



ORACLE

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

Frankfurt – May 14, 2024



Oracle

**DBAs**

run the world







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### Episode 1

#### Release and Patching Strategy

105 minutes – Feb 4, 2021



### Episode 2

#### AutoUpgrade to Oracle Database 19c

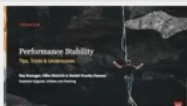
115 minutes – Feb 20, 2021



### Episode 3

#### Performance Stability, Tips and Tricks and Underscores

120 minutes – Mar 4, 2021



### Episode 4

#### Migration to Oracle Multitenant

120 minutes – Mar 16, 2021



### Episode 5

#### Migration Strategies – Insights, Tips and Secrets

120 minutes – Mar 25, 2021



### Episode 6

#### Move to the Cloud – Not only for techies

115 minutes – Apr 8, 2021



## Recorded Web Seminars

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## Webinar | Multitenant



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## Move to Oracle Database 23ai

– Everything you need to know about Oracle Multitenant

PART 1: May 16

PART 2: June 27

[Sign up](#)





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# AGENDA

**09:30**

Welcome  
Release Strategy  
Patching

**11:15**

Upgrade  
Data Pump

**13:30**

Performance Stability  
Insights into development  
Cloud Migration Advisor

**15:15**

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

**11:00**

Coffee break

**12:45**

Lunch

**15:00**

Coffee break





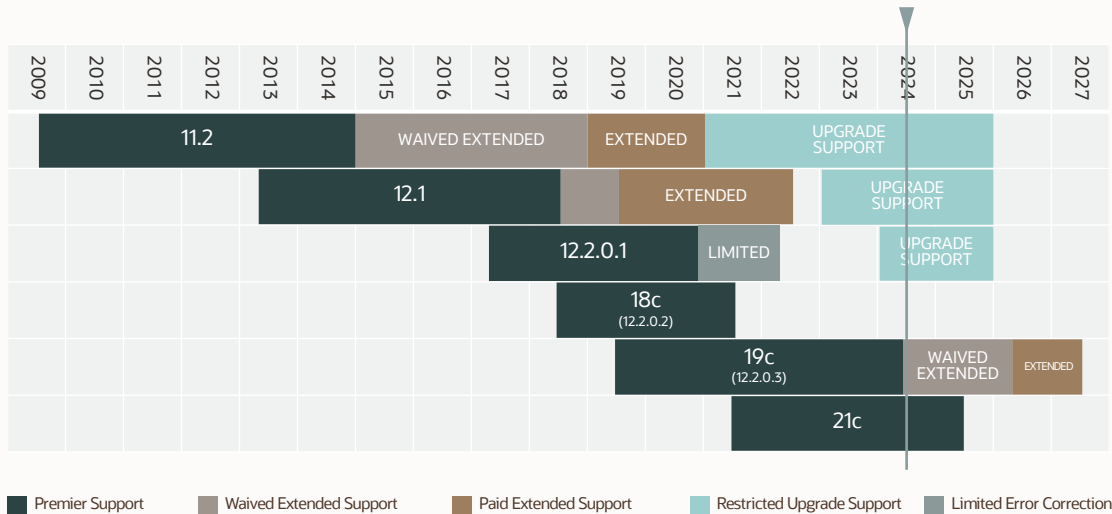


# Release Strategy

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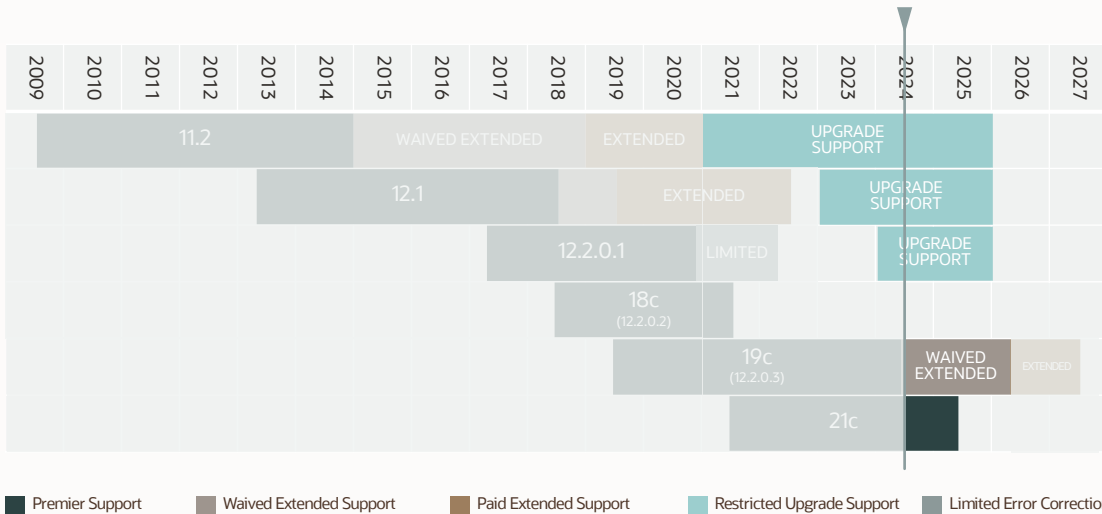


# Lifetime Support Policy



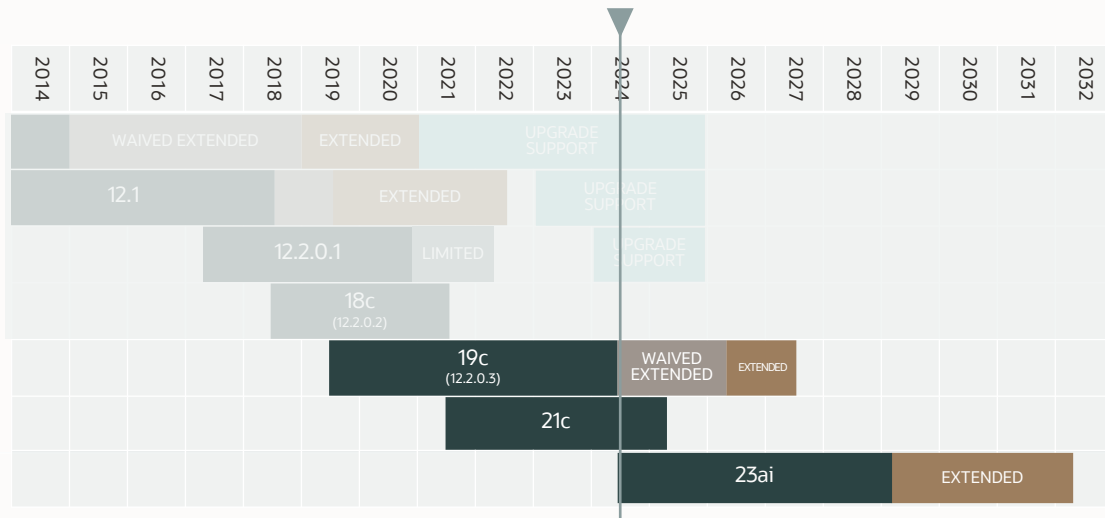


# Lifetime Support Policy





# 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

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Upgrade possible only from:

- Oracle Database 19c
- Oracle Database 21c



# Database and Grid Infrastructure Patching

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# Patching Best Practices

## Installation

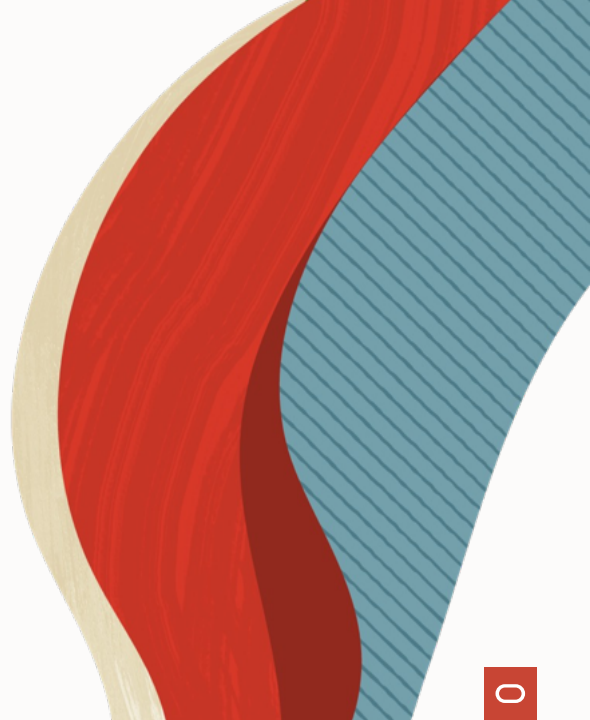
Basics

Methods

Grid Infrastructure

Datapatch

AutoUpgrade







You always start with  
Oracle Database base release

- Oracle Database 19.3.0



# 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  (98)       

**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

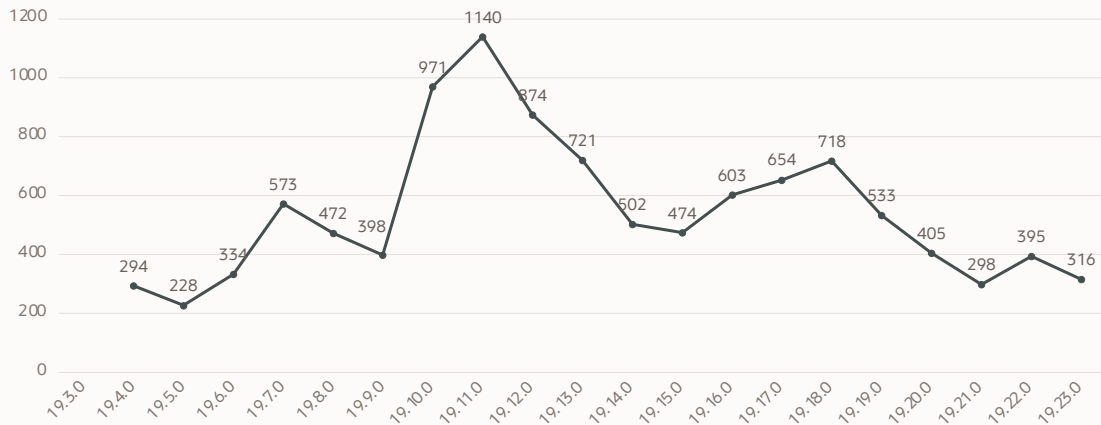
☐ Monthly Recommended Patches (MRPs)

**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

- Almost 11k fixes with 19.23.0
- Almost 300 security fixes



# Apply the Most Important Patches

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

## Recommended Patches for 19.22 DB Home

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

Bug	Fixed in RU	Fixed in MRP	Description	Patches	RAC Rolling Installable	Database Online Installable	Added
<a href="#">36273767</a> (replaces <a href="#">35733946</a> )			ORA-1578: oracle data block corrupted on tempfile even after 35904282, 35733946	<a href="#">[list: patches]</a>	YES	YES	30-APR-2024
<a href="#">35286895</a>	19.23		[KPD] Switchover/Failover Failing for Backup-Based Cadg : ORA-1113: File 3013 Needs Media Recovery	<a href="#">[list: patches]</a>	YES	YES	29-APR-2024
<a href="#">36480774</a>			RECOVERY] Slow Opening of database in RAC database for other instance	<a href="#">[list: patches]</a>	YES	YES	27-APR-2024
<a href="#">36366069</a>	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	<a href="#">[list: patches]</a>	YES	YES	28-MAR-2024
<a href="#">35998116</a> (replaces <a href="#">35037877</a> )	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	<a href="#">[list: patches]</a>	YES	YES	27-MAR-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	19.232.0
21c	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	21.19.0					
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





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

- Delivered as a merge patch





An MRP **does not** change  
the release number

- Like `v$instance.version_full`





MRPs are **cumulative**  
but only within one MRP line

- Example: 19.21.0 MRP6 contains all previous MRPs done for Oracle 19.21.0





MRPs are **Linux** only



# Monthly Recommended Patches

[Introducing Monthly Recommended Patches \(MRPs\) and FAQ \(Doc ID 2898740.1\)](#)

[Patching News: RURs are gone – long live MRPs \(Blog Post\)](#)

[Oracle Database 19c Important Recommended One-off Patches \(Doc ID 555.1\)](#)

[Oracle Database Patch Maintenance](#)





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

---



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

To Bottom

Visibility: EXTERNAL

(7)

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`



# Installation Tip

/home/oracle/stage

└─ DPBP

| └─ 35261302

| └─ PatchSearch.xml

└─ MRP

| └─ 35333937

| | └─ 34340632

| | └─ 35012562

| | └─ 35037877

| | └─ 35116995

| | └─ 35225526

| └─ PatchSearch.xml

└─ OJVM

| └─ 35050341

| └─ PatchSearch.xml

└─ RU

| └─ 35042068

| └─ PatchSearch.xml

## ONE SINGLE COMMAND

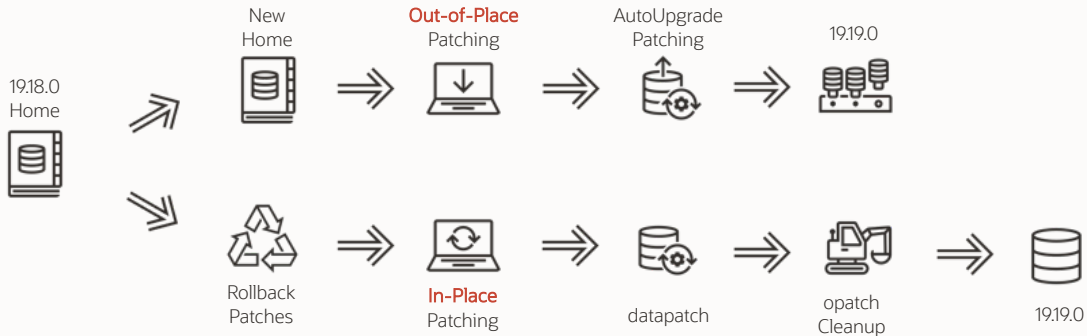
```
./runInstaller  
-applyRU /home/oracle/stage/RU/35042068  
-applyOneOffs ...
```



# Exercise Patching?

Use our brand new **Patch Me If You Can** LiveLabs

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





# Patching Best Practices

Installation

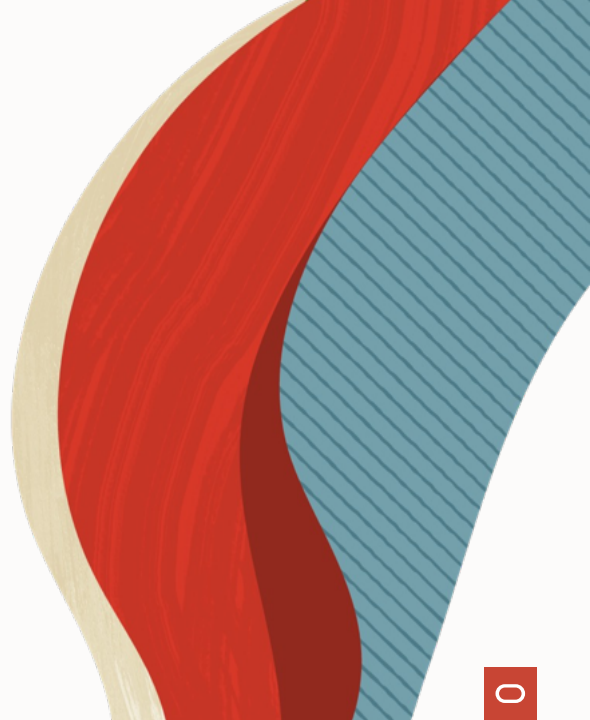
**Basics**

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/timzone\_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: FAO on Queryable Patch Inventory \(Doc ID 1530108.1\)](#)

## In the database / PDB?

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



# Patching Best Practices

Installation

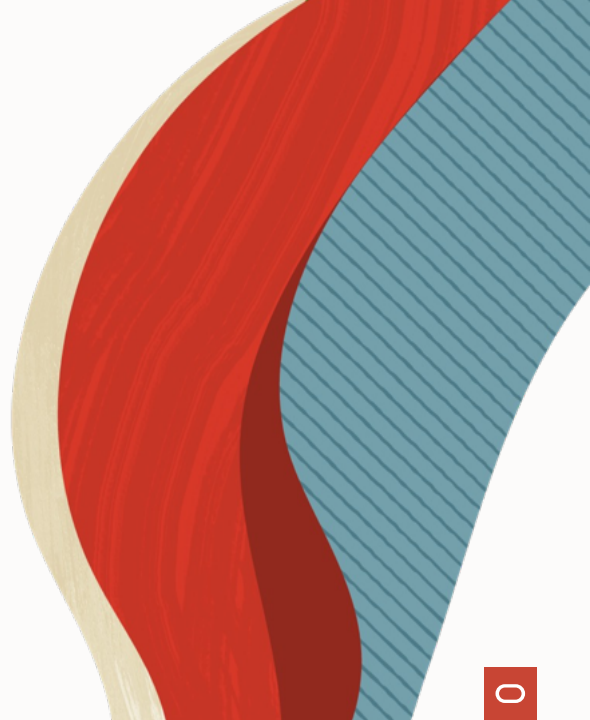
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**Methods**

Grid Infrastructure

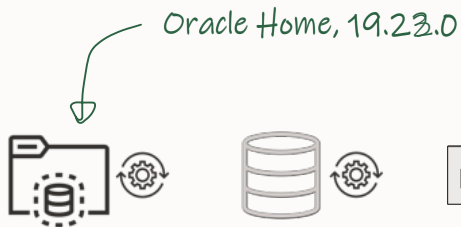
Datapatch

AutoUpgrade





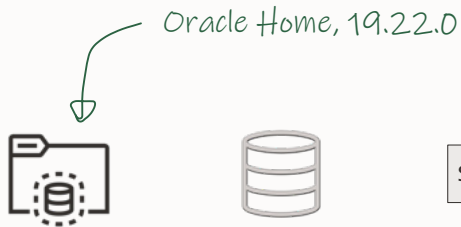
# In-Place Patching



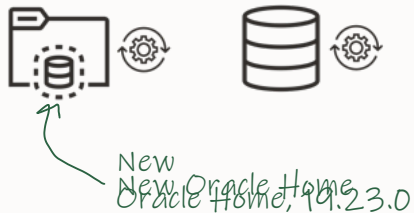
```
[oracle]$ $ORACLE_HOME/OPatch/datapatch -verbose
```



# Out-of-Place Patching



```
SQL> SHUTDOWN IMMEDIATE
```



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





Tim Hall 🇺🇸 +00 📱

@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.

In-Place

55.4%

Out-Of-Place

44.6%





## 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 \(Doc ID 1265700.1\)](#)



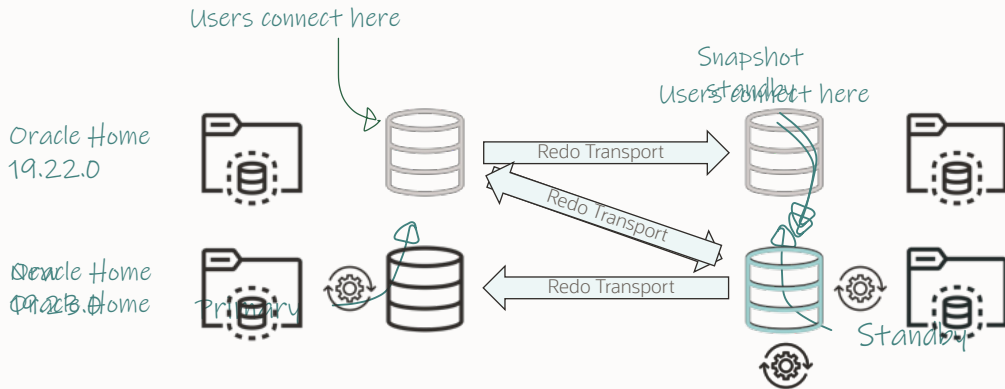


## Safely test and verify patches with Standby-First Patch Apply

- [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





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

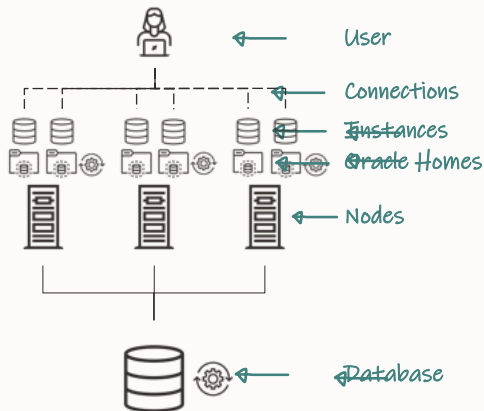




Avoid database downtime with  
RAC Rolling Patch Apply



# 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

Installation

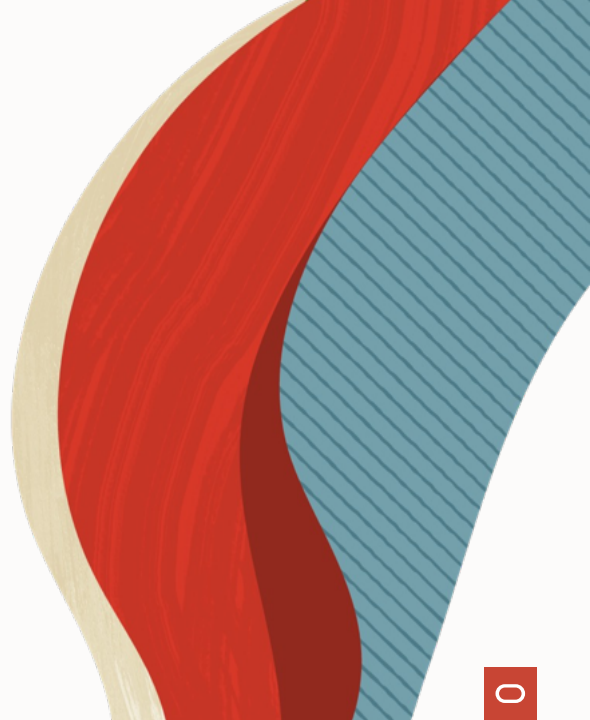
Basics

Methods

**Grid Infrastructure**

Datapatch

AutoUpgrade





# 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 gridSetup





## Use Out-Of-Place Patching

- Minimize downtime
- Minimize risk during outage
- Easier rollback





23ai GI home disk space  
**greatly** reduced to 3 GB

- 12 GB in 19c



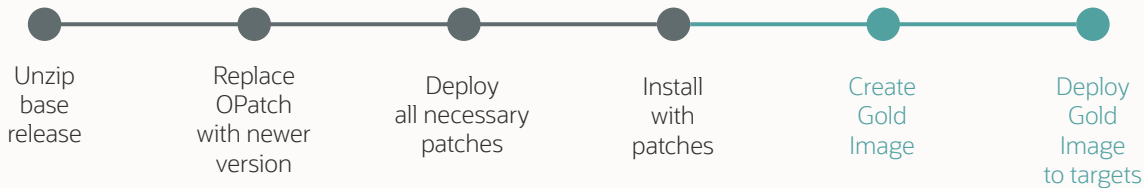


## Use golden images

- [Blog post](#)



# Golden Images





--Unzip base release and update OPatch

```
unzip -oq LINUX.X64_193000_grid_home.zip
```

```
mv OPatch OPatch_old
```

```
unzip p6880880...zip
```



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

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



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

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



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

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



# Demo

Install GI home  
Apply Release Update  
Create golden image

Watch on [YouTube](#)





Works for database homes as well

- Use **runInstaller** instead





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

---



# Patching GI and DB Homes Together?

Option 1

## TOGETHER

One maintenance window

Longer, single patching window

Several changes

Option 2

## SEPARATELY

Two maintenance windows

Shorter window, but longer overall patching

One change at a time





## Keep GI and DB patch levels in synch

- This is what we test and run in our Cloud





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

- GI 19.20.0 and DB 19.23.0
- Node 1 with GI 19.23.0, node 2 with GI 19.22.0
- Patching node 1 on Monday, node 2 on Tuesday ...
- Mix of GI and DB versions on various nodes





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

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

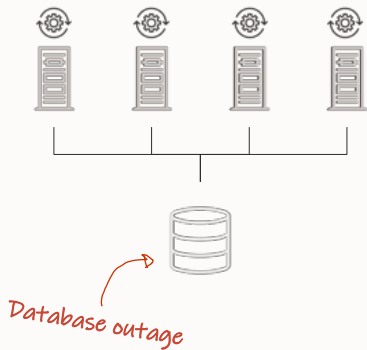




The following patching concepts  
apply to Oracle Database patching as well



# Grid Infrastructure Patching Concepts



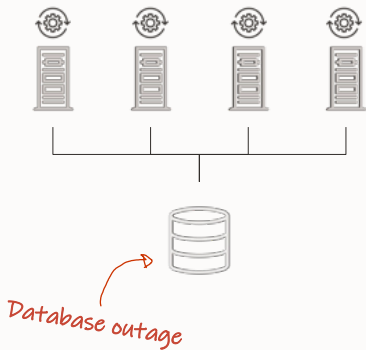
## ALL NODE

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

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



# Grid Infrastructure Patching Concepts



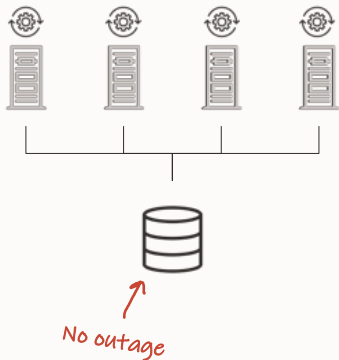
## MINIMUM DOWNTIME

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

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



# Grid Infrastructure Patching Concepts



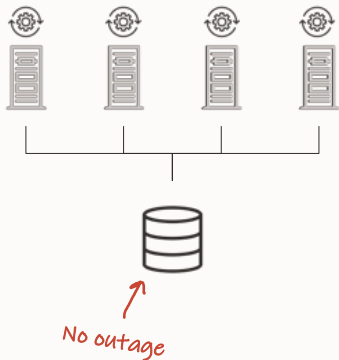
## ROLLING

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

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



# Grid Infrastructure Patching Concepts



## ROLLING IN GROUPS

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

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



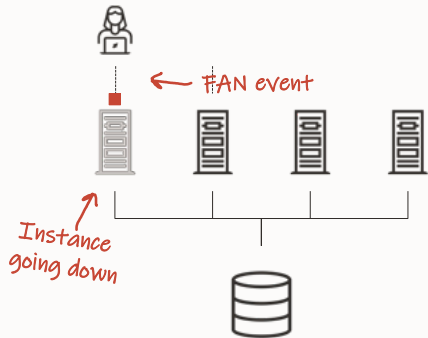


## Rolling patching requires efficient draining

- 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





## Comply with Maximum Availability Architecture (MAA) principles

- [Continuous Availability - MAA Checklist for Applications for the Oracle Database](#)



# Patching Best Practices

Installation

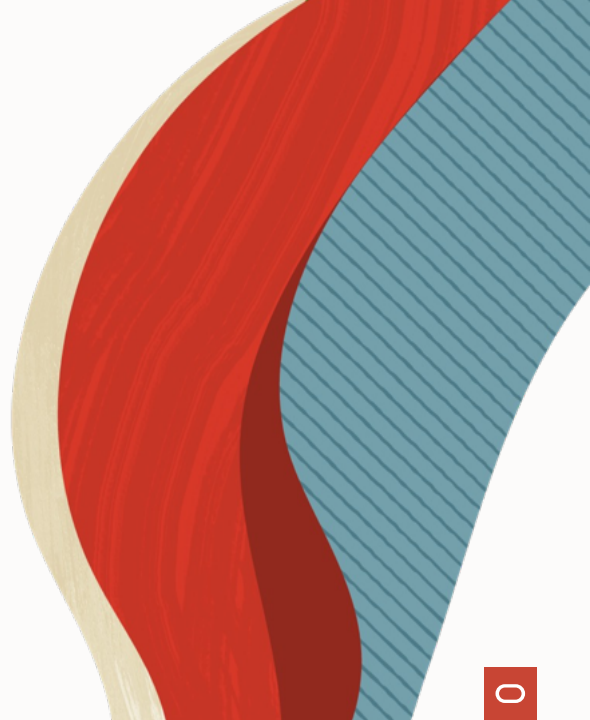
Basics

Methods

Grid Infrastructure

**Datapatch**

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 \(Doc ID 2680521.1\)](#)





## Patch multiple databases simultaneously by starting multiple instances of Datapatch

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





## Analyze the database for patching readiness using Datapatch Sanity Checks

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



```
$ ./datapatch -sanity_checks
```

```
...
```

```
Check: DB Components status - OK
```

```
Check: PDB Violations - OK
```

```
Check: System invalid objects - OK
```

```
Check: Tablespace Status - OK
```

```
Check: Backup jobs - OK
```

```
Check: Temp Datafile exists - OK
```

```
Check: Datapump running - OK
```

```
Check: Container status - OK
```

```
Check: Encryption wallet - OK
```

```
Check: Dictionary statistics gathering - OK
```

```
Check: Scheduled Jobs - NOT OK (WARNING)
```

```
Message: There are current running or scheduled jobs set to run on the next hour.  
Scheduled jobs may have an impact when run during patching.
```

```
:
```

```
JOB_NAME,NEXT_RUN_DATE,SCHEMA_NAME,STATE
```

```
CLEANUP_TRANSIENT_PKG,23-MAY-23 11.08.53.000000 AM +01:00,APPUSER,SCHEDULED
```

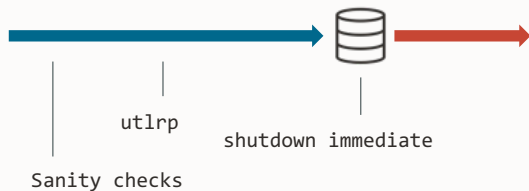




Recompile invalid objects  
before invoking **datapatch**



# Patching Timeline





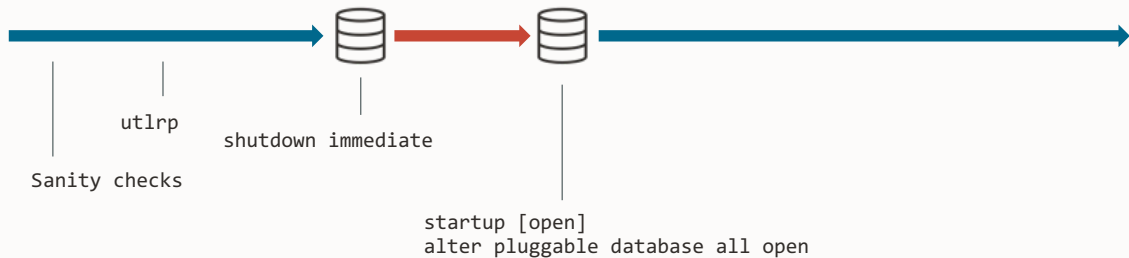


The database must be open  
Only open PDBs are patched

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



# Patching Timeline





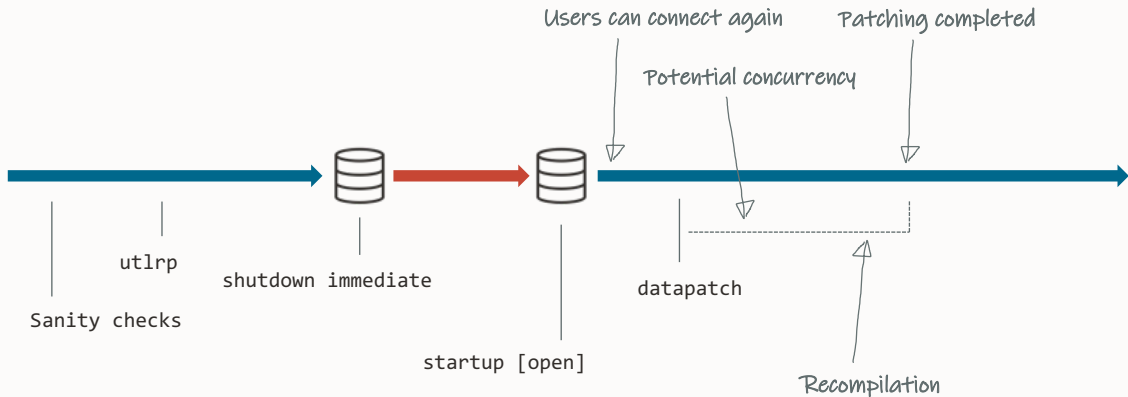


You can run **datapatch** while users are connected to the database

- Details in [blog post](#)

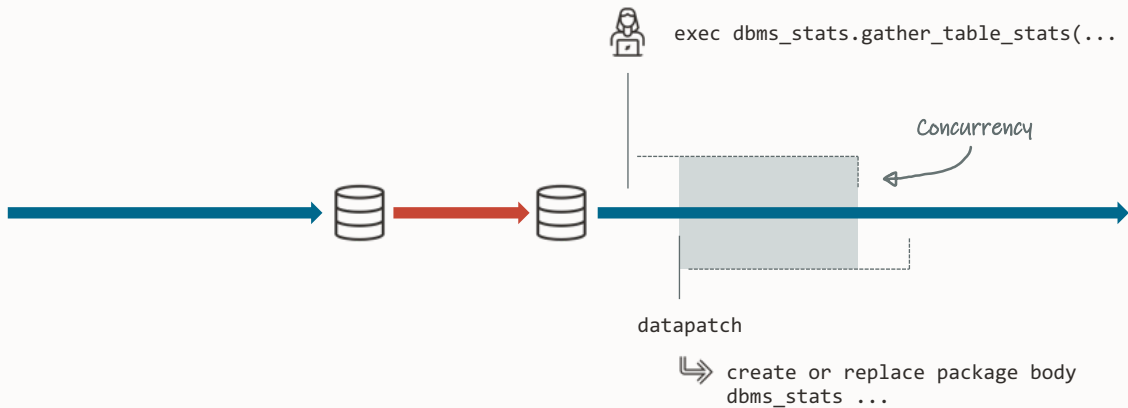


# Patching Timeline





# Patching Timeline



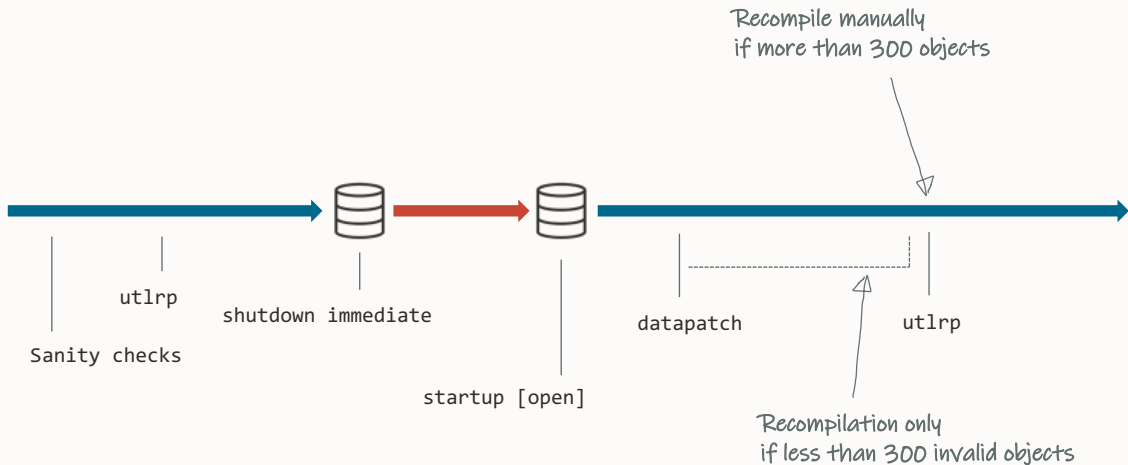


# Concurrency

- 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





# Recompilation

Datapatch recompiles objects **invalidated during patching**

If more than 300 objects are invalidated **no recompilation takes places**

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

Adjust the threshold

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

Consider recompiling invalid objects after patching



```
$ ./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`



# Patching Best Practices

Installation

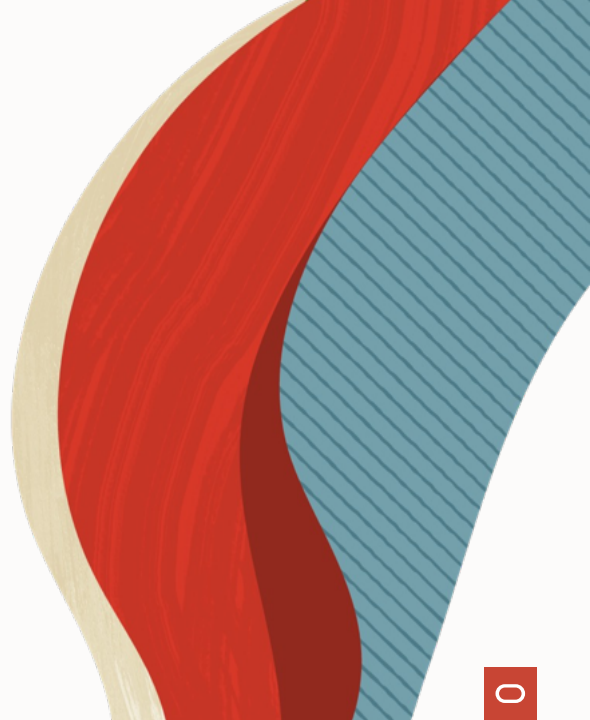
Basics

Methods

Grid Infrastructure

Datapatch

**AutoUpgrade**





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

---

AutoUpgrade functionality extended to patching



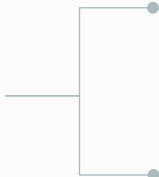
```
$ cat DB19.cfg
```

```
patch1.source_home=/u01/app/oracle/product/19/dbhome_19_22_0  
patch1.target_home=/u01/app/oracle/product/19/dbhome_19_23_0  
patch1.sid=DB19
```

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



# Fleet Patching



## AutoUpgrade

Automate your patching process and benefit from the familiar AutoUpgrade



## Fleet Patching and Provisioning

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



# Break

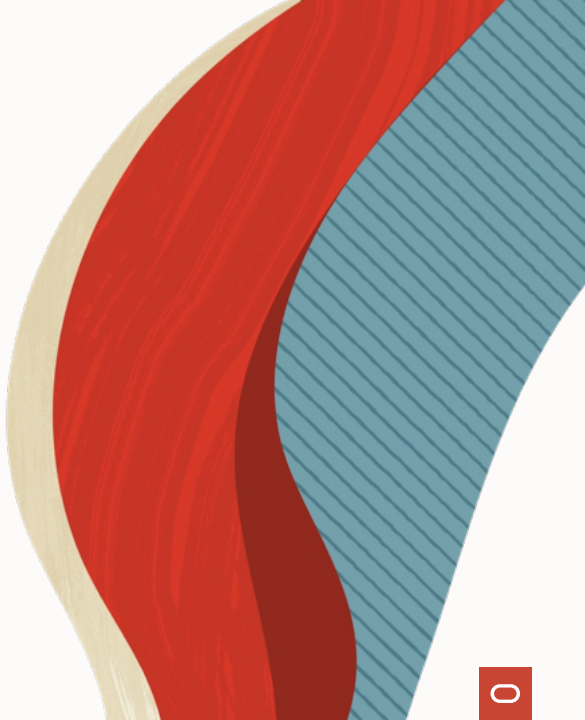
We start again at 11:15



## 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



--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;
```





## 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						
	23c	21c	19c	18c	12.2.0	12.1.0	11.2.0
23c#11	Yes	Yes	Yes	No	No	No	No
21c	Yes	Yes	Yes	Was	Was	Yes#12	No
19c	Yes	Yes	Yes	Was	Was	Yes#12	Yes#9
18c	No	Was	Was	Was	Was	Was	Was
12.2.0	No	Was	Was	Was	Was	Was	Was
12.1.0	No	Yes#12	Yes#12	Was	Was	Yes#12	Yes#12
11.2.0	No	No	Yes#9	Was	Was	Yes#12	Yes#9

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



--List current connections and their driver details

--Join to gv\$session for more details.

--<https://dothdatabase.com/2024/03/19/are-your-oracle-database-clients-ready-for-the-next-database-upgrade/>

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



# JDBC Interoperability

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

For up-to-date information:

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





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
```



```

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

```

```

dbms_dictionary_check on 05-SEP-2023 09:41:30
-----
Catalog Version 19.0.0.0.0 (1900000000)
db_name: DB19
Is CDB?: NO
Trace File: /opt/oracle/diag/rdbms/db19/DB19/trace/DB19_ora_25104_DICTCHECK.trc

```

Procedure Name	Catalog Version	Fixed Vs Release	Timestamp	Result
.. OIDOnObjCol	1900000000	<= *All Rel*	09/05 09:41:30	PASS
.. LocalInObj	1900000000	<= *All Rel*	09/05 09:41:30	PASS
.. SourceNotInObj	1900000000	<= *All Rel*	09/05 09:41:30	PASS
.. OversizedFiles	1900000000	<= *All Rel*	09/05 09:41:30	PASS
.. PoorDefaultStorage	1900000000	<= *All Rel*	09/05 09:41:30	PASS
.. PoorStorage	1900000000	<= *All Rel*	09/05 09:41:30	PASS
*** 2023-09-05T09:41:30.934258+00:00				
.. TabPartCountMismatch	1900000000	<= *All Rel*	09/05 09:41:30	PASS
.. TabComPartObj	1900000000	<= *All Rel*	09/05 09:41:30	PASS
.. Mview	1900000000	<= *All Rel*	09/05 09:41:30	PASS
.. ValidDir	1900000000	<= *All Rel*	09/05 09:41:30	PASS
.. DuplicateDataobj	1900000000	<= *All Rel*	09/05 09:41:30	PASS
.. ObjSyn	1900000000	<= *All Rel*	09/05 09:41:31	PASS
.. ObjSeq	1900000000	<= *All Rel*	09/05 09:41:31	PASS





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;
```

```
/
```



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

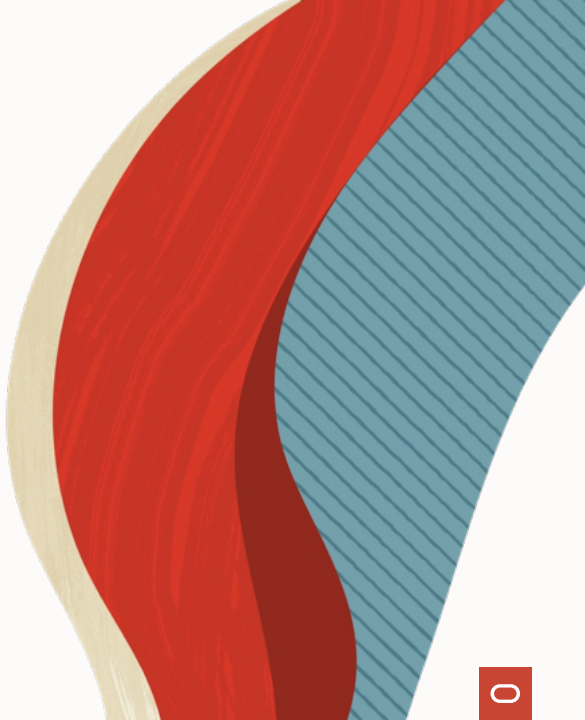
*"After gathering dictionary stats, our Data Pump export went **from 46 to 8 minutes**"*



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



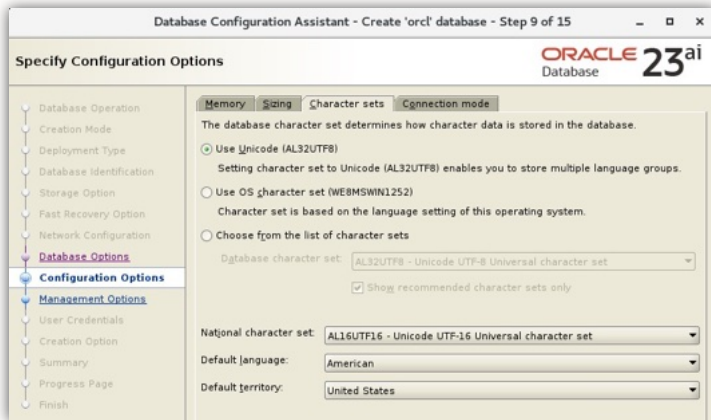
# Create Container Database

## 1 Character set

- Always choose AL32UTF8
- Allows PDBs with any character set

## 2 Components

## 3 COMPATIBLE





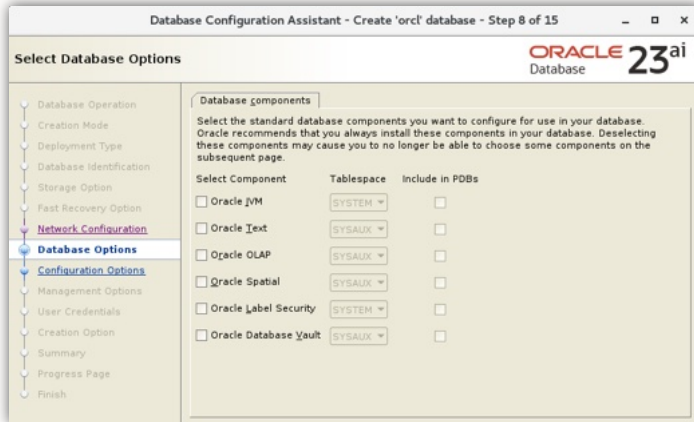
# Create Container Database

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



--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/](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 24.3.240419
```

```
build.date 2024/04/19 15:45:58 -0400
```

```
build.hash a1ea950cc
```

```
build.hash_date 2024/04/19 15:05:29 -0400
```

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

```
build.type production
```

```
build.label (HEAD, origin/devel)
```



# Flow

1

Plug in

2

Upgrade

3

Convert



23<sup>ai</sup>

*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
```

```
-----
```

```
23.4.0.24.05
```



# 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



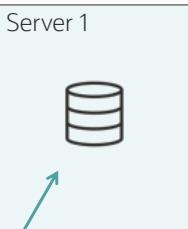
## CONVERT

To become a proper PDB, it must be converted

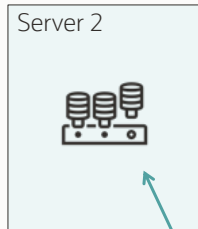


# Refreshable Clone

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



Source  
non-CDB



Target  
CDB



# Refreshable Clone

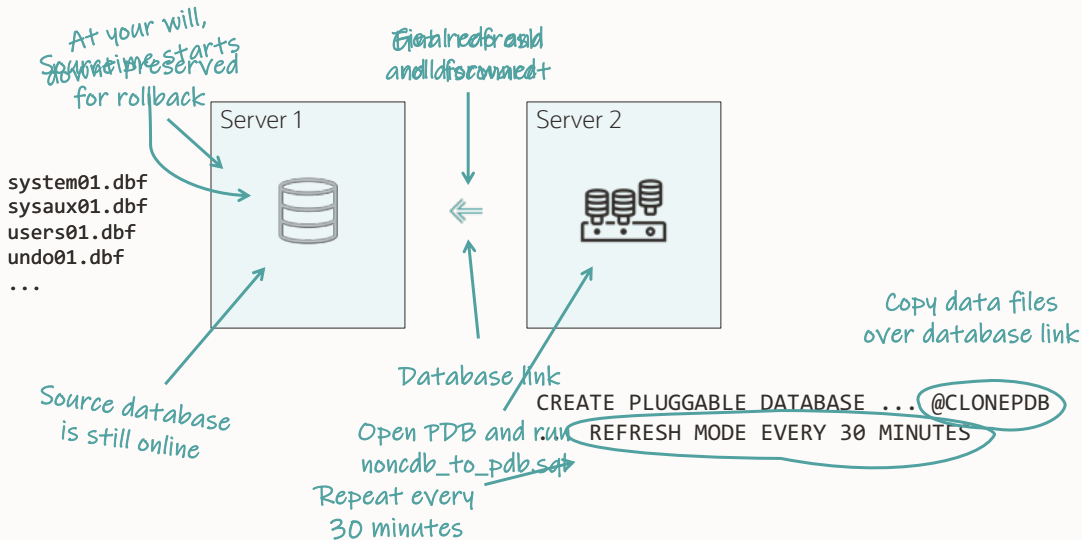
system01.dbf  
sysaux01.dbf  
users01.dbf  
undo01.dbf  
...



← 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=18/05/2024 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=18/05/2024 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

**1.**

PDB  
is created

**2.**

Data files  
are copied

**3.**

Redo is  
applied

**4.**

Final refresh

**5.**

Disconnect  
and convert

autoupgrade.jar ... -mode deploy

upg1.start\_time=18/05/2024 02:00:00





Works for unplug-plug upgrades as well





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

Project

Constraints

**Preparation**

Migration

Success?

Remarks

Cloning user

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

Permissions

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

Database link

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



# Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

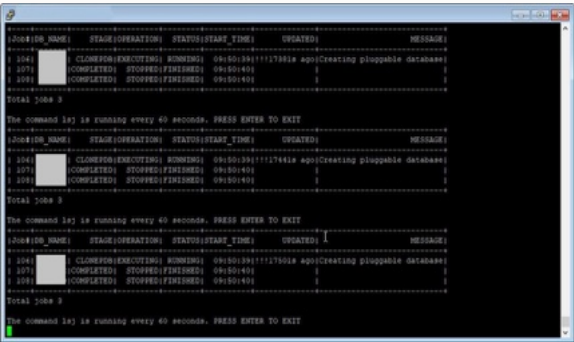
Preparation

Migration

Success?

Remarks

Migration in progress



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





# Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

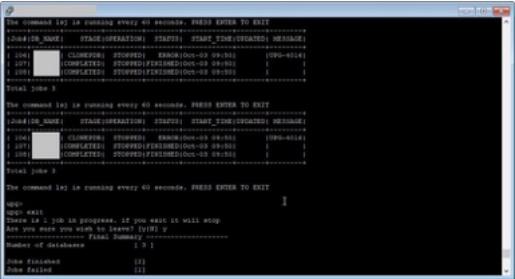
Preparation

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

Project

Constraints

Preparation

Migration

**Success**

Remarks

First non-CDBs migrated successfully

- Project is ongoing



# Customer Case | Zürcher Kantonalbank

Customer

Project

Constraints

Preparation

Migration

Success?

**Remarks**

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

- Solution: restore archive logs 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

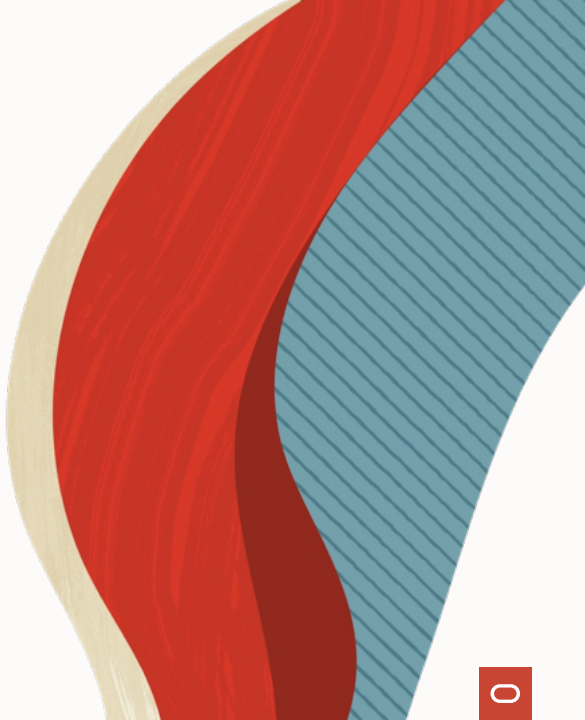




Before upgrade

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

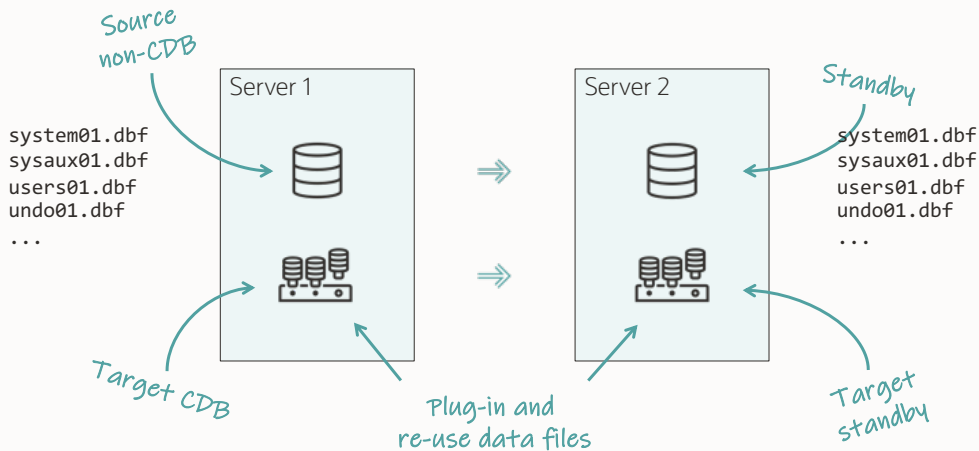
*Default*

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



# Data Guard | Enabled Recovery

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

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

**In this Document**

- [Goal](#)
- [Solution](#)
- [Prerequisites](#)
- [Steps](#)
- [Resolving Errors](#)
- [References](#)

**APPLIES TO:**

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

**GOAL**

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

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

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

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





# 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

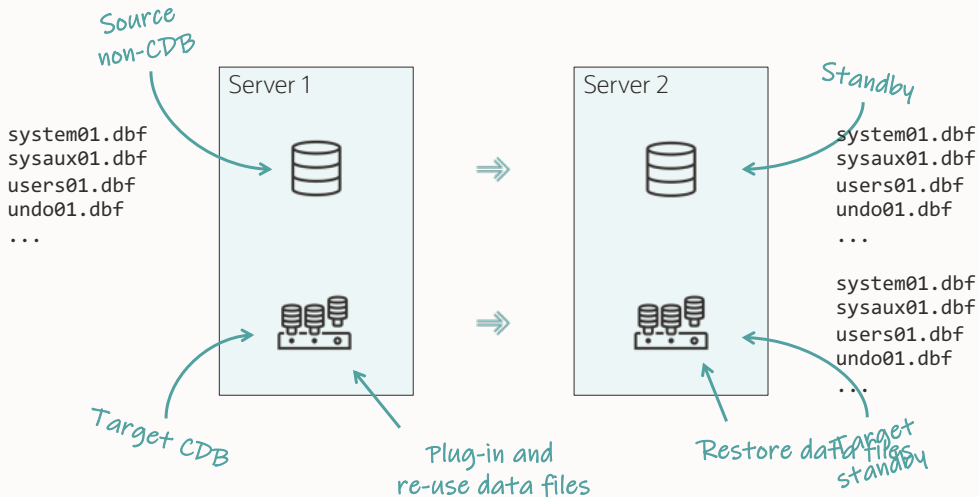
Standby ignores data files

MRP skips redo

**PDB protected after restore**



# Deferred Recovery





# Deferred Recovery



Source  
Non-CDB



Target  
Primary

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



Target  
Standby



# Deferred Recovery



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



PDB created  
Data files missing



# Deferred Recovery



```
SQL> show pdbs
```

CON_NAME	OPEN	MODE
PDB1	READ	WRITE

```
SQL> show pdbs
```

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



# Data Guard | Deferred Recovery

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

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

### In this Document

[Goal](#)

[Solution](#)

[Creating a PDB with the STANDBYS=NONE clause in a Data Guard configuration with 1 physical standby](#)

[Showing how the cloned PDB will appear in certain tables and views on the physical standby](#)

[Performing a Data Guard Role Transition with a PDB in DISABLED RECOVERY](#)

[The zero downtime instantiation process using RMAN for copying the files from the primary to standby](#)

[Steps required for enabling recovery on the PDB after the files have been copied](#)

[Steps to DISABLE RECOVERY of a Pluggable Database](#)

[Conclusion](#)

[References](#)

### APPLIES TO:

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



# Data Guard | Additional Information

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

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

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





## Don't jeopardize your Data Guard

- Test the procedure and verify your environment



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

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



```
--Default value is for CDBs with many PDBs  
--Other places, it leads to concurrency issues  
--Reset back to 12.1 default as described in MOS 2431353.1  
  
alter system set "_cursor_obsolete_threshold"=1024  
comment="Advice from Daniel MOS doc 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





## You can also migrate with Data Pump or Transportable Tablespaces

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



# Data Pump Top Tips

The background of the slide features a pattern of light gray concentric circles. In the top right corner, there is a blue circle with horizontal lines and a dark gray circle. In the bottom right corner, there is a red circle with a grid pattern and a green circle.

---

Supercharge data loading/unloading





Always use  
Data Pump Bundle Patch







## Almost 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 convert to  
SecureFile LOBs





--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`





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

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





Boost performance even more  
with partitioning





## Do you still have BasicFile LOBs?

- Use [DIY parallelism](#) during export
- Be sure to convert to SecureFile LOB on import





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



--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

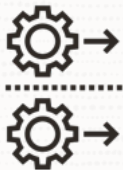
**Total 8h 46m**

Export parallel 16 1h 8m

Import parallel 16 1h 23m


**Total 2h 31m**






Set parallel to 2 x physical cores  
or number of OCPUs





Always add diagnostics  
to your log file






--Add more diagnostics information to your log file


```
expdp ... metrics=yes logtime=all
```

```
impdp ... metrics=yes logtime=all
```





Specify a job name  
and attach to the job





```
$ expdp system ... job_name=APPS_STUFF
```

```
Export: Release 23.0.0.0.0 - Production on Fri May 3 14:56:06 2024  
Version 23.4.0.24.05
```

```
Copyright (c) 1982, 2024, Oracle and/or its affiliates. All rights reserved.  
Connected to: Oracle Database 23ai EE High Perf Release 23.0.0.0.0 - Production  
03-MAY-24 14:56:13.420: Starting "SYSTEM"."APPS_STUFF"  
03-MAY-24 14:56:13.799: W-1 Startup on instance 1 took 0 seconds  
03-MAY-24 14:56:30.550: W-2 Startup on instance 1 took 0 seconds  
03-MAY-24 14:56:38.519: W-3 Startup on instance 1 took 0 seconds  
03-MAY-24 14:56:38.529: W-4 Startup on instance 1 took 0 seconds
```



```
$ expdp ... attach=SYSTEM.APPS_STUFF
```

```
Export> status
```

```
...
```

```
Worker 1 Status:
```

```
Instance ID: 1
```

```
Instance name: CDB23
```

```
Host name: dbs23
```

```
Object start time: Friday, 3 May, 2024 15:22:30
```

```
Object status at: Friday, 3 May, 2024 15:30:35
```

```
Process Name: DW00
```

```
State: EXECUTING
```

```
Object Schema: APPS
```

```
Object Name: AP_INVOICE_DISTRIBUTIONS_PKG
```

```
Object Type: DATABASE_EXPORT/SCHEMA/PACKAGE_BODIES/PACKAGE/PACKAGE_BODY
```

```
Completed Objects: 1,938
```

```
Worker Parallelism: 1
```





No, it's not!  
Data Pump is hanging  
Let's trace it...







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"*



```
-- Change AWR snap interval to 15 minutes and create snapshot
exec dbms_workload_repository.modify_snapshot_settings(null, 15);
exec dbms_workload_repository.create_snapshot;

-- Optionally, enable SQL trace for Data Pump processes or specific SQL ID
alter system set events 'sql_trace {process: pname = dw | process: pname = dm} level=8';
alter system set events 'sql_trace[SQL: 03g1bnw08m4ds ]';

-- Run Data Pump job with trace (Doc ID 286496.1)
expdp ... metrics=yes logtime=all trace=1FF0300
impdp ... metrics=yes logtime =all trace=1FF0300

-- Create AWR snapshot and produce AWR report
exec dbms_workload_repository.modify_snapshot_settings(null, <original-value>);
exec dbms_workload_repository.create_snapshot;
@?/rdbms/admin/awrrpt
```



```
-- Change AWR snap interval to 15 minutes and create snapshot
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exec dbms_workload_repository.create_snapshot;

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alter system set events 'sql_trace[SQL: 03g1bnw08m4ds ]';

-- Run Data Pump job with trace (Doc ID 286496.1)
expdp ... metrics=yes logtime =all trace=1FF0300
impdp ... metrics=yes logtime =all trace=1FF0300

-- Create AWR snapshot and produce AWR report
exec dbms_workload_repository.modify_snapshot_settings(null, <original-value>);
exec dbms_workload_repository.create_snapshot;
@?/rdbms/admin/awrrpt
```



# Data Pump Trace

## Collect:

- Data Pump log file
- AWR report
- Data Pump trace files
  - Stored in the database trace directory
  - Control process file name: **\*dm\***
  - Worker process file names: **\*dw\***





## How to trace Data Pump jobs

- MOS Doc ID [286496.1](#)





Data Pump never grant  
on SYS objects







Manually grant privileges  
on SYS objects after import





## Speed up imports by using NOVALIDATE constraints





--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 using NOVALIDATE clause

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



# NOVALIDATE Constraints

- Potentially a huge time saver
- Validate constraints after import, or even after go-live

```
alter table sales modify constraint ... validate;
```


- Still requires a full scan of the table
- But no table lock!




# NOVALIDATE Constraints

- Use with care if you are transforming data on import
- Requires 19.23.0 Data Pump Bundle Patch
- Data Pump always validates certain constraints
- NOVALIDATE constraints prevent the optimizer from certain query rewrites
  - Check [QUERY\\_REWRITE\\_INTEGRITY](#)





We think you'll  
love this one







Use index size to determine  
parallel degree on index creation



# Index Creation

## Before 12.1

1 worker,

```
CREATE INDEX .... PARALLEL 16
```

*Really good for few big indexes*

## From 12.1

16 workers,

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

*Really good for many small indexes*

## From 23

1 worker,

```
CREATE INDEX .... PARALLEL 8
```

1 worker,

```
CREATE INDEX .... PARALLEL 4
```

1 worker,

```
CREATE INDEX .... PARALLEL 2
```

2 workers,

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

*The best of both worlds*



# Lunch Break

We start again at 13:30



# Cloud Migration Advisor

---

Your ultimate migration guidance tool, not only for cloud migrations



# Migration Challenges

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




36 migration methods.


Which one is the **best**?





# Cloud Migration Advisor


 Oracle Cloud Migration Advisor


rodrigo.r.jorge@oracle.com


 Home


 Guided Mode


 Create Project


 My Available Projects

 Download Collectors

 File Exchange with Custom...

 REST Services

 Help



## Oracle Cloud Migration Advisor

### Welcome to the Cloud Migration Advisor (CMA)

Oracle Cloud Migration Advisor brings you the expert technical knowledge of Oracle Database upgrade and migration development teams, combined with more than a century of combined real-world experience with customer migrations, to give your customer the **best possible migration advice**.

With [Guided Mode](#), CMA will quickly tell you


- Which databases can be **most easily migrated** to Oracle Autonomous Database, or
- What is the **best migration method** to move chosen databases to a desired Oracle Cloud platform?

For more options, you can

- Create and configure migration scenarios using [Create Project](#), or
- Access your existing migration projects and scenarios with [My Available Projects](#).

Now it is time to start - let's move to the Oracle Cloud!

[Guided Mode](#) [My Available Projects](#) [Create New Project](#)



CMA - Oracle Cloud Migration Advisor

Watch later Share

www.oracle.com/goto/upgrade

Watch on YouTube





## Step 1

Customer collects estate  
information



# Cloud Migration Advisor

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



Customer  
Fleet



Download  
Extractor

- CPAT
- SQL Extractor
- OEM Extractor
- Excel sheet



Collect  
Information

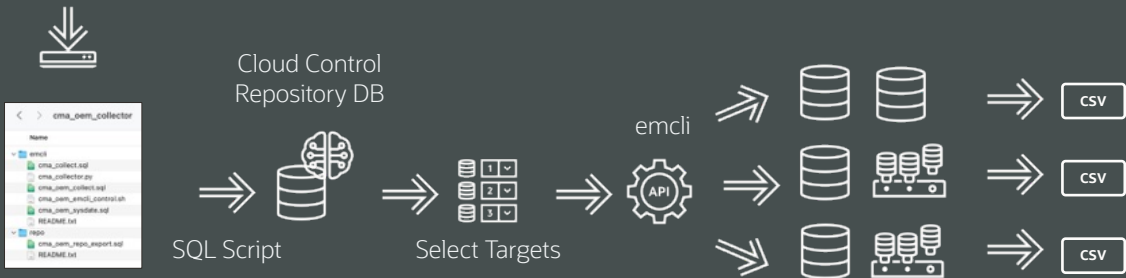


Option 3:  
Install CMA in  
your VBox  
Vagrant Build



# Cloud Migration Advisor

## OEM Collector





# Cloud Migration Advisor

## CPAT – Cloud Premigration Advisor Tool



**MOS Note: 2758371.1**

```
premigration.sh  
premigration.cmd  
bin  
README.txt  
misc  
lib  
p32613591_112048_Generic.zip
```



Shell Script



JSON



JSON



JSON

Discovers information from non-CDB  
or PDB individually on a per-DB basis



Start here:

[www.oracle.com/goto/upgrade](http://www.oracle.com/goto/upgrade)



# Cloud Migration Advisor

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

AutoUpgrade tool for  
Oracle Database

Cloud Migration Advisor  
(CMA)

Database migration  
resources

Load data into Oracle  
Database

## Cloud Migration Advisor

The Oracle Cloud Migration Advisor (CMA) is the best tool for advising you about your migration to Oracle Autonomous Database, Oracle Exadata Cloud at Customer, Oracle Exadata Cloud Service, and other Oracle Cloud Infrastructure (OCI) Database services—and more.

CMA collects database metadata details about your current Oracle Database environment, including patch levels. (No business data or customer information is collected.) CMA uses this database metadata to provide detailed technical advice about possible migration targets and methods.

Choose and download the most appropriate metadata collection method for your situation:

- Cloud Pre-Migration Advisor Tool (CPAT) (Use [Oracle SQLcl MIGRATEADVISOR Command](#), see [Jeff Smith's blog post](#) — or if you can't use SQLcl, [Download CPAT from My Oracle Support Note 2758371.1 — Documentation \(PDF\)](#))
- SQL CSV script ([Download — Documentation \(PDF\)](#))
- Oracle Enterprise Manager script ([Download — Documentation \(PDF\)](#))
- Spreadsheet ([Download — Documentation \(PDF\)](#))

The documentation for each method describes how to collect the metadata and share it with your Oracle advisor.





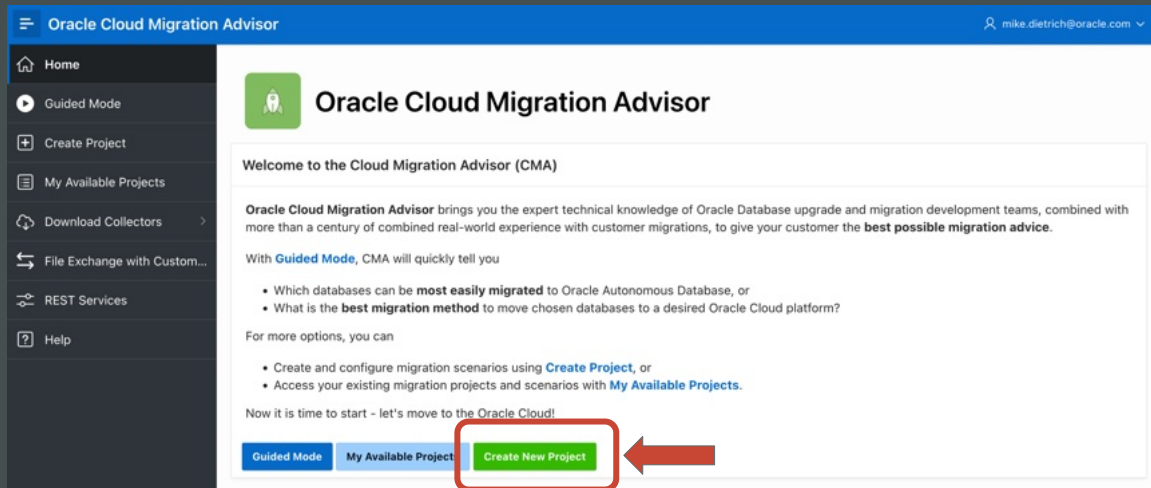
## Step 2

Load estate information into  
CMA



# Cloud Migration Advisor

## Create New Project



Oracle Cloud Migration Advisor

mike.dietrich@oracle.com

Home

Guided Mode

Create Project

My Available Projects

Download Collectors

File Exchange with Custom...

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Now it is time to start - let's move to the Oracle Cloud!

Guided Mode My Available Project **Create New Project**



# Cloud Migration Advisor

## Example

### Databases

Here you have the source databases for this project. Click on "Manage Databases" button to add, modify or edit databases in this list.

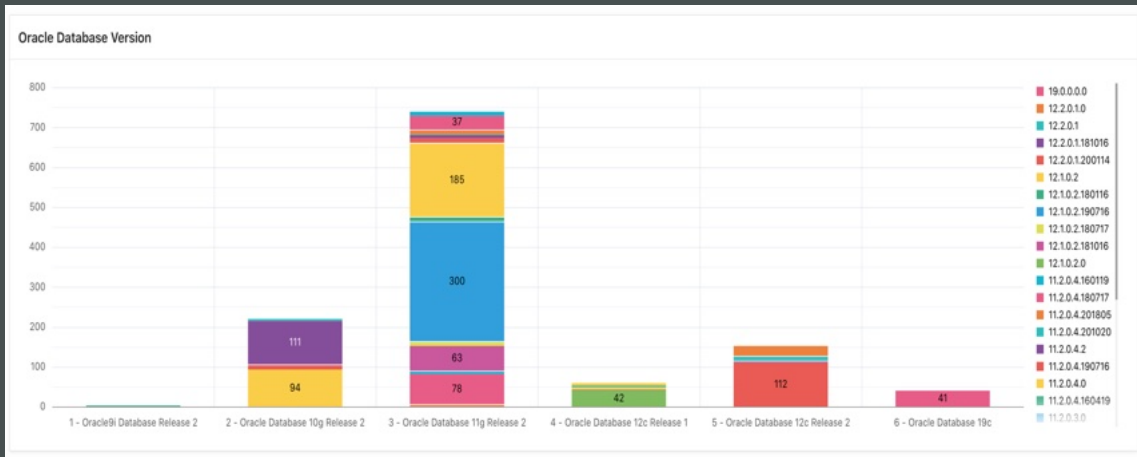
The *Upgrade* and *Accepted Downtime* columns can be used to add information about business requirements for each database.

<input type="checkbox"/>	Database Display Name	Database Version	Block Size	Platform Name	First Hostname	Instances	Upgrade	Accepted Downtime
<input type="checkbox"/>	DB12	12.2.0.1.0		Linux x86 64-bit	hol.localdomain	1		
<input type="checkbox"/>	FTEX	11.2.0.4.0		Linux x86 64-bit	hol.localdomain	1		
<input type="checkbox"/>	PDB1 (CDB2)	19.18.0.0.0		Linux x86 64-bit	hol.localdomain	1		
<input type="checkbox"/>	PDB2 (CDB3)	21.10.0.0.0		Linux x86 64-bit	hol.localdomain	1		
<input type="checkbox"/>	PDB3 (CDB1)	12.2.0.1.0		Linux x86 64-bit	hol.localdomain	1		
<input type="checkbox"/>	UP19	19.18.0.0.0		Linux x86 64-bit	hol.localdomain	1		
<input type="checkbox"/>	UPGR	11.2.0.4.0		Linux x86 64-bit	hol.localdomain	1		
<input type="checkbox"/>	V121	12.1.0.2.0		Linux x86 64-bit	hol.localdomain	1		

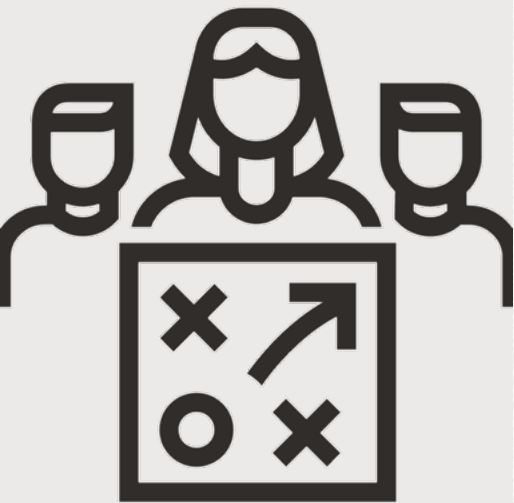


# Cloud Migration Advisor

## Example: Estate Overview







### Step 3

Add additional information and constraints



# Cloud Migration Advisor | Specify Additional Information

Databases						
Here you have the source databases for this project. Click on "Manage Databases" button to add, modify or edit databases in this list.						
The Upgrade and Accepted Downtime columns can be used to add information about business requirements for each database.						
<input type="text" value="Search: All Text Columns"/>	<input type="button" value="Go"/>	<input type="button" value="Actions"/>	<input type="button" value="Edit"/>	<input type="button" value="Save"/>	<input type="button" value="Delete Selected"/>	<input type="button" value="Reset Layout"/>
<input type="checkbox"/>	Database Display Name...	Database Version	Block Size	Platform Name	First Hostname	Instances
<input type="checkbox"/>	DB12	12.2.0.1.0		Linux x86 64-bit	hol.localdomain	1
<input type="checkbox"/>	FTEK	11.2.0.4.0		Linux x86 64-bit	hol.localdomain	1
<input type="checkbox"/>	PDB1 (CDB3)	19.18.0.0.0		Linux x86 64-bit	hol.localdomain	1
<input type="checkbox"/>	PDB2 (CDB3)	21.10.0.0.0		Linux x86 64-bit	hol.localdomain	1
<input type="checkbox"/>	PDB3 (CDB3)	12.2.0.1.0		Linux x86 64-bit	hol.localdomain	1
<input checked="" type="checkbox"/>	UP19	19.18.0.0.0		Linux x86 64-bit	hol.localdomain	1
<input type="checkbox"/>	UPGR	11.2.0.4.0		Linux x86 64-bit	hol.localdomain	1
<input type="checkbox"/>	V121	12.1.0.2.0		Linux x86 64-bit	hol.localdomain	1
1 rows selected						

Upgrade	Accepted Downtime
Yes (DB must be upgraded)	< 30min
No (DB can't be upgraded)	< 2d
	< 30min
Yes (DB must be upgraded)	< 30min
	< 1min
Yes (DB must be upgraded)	
Yes (DB must be upgraded)	



# Cloud Migration Advisor | Add New Target Server

**Target Servers**

Display Name  
Exadata Cloud at Customer No.1

Is Source Host?  
☐

Host Name  
ourexacc1

Operating System  
-

Database Edition  
Oracle Database Exadata Cloud Service

Cancel Create

- 
- ADWD - Autonomous Data Warehouse Dedicated
- ADWS - Autonomous Data Warehouse Serverless
- ATPD - Autonomous Transaction Processing Dedicated
- ATPS - Autonomous Transaction Processing Serverless
- ✓ ExaCC - Exadata Cloud@Customer
- ExaCS - Exadata Cloud Service
- Exadata On-premises
- Generic Server
- Oracle BaseDB System (VM, BM)





#### Step 4

Group the databases into scenarios and customize methods



# Cloud Migration Advisor | Scenarios

## Scenarios

1-Click Solution

To build a migration plan, the next step is to create a scenario where you will define the migration settings. Use the **"1-Click Solution"** or the **"1-Click Solution ADB"** buttons to let CMA automatically create one for you.

Q Search: All Text Columns Go Edit Save Reset Layout

Delete Selected

(Open)	Scenario Name	Assigned Databases
No data found		

## Scenarios

To build a migration plan, the next step is to create a scenario where you will define the migration settings. Use the **"1-Click Solution"** or the **"1-Click Solution ADB"** buttons to let CMA automatically create one for you.

Q Search: All Text Columns Go

Delete Selected

(Open)	Scenario Name
	Can't be upgraded
	Must be upgraded



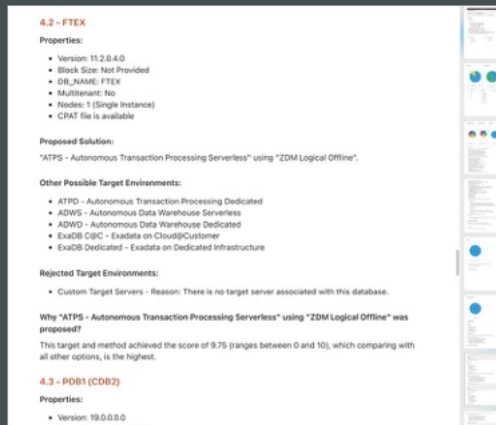


**Step 5**

Create solution



# Cloud Migration Advisor | Detailed Solution Report







**Anything else?**

Additional Features



# Cloud Migration Advisor | Guided Mode

## Guided Mode

✓

●

●

●

Introduction

Step 1

Step 2

Step 3

Selected Option

☒ What are the best candidates to move to ADB?

☐ I have my target defined. What is the best migration method?

<

Cancel

Next >



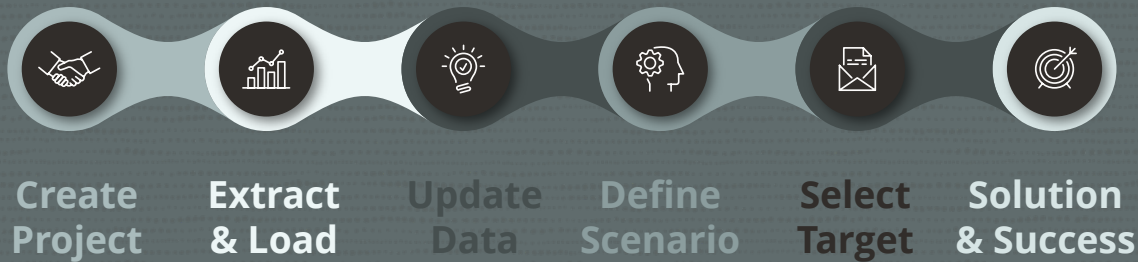
# Cloud Migration Advisor | How to get it?

## Downloadable version

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



# CMA | Workflow





# Performance Stability Prescription

---



A person is standing in the ocean, their legs partially submerged in the water. The sky is filled with large, dark, and dramatic clouds, with some light breaking through. The water is dark and has small waves. The overall mood is contemplative and powerful.

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 ocean waves are visible in the distance. The hammock is made of a dark, woven material and has some tassels hanging from it. The palm trees are silhouetted against the bright sky.

# 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

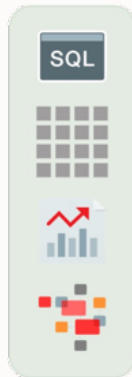
SQL statement

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

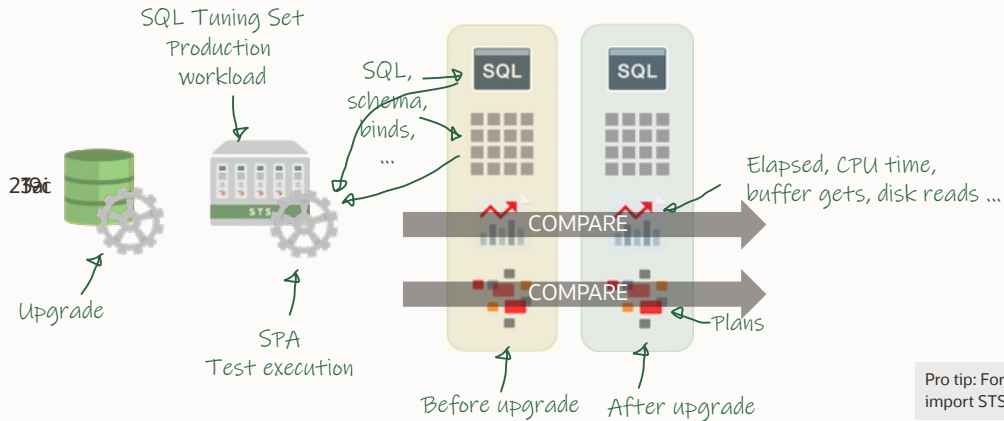
1st						2nd					
Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time	Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time
CPU time			68,289.05		43.73	db file sequential read	User I/O	22,193,998	114,919.21	5.18	23.17
db file sequential read	User I/O	6,686,953	37,737.81	5.64	24.17	enq: SS - contention	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	1,156.62	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	<a href="#">csv0xdm9c394t</a>	4.02%	3262	6149.0885959534	4208	31.57%	n
41	<a href="#">7m5h0wf6stq0q</a>	2.79%	21694	692.311883470084	490	29.22%	y
34	<a href="#">4wg725nwpxb1z</a>	2.3%	19715	692.202079634796	509	26.47%	y
40	<a href="#">7jyw5gy3d1t1b</a>	-1.43%	31816	12.0617299471964	83	-588.13%	n
36	<a href="#">5ps73nuy5f2vj</a>	1.06%	31819	61.1872151858952	9	85.29%	n
44	<a href="#">88fgqncchy6wg</a>	-.41%	325424	6.00316202861498	8	-33.26%	n
57	<a href="#">g5u7xuchhfu62</a>	.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		
↓	3fv28gfuSy0aq	-0.050	26,504	29,573	-11.580	Y
↓	czzzubf8fjz95	-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		
↓	3fv28qfu9v0ag	-0.050	26,504	29,573	-11.580	Y
↓	<b>czzzubf8fjz96</b>	-0.030	1,410	1,981	-40.500	Y

## SQL Details: czzzubf8fjz96

Parsing Schema APPS

Execution Frequency 3

SQL Text



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

### Single Execution Statistics

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



# SQL Performance Analyzer | Report

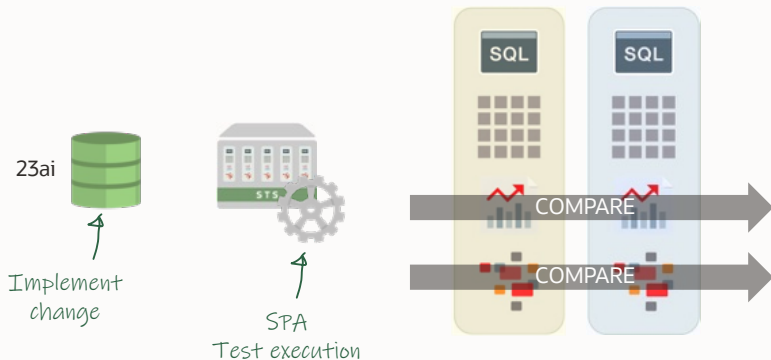
Regressed SQL Statements						
	SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
			SQL Trial 1	SQL Trial 2		
↓	3fv28qfu9y0ag	-0.050	26,504	29,573	-11.580	Y
↓	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

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 statistics.  
execute dbms\_stats.gather\_table\_stats(  
    'dbpart', 'TABPARTS', estimate\_percent => 100,  
    method\_opt => 'FOR ALL C

#### Rationale

The optimizer requires up-to-date statistics to 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.





# SQL Tuning Advisor | Findings

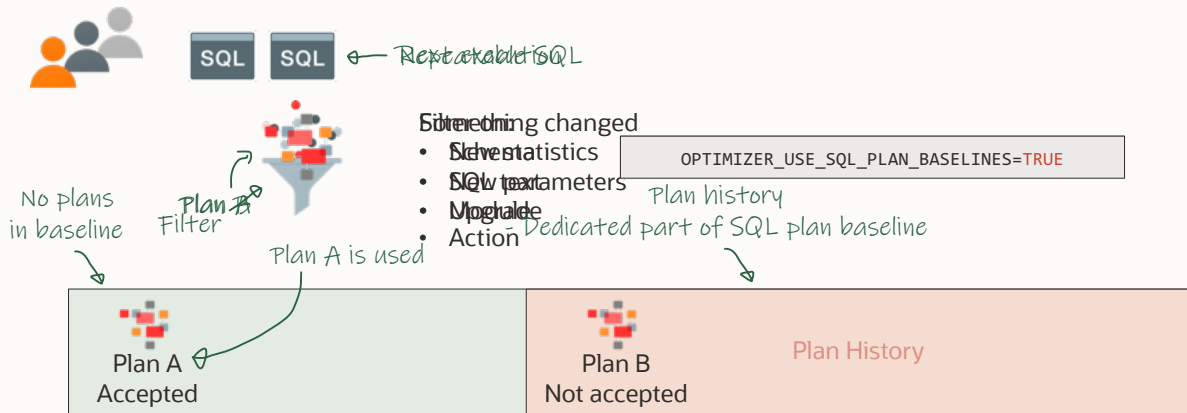
## Types of findings:

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

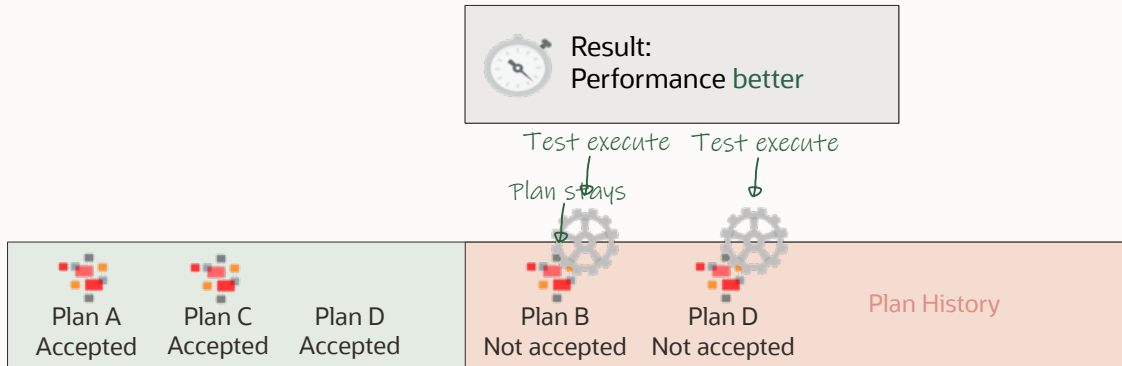
Pro tip: SQL Developer has a good [interface](#) to SQL Tuning Advisor



# SQL Plan Management | Concept









# SPM | 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



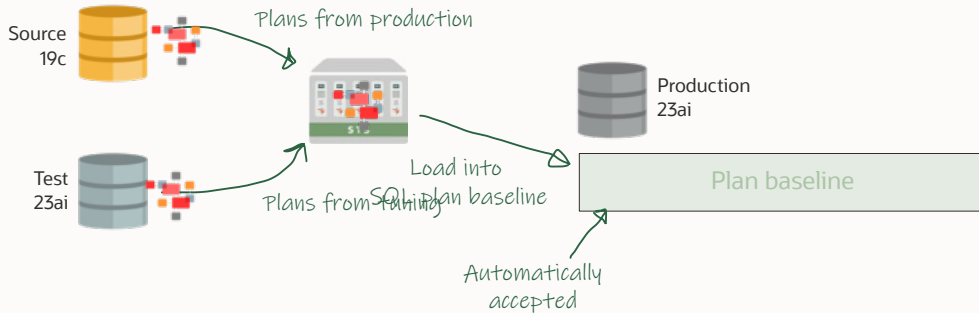
Plan B  
Not accepted

Plan History

Automatically  
accepted



# 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











# 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





try it out for free

**IT'S EASY**



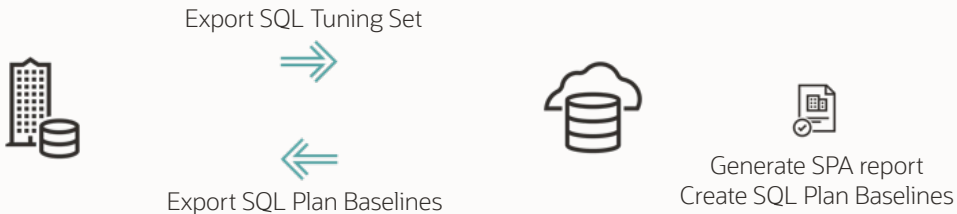


If you don't have the right license,  
use a database system in OCI

- 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`





## 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 expression. He is standing in front of a whiteboard that has some handwritten notes on it. The text "BIG PROBLEM!!" is overlaid on the image in large, bold letters.

# BIG PROBLEM!!


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



... you hit a bug!!





A photograph of two men in a playful struggle. The man on the left is wearing a yellow Star Wars costume with a red flower on the chest and is being held by the man on the right. The man on the right is wearing a plaid shirt and is laughing. The background is a blurred outdoor setting with buildings and people.

**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	<a href="#">Knowledge, Patches, Service Requests and Bugs related to this bug</a>	

▼ 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)



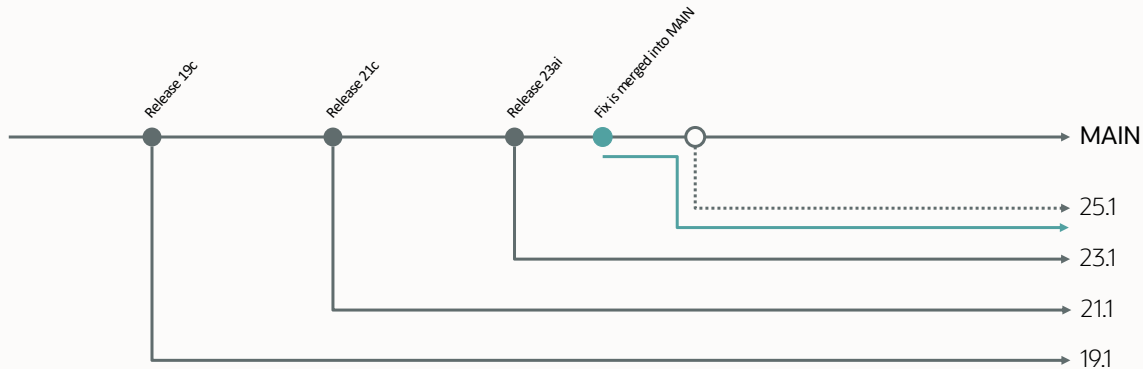
# Insights into the Patching Process



- 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	<b>Fixed in Product Version</b>	<b>25.1</b>
Severity	2 - Severe Loss of Service	Product Version	23.1
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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





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

**But you just released 23ai???**



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

**No worry ...**

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



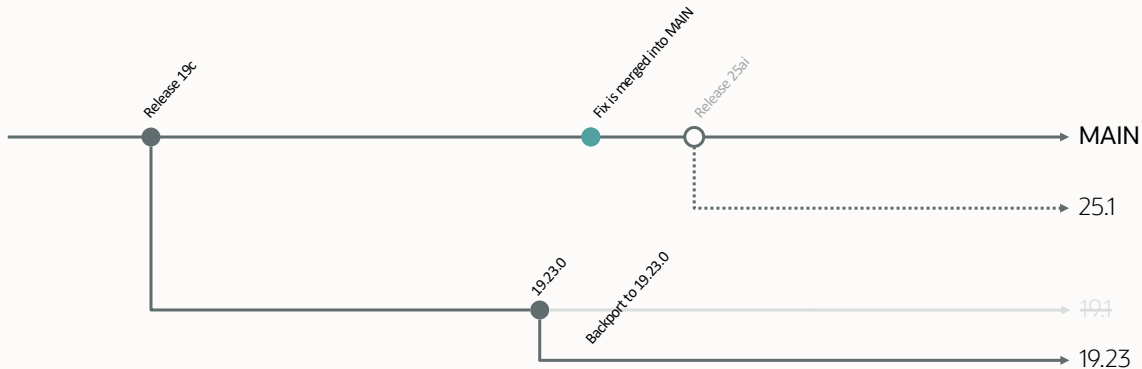
# Insights into the Patching Process



- 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 19.23.0
- `opatch lsinventory`



# Branches





# Insights into the Patching Process



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



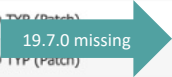
Patch Simple Search Results

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







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

Updated By:

Sup Rep:

Customer:

Status: 80 - Development to QA/Fix Delivered Internal





## BUG 32765738 - AIM:ORA-7445 [KEWSSYSVF\_1] - KEWSSYSVF\_1

[Edit this bug](#) [Bug Tree](#) [ARU R](#)

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)

<b>Product</b>	Oracle Database - Enterprise Edition <a href="#">(More...)</a>	<b>Size</b>	1.3 MB
<b>Release</b>	Oracle Database 19.12.0.0.0 DBRU	<b>Download Access</b>	Software
<b>Platform</b>	Generic Platform	<b>Classification</b>	General
		<b>Patch Tag</b>	

**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** Oracle Database 19.12.0.0.0 DBRU

**Platform** Generic Platform

**Language** American English

[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:



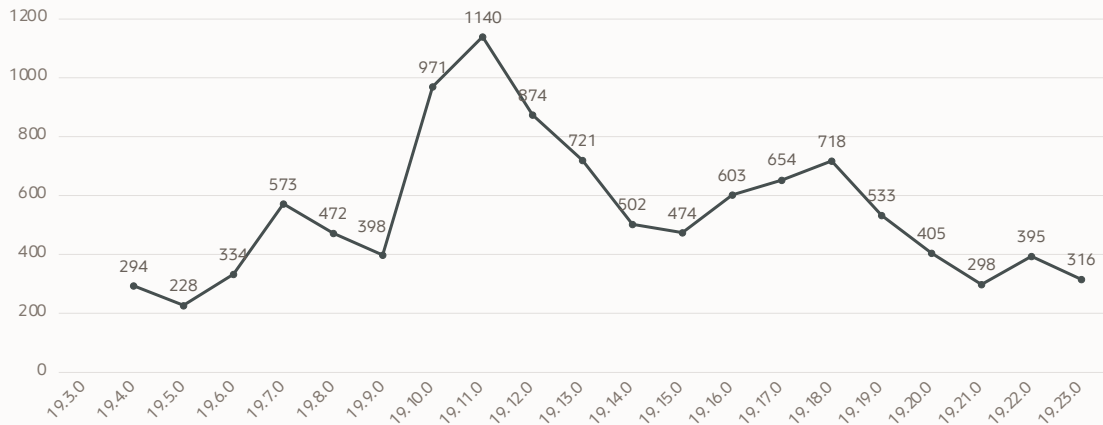
# Insights into the Patching Process



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



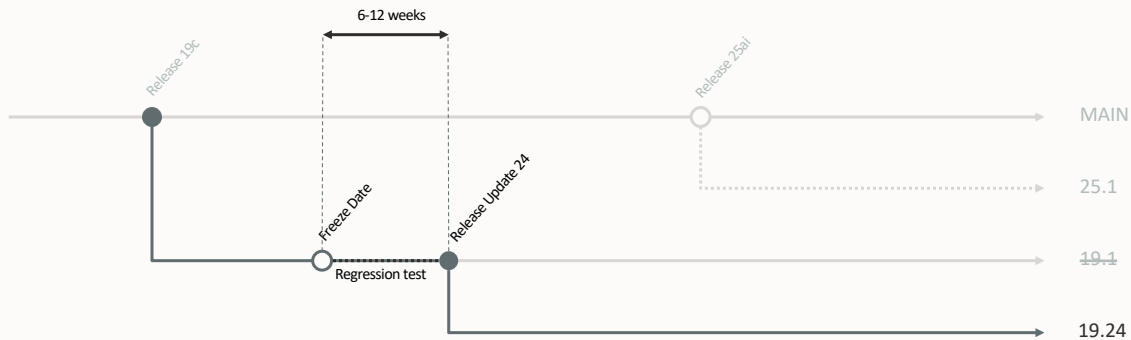
# Release Update Contents



[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 "checkconflictagainstohwithdetail"
```

```
ZOP-40: The patch(es) has conflicts with other patches installed in the  
Oracle Home (or) among themselves.
```

```
Prereq "checkConflictAgainstOHWithDetail" failed.
```

```
Summary of Conflict Analysis:
```

```
There are no patches that can be applied now.
```

```
Following patches have conflicts. Please contact Oracle Support and get  
the merged patch of the patches :
```

```
35012562, 35095748
```

```
Conflicts/Supersets for each patch are:
```

```
Patch : 35095748
```

```
Conflict with 35012562
```

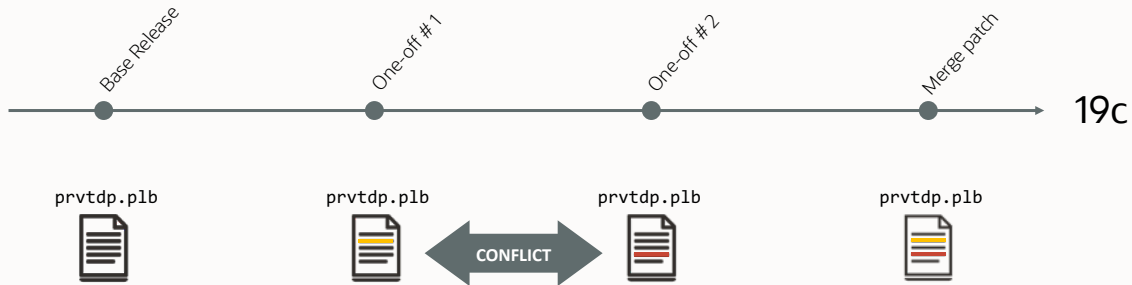
```
Conflict details:
```

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

```
OPatch succeeded.
```



# Basic Facts | Conflicts







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





## Don't name it

- `optch_lsinv.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 ...



Please wait while we install a system update





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



### 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	<a href="#">36219938</a>	<a href="#">36199232</a>
19.22.0.0.240116	<a href="#">35962832</a>	<a href="#">35926646</a>
19.21.0.0.231017	<a href="#">35681552</a>	<a href="#">35648110</a>
19.20.0.0.230718	<a href="#">35348034</a>	<a href="#">35354406</a>
19.19.0.0.230418	<a href="#">35046439</a>	<a href="#">35050341</a>

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 PDBs 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	<a href="#">Patch 36352352</a>	Linux x86-64	Available
		HP-UX Itanium	07-May
21.14.0.0.240416 GI RU	<a href="#">Patch 36352207</a>	Linux x86-64	Available
		HP-UX Itanium	07-May
21.14.0.0.240416 WIN BP	<a href="#">Patch 36219877</a>	WINDOWS x64, NT	Available
19.23.0.0.240416 DB RU (& assoc. COMBO)	<a href="#">Patch 36233263</a> (& <a href="#">Patch 36209492</a> )	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)	<a href="#">Patch 36233126</a> (& <a href="#">Patch 36209493</a> )	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	<a href="#">Patch 36219938</a>	WINDOWS.X64	23-Apr
		WINDOWS NT	07-May
19.23.0.0.240416 OJVM	<a href="#">Patch 36199232</a>	All except Linux x86-64	07-May





Find the PAD by searching for  
*Patch Availability Document DB-only* **April 2024**



A close-up, low-angle shot of a computer keyboard. The focus is on a central key featuring the Windows logo. Other keys like 'Ctrl' and 'Alt' are visible but blurred in the background. The lighting is dramatic, with strong highlights and deep shadows.

**... Oracle on Windows is different**





But this MOS note is missing ...



# MOS Note is not accessible

MOS Notes into UNDER REVIEW state without telling you more details

- See blog post "[This MOS note is not available anymore?](#)"

Document cannot be displayed. Possible reasons are:

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





Just try it again a few days

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



A photograph of a penguin standing on a large, jagged piece of ice in a snowy, arctic landscape. The penguin is facing away from the camera, looking out over a vast, flat expanse of snow and ice under a pale sky. The ice it stands on is a large, irregular chunk with sharp edges and some snow piled up around it.

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

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

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

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



# Break

We start again at 15:15



# Oracle Database 23ai



## What's Changing



# Oracle7 Server™

Release 7.3 for Windows NT Versions 3.51 and 4.0

*The Enterprise  
Database Engine  
of Choice*

Version  
7.3.4.0.0



**ORACLE®**  
Enabling the Information Age™





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

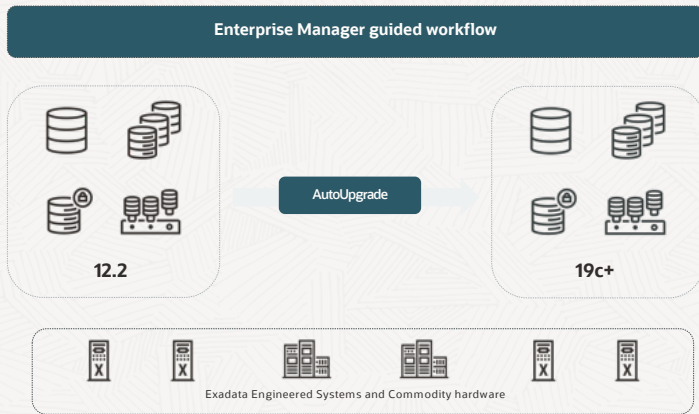
- DBUA is desupported



# Enterprise Manager

## AutoUpgrade integration into EM CC

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





# Oracle Database 23ai



## What's New





## Examine Oracle Database changes using ORAdiff

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

The screenshot shows the 'Version Selector' section of the ORAdiff application. It contains two rows of dropdown menus. The first row is for 'Source Version' and 'Source Patch Level', with '18.17.0' selected in the patch level dropdown. The second row is for 'Target Version' and 'Target Patch Level', both with '- Select Version -' and '- Select Patch Level -' respectively. Below these is a section titled 'V\_PARAMETER' which includes a table with columns 'Added', 'Removed', and 'Changed'. There is a search bar with a magnifying glass icon and a 'Go' button, and an 'Actions' dropdown menu.

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

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: 19.0.0

Target Version: 19.0.0

Select Patch Level: [Dropdown]

V\_\$PARAMETER

Index	Name	Changed
1	V_\$PARAMETER	Yes

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.

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Questions? Ideas? Enhancement requests? Contact us on: [#oradiff-int](#)

[Watch on YouTube](#)



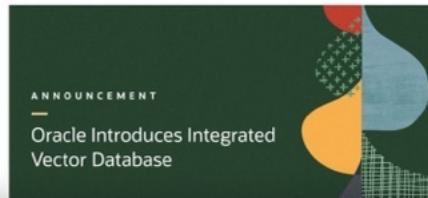
Press Release

# Oracle Introduces Integrated Vector Database to Augment Generative AI and Dramatically Increase Developer Productivity

*New AI vector similarity search in Oracle Database 23c allows the combination of search on semantic and business data resulting in highly accurate answers quickly and securely*

Oracle CloudWorld, Las Vegas—September 19, 2023

Oracle today announced its plans to add semantic search capabilities using AI vectors to [Oracle Database 23c](#). The collection of features, called AI Vector Search, includes a new vector data type, vector indexes, and vector search SQL operators that enable the Oracle Database to store the semantic content of documents, images, and other unstructured data as vectors, and use these to run fast similarity queries. These new capabilities also support [Retrieval Augmented Generation \(RAG\)](#), a breakthrough generative AI technique that combines large





# Welcome to Oracle Cloud World!!

## Movies Demo

Explore your favorite movies with Oracle AI Vector Search

 Demo

## OCW Sessions Demo

Explore sessions at Oracle CloudWorld 2023 with our OCW Chatbot powered by Oracle AI Vector Search

 Demo



**ORACLE**  
CloudWorld



## Filter



Year ▼

Genre ▼

Nominations

Awards

## Question

Message

Motivational movies about athletics

35

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](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

35





Search Type

☐ Text Search☒ Vector Search



## Results

1 - 10 of 10

	Title	Awards	Year	Nominations	Genre
	The Do-Deca-Pentathlon	NONE	2012	NONE	Comedy
	Champions	NONE	2023	NONE	Comedy,Sport
	Across the Tracks	NONE	1991	NONE	Drama,Action
	Hustle	NONE	2022	NONE	Sport



## Filter



Year

2023



Genre

Sport



Nominations

Awards

## Question

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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

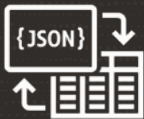
1 - 3 of 3



# AI Vector Search can capture semantics better than Text Theme search.


And can easily be combined with relational predicates to get exactly what you want






Get the best of both worlds  
with JSON Duality Views







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




CID	CLASS	ROOM	TIME	TCHID
C123	MATH 201	A102	14:00	T543
C345	SCIENCE 102	B405	16:00	T789
...	...	...	...	...
...	...	...	...	...



STUID	CID
S3245	C123
...	...
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

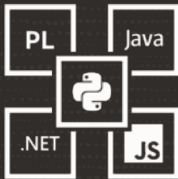
SQL Firewall

ACID

No data duplication

... and so much more

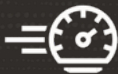




Easily convert your existing application with  
Oracle Database API for MongoDB

- Using Oracle Database API for MongoDB





Accelerate your applications 10x  
with True Cache

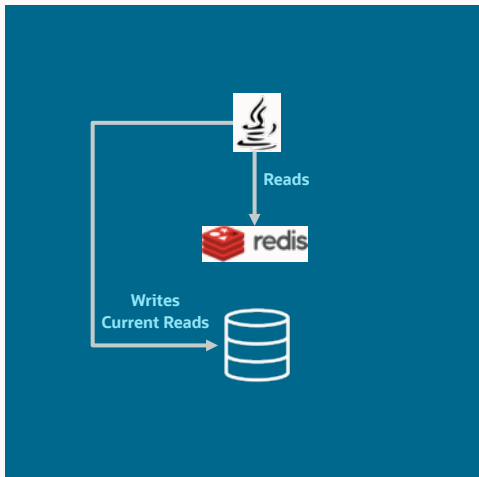




We have a performance problem;  
we need a cache!



# True Cache





# True Cache

Who takes care of the cache:

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





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

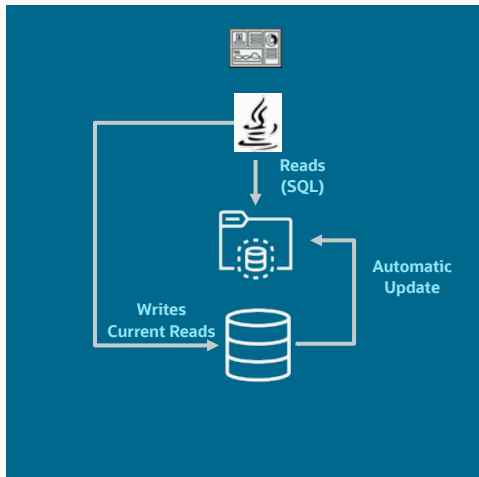




True Cache is conceptually  
a diskless Active Data Guard



# True Cache







# True Cache

Operation	Conventional Caches	True Cache
Loading the cache	Developer responsibility	<b>Automated</b>
Cache consistency with DB	Developer responsibility	<b>Automated</b>
Cache consistency with objects in the same cache	Developer responsibility	<b>Automated</b>
Cache consistency with other caches	Developer responsibility	<b>Automated</b>
Complex data type support	Developer responsibility	<b>Automated</b>
Full JSON support	Developer responsibility	<b>Automated</b>
Comprehensive security	Developer responsibility	<b>In-Built</b>
Parallel processing	Developer responsibility	<b>In-Built</b>
High Availability	Developer responsibility	<b>In-Built</b>



# True Cache



**Mid-Tier  
Cache**



**Edge  
Cache**



**Cross-Region  
Cache**



**Cross-Cloud  
Cache**





## 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
```





Automatically rollback sessions  
blocking high-priority sessions

- [Automatic Transaction Rollback](#)



## Session 1

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

## Session 2

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



## Session 1

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

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

## Session 2

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



## Session 1

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

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

## Session 2

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

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



## Session 1

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

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

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

## Session 2

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

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



## Session 1

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

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

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

## Session 2

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

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

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





## Even wider tables

- Up to 4096 columns



```
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





Even **stronger** passwords

- Up to 1024 bytes





Get started quickly and securely  
using new developer role

- `DB_DEVELOPER_ROLE`





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

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





By default even **stronger** encryption algorithms are used

- RMAN backups
- TDE Tablespace Encryption



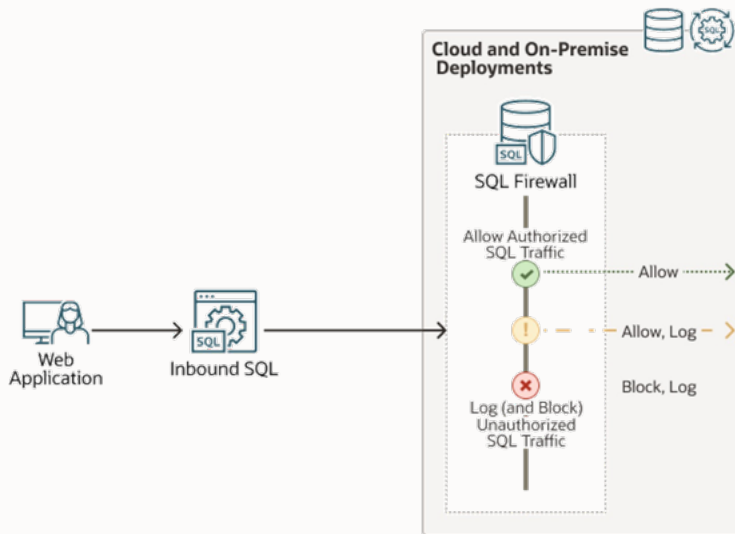


## Tighten security with SQL Firewall

- Prevent SQL injection attacks and unauthorized queries

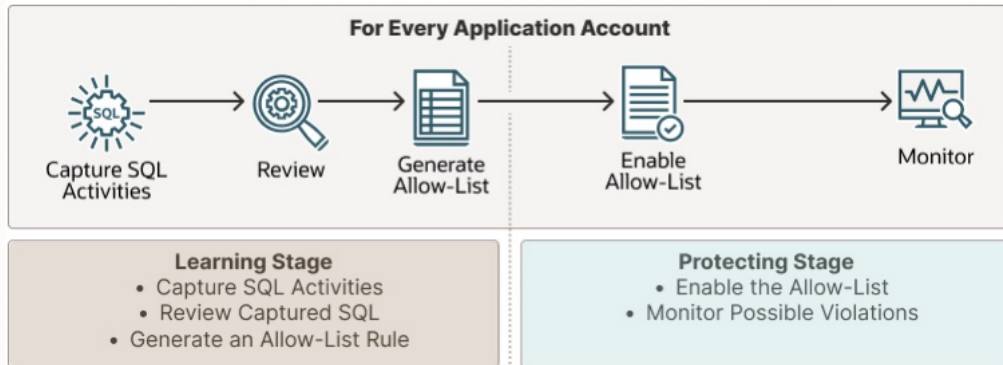


# SQL Firewall





# SQL Firewall





# 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/
```



```
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> oerr ORA-12154

Message: "Cannot connect to database. Could not find alias %s in %s."

Help: <https://docs.oracle.com/error-help/db/ora-12154/>

Cause: A connection to a database or other service was requested using a connection alias but the alias specified could not be resolved into a connect descriptor using one of the configured naming methods.

Action: Do the following:

- Check for mistakes in the connection string that you used.
- If you have a sqlnet.ora file containing a NAMES.DIRECTORY\_PATH parameter, then ensure that the parameter contains valid values.
- If you are using an alias from a tnsnames.ora file:
  - \* Verify that the tnsnames.ora file exists, is in the proper directory, and is accessible.
  - \* Ensure that the alias exists in one of the tnsnames.ora files.
  - \* Ensure that there are no syntax errors anywhere in the tnsnames.ora file or files. Look for unmatched parentheses or stray characters. Ensure that magic quotes are not used.

...



```
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;



Oracle

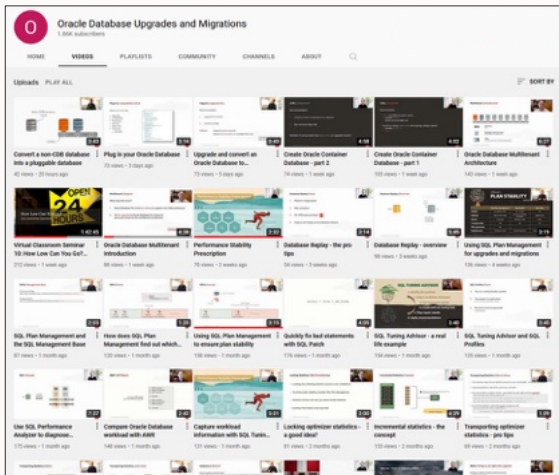
**DBAs**

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

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