

Oracle

DBAs

run the world









MIKE DIETRICH

Vice President Database Upgrade, Migrations & Patching

- in mikedietrich
- mikedietrichde.com
- https://mikedietrichde.com









DANIEL OVERBY HANSEN

Distinguished Product Manager Database Upgrade, Migrations & Patching

- **in** dohdatabase
- **₩** @dohdatabase.com
- **B** https://dohdatabase.com



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MikeDietrichDE.com

Mike.Dietrich@oracle.com



dohdatabase.com

Daniel.Overby.Hansen@oracle.com



DBArj.com.br

Rodrigo.R.Jorge@oracle.com



AlexZaballa.com

Alex.Zaballa@oracle.com



Virtual Classroom Seminars

Episode 16

(replaces Episode 1 from Feb 2021)

Oracle Database Release and Patching Strategy for 19c and 23c

115 minutes - May 10, 2023

Episode 17

From SR to Patch – Insights into the Oracle Database Development process

55 minutes - June 22, 2023

Episode 18

Cross Platform Migration – Transportable Tablespaces to the Extreme

145 min - February 22, 2024

Episode 19

Move to Oracle Database 23ai – Everything you need to know about

Multitenant PART 1

145 min - May 16, 2024

Episode 20

Move to Oracle Database 23ai – Everything you need to know about

100 min - June 28, 2024

Slides











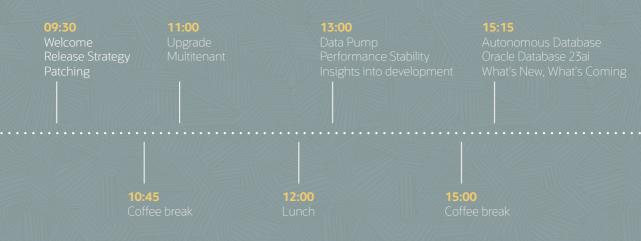
Recorded Web Seminars

https://MikeDietrichDE.com/videos

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



AGENDA







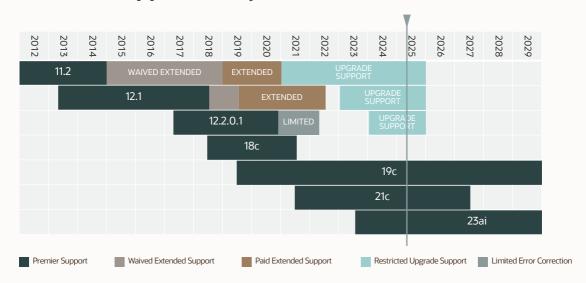




Release Strategy

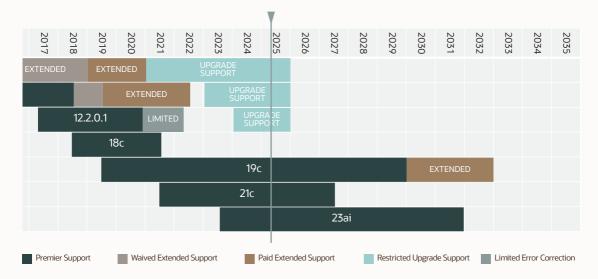


Lifetime Support Policy





Lifetime Support Policy







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

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



Next Long Term Support release

Oracle Database 23ai

Upgrade possible only from:

- Oracle Database 19c
- Oracle Database 21c



Database and Grid Infrastructure Patching



Patching Best Practices

Installation

Basics

Methods

Grid Infrastructure

Datapatch

AutoUpgrade





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

• Oracle Database 19.3.0





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

• Updated with latest Release Update



Always Apply the Most Recent RU

Use the Patch Download Assistant MOS Note: 2118136.2





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 12k fixes with 19.26.0
- More than 300 security fixes

Apply the Most Important Patches

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

Recommended Patches for 19.23 DB Home

Below is the list of important patches to consider applying on top of 19.23. In addition to the relevant patches listed below, you should also review patches in <u>Database</u> <u>PSU/BPI/Update/Revision - Known Issues Primary Note(Doc ID 1227443.1)</u> and <u>Oracle Database Patches to Consider for 19c (Doc ID 2781612.2)</u> which contains patches to consider for specific areas such as Data Pump, Golden gate etc.

Bug	Fixed in RU	Fixed in MRP	Description	Patches	Rolling	Database Online Installable	Added
36587533	19.24	DBMRP 19.22.0.0.240618, DBMRP 19.23.0.0.240618	[SQL EXECUTION] Result Cache: Global Flush Should Always Clear Bypass Flag even if the Result Cache is Uninitialized	[list- patches]	YES	YES	27- SEP-2024
<u>32781163</u>			[QRY OPTIMIZER] Deadlock on library cache lock on MV refresh and dbms_stats gathering the same object	[list- patches]	YES		27- SEP-2024
36908826 (replaces 33539779)			[RMAN] ORA-600[krbr1sf_no_dc_record] during RMAN Restore	[list- patches]	YES		24- SEP-2024
35398148			[VOS HEAP MGMT] SHARED POOL not shrinking during shrink of SGA	[list- patches]	YES	YES	19- SEP-2024

Monthly Recommended Patches

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



Quarterly Release Updates

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



Monthly Recommended Patches

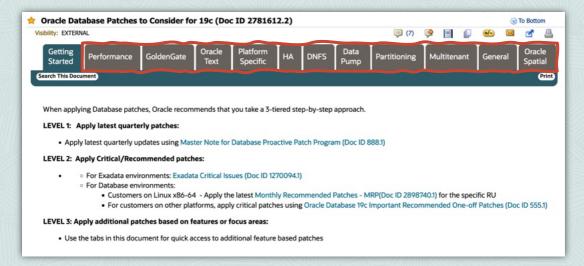
	2024			2025										
	October	November	December	January	February	March	April	May	June	July	August	September	October	November
19.25.0	19.25.0	MRP1	MRP2	MRP3	MRP4	MRP5	MRP6							
19.26.0				19.26.0	MRP1	MRP2	MRP3	MRP4	MRP5	MRP6				
19.27.0							19.27.0	MRP1	MRP2	MRP3	MRP4	MRP5	MRP6	
19.28.0										19.28.0	MRP1	MRP2	MRP3	MRP4
19.29.0													19.29.0	MRP1



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



Apply Additional Important Fixes and Bundles





Always use the latest OPatch

• Patch 6880880





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

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

Patching Best Practices

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What Can Be in a Patch?

FILES

New or changed executables, libs or files bin/oracle bin/srvctl oracore/zoneinfo/timezone_42.dat

Apply and rollback scripts sqlpatch/.../nnn_apply.sql sqlpatch/.../nnn_rollback.sql

SQL PL/SQL

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

How to Apply a Patch?





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 Oueryable Patch Inventory (Doc ID 1530108.1)

In the database / PDB?

SQL> select * from cdb_registry_sqlpatch;



Patching Best Practices

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In-Place Patching







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



Out-of-Place Patching

Oracle Home, 19.25.0



SQL> SHUTDOWN IMMEDIATE



[oracle]\$ \$ORACLE_HOME/OPatch/datapatch





..

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)



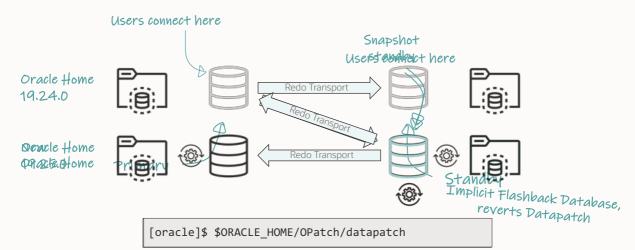


Safely test and verify patches with Standby-First Patch Apply

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



Standby-First Patching







Patch must Standby-First installable

• Check the patch readme





Use AutoUpgrade to patch your standby database

• Check <u>blog posts</u> for details

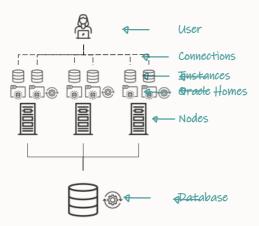




Avoid database downtime with RAC Rolling Patch Apply



RAC Rolling Patching



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



Release updates are always:



Standby-First installable



RAC Rolling installable



Patching Best Practices

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Grid Infrastructure Patching Methods





Grid Infrastructure Patching Methods





```
--Ahead of maintenance window, create and patch new GI homes
--Optionally, create and use gold images
./gridSetup.sh -applyRU ... \
-applyOneOffs ... \
-clusterNodes ... \
```

--During maintenance window, switch to the new GI home by stopping -- the old home and start the new home. Repeat on all nodes. \$ORACLE_HOME/gridSetup.sh -switchGridHome ... \$ORACLE_HOME/root.sh

Demo

Patch a 2-node RAC system GI and database

Watch on YouTube





23ai GI home disk space greatly reduced to 3 GB

• 12 GB in 19c





Use golden images

- Blog postAlso for database homes

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



Patching GI and DB together?



Option 1
TOGETHER

One maintenance window

Longer, single patching window

Several changes

When draining is a problem

Option 2

SEPARATELY

Two maintenance windows

Shorter window, but longer overall patching

One change at a time

For well-behaving applications





Keep GI and DB patch levels in sync

• This is what we test and run in our Cloud



GI and DB Patch Levels

Method	Status	Example
In sync	Recommended, best practice	GI 19.26 + DB 19.26



Complete a rolling patching operation always as quickly as possible

• RAC: Frequently Asked Questions (Doc ID 220970.1)





Unusual combinations are supported, but we strongly advice against it

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



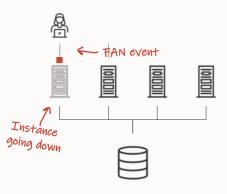


Rolling patching requires efficient draining

• Optionally, consider a batched approach



Draining Connections



DRAINING

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



Drain Timeout



Setting drain_timeout very low?

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



Setting drain_timeout very high?

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



Patching Best Practices

Installation

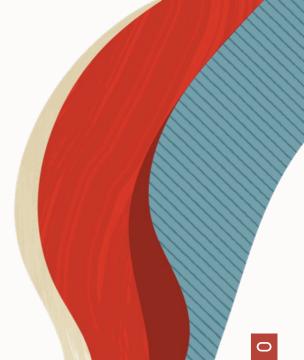
Basics

Methods

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AutoUpgrade







1

Start database in new Oracle Home

Start in normal open Open all PDBs



2

Complete patching with datapatch

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





Analyze the database for patching readiness using Datapatch Sanity Checks

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

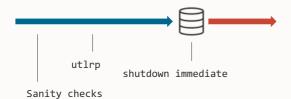




Recompile invalid objects before invoking datapatch



Patching Timeline





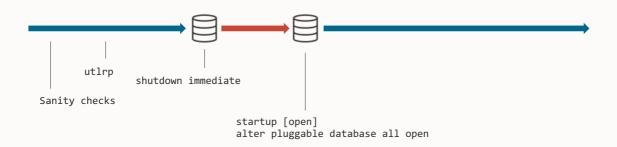


The database must be open Only open PDBs are patched

• Upgrade mode or restricted session is not needed



Patching Timeline



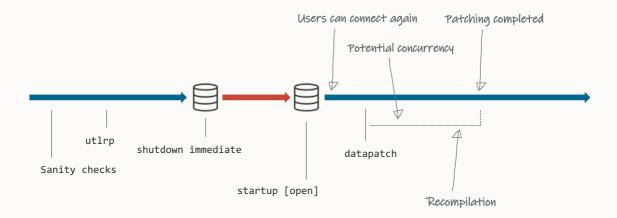


You can run **datapatch** while users are connected to the database

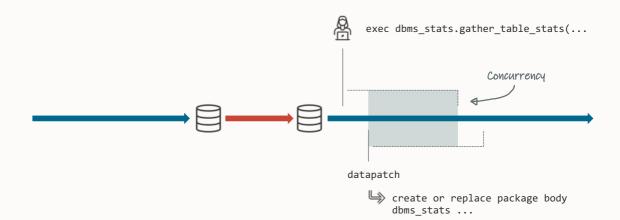
Details in blog post



Patching Timeline



Patching Timeline





Concurrency

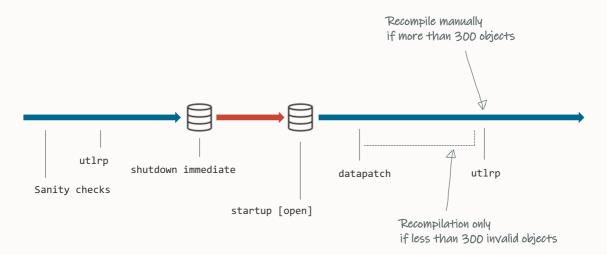
- Datapatch waits 15 min to acquire a lock
 - On timeout, ORA-04021 timeout occurred while waiting to lock object

Optionally, <u>find blocking session</u> and kill it

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



Patching Timeline



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

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

Automatic recompilation incomplete; run utlrp.sql to revalidate.



PDBs: PDB1 PDB\$SEED



Datapatch uses

REGISTRY\$SQLPATCH_RU_INFO to control the patching operations





If in doubt run datapatch again

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



Datapatch Rollback Scripts



Apply/rollback scripts: \$ORACLE_HOME/sqlpatch/.../nnn_apply.sql \$ORACLE_HOME/sqlpatch/.../nnn_rollback.sql



Rollback scripts (zipped as BLOB): SELECT PATCH_DIRECTORY FROM REGISTRY\$SQLPATCH_RU_INFO





Update database directories using rdbms/admin/utlfixdirs.sql

• AutoUpgrade executes the script



Patching Best Practices

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AutoUpgrade





Download

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

2

Install

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



Patch

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





Download

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

2

Install

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



Patch

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



```
$ cat DB19.cfg
```

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

```
$ cat DB19.cfg
```

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

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

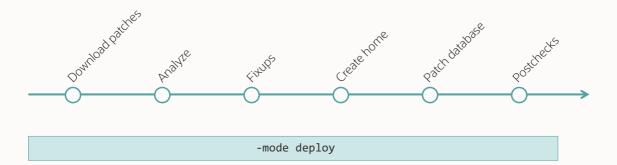
Demo

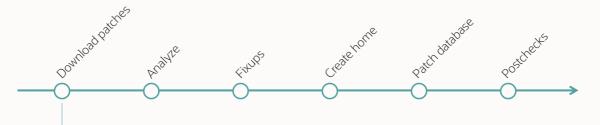
One-Button Patching

- Download patches
- Install Oracle home
- Patch database

Watch on YouTube

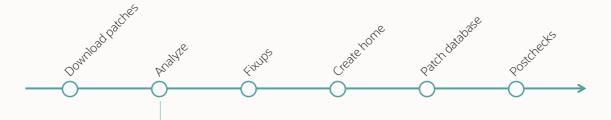






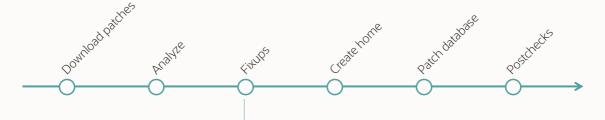
- Finds and downloads patches
- Uses your MOS credentials
- Chooses the right platform
- Stores patches in local repository





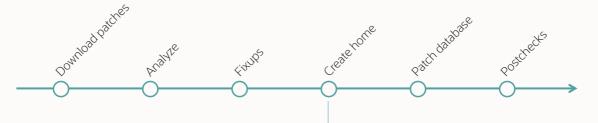
- Analyzes database for patch readiness
- Datapatch Sanity Checks
- Lightweight
- Non-intrusive
- Recommended, not required





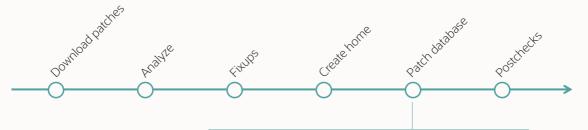
- · Gathers dictionary statistics if needed
- · Recompiles Oracle-maintained objects if needed
- Executes checks see Doc ID 2380601.1





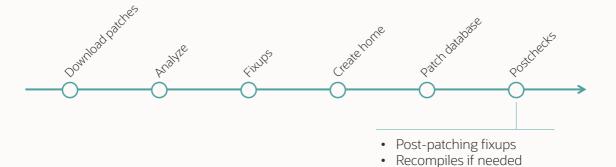
- Out-of-place patching
- Creates a brand-new Oracle home
- Uses runInstaller settings and binary options from source Oracle home
- Execute root.sh via sudo or stored credentials





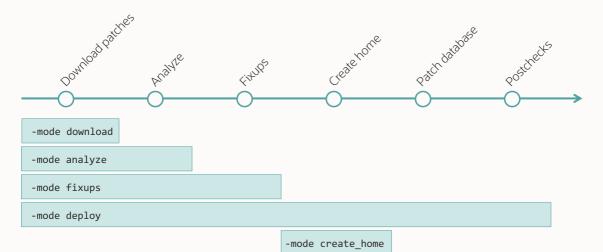
- Moves database instance to new Oracle home
- Moves configuration files
- Executes Datapatch
- Updates system directories (utlfixdirs.sql)
- Updates /etc/oratab
- Supports read-only Oracle home





Cleans up

Patching Modes







Which patches should you install?



```
global.keystore=/home/oracle/autoupgrade-patching/keystore
patch1.source_home=/u01/app/oracle/product/19/dbhome_19_25_0
patch1.target_home=/u01/app/oracle/product/19/dbhome_19_26_0
patch1.sid=DB19
patch1.folder=/home/oracle/autoupgrade-patching/patch
patch1.patch=RECOMMENDED
```

Recommended Patches

patch1.patch=RECOMMENDED	ОРАТСН	The latest OPatch
	RU	The latest Release Update
	ОЈУМ	OJVM bundle matching Release Update
	DPBP	Data Pump bundle patch matching RU



Important MOS Notes





Download Assistant

MOS Note: 2118136.2

Download Release Update, OJVM, Bundles



Important One-Offs

MOS Note: 555.1

Add critical fixes on top for known issues



Additional Fixes MOS Note: 2781612.2

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

more



SQL Performance MOS Note: 2773715.1

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



```
$ cat DB19.cfg
```

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

MOS Note: 555.1

Recommended Patches for 19.25 DB Home

Below is the list of important patches to consider applying on top of 19.25. In addition to the relevant patches listed below, you should also review patches in Database PSU/BPI/Updater/Revision - Known Issues Primary, Note(Doc ID 1227443.)] and Oracle Database Patches to Consider for 19c (Doc ID 1278163.2.2) which contains patches to consider for specific areas such as Data Pump, Golden gate etc.

Bug	Fixed in RU	Fixed in MRP	Description	Patches		Database Online Installable	Added
36760879	19.26		[OSS SRV LAYER] Exadata: Warm up flash cache for disks that are being synced	[list: patches]	YES		11- JAN-2025
36006239	19.26		[VOS] Exadata: Flash Cache Space Pressure After Cell Goes Down	[list- patches]	YES		11- JAN-2025
37166484	19.26	DBMRP 19.24.0.0.241217, DBMRP 19.25.0.0.241217	[SPACE LOB] To defer foreground materialize(chunks movement ufs->cfs)	[list: patches]	YES	YES	28- NOV-2024
35197819	19.26	DBMRP 19.24.0.0.241119, DBMRP 19.25.0.0.241119, GIMRP 19.24.0.0.241119, GIMRP 19.25.0.0.241119	[ASM] CSSD Leaking Memory When There Are Voting File Add/ Drops	(list: patches)	YES	YES	19- OCT-2024
34672698 (replaces 34286265)		Not Applicable	[VOS] DB50: ORA-800: soft external error, arguments: [set priority failed], [vktm] , dism(16)	[list: patches]	YES		22- FEB-2024
34774667			[AQ] ORA-7445 in Purge Queue Table / High CPU usage in SVCB Service	[list: patches]			11- JUL-2023
29213893		Not Applicable	[QRY OPTIMIZER] DBMS_STATS Failing With Error Ora-1422 When Gathering Stats for User\$ Table	[list- patches]			01- SEP-2021

This list may not be conflict-free!



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

```
$ cat DB19.cfg
```

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

```
$ cat DB19.cfg
```

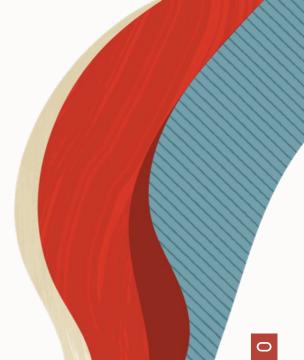
```
global.keystore=/home/oracle/autoupgrade-patching/keystore patch1.source_home=/u01/app/oracle/product/19/dbhome_19_24_0 patch1.target_home=/u01/app/oracle/product/19/dbhome_19_25_0 patch1.sid=DB19 patch1.folder=/home/oracle/autoupgrade-patching/patch patch1.patch=RECOMMENDED,OCW
```

Demo

Applying recommended patches

- Specifying patches
- Patch database

Watch on YouTube

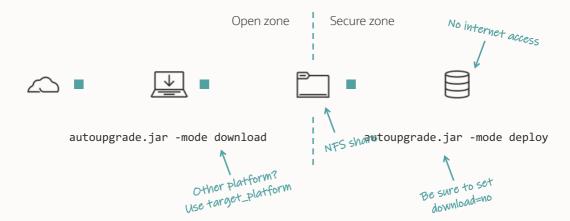




Your database host doesn't have internet access?



Using Download Mode



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

• Unless you explicit specify a different RU



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

AutoUpgrade functionality extended to patching





One-Button Patching

Makes life easier for every Oracle DBA



Recording on <u>YouTube</u> Get the <u>slides</u>



Hands-on Lab

Patch Me If You Can

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



Access lab on Oracle Live Labs

Key Learnings



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

Break

We start again at 11:20



Before upgrade

How to upgrade and convert

After upgrade



Do you want to upgrade?

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



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



⇒ Oracle Database 19c ⇒ Oracle Database 23ai







Oracle Database 23ai supports the multitenant architecture only

• You must convert your database to a PDB





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

Single vs. Multitenant



Single Tenant

One PDB No extra license



Multitenant

Multiple PDBs Extra license if more than 3 PDBs

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

alter system set max_pdbs=3;





Update Exadata System Software to the latest version, minimum 24.1.6

 Exadata Database Machine and Exadata Storage Server Supported Versions (Doc ID <u>888828.1</u>)





Upgrade to Oracle Grid Infrastructure 23ai

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



Raise ASM disk group compatibility

• Set compatible.rdbms to 19.0.0.0.0





Ensure your clients can connect to Oracle Database 23ai

• Upgrade your clients well in advance of the upgrade



Client / Server Interoperability

Client Version	Server Version									
	23ai	21c	19c	18c	12.2.0	12.1.0	11.2.0			
23ai ^{#11}	Yes	Yes	Yes	No	No	No	No			
21c	Yes	Yes	Yes	Was	Was	Yes <u>#12</u>	No			
19c	Yes	Yes	Yes	Was	Was	Yes <u>#12</u>	Yes <u>#9</u>			
18c	No	Was	Was	Was	Was	Was	Was ^{#9}			
12.2.0	No	Was	Was	Was	Was	Was	Was			
12.1.0	No	Yes <u>#12</u>	Yes <u>#12</u>	Was	Was	Yes <u>#12</u>	Yes <u>#12</u>			
11.2.0	No	No	Yes <u>#9</u>	Was ^{#9}	Was	Yes <u>#12</u>	Yes <u>#9</u>			

MOS Note: 207303.1 - Client / Server Interoperability Support Matrix

Client / Server Interoperability

Client Version				Server Version				
	23ai	21c	19c	18c	12.2.0	12.1.0	11.2.0	
23ai ^{#11}	Yes	Yes	Yes	No	No	No	No	
21c	Yes	Yes	Yes	Was	Was	Yes <u>#12</u>	No	
19c	Yes	Yes	Yes	Was	Was	Yes <u>#12</u>	Yes <u>#9</u>	
18c	No	Was	Was	Was	Was	Was	Was ^{#9}	
12.2.0	No	Was	Was	Was	Was	Was	Was	
12.1.0	No	Yes <u>#12</u>	Yes <u>#1</u> 2	Was	Was	Yes <u>#12</u>	Yes <u>#12</u>	
11.2.0	No	No	Yes <u>#9</u>	Was ^{#9}	Was	Yes <u>#12</u>	Yes <u>#9</u>	

MOS Note: 207303.1 - Client / Server Interoperability Support Matrix

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

select * from gv\$session_connect_info;





On important databases, execute a dictionary check before upgrade

- Formerly known as Health Check
- MOS Doc ID 136697.1

```
upg1.sid=DB19
upg1.source home=/opt/oracle/product/19c
upg1.target home=/opt/oracle/product/23ai
upg1.target cdb=CDB1
upg1.run dictionary health=full
#To run only the critical checks
#upg1.run dictionary health=critical
```



Ensure dictionary and fixed objects statistics are accurate

• Save downtime by gathering in advance

```
begin
```

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

Before upgrade

How to upgrade and convert

After upgrade



How Do You Start?









Installation

Download and install Oracle Database 23ai Container Database

AutoUpgrade





Installation of Oracle Home is simpler

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



Simplified Installation

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



Simplified Installation

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



Simplified Installation

- Download software
- **2** Unzip
 - .
- 3 Install



Fully updated Oracle Home

How Do You Start?





Installation



Container Database

Create a new CDB in Oracle Database 23ai



AutoUpgrade



1 Character set



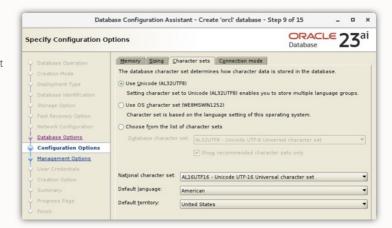


2 Components

3 COMPATIBLE

- 1 Character set
- Always choose AL32UTF8
- Allows PDBs with any character set
- **2** Components

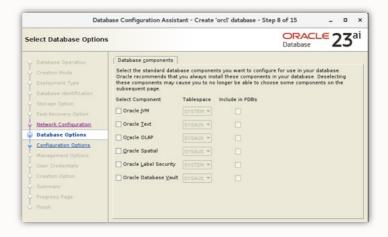
3 COMPATIBLE





1 Character set

- 2 Components
- Install as many as you need
- No more than that
- **3** COMPATIBLE





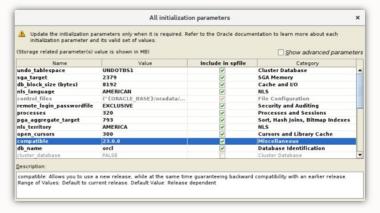
1 Character set

2 Components

3 COMPATIBLE

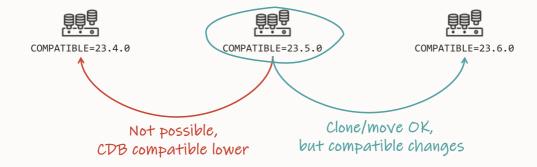
• Keep at the default setting, 23.0.0

Unless you want the option of downgrade





Compatible





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

alter system set "_exclude_seed_cdb_view"=false;



How Do You Start?





Installation



Container Database



AutoUpgrade

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



```
$ java -jar autoupgrade.jar -version
build.version 24.7.241021
build.date 2024/10/21 11:16:20 -0400
build.hash babf5a631
build.hash date 2024/10/18 18:36:27 -0400
build.supported target versions 12.2,18,19,21,23
build.type production
build.label (HEAD, tag: v24.7)
build.MOS NOTE 2485457.1
build.MOS LINK https://support.oracle.com/.../?id=2485457.1
```

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

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



Flow

Plug in

Floreversible

Floreversible

Floreversible

Floreversible

2

Upgrade

3

Convert



23^{ai}

Demo

Upgrade to Oracle Database 23ai

- Using AutoUpgrade
- Including PDB conversion

Watch on YouTube



SQL> select version_full from v\$instance;

VERSION_FULL

23.5.0.24.07



Non-CDB to PDB conversion is irreversible

What are your rollback options?





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





Backup / restore

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





Copy data file

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



Refreshable clone PDB

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

Requires Oracle Database 12.2 or newer





CREATE

Create PDB from non-CDB over a database link



REFRESH

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



OUTAGE

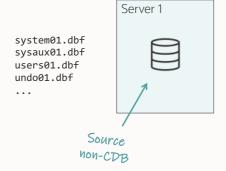
Disconnect users and refresh PDB for the last time

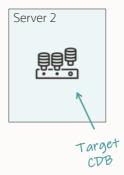


CONVERT

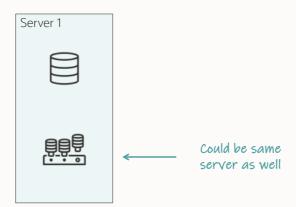
To become a proper PDB, it must be converted





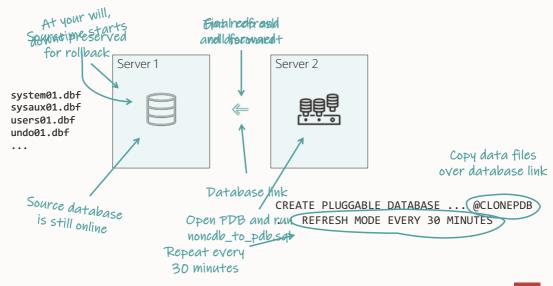


system01.dbf
sysaux01.dbf
users01.dbf
und001.dbf
...





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



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=12/04/2025 02:00:00

--Specify relative start time

--upg1.start_time=+1h30m



Source non-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=12/04/2025 02:00:00

upg1.parallel_pdb_creation_clause=4



Refreshable Clone

1

Run on source

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

2

Run on target

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



PDB is created Data files are copied Redo is applied Final refresh

Disconnect

and convert

autoupgrade.jar ... -mode deploy

upg1.start_time=12/04/2025 02:00:00



--When a job is in REFRESHPDB stage,
--you can force it to start immediately
upg> proceed -job 101



- --When a job is in REFRESHPDB stage,
 --you can force it to start immediately
 upg> proceed -job 101
- --Or postpone it
 upg> proceed -job 101 -newstarttime +2h30m



- --When a job is in REFRESHPDB stage,
 --you can force it to start immediately
 upg> proceed -job 101
- --Or postpone it
 upg> proceed -job 101 -newstarttime +2h30m
- --Or reschedule it upg> proceed -job 101 -newstarttime 19/04/2025 02:30:00



Works for unplug-plug upgrades as well



The source non-CDB stays intact to allow rollback



Refreshable clone works only with deferred recovery on standby database

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



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





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

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

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

Cloning user

Project

create user dblinkuser identified by Oracle_4UOracle_4U;

Constraints

Permissions

Preparation

Migration

Success?

Remarks

Database link

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



Customer

Project

Constraints

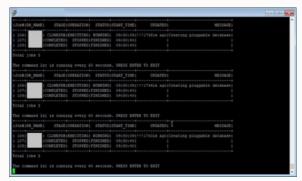
Preparation

Migration

Success?

Remarks

Migration in progress



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



Customer

Project Constraints

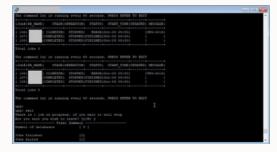
Preparation

Migration

Success?

Remarks

Migration completed



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

Customer

First non-CDBs migrated successfully

Project

Project is ongoing

Constraints

Preparation

Migration

Success

Remarks



Customer

Project

Constraints

Preparation

Migration

Success?

Remarks

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

Solution: restore archivelogs from backup

User profile with IDLE_TIME lead to kill of the session

Solution: assign a different profile to the clone user

Summary

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

Very Stable





In OCI, upgrade individual PDBs using AutoUpgrade and refreshable clone PDB

• See blog post for details





In OCI, upgrade entire CDBs using cloud tooling

- · Be sure to update cloud tooling beforehand
- See <u>blog post</u> for details





You can also migrate with Data Pump or Transportable Tablespaces

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



Before upgrade

How to upgrade and convert

After upgrade



Fallback Options | After Go-Live





- 1 Back to 19c non-CDB
 - Data Pump
 - GoldenGate

- 2 Back to 19c, stay multitenant
 - Downgrade
 - COMPATIBLE must be 19.0.0 in 23ai CDB



Backup your database after migration

- Level 0
- Practice restore with pre-plugin backups



Check your standby databases

• Special attention is needed for standby databases



Data Guard





Plug-in on primary propagates to standby database via redo

1 Enabled recovery

2 Deferred recovery

1

Enabled recovery

2

<u>Deferred recovery</u>

create pluggable database ... standbys=all

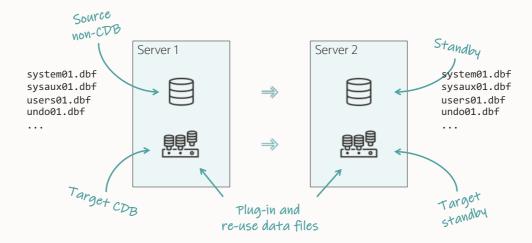
Standby records PDB creation

Standby locates data files

MRP applies redo to PDB

PDB is immediately protected





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



- 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?



1 Regular files

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

2 OMF in regular file system

3 ASM



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



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



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









```
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.266.1103050009

+DATA/DB_CHICAGO/DATAFILE/sysaux.269.1103050009
```



```
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







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

Standby



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



1

Enabled recovery

create pluggable database ... standbys=all

Standby records PDB creation

Standby locates data files

MRP applies redo to PDI

PDB is immediately protected

2

<u>Deferred recovery</u>

create pluggable database ... standbys=none

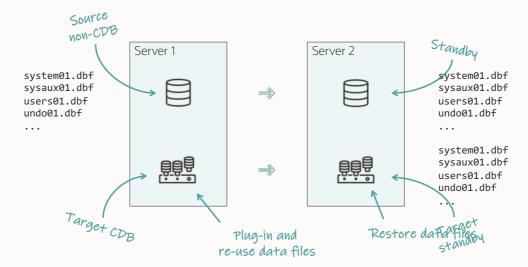
Standby records PDB creation

Standby ignores data files

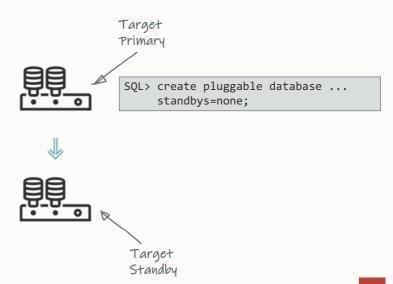
MRP skips redo

PDB protected after restore











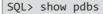
SQL> create pluggable database ... standbys=none;

PDB created
Data files missing









CON_NAME OPEN MODE PDB1 READ WRITE





SQL> show pdbs

CON_NAME OPEN MODE PDB1 MOUNTED







SQL> select name, recovery_status
 from v\$pdbs;

NAME RECOVERY_STATUS

PDB1 DISABLED









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

SQL> alter pluggable database enable recovery;

SQL> alter database datafile
 ... online;









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

Further Details

Webinar:

<u>Move to Oracle Database 23ai –</u> <u>Everything you need to know about Oracle Multitenant – Part 1</u>





Don't jeopardize your Data Guard

• Test the procedure and verify your environment



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

alter system set "_cursor_obsolete_threshold"=1024;



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

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

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

alter system set "_sql_plan_directive_mgmt_control"=0;



- --Database collects expression statistics for
- -- SQL Plan Directives and Auto-Indexing.
- --If you don't use any of these, then turn it to the 11.2 value of "1".
- --Tables being used in dictionary: EXP_HEAD\$, EXP_OBJ\$, EXP_STAT\$
- --Doc ID 2674400.1, Value of "0" fully disables tracking.

alter system set "_column_tracking_level"=1;



Key Learnings



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

Lunch Break

We start again at 13:30



Data Pump Top Tips

Supercharge data loading/unloading



Always use Data Pump Bundle Patch





More than 200 functional and performance fixes

 Data Pump Recommended Proactive Patches For 19.10 and Above (Doc ID <u>2819284.1</u>) Importing a complete application with data drops from almost 2.5 hours to 48 minutes – by just applying the Data Pump bundle patch

A global provider of financial services



Always ensure dictionary and fixed objects statistics are accurate





Ensure dictionary and fixed objects statistics are accurate

- Before export
- · Before import
- Immediately after import

```
begin
```

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

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

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

Use parallel and multiple dump files



--Apply parallelism by simply specifying a degree
expdp ... parallel=8

--Use different parallel degree on import
impdp ... parallel=32







Number of OCPUs

Number of ECPUs / 4



On-prem (x86-64)

2 x physical cores



On-prem (other)

Depends



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



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



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

expdp ... checksum=yes



For best protection against dump file tampering, use encrypted dump files

- Checksum is a weaker protection
- Requires Advanced Security Option



- -- Protect your dump files from alteration by using encryption
- -- Creating an encrypted dump file requires Advanced Security Option

expdp ... encryption=all encryption_algorithm=AES256





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

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

Tota	al	2h 31m
Imp	ort parallel 16	1h 23m
Exp	ort parallel 16	1h 8m

Always convert to SecureFile LOBs





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

• Alternatively, trick Data Pump with <u>fake stats</u>



Do you still have BasicFile LOBs?

• Use <u>DIY parallelism</u> during export



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

impdp ... transform=lob_storage:securefile



Speed up imports by using NOVALIDATE constraints



A Constraint Can Be

VALIDATED

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

NOT VALIDATED

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



0

Most constraints are VALIDATED





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



```
--Example of which commands Data Pump import might execute as part of an import
create table sales ( .... );
                                                        Recursive full table scan
insert into sales as select ... :
                                                                      Recursive full table scan
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

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

impdp ... transform=constraint_novalidate:y



-- 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;
```



--Transforming constraints to NOVALIDATE to speed up import

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

Database validates new rows

Benchmark, 1 billion rows

Importing VALIDATE constraints

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

Importing NOVALIDATE constraints

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

0

NOVALIDATE constraints prevent the optimizer from certain query rewrites

• Check QUERY REWRITE INTEGRITY



Validate constraints after import, or even after go-live

- Still requires a full scan of the table
- But can <u>use parallel query</u>
- And no table lock!



Exceptions

Data Pump always validates certain constraints:

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





Use with care if you are transforming data on import





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

• Plus patch 37280692 - or be on 19.27



Even faster index imports



New In 23 ai

Use index size to determine parallel degree on index creation

• Coming in future 23ai Data Pump Bundle Patch



Index Creation

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

Before 12.1

Worker 1 CREATE INDEX PARALLEL 16

Really good for few big indexes



Index Creation

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

From 12.1

Worker 1 CREATE INDEX PARALLEL 1

Worker 2 CREATE INDEX PARALLEL 1

... CREATE INDEX PARALLEL 1

Worker 16 CREATE INDEX PARALLEL 1

Really good for many small indexes

Index Creation

impdp ... parallel=16

From 23

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

The best of both worlds



How Data Pump Create Indexes

1 Calculate the optimal parallel degree

2 Create indexes



How Data Pump Create Indexes

Calculate the optimal parallel degree

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



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

Explained.



```
SQL> explain plan for create index i1 on t1(c1) parallel;
SQL> select * from table(dbms xplan.display(format => 'ALL'));
...
Note
   - automatic DOP: Computed Degree of Parallelism is 4 because of degree limit
   - estimated index size: 655K bytes
```



2 Create indexes

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



How Data Pump Creates Indexes

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

```
CREATE INDEX ...
                                    CREATE INDEX ... CREATE INDEX ...
                                                                         CREATE INDEX ...
Worker 1
                     PARALLEL 1
                                       PARALLEL 1
                                                          PARALLEL 1
                                                                             PARALLEL 1
                                             CREATE INDEX ... CREATE INDEX ...
                      CREATE INDEX ...
Worker 2
                         PARALLEL 15
                                                                   PARALLEL 5
                                                 PARALLEL 8
                                                  CREATE INDEX ...
Worker 3
                                                     PARALLEL 7
                                                                CREATE INDEX ...
Worker 4
                                                                   PARALLEL 3
```

Worker 16



Benchmark, 1 billion rows

Importing with 19c settings constraints

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

Importing NOVALIDATE constraints + new index method

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





We expect much better result with more complex schemas





Coming to Oracle Database 19c

• Use 19.27 plus Data Pump Bundle Patch



























- Sample from cursor cache
- Gather from AWR

















```
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

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



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







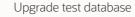












Load workload data (SQL Tuning Set)

















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 purpose

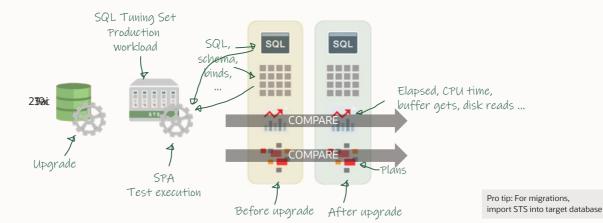
								2nd			
Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time	Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time
CPU time			68,289.05		43.73	db file sequential read	User I/O	22,193,998	114,919.21	5.18	23.17
db file sequential read	User I/O	6,686,953	37,737.81	5.64	24.17	enq: SS - contention	Configuration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

Requires Enterprise Edition + Diagnostic pack

Pro tip: For migrations, you can transport AWR data



SQL Performance Analyzer | Concept





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



Execution Plan Before Change:

Plan Hash Value: 3642382161

ld	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

ld	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



			Buffer Get	s		
	SQL ID	Net Impact on Workload (%)	SQL Trial 1	SQL Trial 2	Net Impact on SQL (%)	New Plan
t.	3fv28gfu9y0aq	-0.050	26,504	29,573	-11.580	Υ
Û.	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y
			y	×		
		From Production	•	\		
		workload		From te	st	
				execution	NA.	

essed SQL Statements				
		S		
		SQL Trial 2	Net Impact on SQL (%)	New Plan
	26,504	29,573	-11.580	Υ
	1,410	1,981	-40.500	



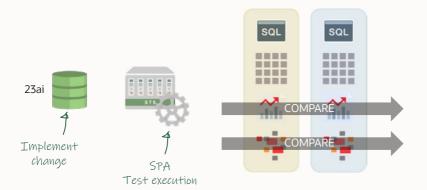
Regn						
			SQL Trial 1	SQL Trial 2		
	3fv28gfu9y0aq		26,504			
0	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

_					
SQL	Details: czzzubf8fjz96				
	Parsing Schema APPS	Execution Freque	ency 3		
> 5	QL Text				
SEL	ECT /* my_query_21 */ /*+ ORDER	ED INDEX(t1) USE_HASH(t1) *.	/ 'B' t2.tal	te_02 take_02, '	B' t2.take_15
tak	e_15, 'B' t2.take_08 take_08	, 'r' t3.record_nr price	eur_id,		
Sing	le Execution Statistics				
			Execution Statistic C	ollected	
	Execution Statistic Name	Net Impact on Workload (%)	SQL Trial 1	SQL Trial 2	Net Impact on SQL (%)
Û	Elapsed Time (sec)	-0.240	0.112	0.164	-46.170
企	Parse Time (sec)	0.220	0.001	0.001	14.490
Û	CPU Time (sec)	-0.030	0.108	0.114	-5.040
\Rightarrow	User I/O Time (sec)	0.000	0.000	0.000	0.000
D	Buffer Gets	-0,030	1,410	1,981	-40.500

Regre	ssed SQL Statements					
			SQL Trial 1			
û	3fv28gfu9y0aq		26,504			
0	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

Comparison QL_TRIAL_1353942463446 Plan Hash Value 1165613724 Expand Al Collapse All					
Operation	Line ID	Object	Rows	Cost	Predicate
▼ SELECT STATEMENT	0		1	9,830	
∀ HASH GROUP BY	1		1	9,830	
	2		1	9,829	
∇ SORT JOIN	3		8	9,795	
∀ HASH JOIN	4	6	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
   1 task varchar2(64);
   1 report clob;
begin
   1 task := dbms sqltune.create tuning task(sql id=> ... );
   dbms sqltune.execute tuning task(l task);
   1 report := dbms sqltune.report tuning task(1 task);
   dbms output.put line(1 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

Rationale

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



SQL Tuning Advisor | Example

6- SQL Profile Finding (see explain plans section below)

FINDINGS SECTION (8 findings)

.....

optimizer statistics for table .

Recommendation

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

Rational

The optimizer requires up-to-date select a good execution plan.

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.

A potentially bette
Recommendation (est
- Consider acceptin
execute dbms_sqlt
task_owne
Validation results
The SQL profile was
and measuring their

SQL Tuning Advisor | Findings

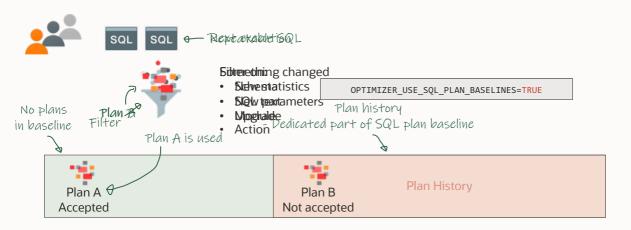
Types of findings:

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

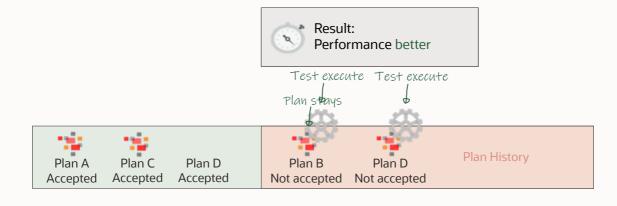
Pro tip: SQL Developer has a good interface to SQL Tuning Advisor



SQL Plan Management | Concept

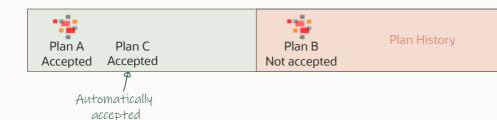


SPM | Evolve

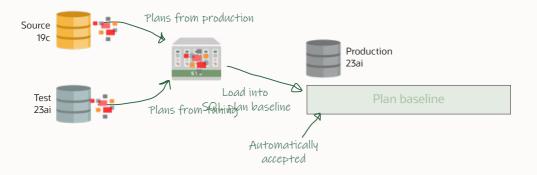


SPM | Load from STS





SPM | Use Case





SPM | What If ... Literals

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

Many distinct statements

• CURSOR_SHARING = FORCE? No!

Optimal solution: Change your application to use bind variables





Use SQL Profiles for statements with literals

Part of Tuning Pack



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



```
dbms_sqltune.accept_sql_profile(..., category=>'TEST_ENV');
alter session set sqltune_category='TEST_ENV';
--After testing, fully enabled profile
dbms_sqltune.alter_sql_profile(..., attribute_name=>'CATEGORY', value=>'DEFAULT');
```



SQL Profiles | Facts

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



There is only one tool to ensure plan stability:

SQL Plan Management

Don't use

- OPTIMIZER_FEATURES_ENABLE
- COMPATIBLE



COMPATIBLE vs. OPTIMIZER_FEATURES_ENABLE



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

OPTIMIZER_FEATURES_ENABLE

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





Hitchhiker's Guide to Upgrade to Oracle Database 23ai

try it out for free

IT'S EASY





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

• Relevant options and packs included in most cloud offerings



Use OCI for Performance Testing



Export SQL Tuning Set









Generate SPA report Create SQL Plan Baselines

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 <u>555.1</u>)
- 4 Check for other SQL performance bug fixes (Doc ID <u>2773715.1</u>)



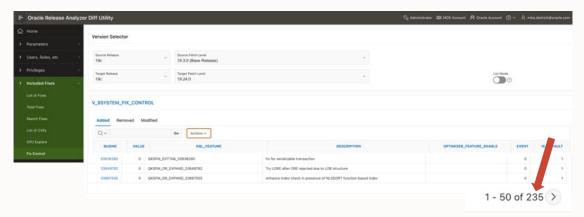
Enable Optimizer Fixes

5 Selectively enable optimizer fixes using DBMS_OPTIM_BUNDLE

Find available bug fixes in ORAdiff or dbms_optim_bundle.GetBugsForBundle



oradiff.oracle.com





Should You Enable Optimizer Fixes?

Upgrade New database Enable optimizer fixes using DBMS_OPTIM_BUNDLE

Patching

Do proper testing before enabling optimizer fixes using DBMS_OPTIM_BUNDLE





Don't gather new optimizer statistics after upgrade

• Upgrades from 11.2.0.4 might be different



Don't gather system statistics

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

Insights into the Oracle Database Development Process





10 Medicana M. Dalan Dasa Salah Sala

BIG PROBLEM!!

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







THREE PARTIES

- You
- Oracle Support
- Oracle Development





- 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





ERROF



FI>



BACKPOR



INCLUSION

- Support Engineer creates a bug
- Help us help you:
 - Clear description
 - Reproducible test case
 - Logs, traces, dumps
 - Various release tests





■ Bug Attributes ■ Bug Attributes

Type	B - Defect	Fixed in Product Version	25.1
Severity	2 - Severe Loss of Service	Product Version	23.1
Status	80 - Development to QA/ Fix Delivered Internal	Platform	226 - Linux x86-64
Created	Nov 7, 2022	Platform Version	ORACLE LINUX GENERIC
Updated	Apr 30, 2024	Base Bug	33786319
Database Version	23.1	Affects Platforms	Generic
Product Source	Oracle	Knowledge, Patches, Service Requests and Bugs related to this bug	

✓ Related Products

 Line
 Oracle Database Products
 Family
 Oracle Database Suite

 Area
 Oracle Database
 Product
 5 - Oracle Database - Enterprise Edition

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



When **your case**

needs further attention



1

Update the SR and raise severity



2

Call Oracle Support









- 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)







ERRUF



FI>



BACKPOR

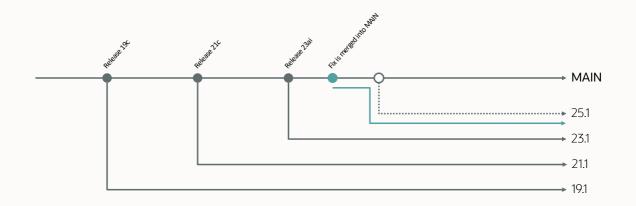


NCLUSION

- 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 ■ Bug Attributes

Туре	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 - x86-6
Created	Nov 7, 2022	Platform Version	ORAC GENE
Updated	Apr 30, 2024	Base Bug	33786
Database Version	23.1	Affects Platforms	Gene
Product Source	Oracle	Knowledge, Patches, Service Requests and Bugs related to this bug	

■ Related Products

Line	Oracle Database Products	ramny	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 ... loudl

Line Overla Database Dividuate Families Overla Database Cuita









ERROF



FIX



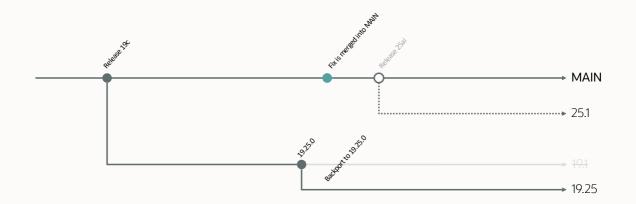


INCLUSION

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



Branches







Insights into the Patching Process



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



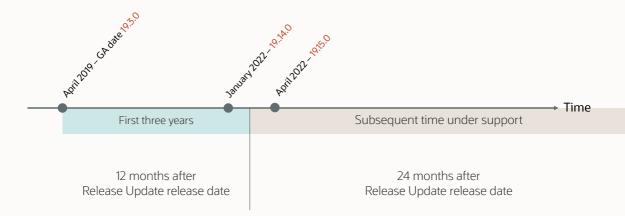
Patch Simple Search Results

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

Edit Search

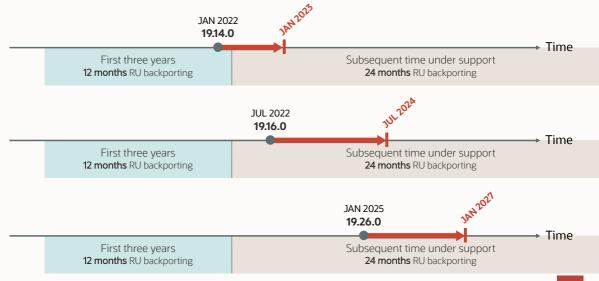
Table → Vie	ew - Detach Share Link		Luit Sea
Patch Name	Description	Release	Platform (Language)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.16.0.0.0DBRU	Generic Platform (American English)
31517417	ORA-22308: OPERATION NOT ALLOWED ON EVOLVED TYP (Patch)	19.15.0.0.0DBRU	Generic 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 TVD (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)

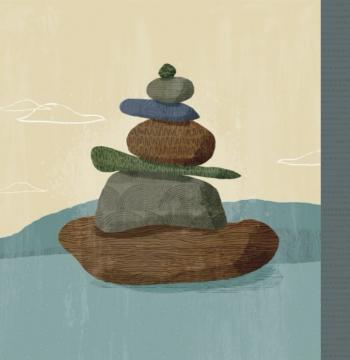
Can I Request a Backport?





Can I Request a Backport? Examples





Why is the patch not in the next Release Update?





ERRUF



FIX



BACKPOR



INCLUSION

- 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.

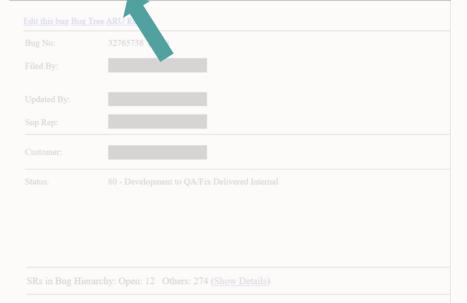
Bug	Fixed in RU	Fixed in MRP	Description	Patches		Database Online Installable	Added
36273767 (replaces 35733946)			ORA-1578: oracle data block corrupted on tempfile even after 35904282, 35733946	[list- patches]	YES	YES	30- APR-2024
35286895	19.23		[KPDB] Switchover/Failover Failing for Backup- Based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

Request for Inclusion

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





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



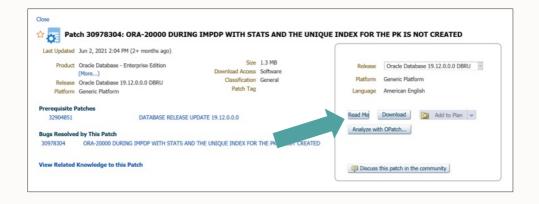
Insights into the Patching Process



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



Inclusion Evaluation and Criteria





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

(I) Prerequisites

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







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



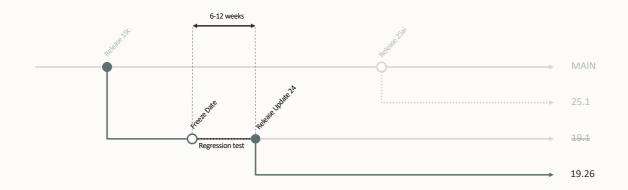
Release Update Contents



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



Limitation



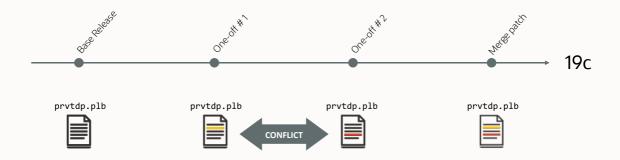




\$ORACLE HOME/OPatch/opatch prereq CheckConflictAgainstOHWithDetail -ph ./ Invoking prereq "checkconflictagainstohwithdetail" ZOP-40: The patch(es) has conflicts with other patches installed in the Oracle Home (or) among themselves. Prereq "checkConflictAgainstOHWithDetail" failed. Summary of Conflict 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_lsinvt.txt
- tekst_fra_opatch.txt
- alle_meine_patches.txt
- textodeopatch.txt





Just name it opatch_lsinventory.txt





Windows is different ...



Photo by Clint Patterson on Unsp





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

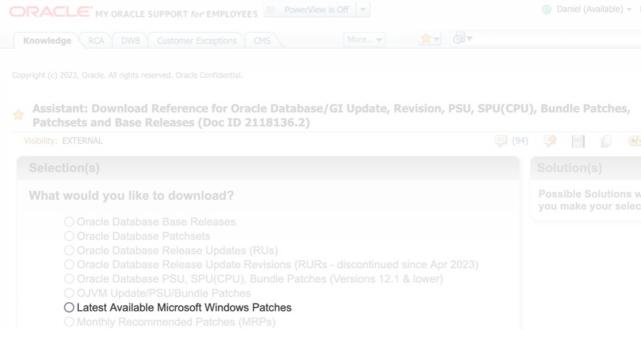
- 153 additional bug fixes
- 528 bug fixes in common





Where do I find the Windows Bundle Patches?





Basic Facts | Patch Availability

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



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"
 - "Separate Products"

Basic Facts | Patch Availability

2.2 Post Release Patches

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

Patch	Patch Number	Platform	Availability
21.14.0.0.240416 DB RU	Patch 36352352	Linux x86-64	Available
		HP-UX Itanium	07-May
21.14.0.0.240416 GI RU	Patch 36352207	Linux x86-64	Available
		HP-UX Itanium	07-May
21.14.0.0.240416 WIN BP	Patch 36219877	WINDOWS x64, NT	Available
19.23.0.0.240416 DB RU (& assoc. COMBO)	Patch 36233263 (& Patch 36209492)	Linux x86-64, Solaris.x64, Solaris SPARC 64-Bit, and AIX.PPC64	Available
		HP-UX Itanium, LINUX.ZSERIES64, and LINUX.ARM64	07-May
19.23.0.0.240416 GI RU (& assoc. COMBO)	Patch 36233126 (& Patch 36209493)	Linux x86-64, Solaris.x64, Solaris SPARC 64-Bit, and AIX.PPC64	Available
		HP-LIX Itanium_LINUX,7SERIES64_and LINUX ARM64	07-May
19.23.0.0.240416 WIN BP	Patch 36219938	WINDOWS.X64	23-Apr
		WINDOWS NT	07-May
19.23.0.0.240416 OJVM	Patch 36199232	All except Linux x86-64	07-May



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 1Rockit 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 MT7

HP NonStop (Guardian) on x86 Fuiitsu BS2000

HP Tru64 UNIX

Tekelec

Oualcomm 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)

> Arme 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 CF

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 IRM 7

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



Key Learnings



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

Break

We start again at 15:15



Autonomous Database

A migration story



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







ORACLE

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Consult the <u>Upgrade Guide</u> for changes, desupports, and deprecations



Traditional Auditing is desupported in Oracle Database 23ai

• Migrate your policies to Unified Auditing

TRADITIONAL AUDITING



• You can't create new polices or change existing ones

UNIFIED AUDITING

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





AutoUpgrade is the only supported tool to upgrade your Oracle Database

• DBUA is desupported

Enterprise Manager

AutoUpgrade integration into EM CC

- Fleet scale
- Non-CDB to PDB
- Non-rolling logical standby
- TDE
- REST and emcli automation
- MOS Note: 2978593.1
 EM 13c: Is Agent 13.5
 Certified on RHEL 9/OL9?)





Oracle Database 23ai

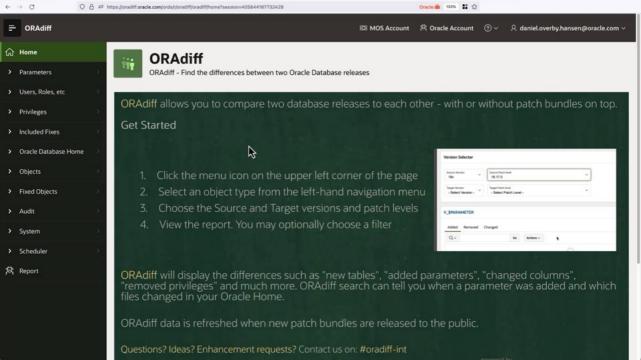
What's New

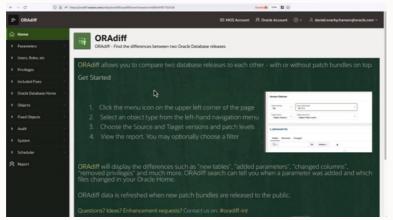




Examine Oracle Database changes using ORAdiff

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





Watch on YouTube

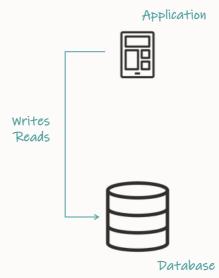




Accelerate your applications 10x with True Cache



True Cache



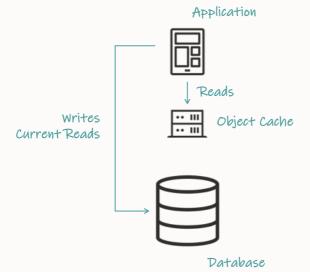




We have a performance problem; we need a cache!



True Cache



True Cache

Who takes care of the cache:

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





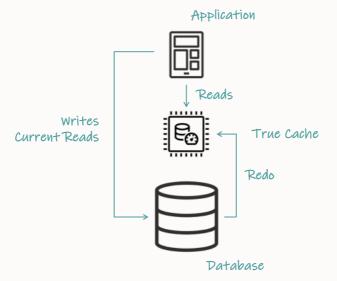
... now we're having a cache problem!





Oracle True Cache - conceptually a diskless Active Data Guard

True Cache





Oracle True Cache is part of Enterprise Edition



Quickly resolve poor performance caused by change in execution plan

• Simplified use of SQL Plan Management



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

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

Backported to 19.22.0



Allow the database to fix regressing plans automatically

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



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

• Automatic Error Mitigation



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

```
SQL> select ... from ...
ERROR at line 1:
ORA-00600: internal error code, arguments: [...]
SQL> alter session set sql_error_mitigation = 'on';
SQL> select ... from ...
n rows returned
```



Even wider tables

- Up to 4096 columns
- Be aware of row chaining



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

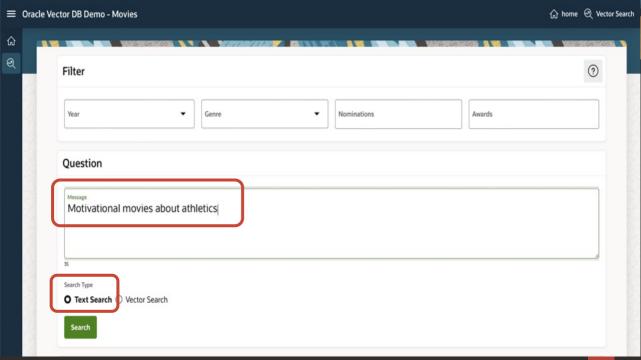




Ensure your database clients are updated

• Older clients do not support more than 1000 columns





Why Batman Returns?

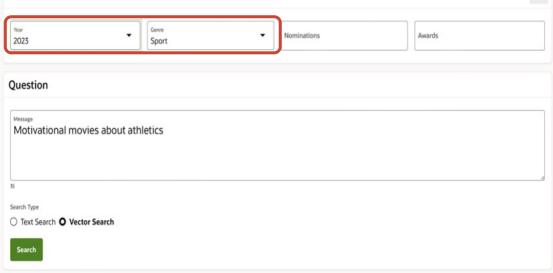
"Motivational Movies about Athletics"

NJQ15253, Batman Returns, 1992, https://upload.wikimedia.org/wikipedia/en/8/83/Batman_returns_poster2.jpg, 'Film-Noir, Action Family, Fantasy', 'Academy Award for Best Makeup and Hairstyling, Academy Award for Best Visual Effects, MTV Movie Award for Best Villain', , Batman Returns is a 1992 American superhero film directed by Tim Burton and produced by Denise Di Novi and Burton, based on the DC Comics character Batman. The sequel to the 1989 film Batman, it is the second installment of Warner Bros. initial Batman film series, and stars Michael Keaton as Bruce Wayne / Batman, alongside Danny DeVito, Michelle Pfeiffer, Christopher Walken, Michael Gough, Pat Hingle and Michael Murphy. In Batman Returns, Batman faces the Penguin, who plots to kill all of Gotham City's firstborn sons, while dealing with Catwoman, who seeks vengeance against Max Shreck, a corrupt tycoon who allies with the Penguin to bring Gotham City under his control. Burton originally did not want to direct another Batman film. Warner Bros. developed a script with Sam Hamm which had the Penguin and Catwoman going after hidden treasure. Burton agreed to return after they granted him more creative control and replaced Hamm with Daniel Waters. Wesley Strick was later chosen to do an uncredited rewrite shortly before filming. This included normalizing dialogue, fleshing out the Penguin's

MOTIVATIONS and master plan, and removing scenes due to budget concerns. Strick continued working as the on-set writer through filming. Annette Bening was originally cast as Catwoman, but became pregnant and was replaced with Pfeiffer. Batman Returns was released on June 19, 1992. It grossed \$266.8 million worldwide on a total budget of \$80 million and received positive reviews. Critics praised its action sequences, performances, Danny Elfman's score, effects and villains, although its dark tone and high level of violence for a PG-13 film, was criticized. The film was nominated for two Academy Awards: Best Visual Effects and Best Makeup, as well as two BAFTA awards. A stand- alone sequel, Batman Forever, was released in 1995, with Val Kilmer replacing Keaton as Batman. An alternate comic book continuation, which ignores the events of the subsequent films, will be published by DC Comics starting in July 2021. Keaton is also set to reprise the role of Batman in the DC Extended Universe beginning with The Flash (2022).

sults					
1 - 10 of 10					
DO DETA PENTATHLER	Title The Do-Deca-Pentathlon	Awards		Nominations NONE	Genre
CHAMPIONS	Champions	NONE	2023	NONE	Comedy,Sport
TRACKS	Across the Tracks	NONE	1991	NONE	Drama,Action
HUSTLE	Hustle	NONE	2022	NONE	Sport





- 3 of 3						
Woody Harrelson	Title	Awards	Year Nominations		Genre	
CHAMPIONS The second of the s	Champions	NONE	2023	NONE	Comedy,Sport	
SWEETWATER	Sweetwater	NONE	2023	NONE	Biography,Spc	
TO THE REPAINS	80 for Brady	NONE	2023	NONE	Sport,Comedy	





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

Vector Database



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

lt's just an array ...

50 21 16 42 33

The dimension is "Now many numbers"





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

Comparing numbers is trivial

$$100 > 50 = true$$

How to compare complex data types?





How to search for search complex data types?

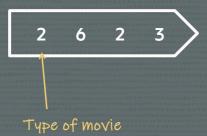


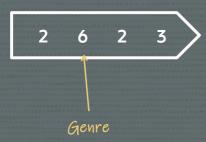


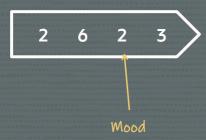




- Search vector data using vector indexes
- Calculate the vector distance







2 6 2 3 3 3 1 2 8

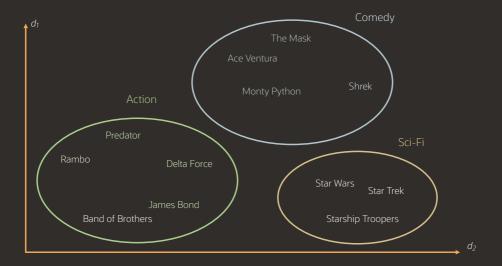
Distance (Euclidean Squared) =
$$(3-2)^2+(1-6)^2+(2-2)^2+(8-3)^2$$



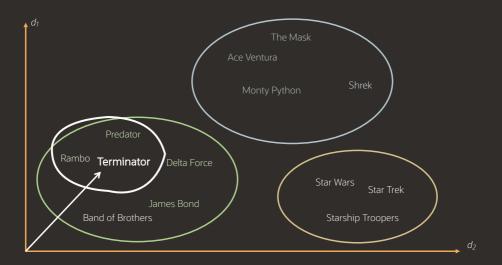
Vector Database



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









How do you convert your data into vectors?







Embedding models transform your data into a vector



10,000 GPU?



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







































Included in any edition of Oracle Database 23ai

No extra license required



Get the best of both worlds with JSON Duality Views







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

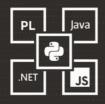
SQL Firewall

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



Oracle Database 23ai

Even More Secure





No more insecure case insensitive password

• 10G password verifies are no longer accepted





Grant privileges to an entire schema in one command

• grant ... on schema ... to ...



Oracle Database 23ai

Small, but useful



```
-- Regardless of whether the object exists or not,
-- the DROP command don't produce an error
SQL> drop table t1;
FRROR 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 ( ... );
FRROR 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:

<code>ORA-12154:</code> Cannot connect to database. Could not find alias alias_does_not_exist in

/opt/oracle/product/23ai/dbhome_1/network/admin/tnsnames.ora.

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



SQL> ping salesgold

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

Ok (1.177 msec)



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

exec dbms_space.tablespace_shrink('USERS');



Tablespace Shrink

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



the most important change

--No longer need to select from dual

select sysdate from dual;

select sysdate;



Key Learnings



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

Oracle

DBAs

run the world



+++++

YouTube | Oracle Database Upgrades and Migrations



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

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





Thank You

