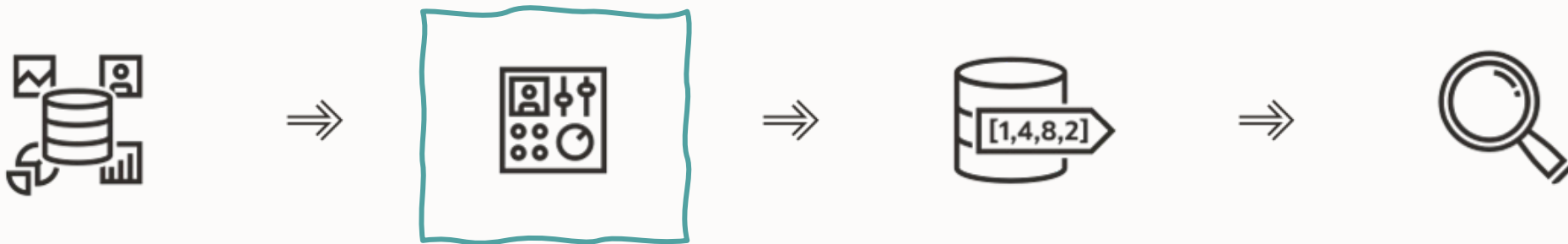


```
INSERT INTO movies
VALUES (:id,
        :description,
        :photo,
        VECTOR_EMBEDDING(All-MiniLM-L6-v2, :description));
```

Vector Database



Vector Database



Vector Database



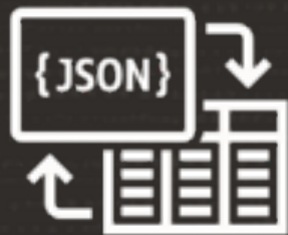
Vector Database





Included in **any** edition
of Oracle Database 23ai

- No extra license required



Get the best of both worlds with JSON Duality Views



STUDENT			
STUID	SNAME	MAJOR	YEAR
S3245	Jill	Math	First
...	...	...	...
...	...	...	...
...	...	...	...



CID	CLASS	ROOM	TIME	TCHID
C025	MATH 201	A102	14:00	T543
C345	SCIENCE 102	B405	16:00	T789
...	...	...	...	...
...	...	...	...	...



STUID	CID
S3245	C025
...	...
S3245	C345
...	...



TCHID	TEACHER	TINFO
...	...	...
T543	Adam	...
T789	Anita	...
...	...	...




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

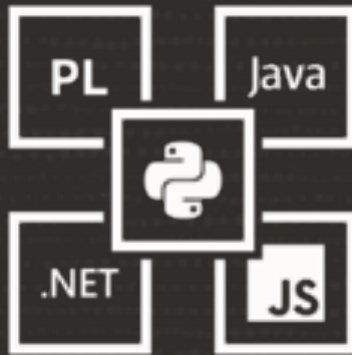
Auditing

SQL Firewall

ACID

No data duplication

... and so much more



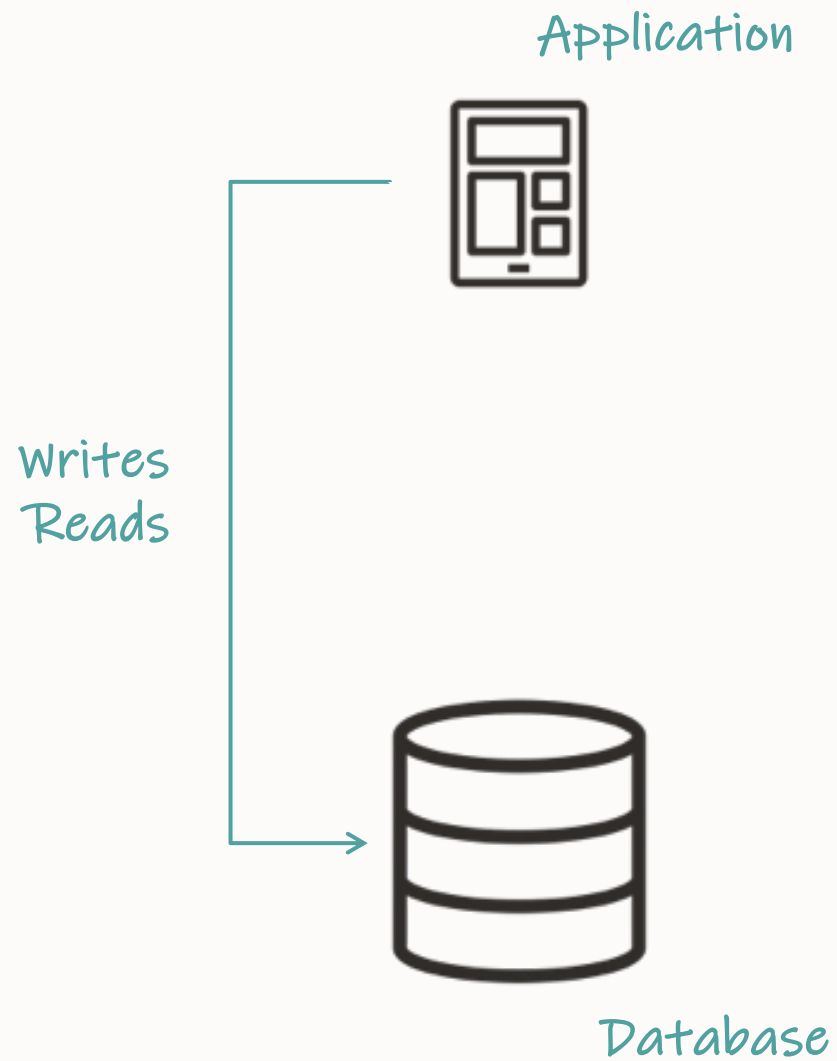
Easily convert your existing application with Oracle Database API for MongoDB

- Using [Oracle Database API for MongoDB](#)



Accelerate your applications 10x
with True Cache

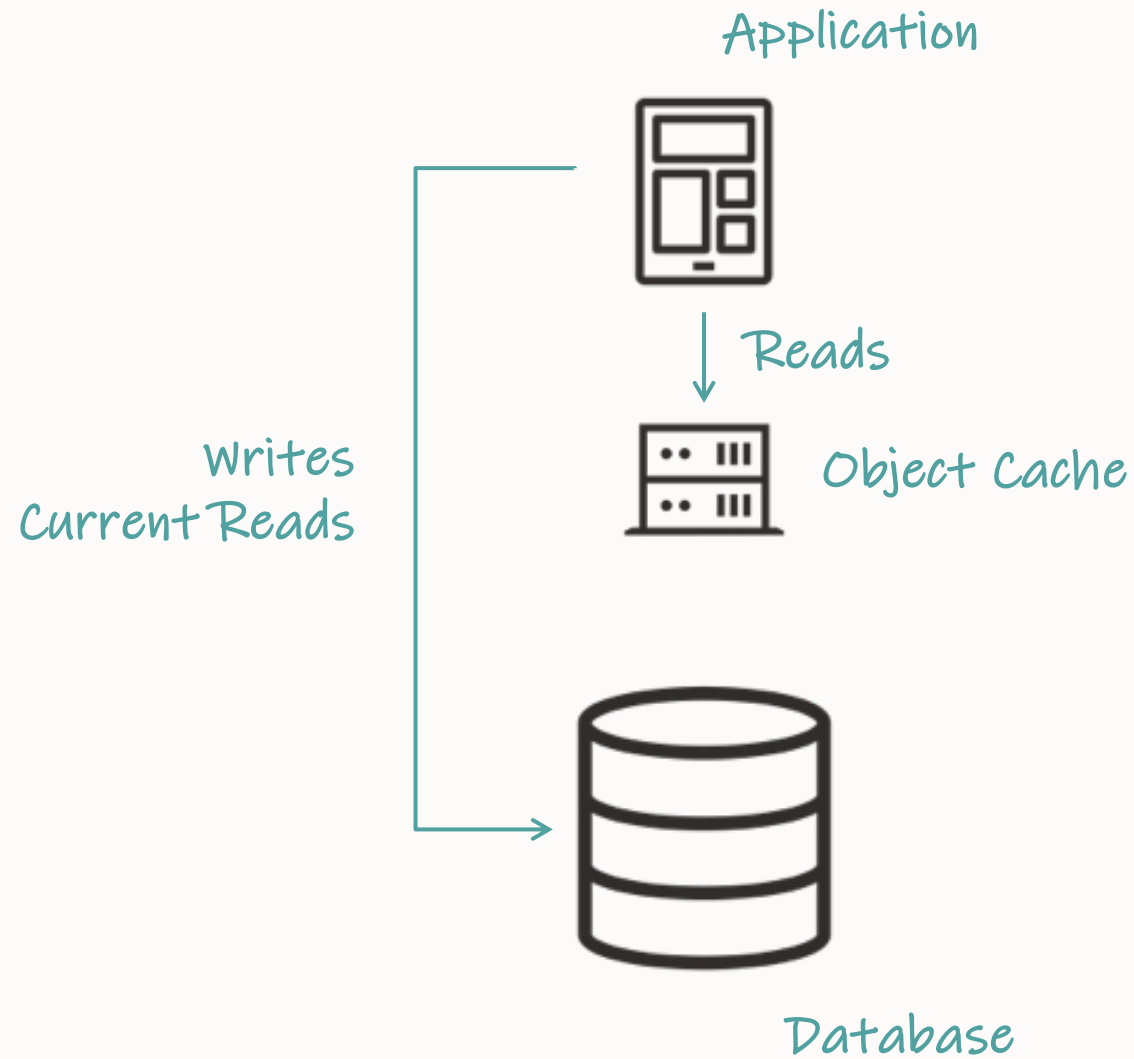
True Cache





We have a performance problem;
we need a cache!

True Cache



True Cache

Who takes care of the cache:

- Populating?
- Consistency?
- Monitoring?
- High availability?
- Security?
- Auditing?
- ...

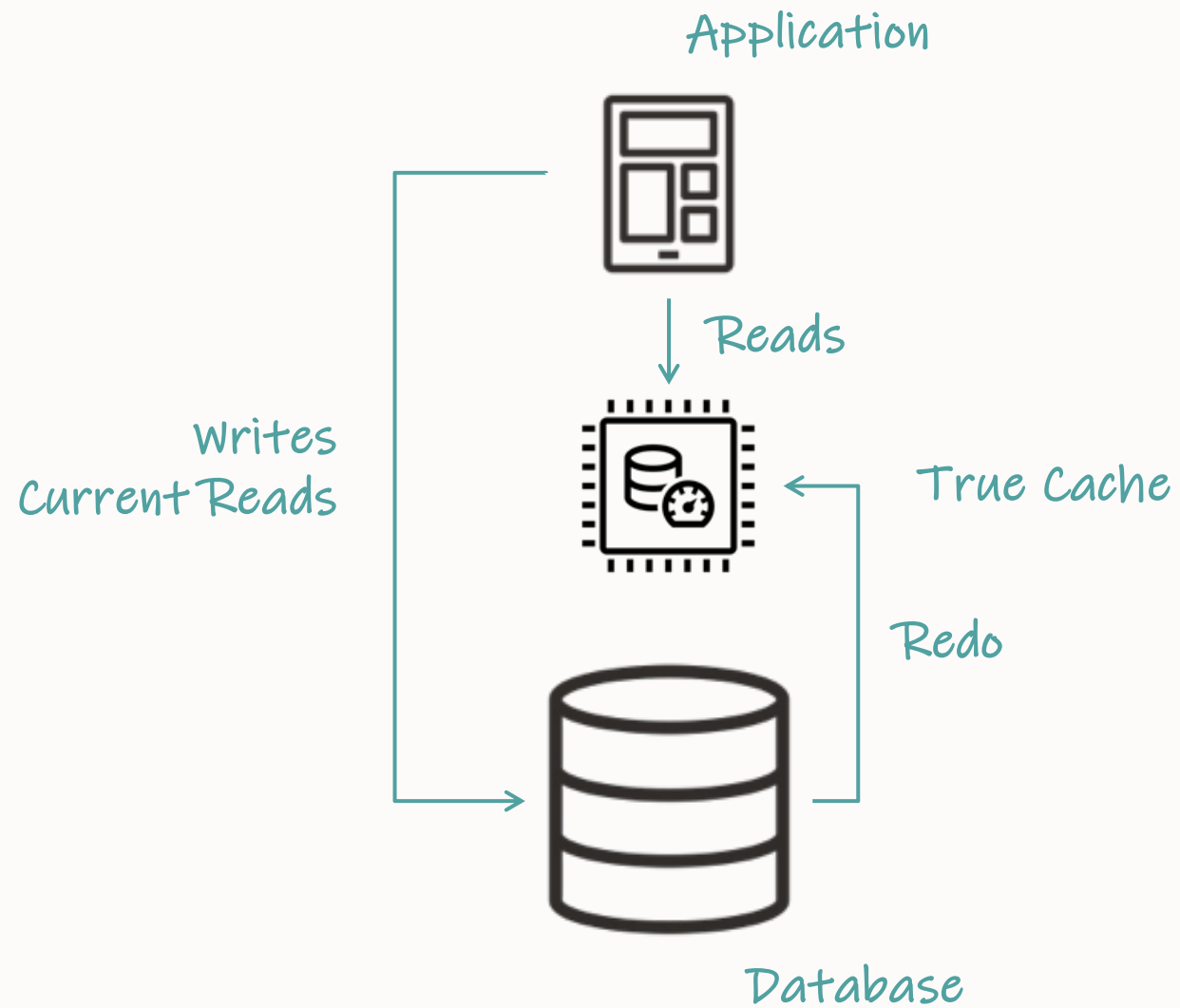


... now we're having a cache problem!



Oracle True Cache - conceptually a diskless Active Data Guard

True Cache





Oracle True Cache is part of Enterprise Edition



Quickly resolve poor performance caused by change in execution plan

- Simplified use of SQL Plan Management


```
--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>');
```


Backported to 19.22.0



Allow the database to fix regressing plans automatically

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



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

- Automatic Error Mitigation


```
SQL> select ... from ...
```

```
ERROR at line 1:
```

```
ORA-00600: internal error code, arguments: [...]
```

```
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
```




Even wider tables

- Up to 4096 columns
- Be aware of row chaining

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



Ensure your database clients are updated

- Older clients **do not** support more than 1000 columns

Oracle Database 23ai



Even More Secure





No more insecure case insensitive password

- 10G password verifies are no longer accepted



Grant privileges to an entire **schema** in one command

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

Oracle Database 23ai



Small, but useful




```
--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
```

```
--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
```



```
--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');
```



```
--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;
```

```
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/23ai/dbhome_1/network/admin/tnsnames.ora.
Help: <https://docs.oracle.com/error-help/db/ora-12154/>


```
SQL> ping salesgold
```

```
Network service name mapping file:
```

```
/opt/oracle/product/23ai/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)
```

```
--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');
```

Tablespace Shrink

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

the most
important change

--No longer need to select from dual

~~select sysdate from dual;~~

select sysdate;

Key Learnings



- 1 Patch regularly and out-of-place
- 2 Use AutoUpgrade
- 3 Use SQL Plan Management

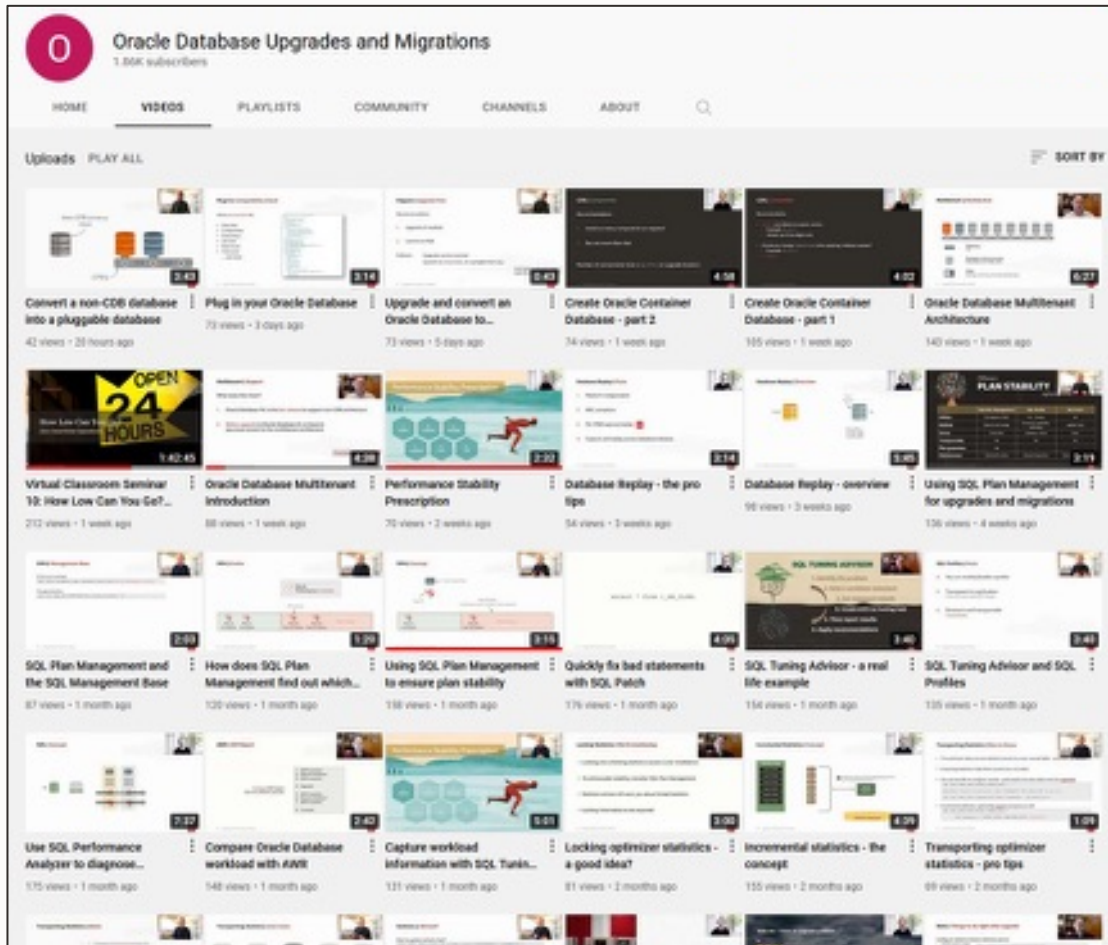
Oracle

DBAs

run the world



YouTube | Oracle Database Upgrades and Migrations



<https://www.youtube.com/@upgradenow>

- 300+ videos
- New videos every week
- No marketing
- No buzzword
- All tech



Thank You

