Upgrade, Migration and Patching to Oracle AI Database 26ai EXTREME EDITION

Brussels, May 2026

Photo by Maurice Sahl on Unsplash

Oracle

DBAs

run the world

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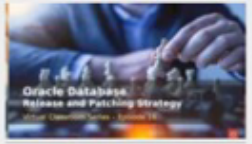
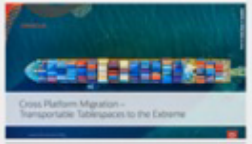
Virtual Classroom Seminars	Slides
Episode 16 (replaces Episode 1 from Feb 2021) Oracle Database Release and Patching Strategy for 19c and 23c *115 minutes – May 10, 2023*	
Episode 17 From SR to Patch – Insights into the Oracle Database Development process *55 minutes – June 22, 2023*	
Episode 18 Cross 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 Multitenant PART 2 *100 min – June 28, 2024*	
Episode 21 One-Button Patching with AutoUpgrade – Easing every DBA's life *55 min – October 24, 2024*	

Recorded Web Seminars

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09:30
Welcome
Upgrade to 26ai
Internals

11:00
Coffee break

11:15
Next-level patching
Grid Infrastructure

12:45
Lunch

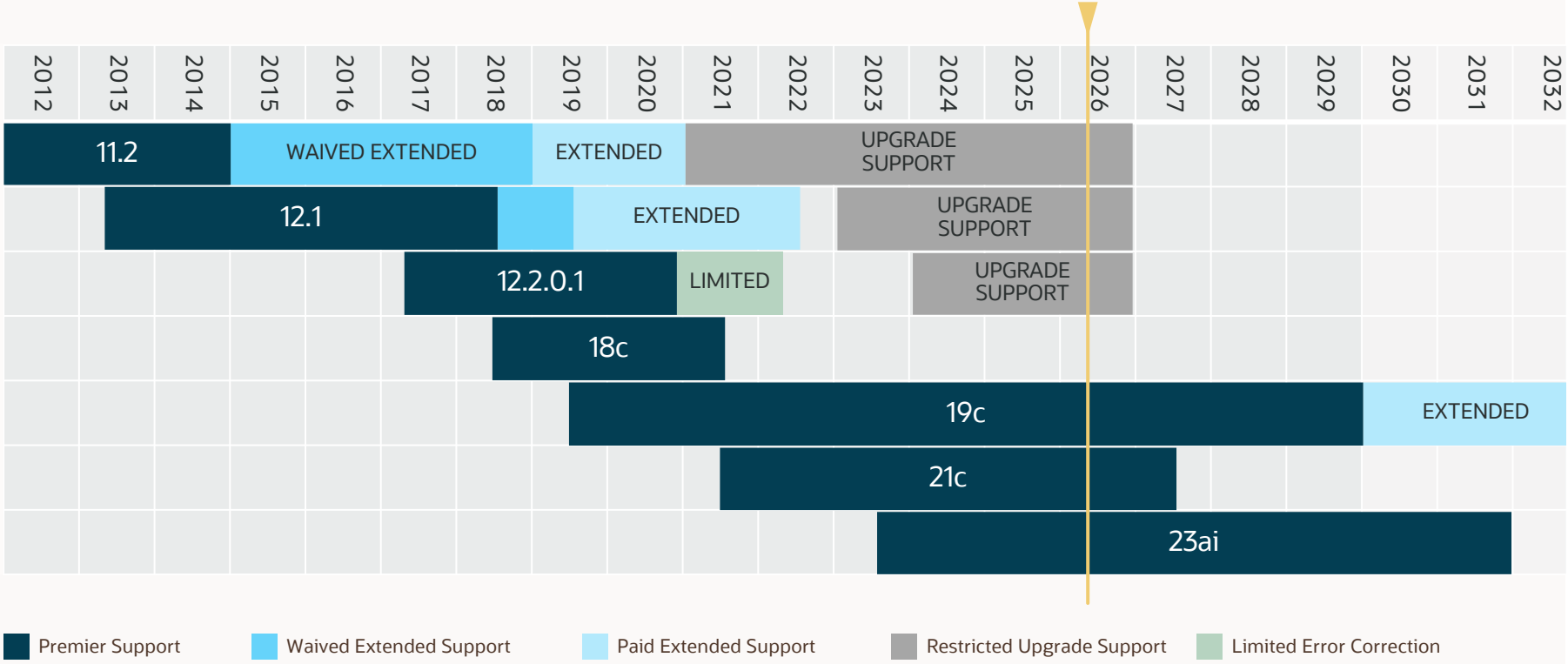
13:30
Performance/migrations
Statistics

15:00
Coffee break

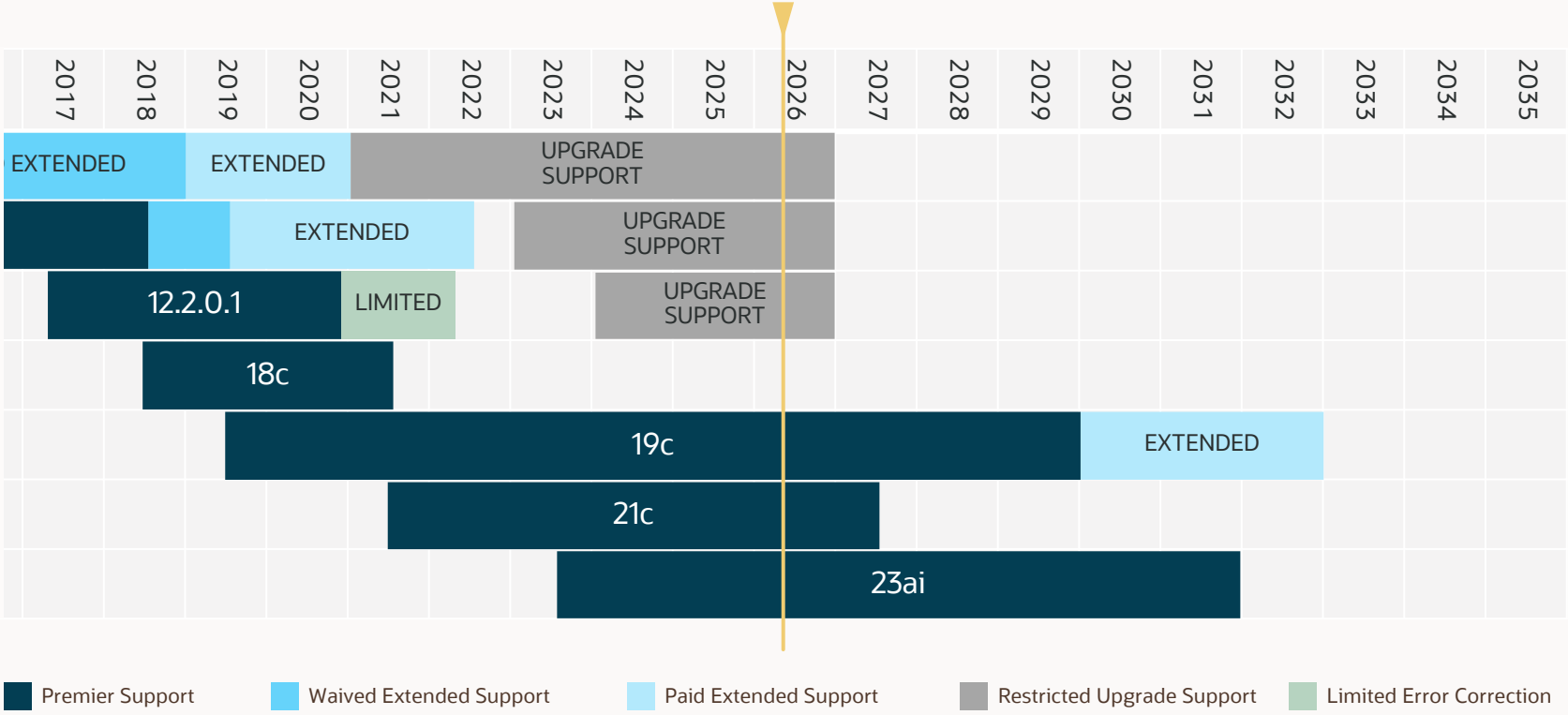
15:15
AutoMigrate
DBA vs. AI

Upgrade to 26ai

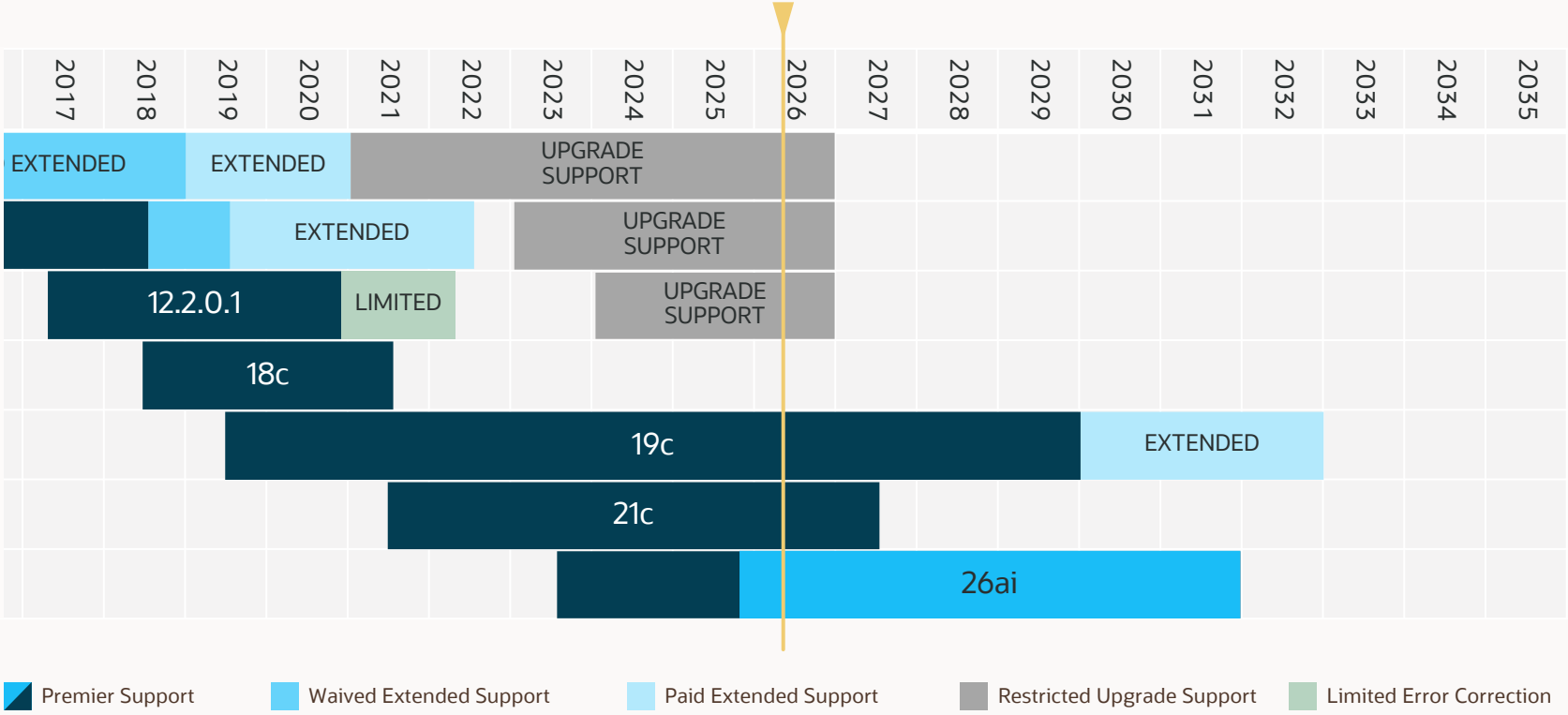
Lifetime Support Policy



Lifetime Support Policy



Lifetime Support Policy



Oracle strongly recommends that you upgrade to a Long Term Support Release

- Oracle Database 19c or Oracle AI Database 26ai

26ai

When will it be available on-prem?

On-Premises Server Releases (includes client)

(Download here)

Linux x86	*Not Planned*	*Not Planned*	*Not planned*	*Not planned*	*Not planned*	*Not planned*	*Not planned*	28-Aug-2013		
Linux x86-64	January 2026 Release Update (23.26.1) (Instant Client and Full Client are available today)	13-Aug-2021	25-Apr-2019	23-Jul-2018	1-Mar-2017	22-Jul-2014	25-Jun-2013	27-Aug-2013		
Linux on Arm	*TBA*	*Not Planned*	28-June-2023 Client: May-2021 download	*Not Planned*	*Not Planned*	*Not Planned*	*Not Planned*	*Not Planned*		
Oracle Solaris SPARC (64-	*TBA*	*See KB126264*	26-Apr-2019	30-Jul-2018	1-Mar-2017	22-Jul-2014	25-Jun-2013	29-Aug-2013		

26ai

What about the other platforms?

Platforms

Microsoft Windows x64 (64-bit)

IBM AIX on POWER Systems

- CY2026

Oracle Solaris SPARC (64-bit)

IBM Linux on System z

- CY2027

Linux on Arm

- TBA

Release Schedule of Current Database Releases (PNEWS1360)

26ai

There is no need to re-certify your app

- Certification for Oracle Database 23ai applies to Oracle AI Database 26ai

Types of Upgrades

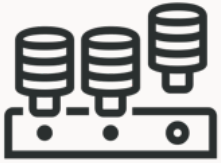
Types of Upgrades

CDB
upgrade

PDB
unplug-plug

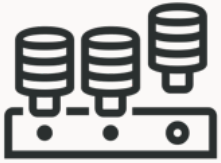
Non-CDB
upgrade and convert

CDB Upgrade



- Upgrades entire CDB including all PDBs
- *Many-as-one* principle
- Less work, more automation
- In-place upgrade, no extra resources needed
- Supports Flashback Database
- Seamless Data Guard + RMAN integration
- At least 30-45 minutes, possibly hours

CDB Upgrade



- Less control
- Common SLAs needed

PDB Upgrade

- Upgrades single PDB
- More flexibility
- More control
- Typically 10-30 minutes

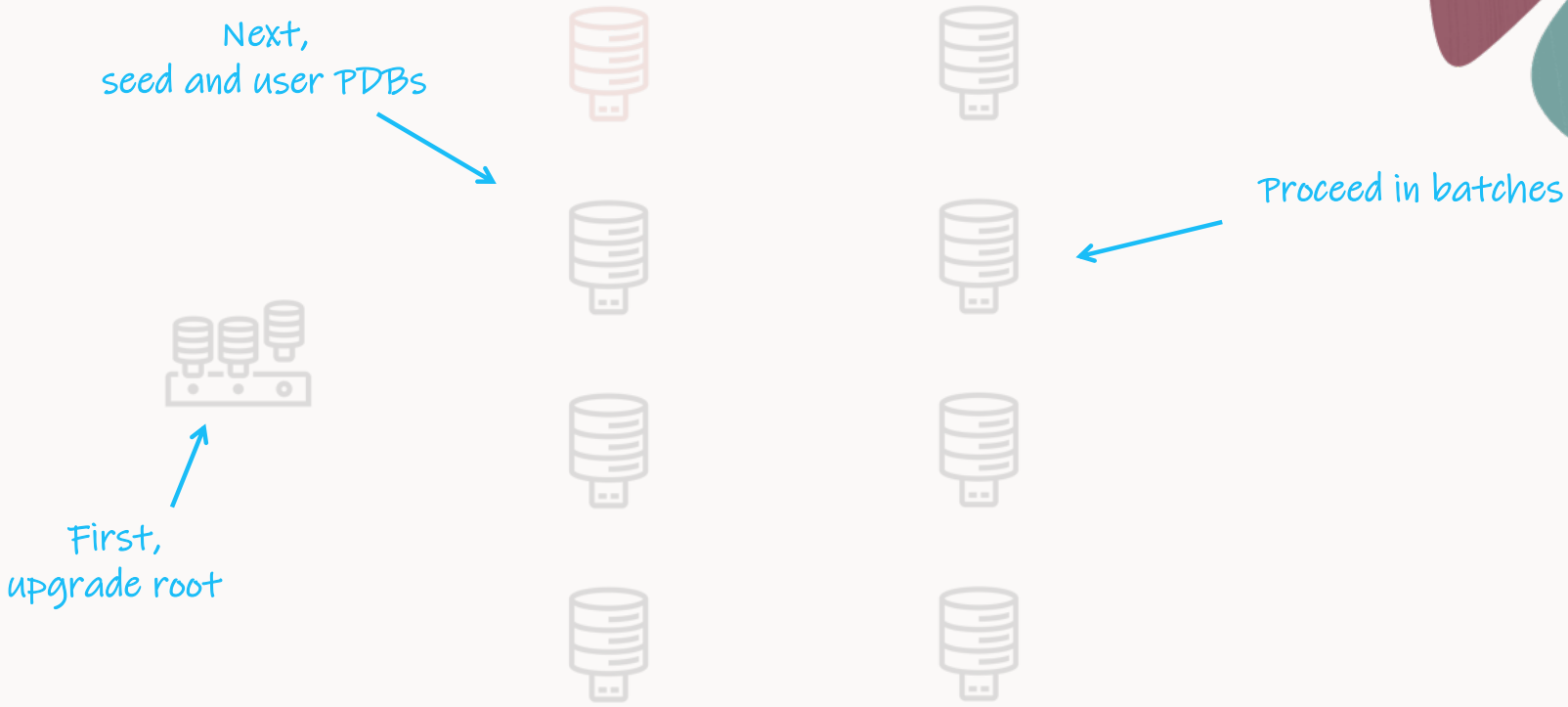
PDB Upgrade

- Additional CDB needed
- Out-of-place upgrade, extra resources needed
- PDB is moved or cloned
- No support for Flashback Database
- Extra work for Data Guard
- Restore between containers requires pre-plugin backups

Non-CDB to PDB

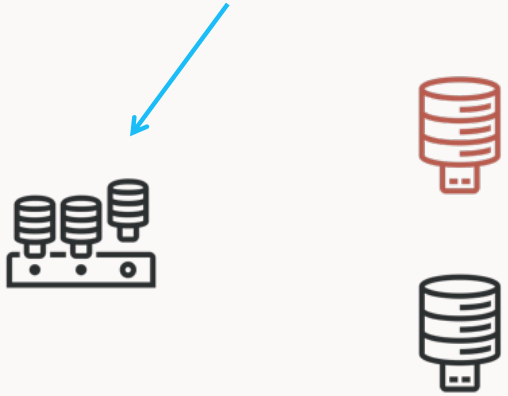
- Similar to unplug-plug upgrade
- One-time conversion
- Irreversible
- No support for Flashback Database
- Extra work for Data Guard
- Typically 5-10 minutes
- Restore requires pre-plugin backups

Comparing CDB and PDB upgrades

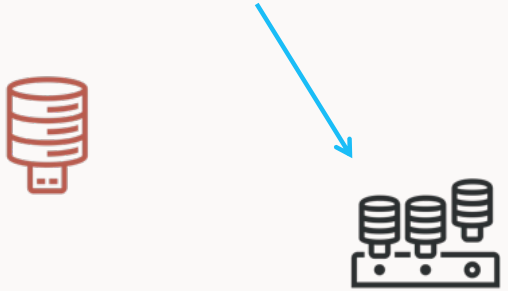


Single tenant,
always two batches

Oracle Database 19c



Oracle AI Database 26ai



Unplug-plug upgrades are faster than upgrading an entire CDB

Comparing UPGRADE types

	CDB upgrade	PDB upgrade	PDB conversion
Time	Longest	Shorter	Very short
Complexity	Easy	Moderate	Moderate
Outage	One big outage	Many smaller outages	Many smaller outages
Rollback	Flashback Database	Other rollback options	Other rollback options
Data Guard + RMAN	Seamless integration	Extra work	Extra work

Upgrading an entire CDB

```
global.global_log_dir=/home/oracle/autoupgrade/logs/CDB1
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/26
upg1.sid=CDB1
```

```
global.global_log_dir=/home/oracle/autoupgrade/logs/CDB19
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/26
upg1.sid=CDB1
upg1.timezone_upg=no
```

```
global.global_log_dir=/home/oracle/autoupgrade/logs/CDB1
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/26
upg1.sid=CDB1
upg1.timezone_upg=no
upg1.run_dictionary_health=full
```

```
global.global_log_dir=/home/oracle/autoupgrade/logs/CDB1
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/26
upg1.sid=CDB1
upg1.timezone_upg=no
upg1.run_dictionary_health=full
upg1.raise_compatible=yes
```

```
global.global_log_dir=/home/oracle/autoupgrade/logs/CDB1
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/26
upg1.sid=CDB1
upg1.timezone_upg=no
upg1.run_dictionary_health=full
upg1.raise_compatible=yes
upg1.emcli_path=/u01/app/oracle/oem
upg1.em_target_name=CDB1_myhost.domain.int
```

```
global.global_log_dir=/home/oracle/autoupgrade/logs/CDB1
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/26
upg1.sid=CDB1
upg1.timezone_upg=no
upg1.run_dictionary_health=full
upg1.raise_compatible=yes
upg1.emcli_path=/u01/app/oracle/oem
upg1.em_target_name=CDB1_myhost.domain.int
upg1.rman_catalog_connect_string=catalogdb
```

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

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

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

Use AutoUpgrade to download patches and install Oracle home

Upgrade

- Webinar: Best Practices for Upgrading to Oracle AI Database 26ai
- Blog post: Upgrade to Oracle AI Database 26ai

Upgrade Internals

Oracle home

Binaries

Database

Data dictionary

Binaries and data dictionary release must match

Oracle Database 19c

Data dictionary 19c

Oracle AI Database 26ai

Data dictionary 26ai

Database Upgrade Guide

3 Upgrading to the New Oracle Database 10*g* Release

This chapter guides you through the process of upgrading a database to the new Oracle Database 10*g* release. This chapter covers the following topics:

- System Considerations and Requirements
- Install the Release 10.2 Oracle Software
- Install the Latest Available Patch Set Release and Any Required Patches

9. Set the system to spool results to a log file for later verification of success:

```
SQL> SPOOL upgrade.log
```

10. Run `catupgrd.sql`:

```
SQL> @catupgrd.sql
```

The `catupgrd.sql` script determines which upgrade scripts need to be run and then runs each necessary script. You must run the script in the new release 10.2 environment.

The upgrade script creates and alters certain data dictionary tables. It also upgrades or installs the following database components in the new release 10.2 database:

- Oracle Database Catalog Views
- Oracle Database Packages and Types
- JServer JAVA Virtual Machine

dbua
dbupgrade

catctl

@catupgrd.sql

@@catupstr.sql
@@catalog.sql
@@cdstrt.sql
@@cdfixed.sql
...
@catshutdown.sql

~~dbua~~

~~dbupgrade~~

```
java -jar autoupgrade.jar -config UPGR26.cfg -mode deploy
```

catctl

@catupgrd.sql

@@catupstr.sql
@@catalog.sql
@@cdstrt.sql
@@cdfixed.sql
...
@catshutdown.sql

`catupgrd.sql` Overview

Initialize

- i-script / c-script

RDBMS upgrade

- catalog/catproc
- a-script

Components

- javavm,dv,ols,sdo,...

Finalizing

- bootstrap upgrade

```
$ ll $ORACLE_HOME/rdbms/admin

-rw-r-----. 1 oracle oinstall 46693 Feb 10 2025   a19.sql
-rw-r-----. 1 oracle oinstall 11261 Nov 10 2022   a20.sql
-rw-r-----. 1 oracle oinstall 113582 Jul 4 06:47  a21.sql

-rw-r-----. 1 oracle oinstall 106648 Feb 27 2025  c19.sql
-rw-r-----. 1 oracle oinstall 70597 Oct 18 2024   c20.sql
-rw-r-----. 1 oracle oinstall 406297 Jul 10 06:42 c21.sql

-rw-r-----. 1 oracle oinstall 3933 Jul 20 2020    i19.sql
-rw-r-----. 1 oracle oinstall 3712 Nov 23 2022    i20.sql
-rw-r-----. 1 oracle oinstall 13877 Oct 9 2024    i21.sql
```

```
$ ll $ORACLE_HOME/rdbms/admin

-rw-r-----. 1 oracle oinstall 46693 Feb 10 2025   a19.sql
-rw-r-----. 1 oracle oinstall 11261 Nov 10 2022   a20.sql
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-rw-r-----. 1 oracle oinstall 3933 Jul 20 2020    i19.sql
-rw-r-----. 1 oracle oinstall 3712 Nov 23 2022    i20.sql
-rw-r-----. 1 oracle oinstall 13877 Oct 9 2024    i21.sql
```

```
$ vi i19.sql

(output truncated)

Rem ============================================================================
Rem Bug 28618619: Add new col to lob$ and lobfrag$, with values
Rem               4000 for enable and 0 for disable storage in row
Rem ============================================================================

alter table lob$ add maxinl number;
update lob$ set maxinl =
               case when bitand(property, 2) != 0 then 4000 else 0 end;
commit;
alter table lob$ modify maxinl not null;

alter table lobfrag$ add maxinl number;
update lobfrag$ set maxinl =
                  case when bitand(fragpro, 2) != 0 then 4000 else 0 end;
commit;
alter table lobfrag$ modify maxinl not null;
```


Upgrading from Oracle Database 19c to Oracle AI Database 26ai:

- 20,000 `CREATE OR REPLACE`
- 7,000 `CREATE ...`
- 1,500 `ALTER TABLE`
- 300 `ALTER TYPE`
- 7,000 `ALTER SESSION`
- … and many more statements

Parallel Upgrade

```
$ vi catupgrd.sql
```

```
Rem
Rem Initial checks and RDBMS upgrade scripts
Rem
@@catupstr.sql

Rem
Rem Execute upgrade and catalog session script
Rem
@@catupses.sql    --CATFILE -SES
@@catalogses.sql  --CATFILE -SESS
@@catalogses.sql  --CATFILE -SESS

Rem
Rem Run catalog with some multiprocess phases
Rem
@@catalog.sql     --CATFILE -X

Rem
Rem Execute catproc session script
Rem
@@catprocses.sql  --CATFILE -SESE -SESS

Rem
Rem Run catproc with some multiprocess phases
Rem
@@catproc.sql     --CATFILE -X
```

```
Rem
Rem Initial checks and RDBMS upgrade scripts
Rem
@@catupstr.sql

Rem
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Rem
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@@catprocses.sql  --CATFILE -SESE -SESS

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@@catproc.sql     --CATFILE -X
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Rem Execute catproc session script
Rem
@@catprocses.sql  --CATFILE -SESE -SESS

Rem
Rem Run catproc with some multiprocess phases
Rem
@@catproc.sql     --CATFILE -X
```

```
--CATCTL -S -D "Catalog Core SQL"    Initial scripts single process
@@cdstrt.sql
@@cdfixed.sql
@@catcdbviews.sql
@@catblock.sql
@@cdcore.sql

--CATCTL -R
--CATCTL -M -D "Catalog Tables and Views"
@@cdplsql.sql
@@cdsqlddl.sql
@@cdmanage.sql
@@cdtxnspc.sql
@@cdenv.sql
@@cdrac.sql
@@cdsec.sql
@@cdobj.sql
@@cdjava.sql
@@cdpart.sql
@@cdrep.sql
@@cdaw.sql
@@cdsummgt.sql
@@cdtools.sql
@@cdexttab.sql
@@cddm.sql
@@cdclst.sql
```

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@@cdrac.sql
@@cdsec.sql
@@cdobj.sql
@@cdjava.sql
@@cdpart.sql
@@cdrep.sql
@@cdaw.sql
@@cdsummgt.sql
@@cdtools.sql
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@@cdclst.sql
```

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@@cdrac.sql
@@cdsec.sql
@@cdobj.sql
@@cdjava.sql
@@cdpart.sql
@@cdrep.sql
@@cdaw.sql
@@cdsummgt.sql
@@cdtools.sql
@@cdexttab.sql
@@cddm.sql
@@cdclst.sql
```

```
$ grep "jloaiza" catalog.sql

Rem     jloaiza    06/20/94 -  fix all_tables
Rem     jloaiza    06/16/94 -  add disable dml locks
Rem     jloaiza    05/23/94 -  add new fixed views
Rem     jloaiza    10/28/92 -  add v$db_object_cache and v$open_cursor
```



Juan Loaiza
EVP, Database Technologies, Oracle

```
Rem
Rem Run catproc with some multiprocess phases
Rem
@@catproc.sql     --CATFILE -X

--CATCTL -R
--CATCTL -S -D "Final RDBMS scripts"
Rem
Rem Final RDBMS upgrade scripts
Rem
@@catupprc.sql

Rem
Rem Upgrade components with some multiprocess phases
Rem
@@cmpupgrd.sql    --CATFILE -X -SESE

--CATCTL -S -D "Final Upgrade scripts"
Rem
Rem Final upgrade scripts
Rem
@@catupend.sql
```

```
--CATCTL -M  -D "Upgrading Java and non-Java"
Rem
Rem Java upgrade (JAVAVM, XML, CATJAVA)
Rem
@@cmpupjav.sql

Rem
Rem non-Java dependent upgrades (include XDB and Dependent since all
Rem     single process while Java components being upgraded in other single
Rem     process):
Rem     APS, AMD, OLS, DV, CONTEXT, XDB, OWM, MGW, RAC
Rem
@@cmpupnjv.sql

--CATCTL -R
--CATCTL -S
Rem
Rem Extracted grants/revokes of bootstrap tables for component scripts
Rem These are run serially as to not run into timeout/deadlocking issues
Rem
@@cmpupprv.sql

--CATCTL -R -D "Upgrading XDB"
Rem
Rem Oracle XDB (uses catctl directly)
Rem
--CATCTL -CP XDB -X
```

```
--CATCTL -M  -D "Upgrading Java and non-Java"
Rem
Rem Java upgrade (JAVAVM, XML, CATJAVA)
Rem
@@cmpupjav.sql

Rem
Rem non-Java dependent upgrades (include XDB and Dependent since all
Rem     single process while Java components being upgraded in other single
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Rem     APS, AMD, OLS, DV, CONTEXT, XDB, OWM, MGW, RAC
Rem
@@cmpupnjv.sql

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--CATCTL -S
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Rem
@@cmpupprv.sql

--CATCTL -R -D "Upgrading XDB"
Rem
Rem Oracle XDB (uses catctl directly)
Rem
--CATCTL -CP XDB -X
```

```
$ pwd
/u02/app/oracle/autoupgrade/runs/LONGHORN1/LONGHORN1/101/dbupgrade

$ vi autoupgrade*cdbroot.log
```

```
----------------------------------------------------
Phases [0-106]         Start Time:[2025_08_22 18:00:46]
Container Lists Inclusion:[CDB$ROOT] Exclusion:[NONE]
----------------------------------------------------
***********   Executing Change Scripts   ***********
Serial   Phase #:0    [CDB$ROOT] Files:1    Time: 51s
***************   Catalog Core SQL   ***************
Serial   Phase #:1    [CDB$ROOT] Files:5    Time: 40s
Restart  Phase #:2    [CDB$ROOT] Files:1    Time: 0s
***********   Catalog Tables and Views   ***********
Parallel Phase #:3    [CDB$ROOT] Files:21   Time: 18s
Restart  Phase #:4    [CDB$ROOT] Files:1    Time: 0s
*************   Catalog Final Scripts   ************
Serial   Phase #:5    [CDB$ROOT] Files:7    Time: 12s
*****************   Catproc Start   *****************
Serial   Phase #:6    [CDB$ROOT] Files:1    Time: 9s
*****************   Catproc Types   *****************
Serial   Phase #:7    [CDB$ROOT] Files:2    Time: 9s
Restart  Phase #:8    [CDB$ROOT] Files:1    Time: 0s

(output truncated)

***   End PDB Application Upgrade Post-Shutdown   **
Serial   Phase #:104  [CDB$ROOT] Files:2    Time: 101s
Serial   Phase #:105  [CDB$ROOT] Files:1    Time: 0s
Serial   Phase #:106  [CDB$ROOT] Files:1     Time: 24s
Serial   Phase #:106  [CDB$ROOT] Files:1     Time: 24s
```

```
Phases [0-106]         Start Time:[2025_08_22 18:00:46]
Container Lists Inclusion:[CDB$ROOT] Exclusion:[NONE]
**********   Executing Change Scripts   **********
Serial   Phase #:0    [CDB$ROOT] Files:1     Time: 51s
***************   Catalog Core SQL   ***************
Serial   Phase #:1    [CDB$ROOT] Files:5     Time: 40s
Restart  Phase #:2    [CDB$ROOT] Files:1     Time: 0s
**********   Catalog Tables and Views   **********
Parallel Phase #:3    [CDB$ROOT] Files:21
Restart  Phase #:4    [CDB$ROOT] Files:1
*************   Catalog Final Scripts   ****
Serial   Phase #:5    [CDB$ROOT] Files:7
*****************   Catproc Start   ********
Serial   Phase #:6    [CDB$ROOT] Files:1
*****************   Catproc Types   ********
Serial   Phase #:7    [CDB$ROOT] Files:2
Restart  Phase #:8    [CDB$ROOT] Files:1

(output truncated)

***   End PDB Application Upgrade Post-Shutd
Serial   Phase #:104  [CDB$ROOT] Files:2
Serial   Phase #:105  [CDB$ROOT] Files:1
Serial   Phase #:106  [CDB$ROOT] Files:1
Serial   Phase #:106  [CDB$ROOT] Files:1     Time: 24s
```

```
--CATCTL -S -D "Catalog Core SQL"    Initial scripts single process
@@cdstrt.sql
@@cdfixed.sql
@@catcdbviews.sql
@@catblock.sql
@@cdcore.sql

--CATCTL -R
--CATCTL -M -D "Catalog Tables and Views"
@@cdplsql.sql
@@cdsqlddl.sql
@@cdmanage.sql
@@cdtxnspc.sql
@@cdenv.sql
@@cdrac.sql
@@cdsec.sql
@@cdobj.sql
@@cdjava.sql
```

```
----------------------------------------------------
Phases [0-106]         Start Time:[2025_08_22 18:00:46]
Container Lists Inclusion:[CDB$ROOT] Exclusion:[NONE]
----------------------------------------------------
**********   Executing Change Scripts   **********
Serial   Phase #:0    [CDB$ROOT] Files:1     Time: 51s
***************   Catalog Core SQL   ***************
Serial   Phase #:1    [CDB$ROOT] Files:5     Time: 40s
Restart  Phase #:2    [CDB$ROOT] Files:1     Time: 0s
**********   Catalog Tables and Views   **********
Parallel Phase #:3    [CDB$ROOT] Files:21
Restart  Phase #:4    [CDB$ROOT] Files:1
*************   Catalog Final Scripts   ****
Serial   Phase #:5    [CDB$ROOT] Files:7
*****************   Catproc Start   ********
Serial   Phase #:6    [CDB$ROOT] Files:1
*****************   Catproc Types   ********
Serial   Phase #:7    [CDB$ROOT] Files:2
Restart  Phase #:8    [CDB$ROOT] Files:1

(output truncated)

***   End PDB Application Upgrade Post-Shutd
Serial   Phase #:104  [CDB$ROOT] Files:2
Serial   Phase #:105  [CDB$ROOT] Files:1
Serial   Phase #:106  [CDB$ROOT] Files:1
Serial   Phase #:106  [CDB$ROOT] Files:1     Time: 24s
```

```
--CATCTL -S -D "Catalog Core SQL"   Initial scripts single process
@@cdstrt.sql
@@cdfixed.sql
@@catcdbviews.sql
@@catblock.sql
@@cdcore.sql

--CATCTL -R
--CATCTL -M -D "Catalog Tables and Views"
@@cdplsql.sql
@@cdsqlddl.sql
@@cdmanage.sql
@@cdtxnspc.sql
@@cdenv.sql
@@cdrac.sql
@@cdsec.sql
@@cdobj.sql
@@cdjava.sql
```

```
----------------------------------------------------
Phases [0-106]         Start Time:[2025_08_22 18:00:46]
Container Lists Inclusion:[CDB$ROOT] Exclusion:[NONE]
----------------------------------------------------
**********   Executing Change Scripts   **********
Serial   Phase #:0    [CDB$ROOT] Files:1     Time: 51s
***************   Catalog Core SQL   ***************
Serial   Phase #:1    [CDB$ROOT] Files:5     Time: 40s
Restart  Phase #:2    [CDB$ROOT] Files:1     Time: 0s
**********   Catalog Tables and Views   **********
Parallel Phase #:3    [CDB$ROOT] Files:21
Restart  Phase #:4    [CDB$ROOT] Files:1
*************   Catalog Final Scripts   ****
Serial   Phase #:5    [CDB$ROOT] Files:7
*****************   Catproc Start   ********
Serial   Phase #:6    [CDB$ROOT] Files:1
*****************   Catproc Types   ********
Serial   Phase #:7    [CDB$ROOT] Files:2
Restart  Phase #:8    [CDB$ROOT] Files:1

(output truncated)

***   End PDB Application Upgrade Post-Shutd
Serial   Phase #:104  [CDB$ROOT] Files:2
Serial   Phase #:105  [CDB$ROOT] Files:1
Serial   Phase #:106  [CDB$ROOT] Files:1
Serial   Phase #:106  [CDB$ROOT] Files:1     Time: 24s
```

```
--CATCTL -S -D "Catalog Core SQL"    Initial scripts single process
@@cdstrt.sql
@@cdfixed.sql
@@catcdbviews.sql
@@catblock.sql
@@cdcore.sql

--CATCTL -R
--CATCTL -M -D "Catalog Tables and Views"
@@cdplsql.sql
@@cdsqlddl.sql
@@cdmanage.sql
@@cdtxnspc.sql
@@cdenv.sql
@@cdrac.sql
@@cdsec.sql
@@cdobj.sql
@@cdjava.sql
```

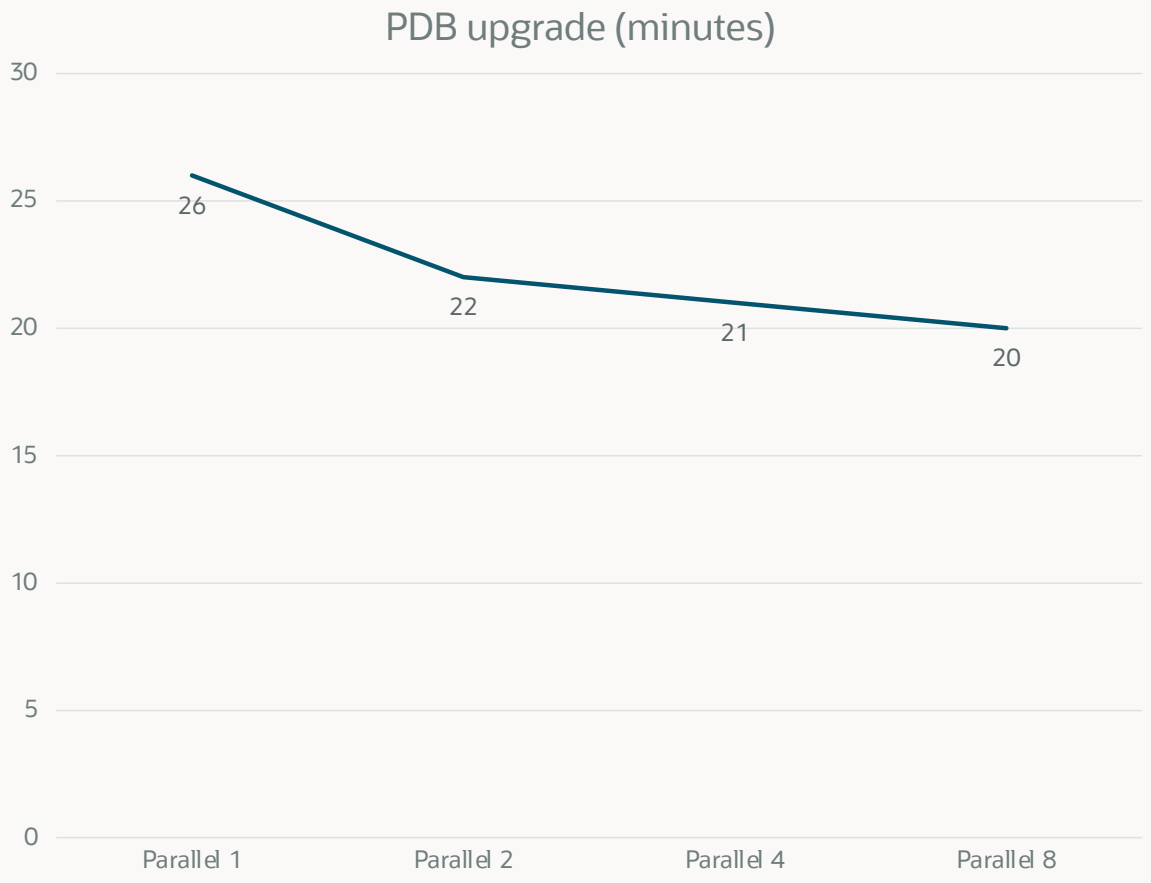
For parallel upgrade, AutoUpgrade

- Uses 8 threads for CDB$ROOT
- Uses 2 threads per PDB
- Upgrades CPU_COUNT / 2 PDBs concurrently

For parallel upgrade, AutoUpgrade

- Uses 8 threads for CDB$ROOT
- Uses 2 threads per PDB
  - Overridable with `upg1.catctl_options=-N <value>`
- Upgrades CPU_COUNT / 2 PDBs concurrently
  - Overridable with `upg1.catctl_options=-n <value>`

More threads leads to more contention



Scale by upgrading
more PDBs concurrently

Upgrade Details

You must `startup upgrade` to upgrade a database

- Enables restricted session

```
ALTER SYSTEM SET "_SYSTEM_TRIG_ENABLED" = FALSE
                 "_UNDO_AUTOTUNE"       = FALSE
                 AQ_TM_PROCESSES        = 0
                 DB_SECUREFILE          = PERMITTED
                 ENABLE_DDL_LOGGING     = FALSE
                 PLSQL_WARNINGS         = 'DISABLE:ALL'
                 RECYCLEBIN             = OFF
                 RESOURCE_MANAGER_PLAN  = ''
                 UNDO_RETENTION         = 900
```

```
SQL> startup upgrade
ORACLE instance started.

Total System Global Area 1002435912 bytes
Fixed Size                  8947016 bytes
Variable Size             272629760 bytes
Database Buffers          713031680 bytes
Redo Buffers                7827456 bytes
Database mounted.
Database opened.

SQL> create table t1 (c1 number);

Table created.

SQL> create table t1 (c1 number);

Table created.

SQL> create table t1 (c1 number);

Table created.
```

A restart is the only way out of *upgrade* mode

AutoUpgrade recompiles invalid objects at the end

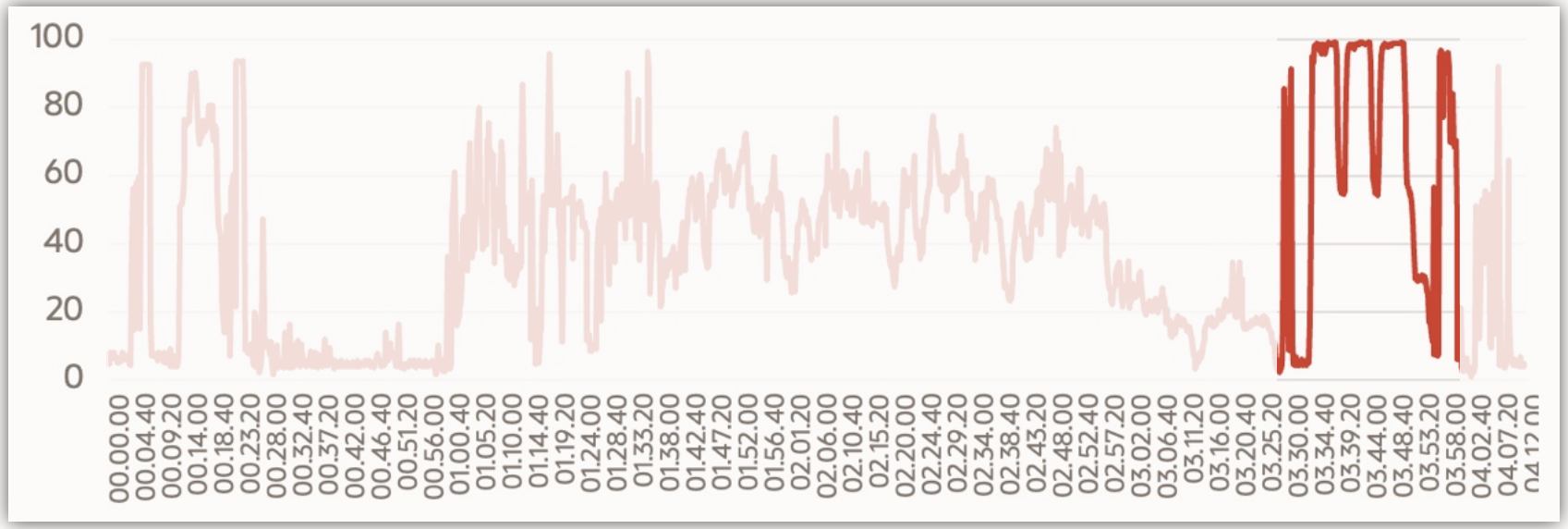
- Only those owned by Oracle-maintained schemas

```
@?/rdbms/admin/utlrp
```

~~@?/rdbms/admin/utlrp~~

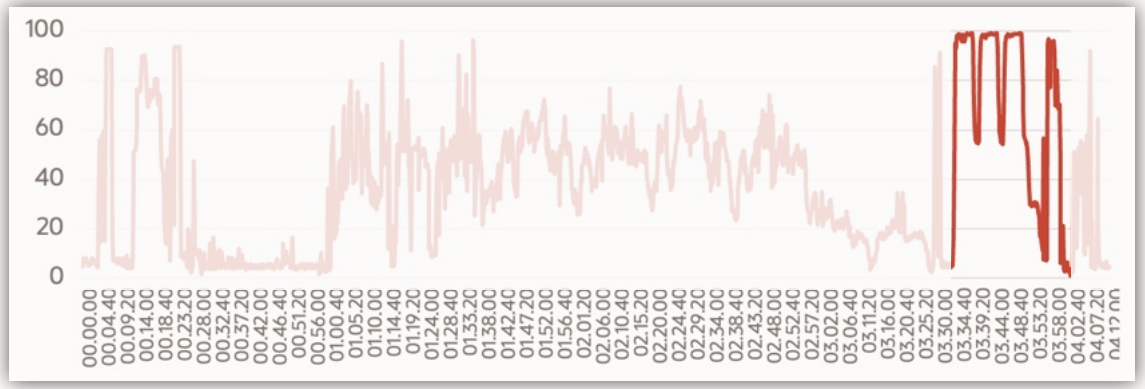
```
@?/rdbms/admin/utlprpom.sql <n>
```

Recompilation



Recompilation

- Uses the scheduler (`DBMS_SCHEDULER`) to parallelize
- Lowering `JOB_QUEUE_PROCESSES` might limit the recompilation
- Very CPU intensive



Bootstrapping

```
STARTUP MOUNT

ALTER SESSION SET EVENTS '10046 TRACE NAME CONTEXT FOREVER, LEVEL 12';

ALTER DATABASE OPEN;
```

```
grep -i "CREATE TABLE" FTEX_ora_328857.trc | cut -c1-100
```

```
create table bootstrap$ ( line#         number not null,   obj#          number not null,   sql_tex
CREATE TABLE TAB$("OBJ#" NUMBER NOT NULL,"DATAOBJ#" NUMBER,"TS#" NUMBER NOT NULL,"FILE#" NUMBER NOT
CREATE TABLE CLU$("OBJ#" NUMBER NOT NULL,"DATAOBJ#" NUMBER,"TS#" NUMBER NOT NULL,"FILE#" NUMBER NOT
CREATE TABLE FET$("TS#" NUMBER NOT NULL,"FILE#" NUMBER NOT NULL,"BLOCK#" NUMBER NOT NULL,"LENGTH" NU
CREATE TABLE UET$("SEGFILE#" NUMBER NOT NULL,"SEGBLOCK#" NUMBER NOT NULL,"EXT#" NUMBER NOT NULL,"TS#
CREATE TABLE SEG$("FILE#" NUMBER NOT NULL,"BLOCK#" NUMBER NOT NULL,"TYPE#" NUMBER NOT NULL,"TS#" NUM
CREATE TABLE UNDO$("US#" NUMBER NOT NULL,"NAME" VARCHAR2(30) NOT NULL,"USER#" NUMBER NOT NULL,"FILE#
CREATE TABLE TS$("TS#" NUMBER NOT NULL,"NAME" VARCHAR2(30) NOT NULL,"OWNER#" NUMBER NOT NULL,"ONLINE
CREATE TABLE FILE$("FILE#" NUMBER NOT NULL,"STATUS$" NUMBER NOT NULL,"BLOCKS" NUMBER NOT NULL,"TS#"
CREATE TABLE OBJ$("OBJ#" NUMBER NOT NULL,"DATAOBJ#" NUMBER,"OWNER#" NUMBER NOT NULL,"NAME" VARCHAR2(
CREATE TABLE IND$("OBJ#" NUMBER NOT NULL,"DATAOBJ#" NUMBER,"TS#" NUMBER NOT NULL,"FILE#" NUMBER NOT
CREATE TABLE ICOL$("OBJ#" NUMBER NOT NULL,"BO#" NUMBER NOT NULL,"COL#" NUMBER NOT NULL,"POS#" NUMBER
CREATE TABLE COL$("OBJ#" NUMBER NOT NULL,"COL#" NUMBER NOT NULL,"SEGCOL#" NUMBER NOT NULL,"SEGCOLLEN
CREATE TABLE USER$("USER#" NUMBER NOT NULL,"NAME" VARCHAR2(128) NOT NULL,"TYPE#" NUMBER NOT NULL,"PA
CREATE TABLE PROXY_DATA$("CLIENT#" NUMBER NOT NULL,"PROXY#" NUMBER NOT NULL,"CREDENTIAL_TYPE#" NUMBE
CREATE TABLE PROXY_ROLE_DATA$("CLIENT#" NUMBER NOT NULL,"PROXY#" NUMBER NOT NULL,"ROLE#" NUMBER NOT
CREATE TABLE CON$("OWNER#" NUMBER NOT NULL,"NAME" VARCHAR2(128) NOT NULL,"CON#" NUMBER NOT NULL,"SPA
CREATE TABLE CDEF$("CON#" NUMBER NOT NULL,"OBJ#" NUMBER NOT NULL,"COLS" NUMBER,"TYPE#" NUMBER NOT NU
CREATE TABLE CCOL$("CON#" NUMBER NOT NULL,"OBJ#" NUMBER NOT NULL,"COL#" NUMBER NOT NULL,"POS#" NUMBE
```

```
create table bootstrap$ ( line#         number not null,   obj#          number not null,   sql_tex
CREATE TABLE TAB$("OBJ#" NUMBER NOT NULL,"DATAOBJ#" NUMBER,"TS#" NUMBER NOT NULL,"FILE#" NUMBER NOT
CREATE TABLE CLU$("OBJ#" NUMBER NOT NULL,"DATAOBJ#" NUMBER,"TS#" NUMBER NOT NULL,"FILE#" NUMBER NOT
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CREATE TABLE UET$("SEGFILE#" NUMBER NOT NULL,"SEGBLOCK#" NUMBER NOT NULL,"EXT#" NUMBER NOT NULL,"TS#
CREATE TABLE SEG$("FILE#" NUMBER NOT NULL,"BLOCK#" NUMBER NOT NULL,"TYPE#" NUMBER NOT NULL,"TS#" NUM
CREATE TABLE UNDO$("US#" NUMBER NOT NULL,"NAME" VARCHAR2(30) NOT NULL,"USER#" NUMBER NOT NULL,"FILE#
CREATE TABLE TS$("TS#" NUMBER NOT NULL,"NAME" VARCHAR2(30) NOT NULL,"OWNER#" NUMBER NOT NULL,"ONLINE
CREATE TABLE FILE$("FILE#" NUMBER NOT NULL,"STATUS$" NUMBER NOT NULL,"BLOCKS" NUMBER NOT NULL,"TS#"
CREATE TABLE OBJ$("OBJ#" NUMBER NOT NULL,"DATAOBJ#" NUMBER,"OWNER#" NUMBER NOT NULL,"NAME" VARCHAR2(
CREATE TABLE IND$("OBJ#" NUMBER NOT NULL,"DATAOBJ#" NUMBER,"TS#" NUMBER NOT NULL,"FILE#" NUMBER NOT
CREATE TABLE ICOL$("OBJ#" NUMBER NOT NULL,"BO#" NUMBER NOT NULL,"COL#" NUMBER NOT NULL,"POS#" NUMBER
CREATE TABLE COL$("OBJ#" NUMBER NOT NULL,"COL#" NUMBER NOT NULL,"SEGCOL#" NUMBER NOT NULL,"SEGCOLLEN
CREATE TABLE USER$("USER#" NUMBER NOT NULL,"NAME" VARCHAR2(128) NOT NULL,"TYPE#" NUMBER NOT NULL,"PA
CREATE TABLE PROXY_DATA$("CLIENT#" NUMBER NOT NULL,"PROXY#" NUMBER NOT NULL,"CREDENTIAL_TYPE#" NUMBE
CREATE TABLE PROXY_ROLE_DATA$("CLIENT#" NUMBER NOT NULL,"PROXY#" NUMBER NOT NULL,"ROLE#" NUMBER NOT
CREATE TABLE CON$("OWNER#" NUMBER NOT NULL,"NAME" VARCHAR2(128) NOT NULL,"CON#" NUMBER NOT NULL,"SPA
CREATE TABLE CDEF$("CON#" NUMBER NOT NULL,"OBJ#" NUMBER NOT NULL,"COLS" NUMBER,"TYPE#" NUMBER NOT NU
CREATE TABLE CCOL$("CON#" NUMBER NOT NULL,"OBJ#" NUMBER NOT NULL,"COL#" NUMBER NOT NULL,"POS#" NUMBE
```

Bootstrap tables are a core part of the data dictionary

- `OBJECT_ID` below 56

```
SQL> select obj#, sql_text from bootstrap$ order by 1;

      OBJ#                                                                         SQL_TEXT
---------- --------------------------------------------------------------------------------
         0 CREATE ROLLBACK SEGMENT SYSTEM STORAGE (  INITIAL 112K NEXT 56K MINEXTENTS 1 MAX ...
         2 CREATE CLUSTER C_OBJ#("OBJ#" NUMBER) PCTFREE 5 PCTUSED 40 INITRANS 2 MAXTRANS 25 ...
         3 CREATE INDEX I_OBJ# ON CLUSTER C_OBJ# PCTFREE 10 INITRANS 2 MAXTRANS 255 STORAGE ...
         4 CREATE TABLE TAB$("OBJ#" NUMBER NOT NULL,"DATAOBJ#" NUMBER,"TS#" NUMBER NOT NULL ...
         5 CREATE TABLE CLU$("OBJ#" NUMBER NOT NULL,"DATAOBJ#" NUMBER,"TS#" NUMBER NOT NULL ...
         6 CREATE CLUSTER C_TS#("TS#" NUMBER) PCTFREE 10 PCTUSED 40 INITRANS 2 MAXTRANS 255 ...
         7 CREATE INDEX I_TS# ON CLUSTER C_TS# PCTFREE 10 INITRANS 2 MAXTRANS 255 STORAGE ( ...
         8 CREATE CLUSTER C_FILE#_BLOCK#("TS#" NUMBER,"SEGFILE#" NUMBER,"SEGBLOCK#" NUMBER) ...
         9 CREATE INDEX I_FILE#_BLOCK# ON CLUSTER C_FILE#_BLOCK# PCTFREE 10 INITRANS 2 MAXT ...
        10 CREATE CLUSTER C_USER#("USER#" NUMBER) PCTFREE 10 PCTUSED 40 INITRANS 2 MAXTRANS ...
        11 CREATE INDEX I_USER# ON CLUSTER C_USER# PCTFREE 10 INITRANS 2 MAXTRANS 255 STORA ...
        12 CREATE TABLE FET$("TS#" NUMBER NOT NULL,"FILE#" NUMBER NOT NULL,"BLOCK#" NUMBER  ...
        13 CREATE TABLE UET$("SEGFILE#" NUMBER NOT NULL,"SEGBLOCK#" NUMBER NOT NULL,"EXT#"  ...
        14 CREATE TABLE SEG$("FILE#" NUMBER NOT NULL,"BLOCK#" NUMBER NOT NULL,"TYPE#" NUMBE ...
        15 CREATE TABLE UNDO$("US#" NUMBER NOT NULL,"NAME" VARCHAR2(30) NOT NULL,"USER#" NU ...
        16 CREATE TABLE TS$("TS#" NUMBER NOT NULL,"NAME" VARCHAR2(30) NOT NULL,"OWNER#" NUM ...
        17 CREATE TABLE FILE$("FILE#" NUMBER NOT NULL,"STATUS$" NUMBER NOT NULL,"BLOCKS" NU ...
```



```
CREATE CLUSTER C_OBJ#("OBJ#" NUMBER)
PCTFREE 5 PCTUSED 40 INITRANS 2 MAXTRANS 255
STORAGE (
      INITIAL 136K NEXT 200K
      MINEXTENTS 1 MAXEXTENTS 2147483645
      PCTINCREASE 0
      OBJNO 2
      EXTENTS (FILE 1 BLOCK 144)
      ) SIZE 800
```

```
SQL> alter table registry$sqlpatch add(daniel number);

Table altered.
```

```
SQL> alter table registry$sqlpatch add(daniel number);

Table altered.

SQL> alter table tab$ add(daniel number);
alter table tab$ add(daniel number)
*
ERROR at line 1:
ORA-00701: object necessary for warmstarting database cannot be altered
```

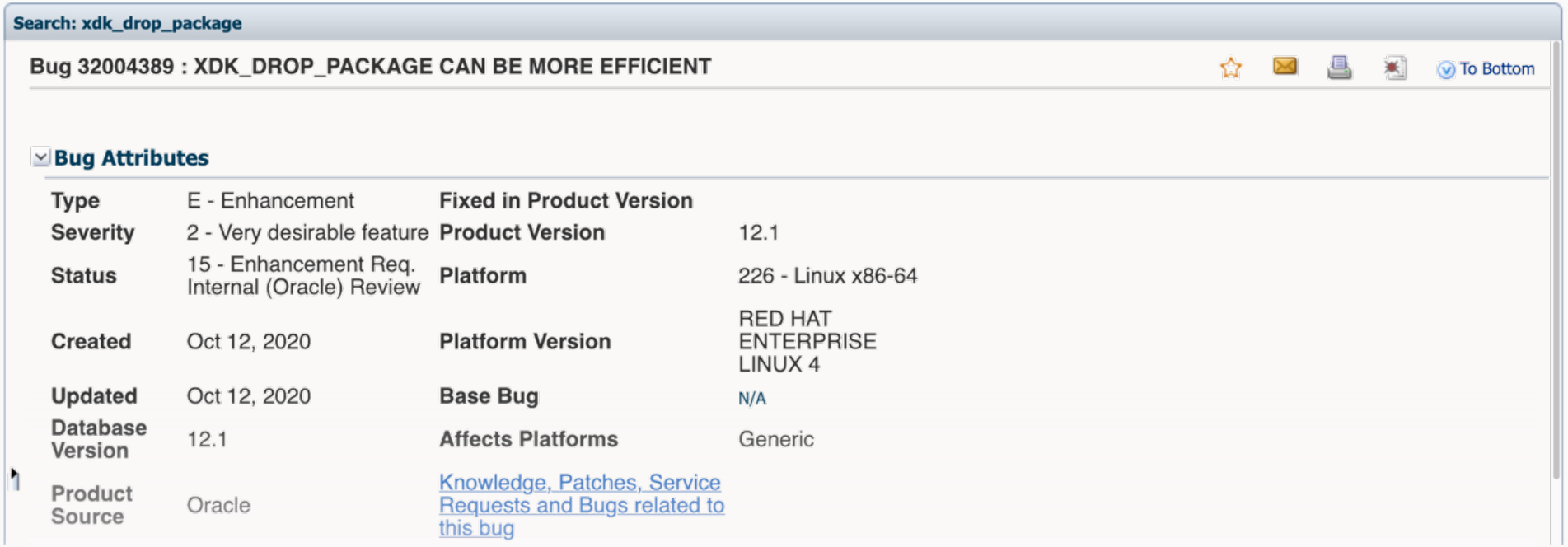

```
SQL> startup

ORA-01092: ORACLE instance terminated. Disconnection forced
ORA-00704: bootstrap process failure
ORA-39700: database must be opened with UPGRADE option
Process ID: 22211
Session ID: 1125 Serial number: 3
```

Diagnosing Upgrades

```
$ pwd
/u02/app/oracle/autoupgrade/runs/FIREBALL1/FIREBALL1/101

$ ll
total 23936
-rw-r----- 1 oracle oinstall 24279072 Aug 22 13:41 autoupgrade_20250822.log
-rw-r----- 1 oracle oinstall   110170 Aug 22 13:41 autoupgrade_20250822_user.log
-rw-r----- 1 oracle oinstall    20655 Aug 22 13:30 autoupgrade_err.log
drwxr-x--- 2 oracle oinstall    32768 Aug 22 13:04 dbupgrade
drwxr-x--- 2 oracle oinstall     4096 Aug 22 11:33 drain
drwxr-x--- 2 oracle oinstall     4096 Aug 22 13:04 postchecks
drwxr-x--- 2 oracle oinstall    12288 Aug 22 13:30 postfixups
drwxr-x--- 2 oracle oinstall     4096 Aug 22 13:31 postupgrade
drwxr-x--- 2 oracle oinstall     4096 Aug 22 11:29 prechecks
drwxr-x--- 2 oracle oinstall    12288 Aug 22 11:29 prefixups
drwxr-x--- 2 oracle oinstall     4096 Aug 22 11:20 preupgrade
drwxr-x--- 2 oracle oinstall     4096 Aug 22 13:41 sysupdates
drwxr-x--- 2 oracle oinstall     4096 Aug 22 13:04 upgstat
```

```
$ pwd
/u02/app/oracle/autoupgrade/runs/FIREBALL1/FIREBALL1/101/dbupgrade

$ grep -h "Grand Total" autoupgrade* | sort
Grand Total Time: 1456s
Grand Total Time: 1690s [PDB017]
Grand Total Time: 1691s [PDB007]
Grand Total Time: 1702s [PDB028]
Grand Total Time: 1703s [PDB019]
...
Grand Total Time: 2157s [PDB006]
Grand Total Time: 2161s [PDB008]
Grand Total Time: 2168s [PDB005]
Grand Total Time: 2180s [PDB003]
Grand Total Time: 2182s [PDB029]
```


```
$ grep -ih "Elapsed" catupgrd*pdb029*.log | sort
...
Elapsed: 00:01:06.01
Elapsed: 00:01:37.71
Elapsed: 00:01:47.52
Elapsed: 00:02:36.98
Elapsed: 00:09:59.70

$ grep -i "00:09:59.70" -B5 catupgrd*pdb0290.log
11:32:26 SQL>
11:32:26 SQL> EXECUTE xdk_drop_package;

PL/SQL procedure successfully completed.

Elapsed: 00:09:59.70
```

Search: xdk_drop_package

Bug 32004389 : XDK_DROP_PACKAGE CAN BE MORE EFFICIENT

To Bottom

Bug Attributes

Type	E - Enhancement	**Fixed in Product Version**	
Severity	2 - Very desirable feature	**Product Version**	12.1
Status	15 - Enhancement Req. Internal (Oracle) Review	**Platform**	226 - Linux x86-64
Created	Oct 12, 2020	**Platform Version**	RED HAT ENTERPRISE LINUX 4
Updated	Oct 12, 2020	**Base Bug**	N/A
Database Version	12.1	**Affects Platforms**	Generic
Product Source	Oracle	Knowledge, Patches, Service Requests and Bugs related to this bug	

You can't use AWR while upgrading

- Or, can you?

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

STATUS
------------
OPEN MIGRATE
```

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

STATUS
------------
OPEN MIGRATE

SQL> exec dbms_workload_repository.create_snapshot();
BEGIN dbms_workload_repository.create_snapshot(); END;

*
ERROR at line 1:
ORA-13516: AWR Operation failed: CATPROC not valid
ORA-06512: at "SYS.DBMS_WORKLOAD_REPOSITORY", line 99
ORA-06512: at "SYS.DBMS_WORKLOAD_REPOSITORY", line 145
ORA-06512: at line 1
Help: https://docs.oracle.com/error-help/db/ora-13516/
```

```
--After upgrading CDB$ROOT and while PDBs are upgrading,
--you can use AWR in the root container

SQL> alter session set container=CDB$ROOT;

SQL> select status from v$instance;

STATUS
------------
OPEN

SQL> exec dbms_workload_repository.create_snapshot();

PL/SQL procedure successfully completed.
```

```
$ pwd
/u02/app/oracle/autoupgrade/runs/DB08221/DB08221/101/upgstat

$ ll
total 144
-rw-r----- 1 oracle oinstall 65575 Aug 24 08:20 fullpdbs.txt
-rw-r----- 1 oracle oinstall 49978 Aug 24 08:20 nonpdb_catproc.txt
-rw-r----- 1 oracle oinstall 21428 Aug 24 08:20 nonpdb_upg.txt
```


```
AUStats Database Upgrade Report

 Database Name  : DB0822
 Instance Name  : DB08221
 Upgrade from   : 19.28.0.0.0 to 23.9.0.25.07
 Snapshots      : 42-62

 Note: This report displays selective data from internal Oracle
 views for database upgrades via AutoUpgrade. For a full Oracle
 statistics report, use AWR (Automatic Workload Repository).

    Begin Snap ID   End Snap ID Elapsed Time
----------------- ------------- ---------------
               42            62 66 mins

Begin Snap ID Begin Time                            Description
------------- ------------------------------------- -----------------------------------
           42 2025-Aug-24 07:13:28 +00:00           PDBS_START

  End Snap ID End Time                              Description
------------- ------------------------------------- -----------------------------------
           62 2025-Aug-24 08:19:41 +00:00           PDBS_END
```

#4 Top 20 Foreground Events

- Ordered by Total Wait Time, Waits

Event	Waits	Total Wait Time (sec)	Avg Wait (ms)	% DB Wait Time	Wait Class
Disk file operations I/O	20,968,536	7,622.0	0.36	11.0	User I/O
library cache lock	26,145	4,959.8	189.70	7.2	Concurre
latch: shared pool	518,161	2,127.7	4.11	3.1	Concurre
library cache: mutex X	180,079	436.2	2.42	.6	Concurre
cell list of blocks physical r	240,920	338.1	1.40	.5	User I/O
cell single block physical rea	65,887	319.3	4.85	.5	User I/O
latch free	1,457,213	287.4	0.20	.4	Other
cell multiblock physical read	132,588	279.5	2.11	.4	User I/O
library cache: bucket mutex X	37,309	191.3	5.13	.3	Concurre
Free private memory to OS	415,968	114.2	0.27	.2	Other
DBWR range invalidation sync	827	74.0	89.50	.1	Configur
online DDL delay	31	60.0	1935.54	.1	Other
row cache lock	15,504	58.2	3.75	.1	Concurre
Allocate CGA memory from OS	2,589,636	50.0	0.02	.1	Other
cursor: pin S wait on X	4,352	48.5	11.15	.1	Concurre
ASM IO for non-blocking poll	1,269,052	46.2	0.04	.1	User I/O

#4 Top 20 Foreground Events

- Ordered by Total Wait Time, Waits

Event	Waits	Total Wait Time (sec)	Avg Wait (ms)	% DB Time	Wait Class
Disk file operations I/O	20,968,536	7,622.0	0.36	11.0	User I/O
library cache lock	26,145	4,959.8	189.70	7.2	Concurre
latch: shared pool	518,161	2,127.7	4.11	3.1	Concurre
library cache: mutex X	180,079	436.2	2.42	.6	Concurre
cell list of blocks physical r	240,920	338.1	1.40	.5	User I/O
cell single block physical rea	65,887	319.3	4.85	.5	User I/O
latch free	1,457,213	287.4	0.20	.4	Other
cell multiblock physical read	132,588	279.5	2.11	.4	User I/O
library cache: bucket mutex X	37,309	191.3	5.13	.3	Concurre
Free private memory to OS	415,968	114.2	0.27	.2	Other
DBWR range invalidation sync	827	74.0	89.50	.1	Configur
online DDL delay	31	60.0	1935.54	.1	Other
row cache lock	15,504	58.2	3.75	.1	Concurre
Allocate CGA memory from OS	2,589,636	50.0	0.02	.1	Other
cursor: pin S wait on X	4,352	48.5	11.15	.1	Concurre
ASM IO for non-blocking poll	1,269,052	46.2	0.04	.1	User I/O

#5. Background Wait Events

Event	Waits	Total Wait Time (s)	Avg Wait Time (ms)
AQPC idle	773	3,987	5,158.37
log file parallel write	2,584,727	123	.05
Streams AQ: load balancer id	316	116	367.73
flashback log file write	118,767	115	.97
db file parallel write	209,083	68	.32
db file async I/O submit	361,607	67	.18
log file sequential read	14,937	28	1.85
latch: shared pool	2,132	21	9.73
oracle thread bootstrap	371	10	27.03
latch free	3,957	9	2.24
ASM file metadata operation	24,151	9	.36
ASM IO for non-blocking poll	189,219	7	.04
latch: MGA shared context la	28	7	265.10
LGWR wait for redo copy	259,860	5	.02
LGWR worker group ordering	8,105	4	.53
resmgr:internal state change	26	3	100.09
KSV master wait	7,368	2	.33
os thread creation	632	2	3.50

#8 Wait Event Histogram for Top 20 Foreground Events

Event	Foreground Waits	Total Waits	% of Waits <1ms	1 to <32ms	32 to <1024ms	>= 1024ms
Disk file operations I/O	20,968,536	20981704	97.45	2.46	.09	.00
library cache lock	26,145	26211	4.65	61.25	31.08	3.02
latch: shared pool	518,161	520308	70.62	26.97	2.41	.00
library cache: mutex X	180,079	180242	80.36	19.51	.13	.00
cell list of blocks physic	240,920	241951	89.49	10.06	.45	.00
cell single block physical	65,887	65886	60.97	37.49	1.54	.00
latch free	1,457,213	1461626	97.60	2.40	.00	.00
cell multiblock physical r	132,588	133264	84.26	15.20	.54	.00
library cache: bucket mute	37,309	37345	54.06	45.66	.28	.00
Free private memory to OS	415,968	415995	98.17	1.82	.01	.00
DBWR range invalidation sy	827	829	1.45	49.46	49.10	.00
online DDL delay	31	31	3.23	.00	.00	96.77
row cache lock	15,504	15539	42.29	57.30	.40	.01
Allocate CGA memory from O	2,589,636	2611823	100.00	.00	.00	.00
cursor: pin S wait on X	4,352	4553	8.41	87.44	4.13	.02
ASM IO for non-blocking po	1,269,052	1458394	99.90	.10	.00	.00

```
SQL> select table_name from dba_tables where table_name like 'UPD$%' and owner='SYS';

TABLE_NAME
--------------------------------------------------------------------------------
UPD$_TOP_FG_EVENTS
UPD$_EVENT_HISTOGRAM
UPD$_OSSTAT
UPD$_PARAMETER
UPD$_SESSION_EVENT
UPD$_SESSTAT
UPD$_SESS_TIME_MODEL
UPD$_SNAPSHOT
UPD$_SYSSTAT
UPD$_SYSTEM_EVENT
UPD$_SYS_TIME_MODEL
UPD$_THREAD

12 rows selected.
```

An upgrade is always resumable and restartable

- All scripts are idempotent, including `catalog.sql` and `catproc.sql`

```
INSERT INTO sys.registry$upg_resume(version,phaseno,errorcnt,starttime,endtime)
VALUES ('23.0.0.0.0', 57,-1, sysdate, sysdate);

...

UPDATE sys.registry$upg_resume SET endtime=sysdate WHERE phaseno=57;
```


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

Previous execution found loading latest data
Total jobs recovered: 1
+--------------------------------+
| Starting AutoUpgrade execution |
+--------------------------------+
Type 'help' to list console commands
upg>
```


```
upg> resume -job 100 -catctl_options=-p 0
```

Replay Upgrade

```
--The database automatically starts an upgrade
--when you plug in a lower-release PDB

SQL> alter pluggable database pdb1 open;

Pluggable database altered.

Elapsed: 00:14:01.95
```

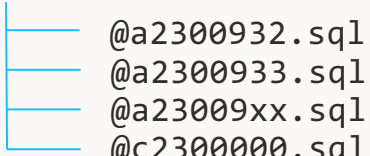
```
SQL> select property_name, property_value
     from   database_properties
     where  property_name like '%OPEN%';

PROPERTY_NAME           PROPERTY_VALUE
----------------------- --------------------
CONVERT_NONCDB_ON_OPEN  true
UPGRADE_PDB_ON_OPEN     true
```

Classic Upgrade

Phase 1
Phase 2
Phase 3
Phase 4
Phase 5
Phase 6
Phase 7
Phase 8
...
Phase *nnn*

Classic Upgrade

Phase 1
Phase 2
Phase 3
Phase 4
Phase 5



Phase 6
Phase 7
Phase 8
...
Phase *nnn*

Classic Upgrade

@a2300932.sql

```
VARIABLE initfile VARCHAR2(32)
COLUMN :initfile NEW_VALUE init_file NOPRINT;

Rem ================================================================
Rem SQLJTYPE
Rem ================================================================

BEGIN
  IF sys.dbms_registry.is_loaded('JAVAVM',sys.dbms_registry.release_version) = 1 THEN
     :initfile := 'initsjty.sql';
  ELSE
     :initfile := 'nothing.sql';
  END IF;
END;
/
SELECT :initfile FROM DUAL;
@@&init_file
```

Classic Upgrade

```
@@&init_file
```

```
.
.
[more PL/SQL code]
.
.
CREATE TABLE SYS.T1 ...
CREATE INDEX SYS.T1I1 ...
.
.
[more PL/SQL code]
.
.
```

Comparison

Classic

Phase 1
Phase 2
Phase 3
Phase 4
Phase 5
Phase 6
Phase 7
Phase 8
...
Phase *nnn*

Replay

```
DROP INDEX SYSTEM.IDX$FLOW ...
CREATE OR REPLACE ...
ALTER TYPE ...
CREATE FUNCTION ...
CREATE TABLE SYS.T1 ...
CREATE INDEX SYS.T1I1 ...
DROP INDEX MDSYS.IDX$IK ...
DROP TABLE MDSYS.TBL$TT ...
CREATE OR REPLACE ...
ALTER TYPE ...
GRANT SELECT ON ...
CREATE VIEW ...
```

```
select sqlstmt from pdb_sync$;


ALTER SESSION SET "_oracle_script_counter"=7
alter pluggable database application app$cdb$pdbonly$ncdbtopdb begin install '1.0.upgmode'
alter session set "_enable_view_pdb"=false
alter session set NLS_LENGTH_SEMANTICS=BYTE
INSERT INTO sys.utl_recomp_skip_list select obj# from obj$ where BITAND(flags, 4194304)=0 ...
create or replace view sys.cdb$common_root_objects sharing=object as
select u.name owner, o.name object_name, o.type# object_type, o.namespace nsp,
       o.subname object_subname, o.signature object_sig,
       decode(bitand(o.flags, (65536+131072+4294967296)),
       4294967296+65536, 'EDL', 131072, 'DL', 'MDL') sharing
  from sys.obj$ o, sys.user$ u
 where o.owner#=u.user# and bitand(o.flags, (65536+131072+4294967296)) <> 0
   and bitand(o.flags,0)=0


(output truncated)
```


Classic

- Triggered by AutoUpgrade
- Runs `catalog.sql` / `catproc.sql`
- Many `CREATE OR REPLACE` statements for objects that didn't change
- Customizable
- Used by AutoUpgrade

Replay

- Triggered by `OPEN` command
- Runs the captured statements
- Only statements that actually do some change
- Automated

Classic

```
Stages
   SETUP              <1 min
   PREUPGRADE         <1 min
   PRECHECKS          <1 min
   PREFIXUPS          <1 min
   DRAIN              <1 min
   DBUPGRADE          19 min
   DISPATCH           <1 min
   UNPLUGWORK         <1 min
   POSTCHECKS         <1 min
   POSTFIXUPS         10 min
   POSTUPGRADE        <1 min
   SYSUPDATES         <1 min
```

Replay

```
Stages
   SETUP              <1 min
   PREUPGRADE         <1 min
   PRECHECKS          <1 min
   PREFIXUPS          <1 min
   DRAIN              <1 min
   DBUPGRADE          17 min
   DISPATCH           <1 min
   UNPLUGWORK         <1 min
   POSTCHECKS         <1 min
   POSTFIXUPS         10 min
   POSTUPGRADE        <1 min
   SYSUPDATES         <1 min
```


Replay upgrade doesn't handle pre- and post-upgrade tasks

- You must run these manually
- Or use *Replay Upgrade* through AutoUpgrade

```
SQL> alter pluggable database pdb1 open;
alter pluggable database pdb1 open
*
ERROR at line 1:
ORA-60510: encountered an error during Replay Upgrade
```

If Replay Upgrade fails

- Check for errors:
  - `SELECT * FROM dba_replay_upgrade_errors`
  - `SELECT * FROM dba_app_errors`
  - `SELECT * FROM dba_applications WHERE app_name='APP$CDB$CATALOG';`
  - Check alert log
  - Trace files

- Revert to classic upgrade
  - Use AutoUpgrade (`upg1.replay=no`)

```
--To disable replay upgrade
ALTER DATABASE UPGRADE SYNC OFF;

--Or
ALTER DATABASE PROPERTY SET UPGRADE_PDB_ON_OPEN='false';

--To disable convert on open
ALTER DATABASE PROPERTY SET CONVERT_NONCDB_ON_OPEN='false';
```

Distributed Upgrades

41%

faster

If you are upgrading a cluster database ...

... you must manually separate the database instance from the cluster. Set the CLUSTER_DATABASE initialization parameter to FALSE.

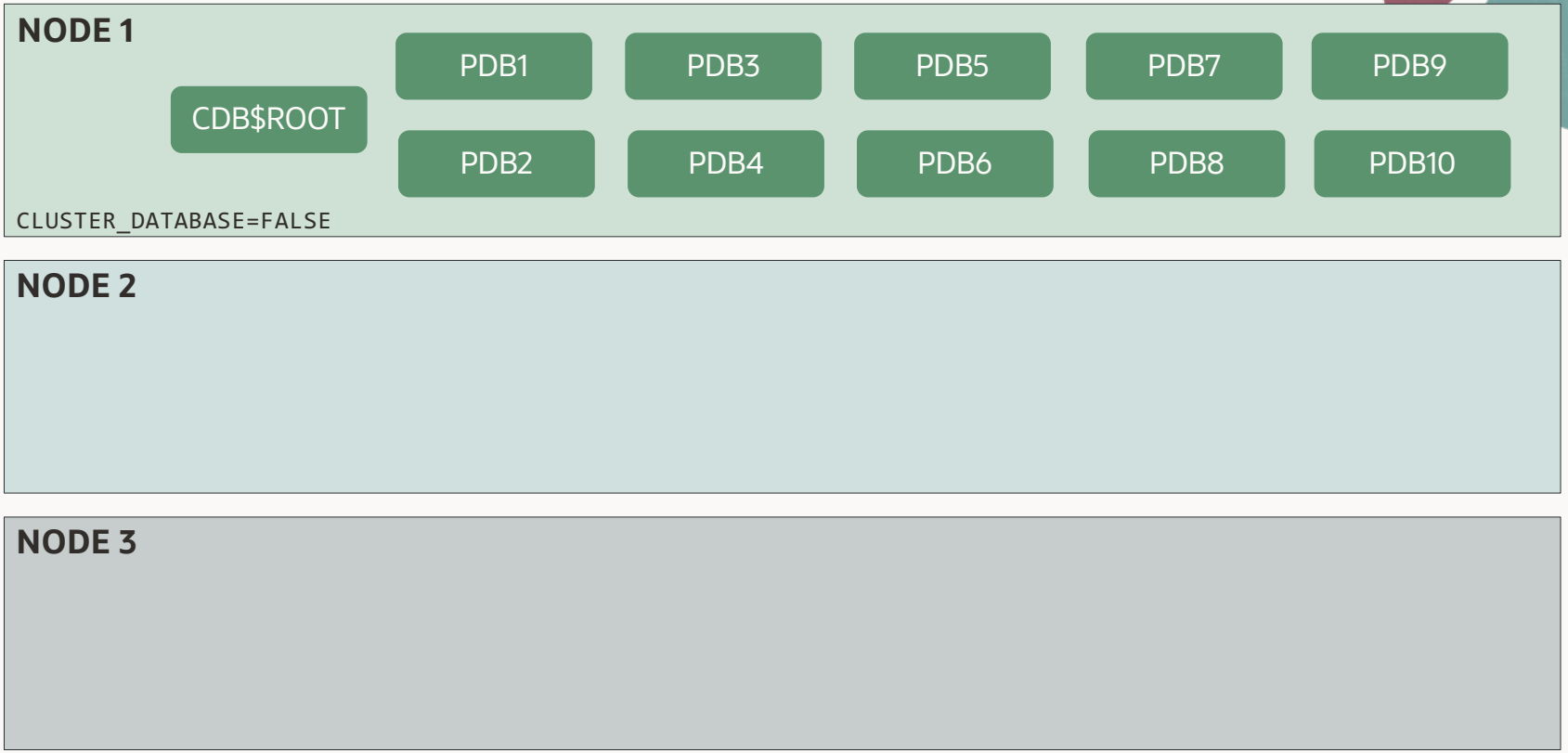
Regular RAC Database Upgrade

- `CLUSTER_DATABASE = FALSE`
- Upgrade root and all PDBs
- One instance active
- All other nodes are idle

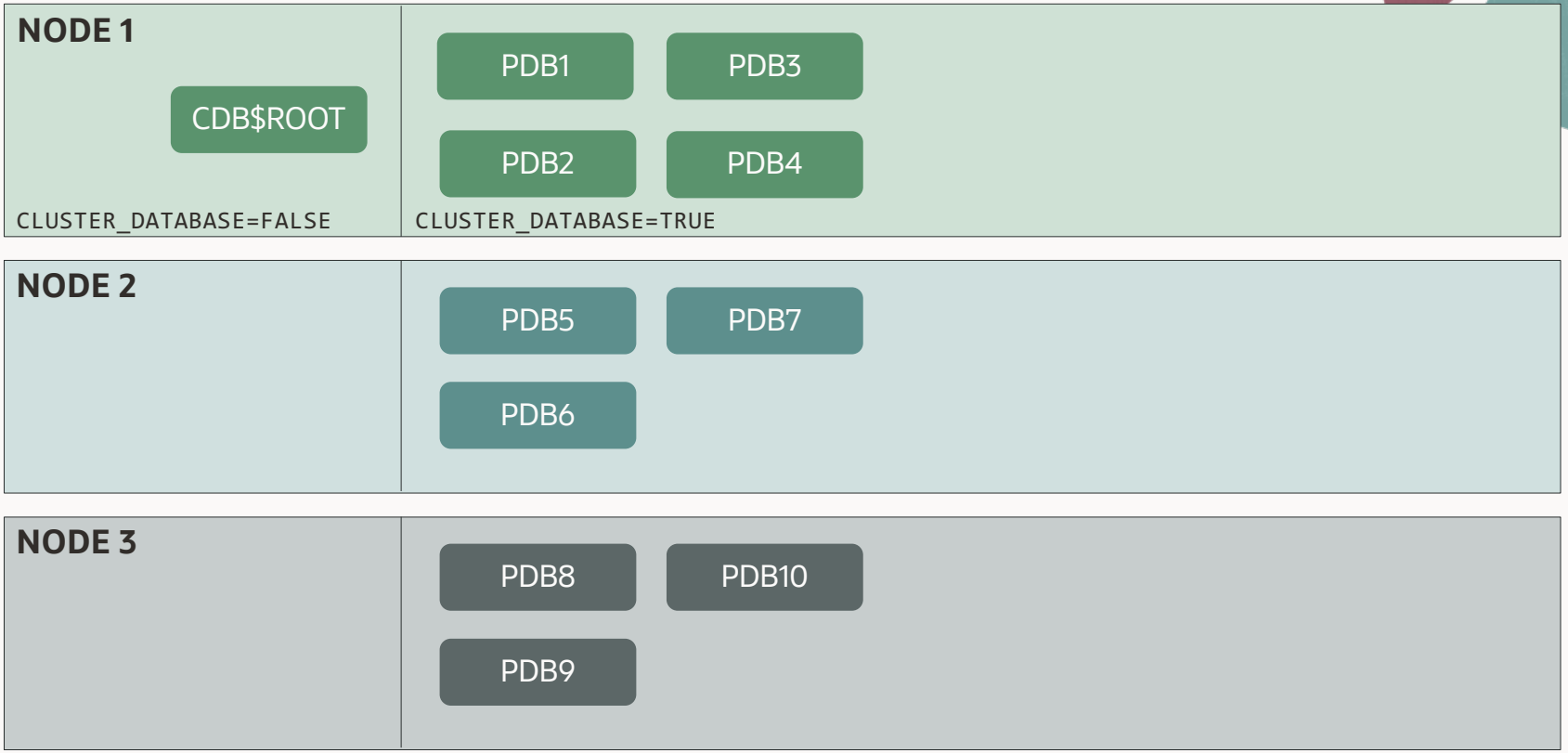
Distributed Upgrade

- `CLUSTER_DATABASE = FALSE`
- Upgrade root only
- `CLUSTER_DATABASE = TRUE`
- Upgrade all PDBs
- All instances active

Distributed Upgrade



Distributed Upgrade



```
cat RACDB.cfg

global.autoupg_log_dir=/u01/app/oracle/autoupgrade
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/23
upg1.sid=RACDB
upg1.tune_setting=distributed_upgrade=true
```

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

```
cat RACDB.cffg

global.autoupg_log_dir=/u01/app/oracle/autoupgrade
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/23
upg1.sid=RACDB
upg1.tune_setting=distributed_upgrade=true

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

```
batch1.source_home=/u01/app/oracle/product/19
batch1.target_home=/u01/app/oracle/product/23
batch1.sid=RACDB1
batch1.upgrade_node=NODE1
batch1.pdbs=PDB1,PDB2,PDB3,PDB4
batch2.source_home=/u01/app/oracle/product/19
batch2.target_home=/u01/app/oracle/product/23
batch2.sid=RACDB2
batch2.upgrade_node=NODE2
batch2.pdbs=PDB5,PDB6,PDB7
batch3.source_home=/u01/app/oracle/product/19
batch3.target_home=/u01/app/oracle/product/23
batch3.sid=RACDB3
batch3.upgrade_node=NODE3
batch3.pdbs=PDB8,PDB9,PDB10
```


```
cat RACDB.cffg

global.autoupg_log_dir=/u01/app/oracle/autoupgrade
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/23
upg1.sid=RACDB
upg1.tune_setting=distributed_upgrade=true

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

```
batch1.source_home=/u01/app/oracle/product/19
batch1.target_home=/u01/app/oracle/product/23
batch1.sid=RACDB1
batch1.upgrade_node=NODE1
batch1.pdbs=PDB1,PDB2,PDB3,PDB4
batch2.source_home=/u01/app/oracle/product/19
batch2.target_home=/u01/app/oracle/product/23
batch2.sid=RACDB2
batch2.upgrade_node=NODE2
batch2.pdbs=PDB5,PDB6,PDB7
batch3.source_home=/u01/app/oracle/product/19
batch3.target_home=/u01/app/oracle/product/23
batch3.sid=RACDB3
batch3.upgrade_node=NODE3
batch3.pdbs=PDB8,PDB9,PDB10
```


```
cat RACDB.cffg

global.autoupg_log_dir=/u01/app/oracle/autoupgrade
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/23
upg1.sid=RACDB
upg1.tune_setting=distributed_upgrade=true

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

```
batch1.source_home=/u01/app/oracle/product/19
batch1.target_home=/u01/app/oracle/product/23
batch1.sid=RACDB1
batch1.upgrade_node=NODE1
batch1.pdbs=PDB1,PDB2,PDB3,PDB4
batch2.source_home=/u01/app/oracle/product/19
batch2.target_home=/u01/app/oracle/product/23
batch2.sid=RACDB2
batch2.upgrade_node=NODE2
batch2.pdbs=PDB5,PDB6,PDB7
batch3.source_home=/u01/app/oracle/product/19
batch3.target_home=/u01/app/oracle/product/23
batch3.sid=RACDB3
batch3.upgrade_node=NODE3
batch3.pdbs=PDB8,PDB9,PDB10
```

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

```
Node 1    java -jar autoupgrade.jar -config mod.conf -mode upgrade -follower
Node 2    java -jar autoupgrade.jar -config mod.conf -mode upgrade -follower
Node 3    java -jar autoupgrade.jar -config mod.conf -mode upgrade -follower
```

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

```
Node 1    java -jar autoupgrade.jar -config mod.conf -mode upgrade -follower
Node 2    java -jar autoupgrade.jar -config mod.conf -mode upgrade -follower
Node 3    java -jar autoupgrade.jar -config mod.conf -mode upgrade -follower
```

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

```
Node 1    java -jar autoupgrade.jar -config mod.conf -mode upgrade -follower
Node 2    java -jar autoupgrade.jar -config mod.conf -mode upgrade -follower
Node 3    java -jar autoupgrade.jar -config mod.conf -mode upgrade -follower
```

```
upg> status -job 101

    +--------+---------+--------+-------------+
    |Database|    Stage|Progress|         Node|
    +--------+---------+--------+-------------+
    |PDB$SEED|DBUPGRADE|    10 %|dragon-dbvui1|
    |  PDB001|DBUPGRADE|     6 %|dragon-dbvui2|
    |  PDB002|DBUPGRADE|    10 %|dragon-dbvui1|
    |  PDB003|DBUPGRADE|     6 %|dragon-dbvui2|

    (output truncated)

    |  PDB027|DBUPGRADE|     6 %|dragon-dbvui2|
    |  PDB028|DBUPGRADE|    10 %|dragon-dbvui1|
    |  PDB029|DBUPGRADE|     6 %|dragon-dbvui2|
    |  PDB030|DBUPGRADE|    10 %|dragon-dbvui1|
    +--------+---------+--------+-------------+
```

```
# Control the number of nodes used, default 2

upg1.tune_setting=distributed_upgrade=true,active_nodes_limit=n
```

Downgrade

A downgraded data dictionary is *different*, but compatible

- A downgraded database is not identical to the pre-upgraded database

```
SQL> select count(*) from dba_tables where owner='SYS';

COUNT_BEFORE
------------
        1549


 COUNT_AFTER
------------
        1805
```

Downgrade

1

Actions in 26ai Oracle home

- Apply latest Release Update
- Open in downgrade mode
- Execute `catdwgrd.sql`
  - Rolls back one-off patches
  - Prepares for old release

2

Actions in 19c Oracle home

- Apply latest Release Update
- Open in upgrade mode
- Execute `catrelod.sql`
  - Invalidates all PL/SQL
  - Executes catalog/catproc
  - Reloads all components
  - Gather stats on bootstrap tables
- Open in normal mode
- Recompile all PL/SQL
- Gather dictionary/fixed objects stats

```
$ grep -i "truncate *table" catdwgrd0.log
...
11:56:38 SQL> truncate table wri$_optstat_tab_model;
11:56:38   3          execute immediate 'truncate table hcs_av_fact_column$';
11:56:38 SQL> Rem truncate table to store service conflicts stats persistently
11:56:38 SQL> truncate table svcobj_conflict$;
11:56:38 SQL> truncate table data_guard_site$;
11:56:38 SQL> truncate table dgpdb_site$;
11:56:39   4          execute immediate 'truncate table hcs_tbl$';
11:56:39 SQL> truncate table rsrc_cnt_history$;
```

```
$ grep -i "truncate *table" catdwgrd0.log
...
11:56:38 SQL> truncate table wri$_optstat_tab_model;
11:56:38   3          execute immediate 'truncate table hcs_av_fact_column$';
11:56:38 SQL> Rem truncate table to store service conflicts stats persistently
11:56:38 SQL> truncate table svcobj_conflict$;
11:56:38 SQL> truncate table data_guard_site$;
11:56:38 SQL> truncate table dgpdb_site$;
11:56:39   4          execute immediate 'truncate table hcs_tbl$';
11:56:39 SQL> truncate table rsrc_cnt_history$;

$ grep -i "truncate *table" catdwgrd0.log | wc -l
311
```

```
SQL> desc pdb_sync$

          Name       Null?              Type
_____________ ___________ ________________
SCNWRP        NOT NULL    NUMBER
SCNBAS        NOT NULL    NUMBER
CTIME         NOT NULL    DATE
SQLSTMT                   VARCHAR2(4000)
NAME          NOT NULL    VARCHAR2(128)
AUXNAME1                  VARCHAR2(128)
AUXNAME2                  VARCHAR2(128)
OPCODE        NOT NULL    NUMBER
FLAGS                     NUMBER
LONGSQLTXT                CLOB
REPLAY#       NOT NULL    NUMBER
CREATION#                 NUMBER
SPARE3                    VARCHAR2(128)
SPARE4                    VARCHAR2(128)
SPARE5                    VARCHAR2(4000)
SPARE6                    NUMBER
SPARE7                    NUMBER
SPARE8                    NUMBER
SQLID                     VARCHAR2(13)
APPID#                    NUMBER
VER#                      NUMBER
PATCH#                    NUMBER
APP_STATUS                NUMBER
SESSSERIAL#               NUMBER
```

```
SQL> desc pdb_sync$

          Name       Null?              Type
_____________ ___________ ________________
SCNWRP        NOT NULL    NUMBER
SCNBAS        NOT NULL    NUMBER
CTIME         NOT NULL    DATE
SQLSTMT                   VARCHAR2(4000)
NAME          NOT NULL    VARCHAR2(128)
AUXNAME1                  VARCHAR2(128)
AUXNAME2                  VARCHAR2(128)
OPCODE        NOT NULL    NUMBER
FLAGS                     NUMBER
LONGSQLTXT                CLOB
REPLAY#       NOT NULL    NUMBER
CREATION#                 NUMBER
SPARE3                    VARCHAR2(128)
SPARE4                    VARCHAR2(128)
SPARE5                    VARCHAR2(4000)
SPARE6                    NUMBER
SPARE7                    NUMBER
SPARE8                    NUMBER
SQLID                     VARCHAR2(13)
APPID#                    NUMBER
VER#                      NUMBER
PATCH#                    NUMBER
APP_STATUS                NUMBER
SESSSERIAL#               NUMBER
OWNER                     VARCHAR2(128)
OBJNAME                   VARCHAR2(128)
EDNAME                    VARCHAR2(128)
NAMESPACE                 NUMBER
SIGNATURE                 RAW(16 BYTE)
MODULE                    VARCHAR2(64)
ACTION                    VARCHAR2(64)
```

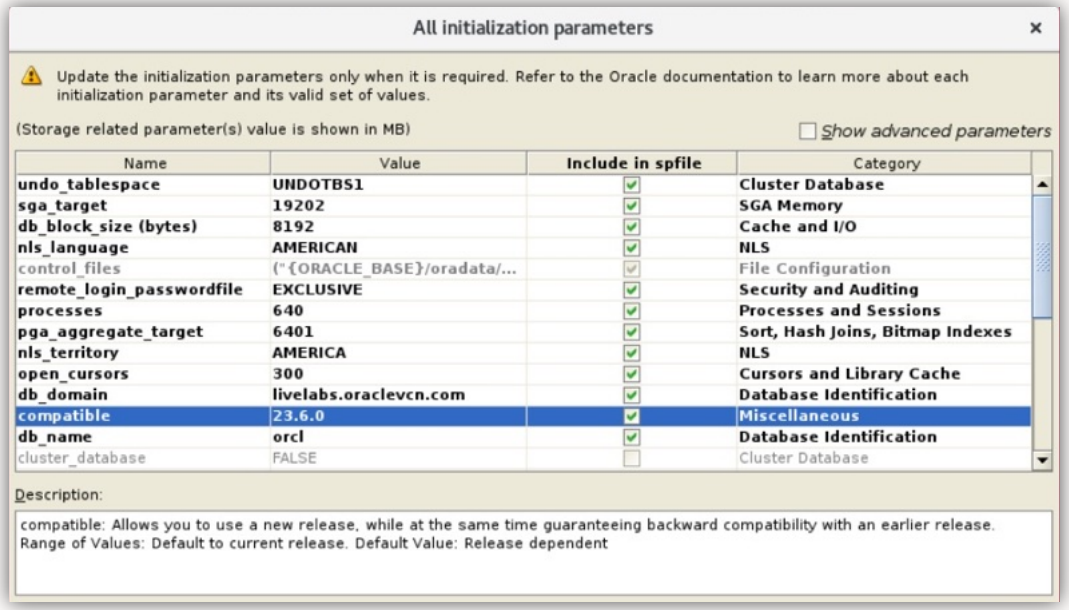
```
SQL> desc REGISTRY$LOG

        Name       Null?             Type
____________ ____________ ________________
CID                       VARCHAR2(30)
NAMESPACE                 VARCHAR2(30)
OPERATION    NOT NULL     NUMBER
OPTIME                    TIMESTAMP(6)
ERRMSG                    VARCHAR2(1000)
```

```
SQL> desc REGISTRY$LOG

        Name       Null?                          Type
____________ ____________ ______________________________
CID                       VARCHAR2(30)
NAMESPACE                 VARCHAR2(30)
OPERATION    NOT NULL     NUMBER
OPTIME                    TIMESTAMP(6) WITH TIME ZONE
ERRMSG                    VARCHAR2(1000)
```

Downgrade, Guidelines

- Generally, dropping is avoided
- Some types of statistics are marked STALE
- Complete rebuild of certain components, such as Data Pump

Don't change `COMPATIBLE` if you want the option of downgrading



You can downgrade days, months, or even years after upgrading

- No data loss

Final Pointers

Use ORAdiff to learn about data dictionary differences

- oradiff.oracle.com

How can I make my upgrades faster?

Things that

Matter a lot

- Number of components
- Dictionary size
- Dictionary complexity
- Some feature/version combinations

Things that

Matter a lot

- Number of components
- Dictionary size
- Dictionary complexity
- Some feature/version combinations

Matter a little

- CPU speed
- I/O capabilities
- Memory
- SGA/PGA

Things that

Matter a lot

- Number of components
- Dictionary size
- Dictionary complexity
- Some feature/version combinations

Matter a little

- CPU speed
- I/O capabilities
- Memory
- SGA/PGA

Don't matter

(usually)

- Physical size
- Amount of user data

Unplug-plug upgrades are faster than upgrading an entire CDB

- Consider your rollback options
- Use refreshable clone PDBs

Key Learnings

1. Use AutoUpgrade
2. Scale by upgrading more PDBs in parallel
3. Use Distributed Upgrade

BREAK

We start again at 11:15

Next-Level Patching

How often do you apply patches?

https://www.oracle.com/security-alerts

Critical Patch Updates

Critical Patch Updates provide security patches for supported Oracle on-premises products. A Critical Patch Update is a collection of patches for multiple security vulnerabilities. These patches address vulnerabilities in Oracle code and in third party components included in Oracle products. These patches are usually cumulative. They are available to customers with valid support contracts. Critical Patch Updates are released on the third Tuesday of January, April, July, and October. The next four dates are:

- 21 July 2026
- 20 October 2026
- 19 January 2027
- 20 April 2027

A pre-release announcement will be published on the Thursday preceding each Critical Patch Update release.

The Critical Patch Updates released since 2021 are listed in the following table. Critical Patch Updates released before 2021 are available here.

Critical Patch Update	Latest Version/Date
Critical Patch Update - April 2026	Rev 2, 24 April 2026
Critical Patch Update - January 2026	Rev 3, 02 February 2026
Critical Patch Update - October 2025	Rev 1, 21 October 2025
Critical Patch Update - July 2025	Rev 4, 28 July 2025

Critical Patch Updates

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Oracle Critical Patch Update Advisory - April 2026

Description

A Critical Patch Update is a collection of patches for multiple security vulnerabilities. These patches address vulnerabilities in Oracle code and in third party components included in Oracle products. These patches are usually cumulative, but each advisory describes only the security patches added since the previous Critical Patch Update Advisory. Thus, prior Critical Patch Update advisories should be reviewed for information regarding earlier published security patches. Refer to "Critical Patch Updates, Security Alerts and Bulletins" for information about Oracle Security advisories.

Oracle continues to periodically receive reports of attempts to maliciously exploit vulnerabilities for which Oracle has already released security patches. In some instances, it has been reported that attackers have been successful because targeted customers had failed to apply available Oracle patches. Oracle therefore strongly recommends that customers remain on actively-supported versions and apply Critical Patch Update security patches without delay.

This Critical Patch Update contains 481 new security patches across the product families listed below. Please note that an MOS note summarizing the content of this Critical Patch Update and other Oracle Software Security Assurance activities is located at April 2026 Critical Patch Update: Executive Summary and Analysis.

Please note that since the release of the January 2026 Critical Patch Update, Oracle has released a Security Alert for Oracle Identity Manager and Oracle Web Services Manager, CVE-2026-21992 (March 20, 2026). Customers are strongly advised to apply the April 2026 Critical Patch Update for Fusion Middleware products, which includes patches for this Alert as well as additional patches.

Oracle Communications Operations Monitor, versions 5.2, 6.0, 6.1	Oracle Communications Operations Monitor
Oracle Communications Order and Service Management, versions 7.5.0, 8.0.0	Oracle Communications Order and Service Management
Oracle Communications Performance Intelligence Center, versions 10.5.0.0-10.5.0.2	Oracle Communications Performance Intelligence Center
Oracle Communications Policy Management, versions 15.0.0.0.0, 15.0.0.1.0	Oracle Communications Policy Management
Oracle Communications Service Catalog and Design, versions 8.0.0.6.0, 8.1.0.5.0, 8.2.0.2.0	Oracle Communications Service Catalog and Design
Oracle Communications Session Border Controller, versions 9.3.0, 10.0.0, 10.1.0	Oracle Communications Session Border Controller
Oracle Communications Session Report Manager, versions 9.0.0-9.0.4	Oracle Communications Session Report Manager
Oracle Communications Unified Assurance, versions 6.1.1-7.0.0	Oracle Communications Unified Assurance
Oracle Communications Unified Inventory Management, versions 7.5.0-7.5.1, 7.6.0-7.8.0, 8.0.0	Oracle Communications Unified Inventory Management
Oracle Configuration Manager, versions 13.5, 24.1	Oracle Enterprise Manager
Oracle Data Integrator, versions 12.2.1.4.0, 14.1.2.0.0	Fusion Middleware
Oracle Database Server, versions 12.1.0.2.0, 12.2.0.1.0, 19.3-19.30, 21.3-21.21, 23.4.0-23.26.1	Database
Oracle Documaker, versions 12.7.2-13.0.2	Contact Support
Oracle E-Business Suite, versions 12.2.3-12.2.15, 15.0	Oracle E-Business Suite
Oracle Enterprise Communications Broker, versions 4.2.0, 5.0.0	Oracle Enterprise Communications Broker
Oracle Enterprise Manager Base Platform, versions 13.5, 24.1	Oracle Enterprise Manager
Oracle Enterprise Manager for Fusion Middleware, versions 13.5, 24.1	Oracle Enterprise Manager

Oracle Critical Patch Update Advisory - April 2026

CVE ID	Component	Package and/ or Privilege Required	Protocol	Remote Exploit without Auth.?	CVSS VERSION 3.1 RISK (see Risk Matrix Definitions)									Supported Versions Affected	Notes
					Base Score	Attack Vector	Attack Complex	Privs Req'd	User Interact	Scope	Confid-entiality	Inte-grity	Avail-ability		
CVE-2026-33870	Clusterware (Micronaut)	None	HTTP	Yes	7.5	Network	Low	None	None	Un-changed	None	High	None	19.3-19.30, 23.4.0-23.26.1	
CVE-2026-35229	Java VM	Create Session	Oracle Net	Yes	7.5	Network	Low	None	None	Un-changed	High	None	None	19.3-19.30, 21.3-21.21	
CVE-2026-31790	RDBMS (OpenSSL)	None	Multiple	No	7.2	Network	Low	High	None	Un-changed	High	High	High	19.3-19.30, 23.4.0-23.26.1	
CVE-2026-26007	RDBMS (Python)	Create Session	Multiple	Yes	6.5	Network	Low	None	Required	Un-changed	High	None	None	21.3-21.21, 23.4.0-23.26.1	
CVE-2026-21999	XML Database	HTTP Listener	HTTPS	Yes	5.3	Network	High	None	Required	Un-changed	High	None	None	23.4.0-23.26.1	
CVE-2025-31948	Data Mining (Intel oneAPI Toolkit OpenMP)	Authenticated User	None	No	3.3	Local	Low	Low	None	Un-changed	None	None	Low	19.3-19.30, 21.3-21.21, 23.4.0-23.26.1	
CVE-2025-48924	RDBMS (Apache Commons Lang)	DBMS Developer	Multiple	No	3.3	Local	Low	None	Required	Un-changed	None	None	Low	23.4.0-23.26.1	
CVE-2026-34312	RDBMS	Row Access Method	Multiple	No	2.4	Network	Low	High	Required	Un-changed	Low	None	None	19.3-19.30	

Oracle Critical Patch Update Advisory - April 2026

CVE ID	Component	Package and/ or Privilege Required	Protocol	Remote Exploit without Auth.?	CVSS VERSION 3.1 RISK (see Risk Matrix Definitions)								Supported Versions Affected	Notes
					Base Score	Attack Vector	Attack Complex	Privs Req'd	User Interact	Scope	Confid-entiality	Inte-grity	Avail-ability	
CVE-2026-33870	Clusterware (Micronaut)	None	HTTP	Yes	7.5	Network	Low	None	None	Un-changed	None	High	None	19.3-19.30, 23.4.0-23.26.1	
CVE-2026-35229	Java VM	Create Session	Oracle Net	Yes	7.5	Network	Low	None	None	Un-changed	High	None	None	19.3-19.30, 21.3-21.21	
CVE-2026-31790	RDBMS (OpenSSL)	None	Multiple	No	7.2	Network	Low	High	None	Un-changed	High	High	High	19.3-19.30, 23.4.0-23.26.1	
CVE-2026-26007	RDBMS (Python)	Create Session	Multiple	Yes	6.5	Network	Low	None	Required	Un-changed	High	None	None	21.3-21.21, 23.4.0-23.26.1	
CVE-2026-21999	XML Database	HTTP Listener	HTTPS	Yes	5.3	Network	High	None	Required	Un-changed	High	None	None	23.4.0-23.26.1	
CVE-2025-31948	Data Mining (Intel oneAPI Toolkit OpenMP)	Authenticated User	None	No	3.3	Local	Low	Low	None	Un-changed	None	None	Low	19.3-19.30, 21.3-21.21, 23.4.0-23.26.1	
CVE-2025-48924	RDBMS (Apache Commons Lang)	DBMS Developer	Multiple	No	3.3	Local	Low	None	Required	Un-changed	None	None	Low	23.4.0-23.26.1	
CVE-2026-34312	RDBMS	Row Access Method	Multiple	No	2.4	Network	Low	High	Required	Un-changed	Low	None	None	19.3-19.30	

Oracle Critical Patch Update Advisory - April 2026

CVE ID	Component	Package and/ or Privilege Required	Protocol	Remote Exploit without Auth.?	CVSS VERSION 3.1 RISK (see Risk Matrix Definitions)									Supported Versions Affected	Notes
					Base Score	Attack Vector	Attack Complex	Privs Req'd	User Interact	Scope	Confid-entiality	Inte-grity	Avail-ability		
CVE-2026-33870	Clusterware (Micronaut)	None	HTTP	Yes	7.5	Network	Low	None	None	Un-changed	None	High	None	19.3-19.30, 23.4.0-23.26.1	
CVE-2026-35229	Java VM	Create Session	Oracle Net	Yes	7.5	Network	Low	None	None	Un-changed	High	None	None	19.3-19.30, 21.3-21.21	
CVE-2026-31790	RDBMS (OpenSSL)	None	Multiple	No	7.2	Network	Low	High	None	Un-changed	High	High	High	19.3-19.30, 23.4.0-23.26.1	
CVE-2026-26007	RDBMS (Python)	Create Session	Multiple	Yes	6.5	Network	Low	None	Required	Un-changed	High	None	None	21.3-21.21, 23.4.0-23.26.1	
CVE-2026-21999	XML Database	HTTP Listener	HTTPS	Yes	5.3	Network	High	None	Required	Un-changed	High	None	None	23.4.0-23.26.1	
CVE-2025-31948	Data Mining (Intel oneAPI Toolkit OpenMP)	Authenticated User	None	No	3.3	Local	Low	Low	None	Un-changed	None	None	Low	19.3-19.30, 21.3-21.21, 23.4.0-23.26.1	
CVE-2025-48924	RDBMS (Apache Commons Lang)	DBMS Developer	Multiple	No	3.3	Local	Low	None	Required	Un-changed	None	None	Low	23.4.0-23.26.1	
CVE-2026-34312	RDBMS	Row Access Method	Multiple	No	2.4	Network	Low	High	Required	Un-changed	Low	None	None	19.3-19.30	

Be sure to subscribe to email notifications

- Critical Patch Updates and Security Alerts

Patching News

Security Updates

Accelerating Vulnerability Detection and Response at Oracle

April 29, 2026 | 3 minute read

Integrated Cyber Center (ICC)

The latest generation of AI is transforming how software vulnerabilities are identified and fixed, increasing the speed and scale of discovery and remediation.

At Oracle, we have long applied AI across our cloud and software environments to support security testing, vulnerability detection, and code analysis. These capabilities run on Oracle Cloud Infrastructure (OCI), leveraging OCI AI services, infrastructure, and development platforms to operate continuously at scale.

Oracle has access to leading frontier AI models, including Anthropic's Claude Mythos Preview and OpenAI's most capable models through Trusted Access for Cyber, and we are extending our capabilities with these models to improve how quickly and effectively vulnerabilities are identified. Combined with our AI-enabled security operations, these capabilities are applied across Oracle-developed software and services, Oracle Health, and the open-source components we build and use in our products.

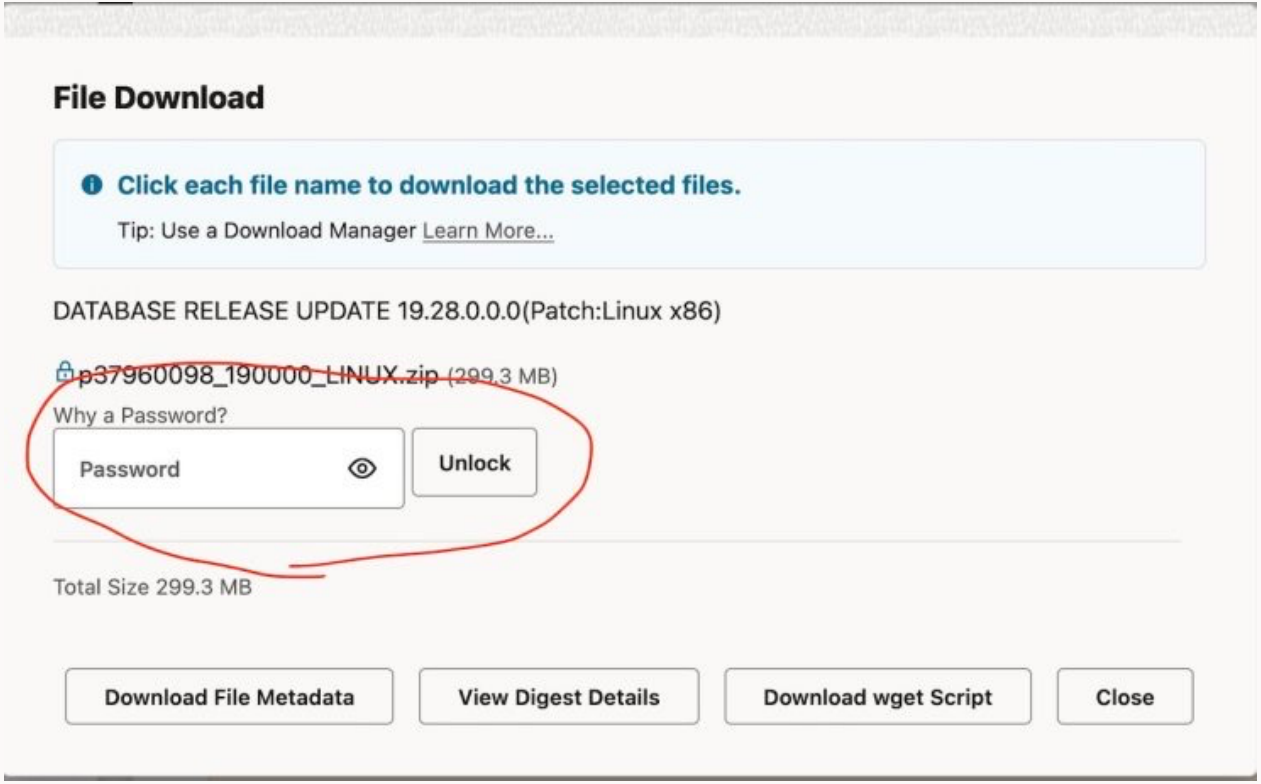
The result is stronger code, earlier identification of risk and mitigations, and better protection for Oracle and our

The security practices of yesterday are not sufficient today anymore

You must upgrade to Oracle Database 19c or Oracle AI Database 26ai

You must patch your database with the most recent Release Update

Older Release Updates?



Oracle also recommends applying monthly patches

Link

Security Updates

Update: Monthly Critical Security Patch Updates (CSPUs) Begin May 28, 2026

May 4, 2026 | 1 minute read

Integrated Cyber Center (ICC)

As a follow-up to our recent post, Accelerating Vulnerability Detection and Response, monthly Critical Security Patch Updates (CSPUs).

Beginning May 28, 2026, Oracle will deliver a Critical Security Patch Update (CSPU) ea vulnerabilities in a smaller, more focused format, allowing customers to address high- release.

CSPUs complement Oracle's existing quarterly Critical Patch Updates (CPUs):

Upcoming Security Release Dates

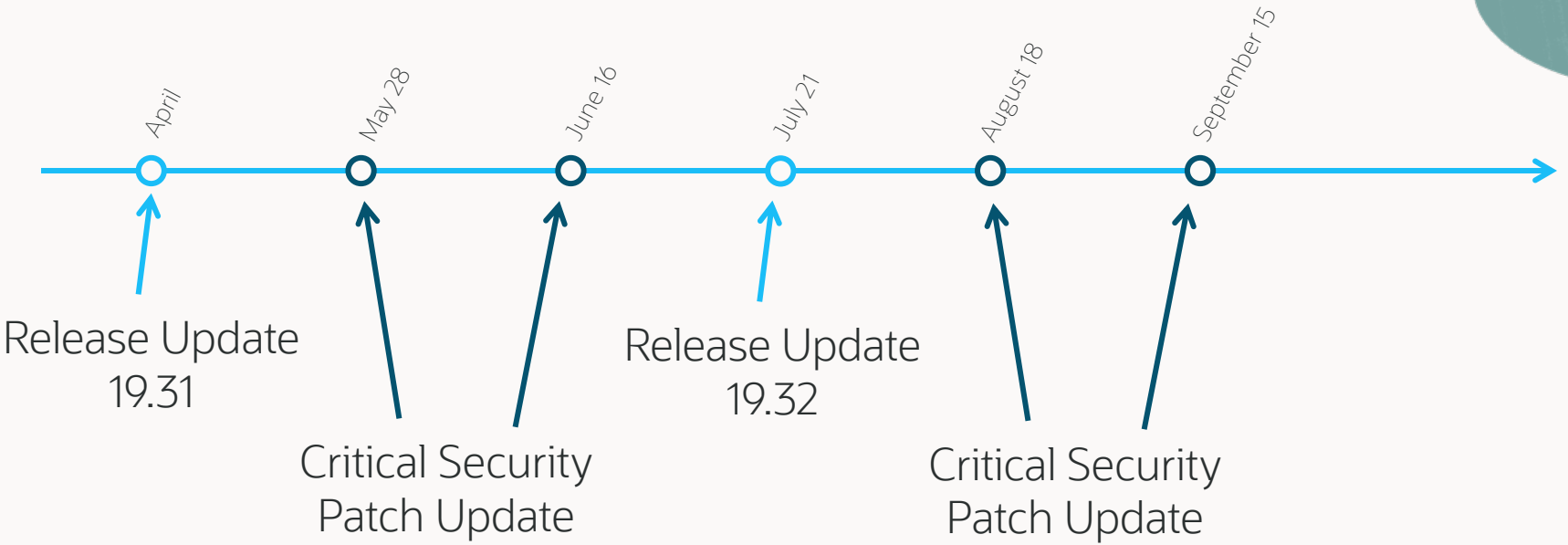
Date	Release Type
May 28, 2026	CSPU
June 16, 2026	CSPU
July 21, 2026	CPU
August 18, 2026	CSPU

Critical Security Patch Update

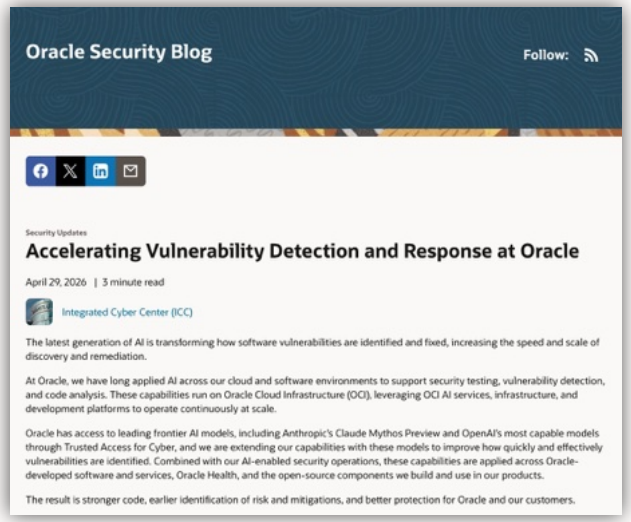
- Monthly Critical Security Patch Updates
  Deliver timely, high-priority fixes for critical issues

- Quarterly Release Updates
  Remain cumulative, including all fixes released in prior CSPUs

Critical Security Patch Update



Blog Posts



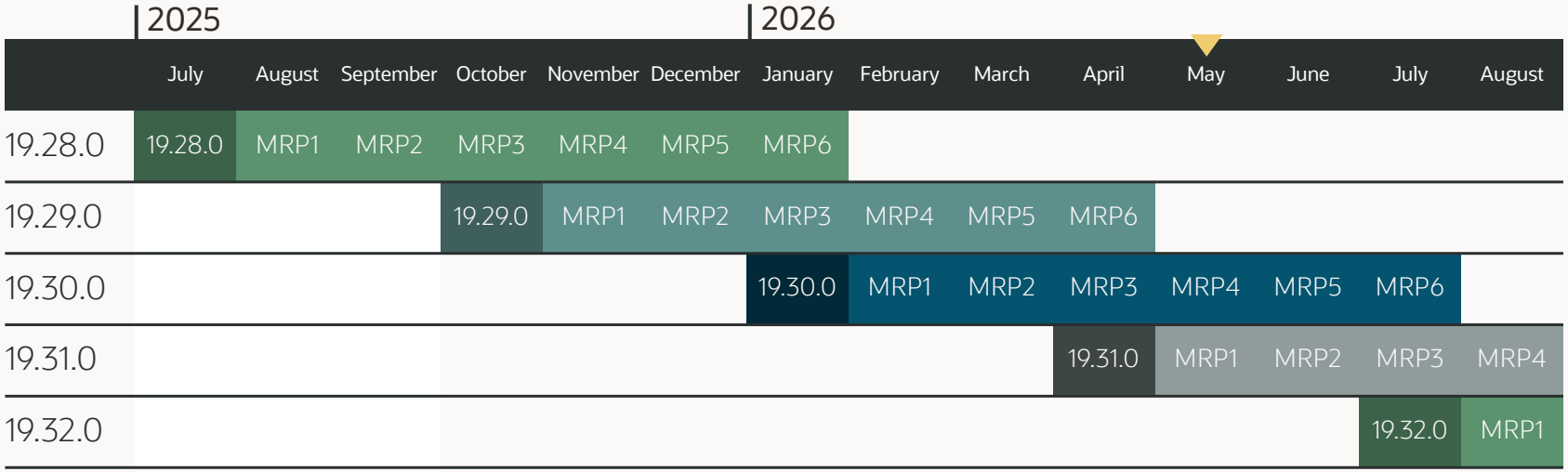
- Accelerating Vulnerability Detection and Response at Oracle
- Update: Monthly Critical Security Patch Updates (CSPUs) Begin May 28, 2026
- Take Action Today: Protect Your Oracle Database Against AI-Enabled Cybersecurity Threats
- Recommendations to Help Protect Oracle Databases from Emerging AI-enabled Security Threats (PNEWS3015)

Long Term Release Updates

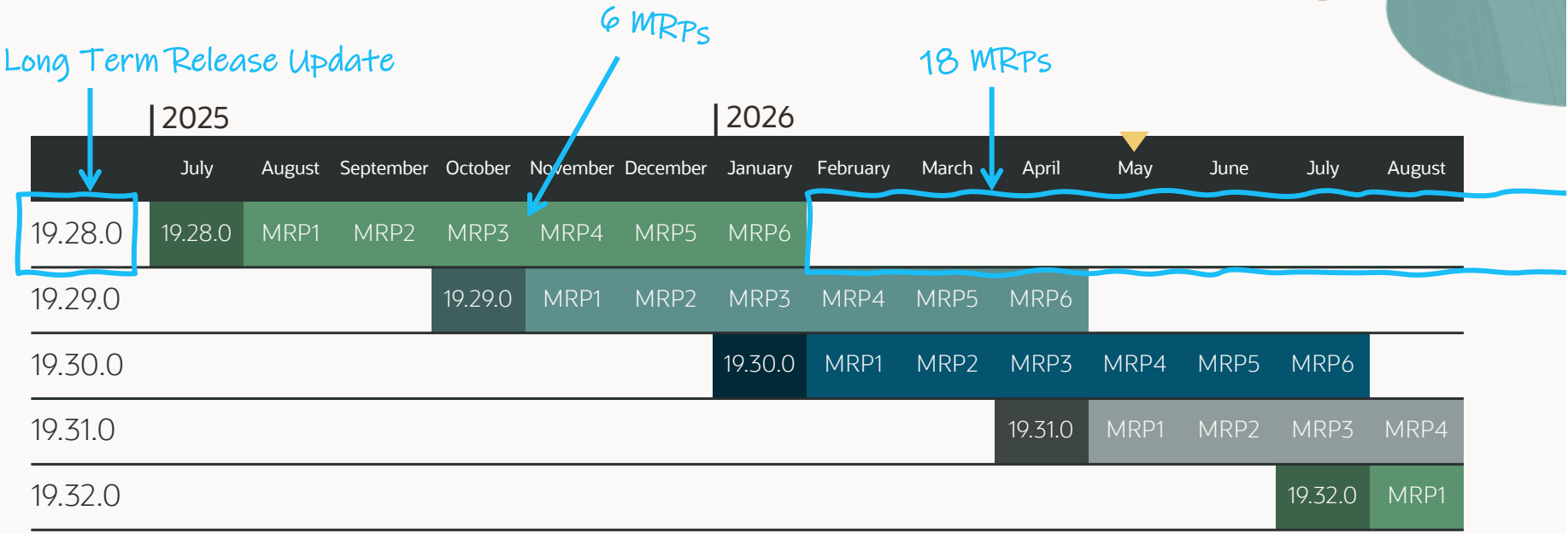
Quarterly Release Updates

	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	21.19.0	21.20.0	21.21.0	21.22.0	21.23.0
26ai							23.5.0	23.6.0	23.7.0	23.8.0	23.9.0	23.26.0	23.26.1	23.26.2	23.26.3

Monthly Recommended Patches



Monthly Recommended Patches



19.28 is the first Long Term Release Update

- Future announcements in KB625385

Long Term Release Updates

1. Security and compliance for 18 months
2. Receive critical updates
3. Less changes, higher stability

Patching

Oracle AI Database

1

DOWNLOAD

2

INSTALL

3

PATCH

4

FINALIZE

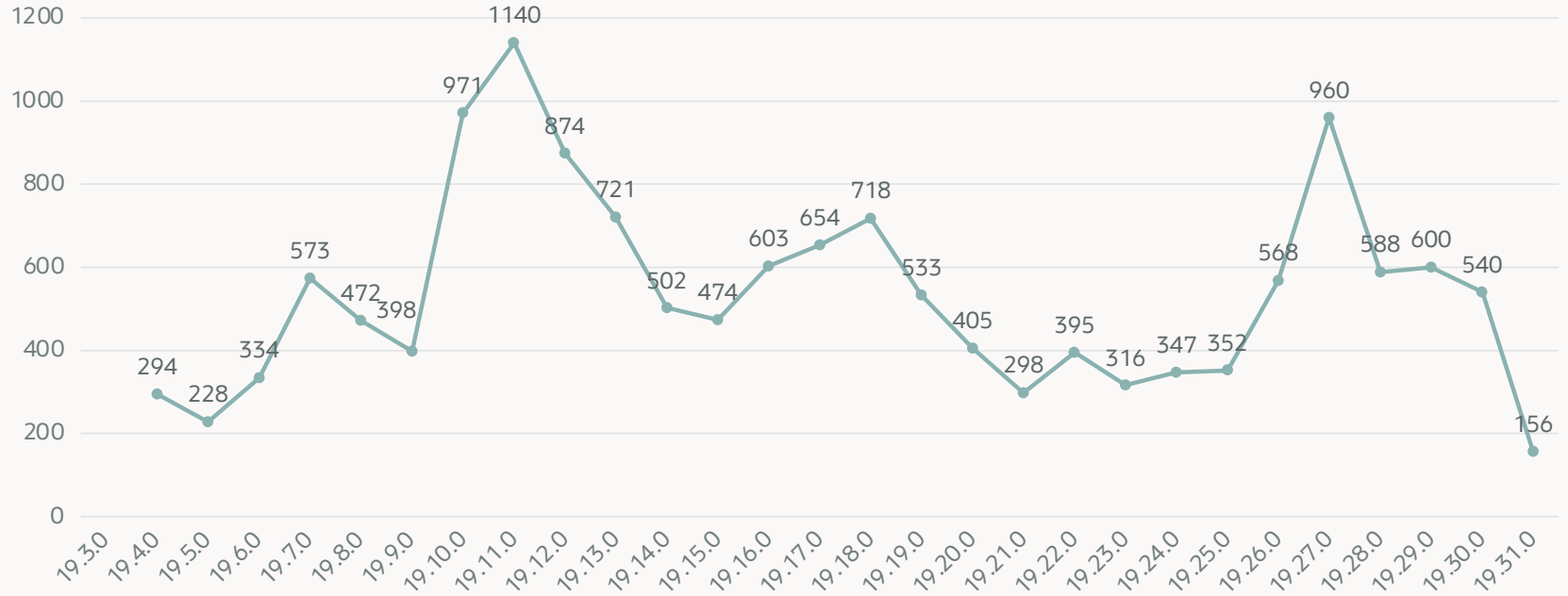
Download

Finding and downloading the right patches

Release Updates are the primary vehicle for delivering patches

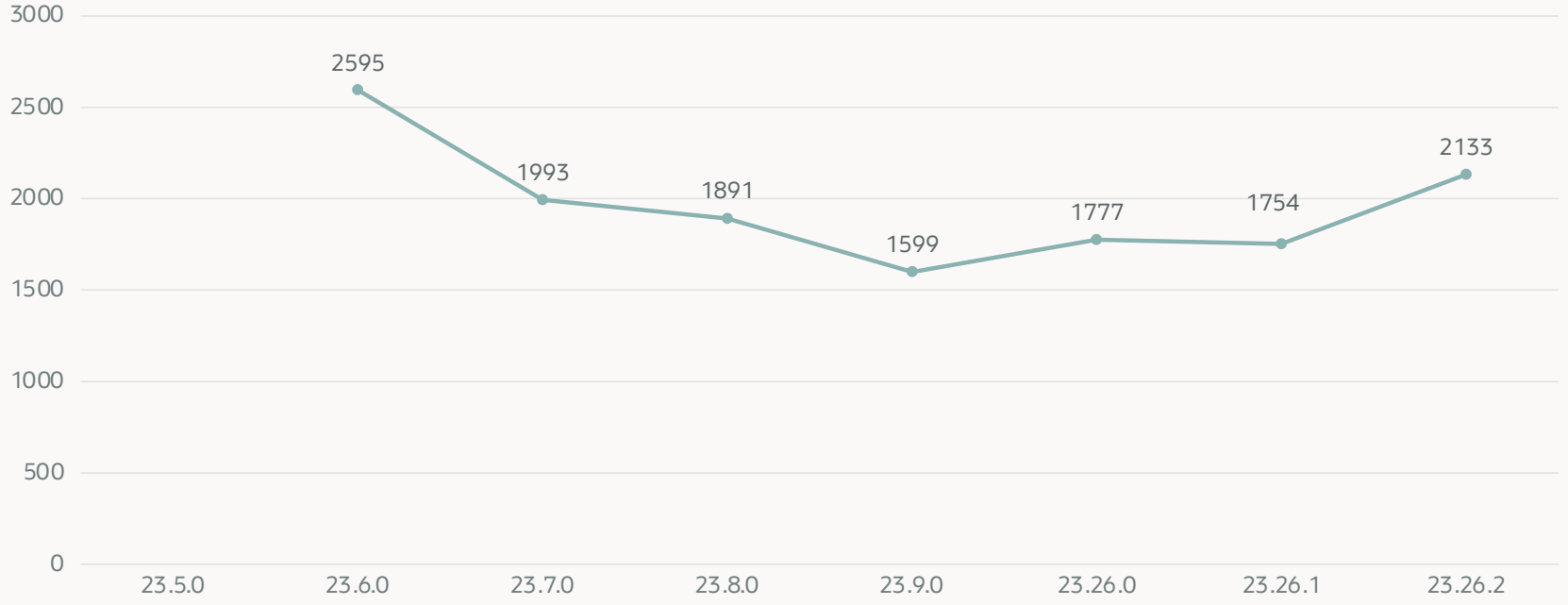
- Include security fixes

Release Update Contents – Oracle Database 19c



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

Release Update Contents – Oracle AI Database 26ai



Source: oradiff.oracle.com

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

- Almost 15,000 fixes on 19c
- Almost 14,000 fixes on 26ai

The easiest way you can download patches is using AutoUpgrade

```
-- Always use the latest version of AutoUpgrade
-- Available via direct download from oracle.com or KB123450

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

One single tool for everything
- on all platforms

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches
```


```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
```


```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=RU
```


```
$ opatch apply

Oracle Interim Patch Installer version 12.2.0.1.17
Copyright (c) 2025, Oracle Corporation.  All rights reserved.

...

The OPatch being used has version 12.2.0.1.17 while the following patch(es)
require higher versions:
Patch 38291812 requires OPatch version 12.2.0.1.47.
Please download latest OPatch from My Oracle Support.
```


```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=OPATCH,RU
```


You can only download the latest Release Update

- Previous Release Updates are password protected
- File an SR if you need an older Release Update

```
AutoUpgrade Patching 26.3.260401 launched with default internal options
Processing config file ...
Loading AutoUpgrade Patching keystore
AutoUpgrade Patching keystore is loaded

Connected to MOS - Searching for specified patches

There were conditions found preventing AutoUpgrade Patching from successfully
running

*Downloading files
Cannot find the latest Release Update
```

Stay secure with monthly Critical Security Patch Updates

- CSPUs complement quarterly Release Updates

AutoUpgrade will support Critical Security Patch Updates (CSPU)

Stay fully up-to-date with the most important one-off patches

Oracle Database 19c and Oracle AI Database 26ai Important Recommended One-off Patches

KB188772

Last Updated
Feb 4, 2026

Service
Oracle Database - Enterprise Edition

1.9

Applies To

All Users

Summary

This note provides a list of important recommended patches that resolve issues affecting Database and Grid Infrastructure 19c and 23ai software homes. These patches resolve issues that have a high likelihood of occurring or that can cause significant impact if they do occur.

This document was MOS Document ID: 555.1 in Legacy MOS.

Solution

NOTE: Unless there is an urgent fix, this document will be updated once a week on Tuesdays at 9AM EST if any new patch is identified.

Through our review of service requests, we often find that issues encountered are the result of customers being on an older Release Update (RU) or Monthly Recommended Patch (MRP). Many issues will have been fixed in the latest updates, which we always recommend.

As noted in the RU-specific tables below, fixes for known issues are targeted for inclusion in the next available MRP and RU. You can always find the latest RUs, MRPs, other patches, lists of fixed bugs and known issues in KB106822 Identifying and installing the latest updates (patches) helps ensure you are using the most current content for security, functional, regression and bug fixes, as well as minor enhancements and any emergency one-offs.

Note:
Oracle encourages customers to install the latest MRP whenever possible. MRPs deliver the safest, fully-tested path to receive the fixes in this document. Refer to FAQ2283 for further details.

In addition to the relevant patches listed below, you should apply patches based on the specific RU after reviewing the following My Oracle Support knowledge documents:

1. Database PSU/BP/Update/Revision - Known Issues Primary NoteDatabase PSU/BP/Update/Revision - Known Issues Primary Note KB260868)
2. Oracle Database Patches to Consider for 19c (Doc ID KA912) which contains patches to consider for specific areas such as Data Guard, Data Pump, GoldenGate.

Recommended Patches for 19.30 DB Home

Below is the list of important patches to consider applying on top of 19.30.

Bug	KM Article	Fixed in RU	Fixed in MRP	Description	Patches	RAC Rolling Installable	Database Online Installable	Added
38854064	PALRT2888			[RAC] (DB55) RAC rolling database update when fix 34352668 is present may cause data/redo corruption	PATCH 38854064	YES	NO	28-JAN-2026
37690446	KI40534	Not Eligible	Not Eligible	[SQL EXECUTION] ORA-600 [ktatmkref-rs] errors in the alert log post-patch 37260974 (19.26.0.0.250121 dbru and above) - Workarounds Available	PATCH 37690446	NO	NO	23-SEP-2025
34672698 (replaces 34286265)	KI54797	Not Eligible	Not Eligible	[VOS] DB50: ORA-800: soft external error, arguments: [set priority failed], [vktm] , dism(16)	PATCH 34672698	YES	NO	22-FEB-2024
34774667	KI36203	Not Eligible	Not Eligible	[AQ] ORA-7445 in Purge Queue Table / High CPU usage in SVCB Service	PATCH 34774667	NO	NO	11-JUL-2023
29213893	KI24589	Not Eligible	Not Eligible	[QRY OPTIMIZER] DBMS_STATS Failing With Error Ora-1422 When Gathering Stats for User$ Table	PATCH 29213893	NO	NO	01-SEP-2021

`Version DB 19.30_555.1: 38854064,37690446,34672698,34774667,29213893`

watch for conflicts

Recommended Patches for 19.30 GI Home

Below is the list of important patches to consider applying on top of 19.30.
Only one OCW (Oracle Clusterware) patch should be applied to GI homes. Ensure you apply the patch starting with X8M if you are on an X8M system

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=OPATCH,RU,38854064,37690446,34672698,34774667,29213893
```

Monthly Recommended Patches

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

Primary Note for Database Quarterly Release Updates

KB106822

Last Updated
Dec 17, 2025

Service

Service
Gen 2 Exadata Cloud at Customer, Generation 1 - Exadata Cloud at Customer (First Generation Cloud Machine), Oracle Cloud Infrastructure - Exadata Cloud Service, Oracle Database - Enterprise Edition, Oracle Database - Standard Edition

1.7

Authoring Instructions

This is a crossover article and must be edited only in Legacy MOS for Document ID : 888.1. Any changes made here will be lost in the next update.

Applies To

All Users

Summary

The purpose of this document is to list Database patches for both proactive and reactive maintenance.

This was MOS Document ID: 888.1 in Legacy MOS. Post migration, we will be moving to KB888 (Date TBA)

Solution

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=OPATCH,RU,MRP
```


MRPs and CSPUs are cumulative but only within one Release Update

CSPU and MRPs will co-exist

Customers on Linux may adopt the MRP

- CSPU content is part of MRP

Content

MRP – Monthly Recommended Patch

- KB188772
  - Critical fixes
  - Regression fixes
  - RAC rolling fixes
- Security fixes

CSPU – Critical Security Patch Update

- Security fixes

Apply the OJVM bundle patch

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=OPATCH,RU,OJVM
```


OJVM is embedded in Release Updates

- No separate download
- Complete RAC Rolling patching support

Don't miss out on all the Data Pump fixes

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=OPATCH,RU,OJVM,DPBP
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=OPATCH,RU,OJVM,DPBP
patch1.patch=RECOMMENDED
```

Recommended Patches

```
patch1.patch=RECOMMENDED
```

OPATCH	The latest OPatch
RU	The latest Release Update
OJVM	OJVM bundle matching Release Update
DPBP	Data Pump bundle patch matching RU
AU	Latest version of AutoUpgrade

Apply product-specific bundle patches based on your usage

Oracle Database Patches to Consider for 19c

KA912

Last Updated
Feb 17, 2026

1.4

Getting Started | Performance | Golden Gate | Oracle Text | Platform Specific | Data Guard High Availability | DNFS | Data Pump | Partitioning | Multitenant | General | Oracle Spatial

Search This Document | Print

Getting Started

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

LEVEL 1: Apply latest quarterly patches:

- Apply latest quarterly updates using Master Note for Database Proactive Patch Program (Doc ID KB106822)

LEVEL 2: Apply Critical/Recommended patches:

- For Exadata environments: Exadata Critical Issues (KB623062)
- For Database environments:
  - Customers on Linux x86-64 - Apply the latest Monthly Recommended Patches - MRP (FAQ2283) for the specific RU
  - For customers on other platforms, apply critical patches using Oracle Database 19c Important Recommended One-off Patches (KB858385)

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

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

Article Feedback

Rate this

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=RECOMMENDED,SDOBP
```


```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=RECOMMENDED,SDOBP,TEXT
```


Apply other bundle patches via patch number

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=RECOMMENDED,SDOBP,TEXT,38879426
```


Any other bundle patch AutoUpgrade should download?

Apply latest JDK patch

"Why is the JDK in my brand-new Oracle home always 3 months old, or even older?"

```
$ORACLE_HOME/jdk/bin/java -version

java version "1.8.0_471"
Java(TM) SE Runtime Environment (build 1.8.0_471-b09)
Java HotSpot(TM) 64-Bit Server VM (build 25.471-b09, mixed mode)
```


JDK and PERL Patches for Oracle Database Home and Grid Home

KB118730

Last Updated
Feb 17, 2026

Service
Gen 2 Exadata Cloud at Customer, Generation 1 - Exadata Cloud at Customer (First Generation Cloud Machine), Oracle Cloud Infrastructure - Exadata Cloud Service, Oracle Database - Enterprise Edition, Oracle Database - Standard Edition

★★★☆☆ 3.0

JDK and PERL Patches for Oracle Database Home and Grid Home

2.1 Latest JDK Patches for Database

Jan2026 Quarter

Version	Patch	Linux64	Windows64	WindowsNT	Sparc64	Solaris.x64	Linux32	AIX64	HPIA64	ZLinux64	ARM64
26ai	JDK11.0.30	Included in DBRU	***	***	***	***	***	***	***	***	Included in DBRU
21c	JDK8u481 38586761	Released	Released	*	*	*	*	*	*	*	*
19c	JDK8u481 38586770	Released	Released	Released	Released	Released	Released	Released	Released	Released	Released

* This platform is not planned for 21c, as 21c is an Innovation Release

** Some of the JDK's provided by Oracle are dependent on platform vendors. When those platform vendors provide Oracle with the JDK we then package it for Data base Customers, and document it in this table.

*** This platform is not planned for 26ai.

2.2 Latest Perl Patches for Database

As of January 2023, the latest PERL Patches are included with the quarterly security patches and are no longer provided separately.

3.0 Historical Patches

3.1 Historical JDK Patches for Database

Oct2025 Quarter

Version	Patch	Linux64	Windows64	WindowsNT	Sparc64	Solaris.x64	Linux32	AIX64	HPIA64	ZLinux64	ARM64
26ai	JDK11.0.29 38378863	Released	***	***	***	***	***	***	***	***	Included in DBRU

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=RU,JDK
```


Patch the OCW component

```
$ORACLE_HOME/OPatch/opatch lspatches

38632161;Database Release Update : 19.30.0.0.260120(REL-JAN260130) (38632161)
29585399;OCW RELEASE UPDATE 19.3.0.0.0 (29585399)
```


It is mandatory to update OCW with Oracle RAC Database and Oracle Restart

- In the database Oracle home

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=RECOMMENDED,OCW
```


```
$ORACLE_HOME/OPatch/opatch lspatches

38632161;Database Release Update : 19.30.0.0.260120(REL-JAN260130) (38632161)
38661284;OCW RELEASE UPDATE 19.30.0.0.0 (38661284)
```

AutoUpgrade downloads the GI RU
- use it to patch Grid Infrastructure

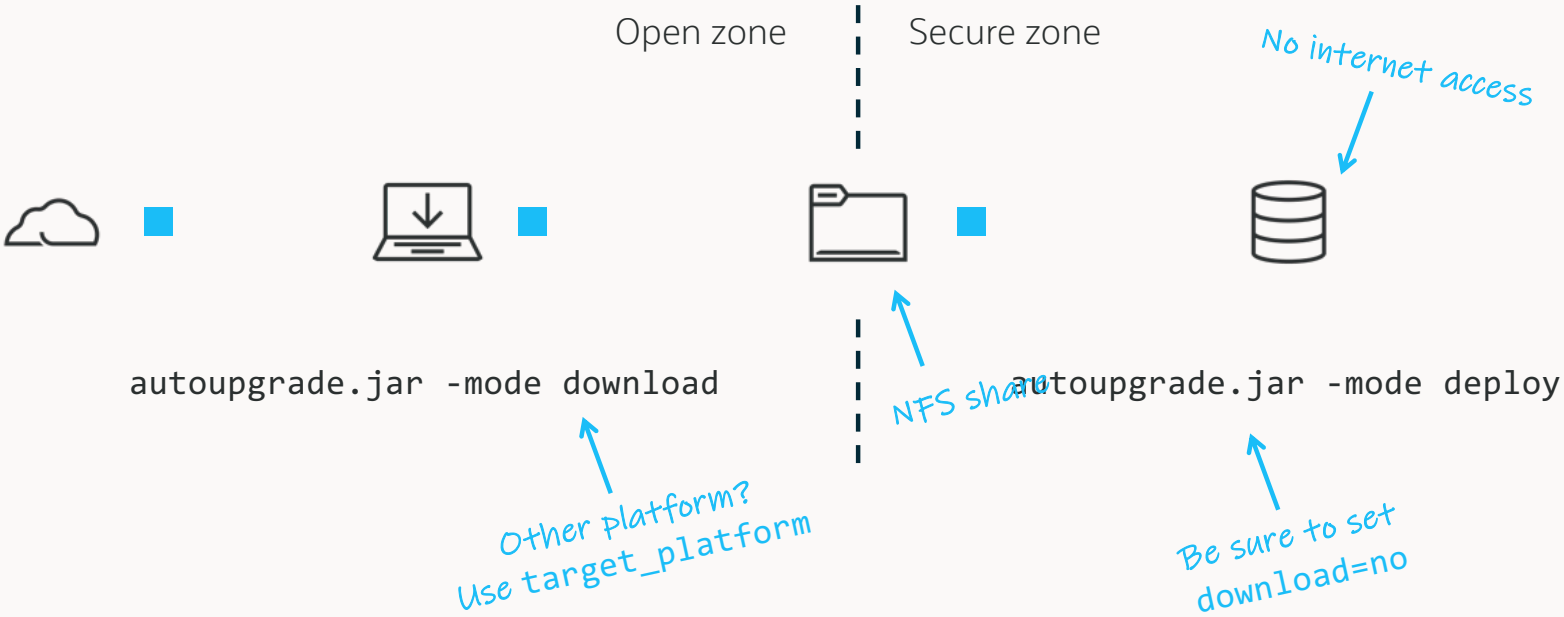
What about AutoUpgrade itself?

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=AU
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.patch=AU,AHF,CVU,SQLCL
```


Your database host doesn't have internet access?

Using Download Mode



Using Proxy to Download Patches

```
$ export https_proxy='https://proxy.example.com:8080'

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


Let's get those patches

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.platform=LINUX.X64
patch1.patch=RECOMMENDED,MRP,38854064,37690446,34672698,34774667,29213893,SDOBP,TEXT,JDK,OCW
```


```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.platform=LINUX.X64
patch1.patch=RECOMMENDED,MRP,38854064,37690446,34672698,34774667,29213893,SDOBP,TEXT,JDK,OCW

patch2.target_version=19
patch2.platform=AIX.X64
patch2.patch=RECOMMENDED,JDK,OCW
```


```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches

patch1.target_version=19
patch1.platform=LINUX.X64
patch1.patch=RECOMMENDED,MRP,38854064,37690446,34672698,34774667,29213893,SDOBP,TEXT,JDK,OCW

patch2.target_version=19
patch2.platform=AIX.X64
patch2.patch=RECOMMENDED,JDK,OCW

patch3.target_version=26
patch3.platform=LINUX.X64
patch3.patch=RECOMMENDED,JDK,OCW
```

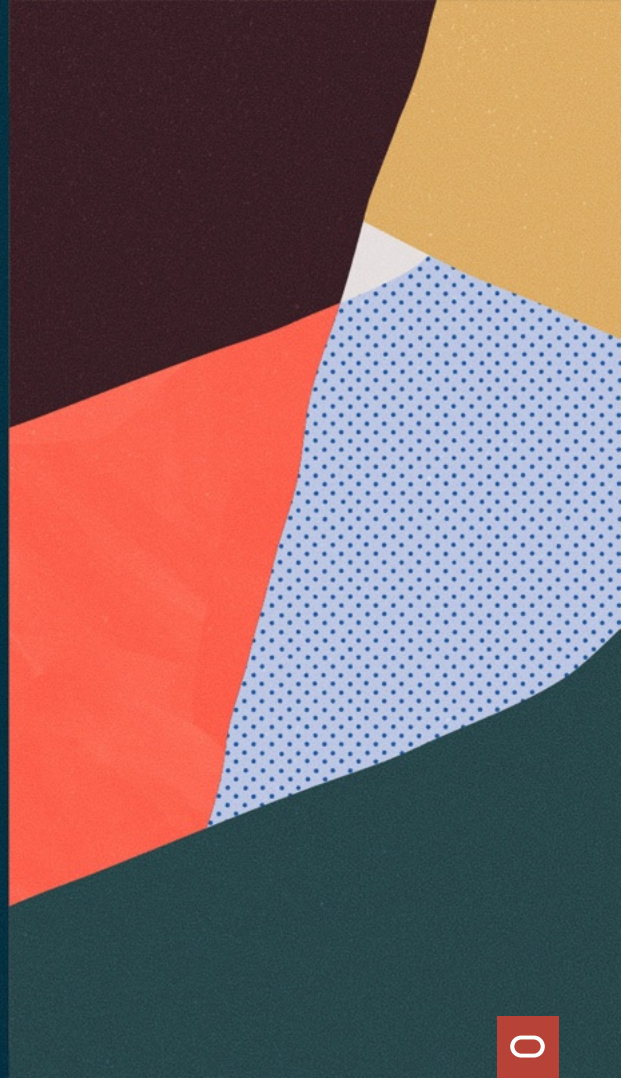

```
-- Start AutoUpgrade in download mode to get the patches specified in the config file

java -jar autoupgrade.jar -config get.cfg -patch -mode download
```

DEMO

Download patches

- Multiple releases
- Multiple platforms

Watch on YouTube



Why isn't my Release Update available?

- Post Release Patches

Oracle Critical Patch Update Advisory - April 2026

Description

A Critical Patch Update is a collection of patches for multiple security vulnerabilities. These patches address vulnerabilities in Oracle code and in third party components included in Oracle products. These patches are usually cumulative, but each advisory describes only the security patches added since the previous Critical Patch Update Advisory. Thus, prior Critical Patch Update advisories should be reviewed for information regarding earlier published security patches. Refer to "Critical Patch Updates, Security Alerts and Bulletins" for information about Oracle Security advisories.

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Please note that since the release of the January 2026 Critical Patch Update, Oracle has released a Security Alert for Oracle Identity Manager and Oracle Web Services Manager, CVE-2026-21992 (March 20, 2026). Customers are strongly advised to apply the April 2026 Critical Patch Update for Fusion Middleware products, which includes patches for this Alert as well as additional patches.

Oracle Communications Operations Monitor, versions 5.2, 6.0, 6.1	Oracle Communications Operations Monitor
Oracle Communications Order and Service Management, versions 7.5.0, 8.0.0	Oracle Communications Order and Service Management
Oracle Communications Performance Intelligence Center, versions 10.5.0.0-10.5.0.2	Oracle Communications Performance Intelligence Center
Oracle Communications Policy Management, versions 15.0.0.0.0, 15.0.0.1.0	Oracle Communications Policy Management
Oracle Communications Service Catalog and Design, versions 8.0.0.6.0, 8.1.0.5.0, 8.2.0.2.0	Oracle Communications Service Catalog and Design
Oracle Communications Session Border Controller, versions 9.3.0, 10.0.0, 10.1.0	Oracle Communications Session Border Controller
Oracle Communications Session Report Manager, versions 9.0.0-9.0.4	Oracle Communications Session Report Manager
Oracle Communications Unified Assurance, versions 6.1.1-7.0.0	Oracle Communications Unified Assurance
Oracle Communications Unified Inventory Management, versions 7.5.0-7.5.1, 7.6.0-7.8.0, 8.0.0	Oracle Communications Unified Inventory Management
Oracle Configuration Manager, versions 13.5, 24.1	Oracle Enterprise Manager
Oracle Data Integrator, versions 12.2.1.4.0, 14.1.2.0.0	Fusion Middleware
Oracle Database Server, versions 12.1.0.2.0, 12.2.0.1.0, 19.3-19.30, 21.3-21.21, 23.4.0-23.26.1	Database
Oracle Documaker, versions 12.7.2-13.0.2	Contact Support
Oracle E-Business Suite, versions 12.2.3-12.2.15, 15.0	Oracle E-Business Suite
Oracle Enterprise Communications Broker, versions 4.2.0, 5.0.0	Oracle Enterprise Communications Broker
Oracle Enterprise Manager Base Platform, versions 13.5, 24.1	Oracle Enterprise Manager
Oracle Enterprise Manager for Fusion Middleware, versions 13.5, 24.1	Oracle Enterprise Manager

Oracle Critical Patch Update (CPU) Apr 2026 for Oracle Database Products

CPU58

Last Updated
Yesterday 4:41 PM

1.4

Critical Patch Update (CPU) Apr 2026 for Oracle Database Products

My Oracle Support CPU58

Released April 21, 2026

This document contains the following sections:

Patch	Patch Number	Platform	Availability
23.26.2 Database Release Update 23.26.2.0.0 GoldImage	39099680	Linux x86-64	Available
23.26.2 GI Release Update 23.26.2.0.0 GoldImage	39099896	Linux x86-64	Available
23.26.2 Client Release Update 23.26.20.0 GoldImage	39099870	Linux x86-64	Available
23.26.12 CMAN Client Release Update 23.26.2.0.0 GoldImage	39099840	Linux x86-64	Available
23.26.2 GSM Client Release Update 23.26.2.0.0 GoldImage	39099882	Linux x86-64	Available
23.26.2 Database Release Update 23.26.2.0.0 Patch	39093711	Linux x86-64	Available
23.26.2 GI Release Update 23.26.2.0.0 Patch	39088031	Linux x86-64	Available
21.22.0.0.260421 Database RU	39073698	Linux 32 bit	Available
21.22.0.0.260421 GI RU	39073631	Linux 32 bit	Available
21.22.0.0.260421 Database RU	38955012	Windows 64-bit & 32-bit	ETA: 15-MAY-2026
19.31.0.0.260421 DB RU & COMBO	DB 39034528 Combo 39062931	Linux x86-64: All Others	Available ETA: 15-May-2026
19.31.0.0.260421 GI RU & COMBO	GI 39036936 Combo 39062956	Linux x86-64: All Others	Available ETA: 15-May-2026
19.31.0.0.260421 OJVM RU	38906621	ALL	Available
19.31.0.0.260421 WIN BP & OJVM	38818049	Windows 64-bit & Windows 32-bit Windows OJVM	ETA: 12-May-2026
19.31 QFSDP for Exadata	39063037	Linux x86-64 Solaris.X64	Available ETA: 15-May-2026
21.22 QFSDP for Exadata	39063054	Linux x86-64	Available
23.26.2 QFSDP for Exadata	39063134	Linux x86-64	Available
GoldenGate for Distributed Applications and Analytics 23.26.2.0.0	39220416	Linux x86-64	ETA: 22-May-2026
Oracle GoldenGate for Big Data 21.22.0.0.0 Microservices	39220426	Linux x86-64	ETA: 15-May-2026
Oracle GoldenGate for Big Data 21.22.0.0.0	39220427	Linux x86-64	ETA: 15-May-2026
Oracle GoldenGate for Big Data 19.1.0.0.23	38858573	Linux x86-64	ETA: 22-May-2026

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23.26.2 GSM Client Release Update 23.26.2.0.0 GoldImage	39099882	Linux x86-64	Available
23.26.2 Database Release Update 23.26.2.0.0 Patch	39093711	Linux x86-64	Available
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21.22.0.0.260421 Database RU	39073698	Linux 32 bit	Available
21.22.0.0.260421 GI RU	39073631	Linux 32 bit	Available
21.22.0.0.260421 Database RU	38955012	Windows 64-bit & 32-bit	ETA: 15-MAY-2026
19.31.0.0.260421 DB RU & COMBO	DB 39034528 Combo 39062931	Linux x86-64: All Others	Available ETA: 15-May-2026
19.31.0.0.260421 GI RU & COMBO	GI 39036936 Combo 39062956	Linux x86-64: All Others	Available ETA: 15-May-2026
19.31.0.0.260421 OJVM RU	38906621	ALL	Available
19.31.0.0.260421 WIN BP & OJVM	38818049	Windows 64-bit & Windows 32-bit Windows OJVM	ETA: 12-May-2026
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Oracle GoldenGate for Big Data 19.1.0.0.23	38858573	Linux x86-64	ETA: 22-May-2026

Further Information

Downloading Patches

- Assistant: Download Reference for Oracle Database/GI Update, Revision, PSU, SPU(CPU), Bundle Patches, Patchsets and Base Releases (KA958)
- Oracle Database 19c and Oracle AI Database 26ai Important Recommended One-off Patches (KB188772)
- Oracle Database Patches to Consider for 19c (KA912)
- Things to Consider to Avoid SQL Performance Problems on 19c (KB138000)
- Long Term Support Model for 19c Database Release Updates (KB625385)
- ORAdiff
- Blog post: The Easiest Way to Download 19.27 Release Update
- Blog post: The Easiest Way To Download Patches for Oracle Grid Infrastructure
- Blog post: AutoUpgrade New Features: Patch OCW Component In Oracle Home

Install

Creating Oracle home

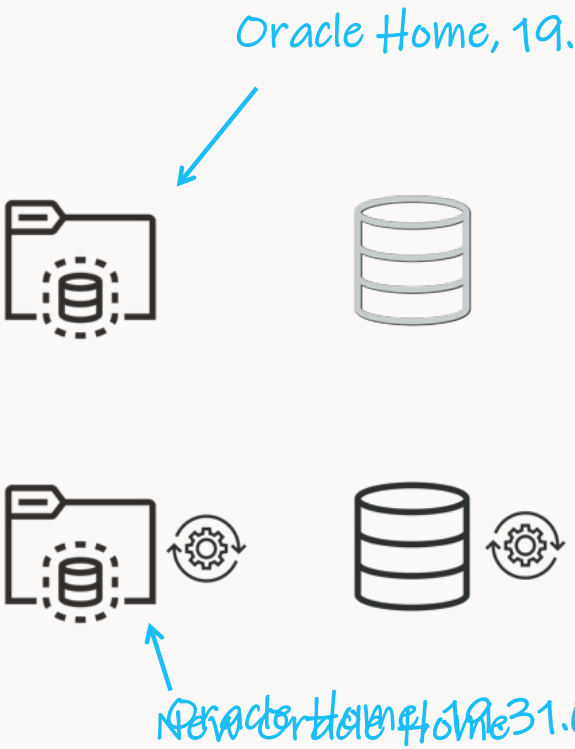
Photo by Long Ma on Unsplash

In-Place Patching

Oracle Home, 19.3.0.0

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

Out-of-Place Patching



Out-of-place Patching Benefits

- Less downtime
- Less risk
- Easier rollback
- Leaner Oracle home

Always patch Out-of-Place

But if you insist ...

```
du -sh $ORACLE_HOME/.patch_storage

14.2G    /u01/app/oracle/product/19/.patch_storage
```

```
-- Clean up Oracle home if you use in-place patching
-- or use out-of-place patching with cloned Oracle homes.
-- Delete obsolete files from $ORACLE_HOME/.patch_storage and trims OPatch XML files
```

```
./opatch util deleteinactivepatches
```

Create new Oracle home
- matching the current Oracle home

```
cat install19.cfg

   global.global_log_dir=/home/oracle/autoupgrade-patching/log
   global.folder=/home/oracle/autoupgrade/patches
   patch1.source_home=/u01/app/oracle/product/dbhome_19_30
   patch1.target_home=/u01/app/oracle/product/dbhome_19_31
   patch1.patch=RECOMMENDED
```

Settings

Patches

```
cat install19.cfg

   global.global_log_dir=/home/oracle/autoupgrade-patching/log
   global.folder=/home/oracle/autoupgrade/patches
   patch1.source_home=/u01/app/oracle/product/dbhome_19_30
   patch1.target_home=/u01/app/oracle/product/dbhome_19_31
   patch1.patch=RECOMMENDED
```

```
java -jar autoupgrade.jar -config install19.cfg -patch -mode create_home
```

Override source home setting

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.folder=/home/oracle/autoupgrade/patches

patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
patch1.patch=RECOMMENDED
patch1.home_settings.home_name=OraDbHome1931
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.folder=/home/oracle/autoupgrade/patches

patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
patch1.patch=RECOMMENDED
patch1.home_settings.home_name=OraDbHome1931
patch1.home_settings.binopt.part=no
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.folder=/home/oracle/autoupgrade/patches

patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
patch1.patch=RECOMMENDED
patch1.home_settings.home_name=OraDbHome1931
patch1.home_settings.binopt.part=no
patch1.home_settings.binopt.uniaud=yes
```

The documentation lists all the Oracle home options

Are you using Oracle RAC Database? Also works for cluster Oracle homes!

- Automatically detected
- No additional configuration

AutoUpgrade runs `root.sh` script

- `oracle` user must have sudo privilege

Further Information

Downloading Patches

- (KB104015) OPatch 12.2.0.1.37+ Introduces a New Feature to Delete Inactive Patches in the ORACLE_HOME/.patch_storage Directory
- Blog post: AutoUpgrade New Features: Install Oracle Home on Brand-New, Empty Server
- Blog post: Cleaning up older patch artifacts – improving opatch performance
- Hands-on lab: Patch Me If You Can

Patch

Patching Oracle AI Database

Start by performing a pre-patch analysis

Analyze

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

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
patch1.sid=CDB19
patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
patch1.sid=CDB19
patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
```

```
$ java -jar autoupgrade.jar -config CDB19.cfg -mode analyze
```


Patch a single instance database

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore

patch1.sid=CDB19
patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore

patch1.sid=CDB19
patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
patch1.rman_catalog_connect_string=catalogdb
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore

patch1.sid=CDB19
patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
patch1.rman_catalog_connect_string=catalogdb
patch1.emcli_path=/u01/app/oracle/oem
patch1.em_target_name=ORCL_myhost.domain.int
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore

patch1.sid=CDB19
patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
patch1.rman_catalog_connect_string=catalogdb
patch1.emcli_path=/u01/app/oracle/oem
patch1.em_target_name=ORCL_myhost.domain.int
patch1.before_action=/home/oracle/scripts/before_db.sh Y
patch1.after_action=/home/oracle/scripts/after_db.sh Y
```

```
-- Patch the database according to the specification in the config file
-- This takes care of all the necessary steps, including pre- and post-tasks

java -jar autoupgrade.jar -config CDB19.cfg -mode deploy
```

AutoUpgrade fully supports Oracle Restart

- No additional configuration

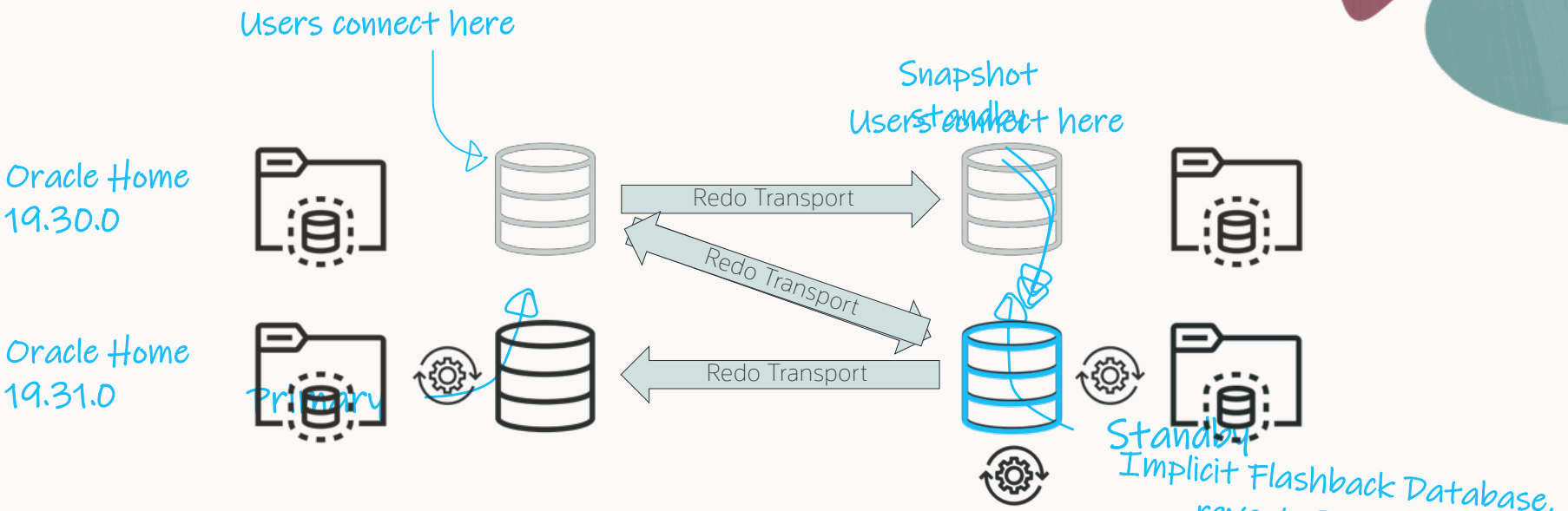
You can also patch individual PDBs
- also using refreshable clone PDBs

Patching Data Guard

Reduce downtime to the time it takes to perform a switchover

Safely test and verify patches with Standby-First Patch Apply

Standby-First Patching




```
java -jar autoupgrade.jar \
   -config ... \
   -mode deploy
```

```
over to PROD2;
```

```
java -jar autoupgrade.jar \
   -config ... \
   -mode upgrade
```

DEMO

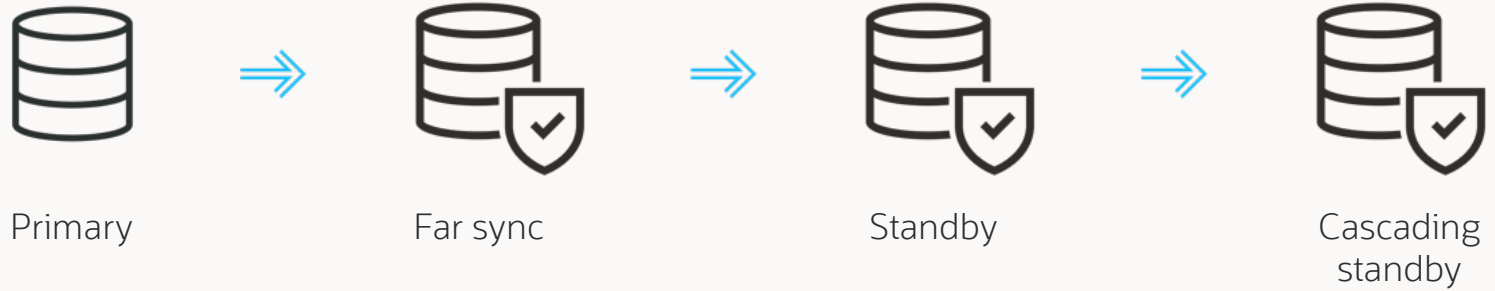
Patch Data Guard

Watch on YouTube

Patch must Standby-First installable

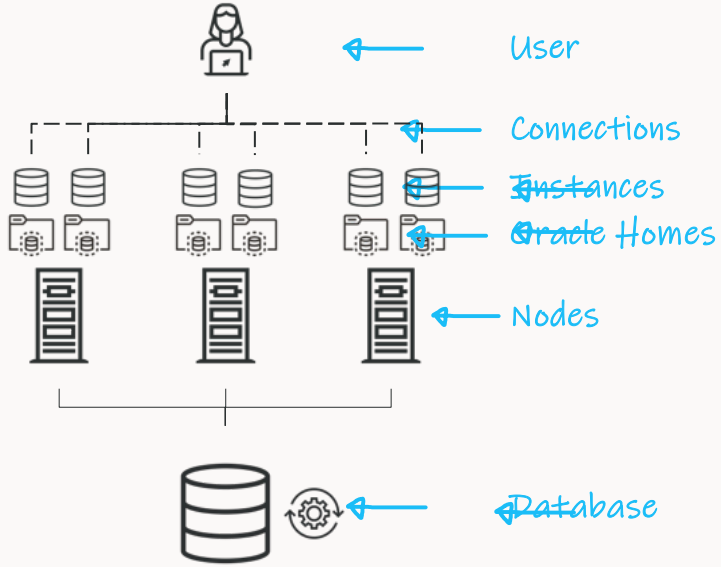
- Check the patch readme

Data Guard Patching



Rolling patch apply on Oracle RAC Database

RAC Rolling Patching



- New DB home

```
autoupgrade.jar ... -mode create_home
```

- Move to new home

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

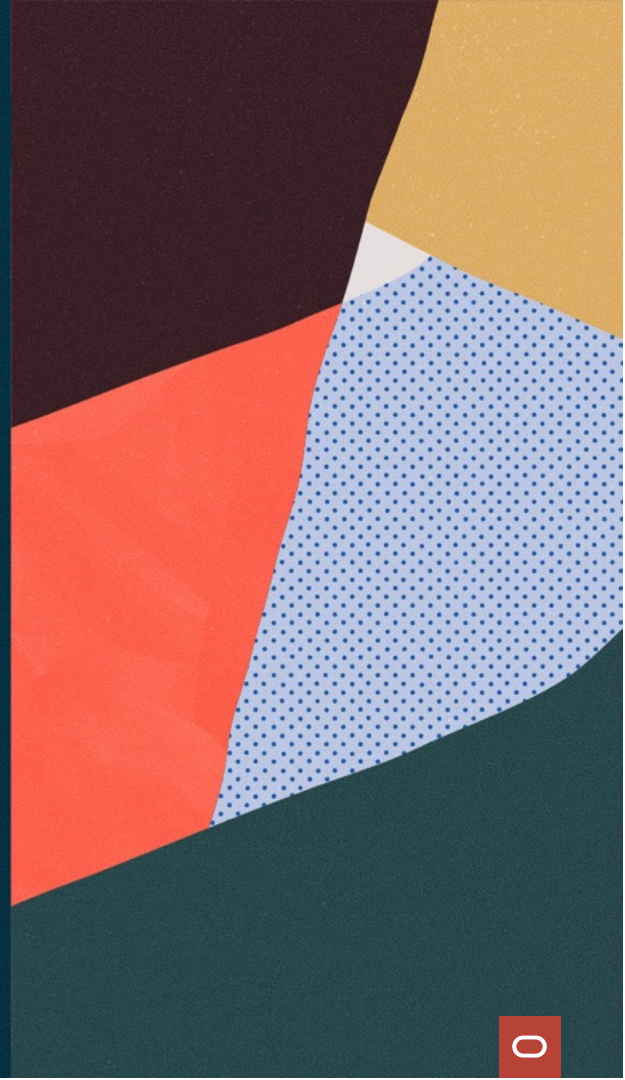
```
global.global_log_dir=/home/oracle/autoupgrade-patching/log

patch1.sid=CDB191
patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
patch1.rac_rolling=auto
```

DEMO

Patch Oracle RAC Database

- Using AutoUpgrade
- Rolling

Watch on YouTube



`patch1.rac_rolling`

`DISABLED`	Patch using non-rolling method (outage)
`REQUIRED`	Patch using rolling method or stop if non-rolling patches are detected
`AUTO`	Automatically detects the best approach (default)
`FORCE`	Force using rolling method

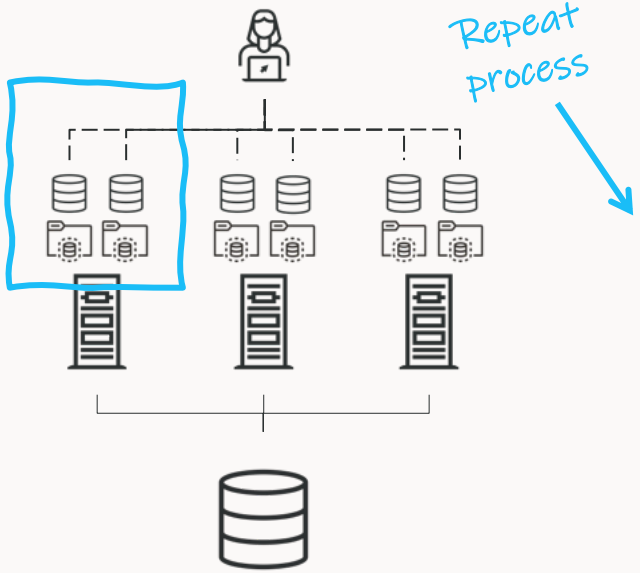
AutoUpgrade stops the service using the default drain timeout

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log

patch1.sid=CDB191
patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
patch1.rac_rolling=auto
patch1.drain_timeout=300
```

But my application doesn't drain …

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log

patch1.sid=CDB191
patch1.source_home=/u01/app/oracle/product/dbhome_19_30
patch1.target_home=/u01/app/oracle/product/dbhome_19_31
patch1.rac_rolling=auto
patch1.drain_timeout=WAIT
```


Controlling the Draining




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

```
srvctl relocate service \
   -stopoption TRANSACTIONAL \
   -drain_timeout 2592000 ...
```

```
upg> proceed -job 101
```

```
srvctl stop instance \
   -stopoption IMMEDIATE \
   -drain_timeout 0 ...
```

drain_timeout

patch1.drain_timeout = WAIT

```
srvctl relocate service
-oldinst node1
-stopoption TRANSACTIONAL
-drain_timeout 2592000
-wait yes
-verbose

> proceed –job 101

srvctl stop instance
-instance node1
-stopoption IMMEDIATE
-drain_timeout 0
-failover
-verbose
-force
```

patch1.drain_timeout = 120

```
srvctl stop instance
-instance node1
-stopoption IMMEDIATE
-drain_timeout 120
-failover
-verbose
-force
```

patch1.drain_timeout *(unset)*

```
srvctl stop instance
-instance node1
-stopoption IMMEDIATE
-failover
-verbose
-force
```

When unset, value used will be the MAX drain of all running services on that instance.

Further Information

Patching Database

- Oracle Patch Assurance - Data Guard Standby-First Patch Apply (KB137118)
- Blog post: Upgrade RMAN Catalog Schema
- Blog post: Update Enterprise Manager Configuration
- Blog post: Introduction to Patching Oracle Data Guard
- Blog post: Downloading and using Gold Image with AutoUpgrade
- Blog post: RAC Rolling mode in AutoUpgrade
- Blog post: How to patch Oracle Database using controlled RAC Rolling with AutoUpgrade
- Blog post: Announcing Oracle Update Advisor
- Hands-on lab: Patch Me If You Can

Finalize

A few things more ...

Don't forget the clients

Security Bug Fixes in Clients

CPU	Clients Affected
Apr 2026	Client-only
Jan 2026	Client-only, SQLcl
Oct 2025	Client-only, SQLcl
Jul 2025	Client-only, JDBC
Apr 2025	Client-only, SQLcl
Jan 2025	
Oct 2024	Client-only
Jul 2024	Client-only
Apr 2025	SQLcl
Jan 2025	

Oracle Critical Patch Update Advisory - April 2026

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Affected Products and Patch Information

Security vulnerabilities addressed by this Critical Patch Update affect the products listed below.

Please click on the links in the Patch Availability Document column below to access the documentation for patch availability information and installation instructions.

Affected Products and Versions	Patch Availability Document

Oracle Database Server Risk Matrix

This Critical Patch Update contains 8 new security patches, plus additional third party patches noted below, for Oracle Database Products. 4 of these vulnerabilities may be remotely exploitable without authentication, i.e., may be exploited over a network without requiring user credentials.

1 of these patches is applicable to client-only installations, i.e., installations that do not have the Oracle Database Server installed. The English text form of this Risk Matrix can be found here.

CVE ID	Component	Package and/ or Privilege Required	Protocol	Remote Exploit without Auth.?	CVSS VERSION 3.1 RISK (see Risk Matrix Definitions)									Supported Versions Affected	Notes
					Base Score	Attack Vector	Attack Complex	Privs Req'd	User Interact	Scope	Confid-entiality	Inte-grity	Avail-ability		
CVE-2026-33870	Clusterware (Micronaut)	None	HTTP	Yes	7.5	Network	Low	None	None	Un-changed	None	High	None	19.3-19.30, 23.4.0-23.26.1	
CVE-2026-35229	Java VM	Create Session	Oracle Net	Yes	7.5	Network	Low	None	None	Un-changed	High	None	None	19.3-19.30, 21.3-21.21	
CVE-2026-31790	RDBMS (OpenSSL)	None	Multiple	No	7.2	Network	Low	High	None	Un-changed	High	High	High	19.3-19.30, 23.4.0-23.26.1	
CVE-2026-26007	RDBMS (Python)	Create Session	Multiple	Yes	6.5	Network	Low	None	Required	Un-changed	High	None	None	21.3-21.21, 23.4.0-23.26.1	
CVE-2026-21999	XML Database	HTTP Listener	HTTPS	Yes	5.3	Network	High	None	Required	Un-changed	High	None	None	23.4.0-23.26.1	
CVE-2025-31948	Data Mining (Intel oneAPI Toolkit OpenMP)	Authenticated User	None	No	3.3	Local	Low	Low	None	Un-changed	None	None	Low	19.3-19.30, 21.3-21.21, 23.4.0-23.26.1	
CVE-2025-48924	RDBMS (Apache Commons Lang)	DBMS Developer	Multiple	No	3.3	Local	Low	None	Required	Un-changed	None	None	Low	23.4.0-23.26.1	
CVE-2026-34312	RDBMS	Row Access Method	Multiple	No	2.4	Network	Low	High	Required	Un-changed	Low	None	None	19.3-19.30	

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Every quarter, you should evaluate the need for client patching

- Establish a structured process

Create a process for patching your clients

- Automation is key
- Also useful for upgrading clients

Database clients are generally very stable

If possible, Oracle recommends upgrading clients to the latest 26ai driver

Client / Server Interoperability

Client Version	Server Version						
	26ai	21c	19c	18c	12.2.0	12.1.0	11.2.0
26ai[#11]	Yes	Yes	Yes	No	No	No	No
21c	Yes	Yes	Yes	Was	Was	Yes[#12]	No
19c	Yes	Yes	Yes	Was	Was	Yes[#12]	Yes[#9]
18c	No	Was	Was	Was	Was	Was	Was[#9]
12.2.0	No	Was	Was	Was	Was	Was	Was
12.1.0	No	Yes[#12]	Yes[#12]	Was	Was	Yes[#12]	Yes[#12]
11.2.0	No	No	Yes[#9]	Was[#9]	Was	Yes[#12]	Yes[#9]

MOS Note: KB141043 - Client / Server Interoperability Support Matrix

If you must use a 19c driver, update to the latest version

To maintain plan stability certain optimizer fixes are installed but disabled

- Automatic Fix Control Persistence

```
int optimGenerateCost(char *sql) {
    n = getBaseSost(sql);
    n = n * 2;
    n = n + 10;
    n = n / 3;
    n = n - 5;
    return n;
}
```

```
int optimGenerateCost(char *sql) {
   n = getBaseSost(sql);
   n = n * 2;

   if (fixEnabled(32854286)) {
      // fixed code
      n = n + 8;
   } else {
      // original code
      n = n + 10;
   }

   n = n / 3;
   n = n - 5;
   return n;
}
```

```
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   }

   n = n / 3;
   n = n - 5;
   return n;
}
```

The fix is installed, but disabled

```
-- Selectively enable a specific optimizer fix

exec dbms_optim_bundle.set_fix_controls(
   fix_control_string          => '32854286',
   scope                       => 'BOTH',
   current_setting_precedence => 'NO'
);
```

```
-- List all optimizer fixes

set serveroutput on;
exec dbms_optim_bundle.getBugsforBundle;
```

Home
Parameters
Users, Roles, etc
Privileges
Included Fixes
List of Fixes
Total Fixes
Search Fixes
List of CVEs
CPU Explore
Fix Control
Oracle Database Ho...
Objects
Fixed Objects
Audit
System

Version Selector

Source Release: 19c
Source Patch Level: 19.3.0 (Base Release)
Target Release: 19c
Target Patch Level: 19.30.0
List Mode

V_$SYSTEM_FIX_CONTROL

Added | Removed | Modified

Go | Actions

BUGNO	VALUE	SQL_FEATURE	DESCRIPTION	OPTIMIZER_FEATURE_ENABLE	EVENT	IS_DEFAULT
9876287	0	QKSFM_PQ_9876287	Fix perf slowdown due to wait event PXNSQ:PQLOADINFOQUERY		0	1
10123661	0	QKSFM_CURSOR_SHARING_10123661	Enable cursor sharing for AS OF queries		0	1
17295505	0	QKSFM_OBJ_EXT_17295505	allow stateful-access to image operator for ODCI table function		0	1
18101156	0	QKSFM_PARTITION_18101156	no RowCR for global index access on partitioned table		0	1

BUGNO	VALUE	SQL_FEATURE	DESCRIPTION	OPTIMIZER_FEATURE_ENABLE	EVENT	IS_DEFAULT
			table			
29487407	0	QKSFM_SQL_CODE_GENERATOR_29487407	Streamline traversal of CAST_PSR operator		0	1
29499077	0	QKSFM_CBO_29499077	correct sel for LIKE preds with char binds holding numeric data		0	1
29590666	0	QKSFM_ALL_29590666	Do not perform xmlexists(fn:not) rewrite		0	1
29651517	0	QKSFM_COMPILATION_29651517	do not mark load into CDT as multi-start with result cache		0	1
29653132	0	QKSFM_ALL_29653132	Force the usage of BLOB in XMLAGG and XMLELEMENT		0	1
29657973	0	QKSFM_ACCESS_PATH_29657973	for update: force VC base column into row vector for top qbc onl		0	1
29687220	0	QKSFM_CBO_29687220	improve costing for indexes with empty statistics.		0	1
29696242	0	QKSFM_ACCESS_PATH_29696242	use only the best auto index for access path analysis		0	1
29712727	0	QKSFM_DYNAMIC_SAMPLING_29712727	analysis of skipped non-empty table partitions		0	1

1 - 50 of 306

The Release Update should fix it. Why does it still fail?

- Check for a matching fix control

Should You Enable Optimizer Fixes?

PATCHING 

Selective enable optimizer fixes
Enable all, if you can properly test

NEW DATABASE 

Enable all optimizer fixes
Perform testing

Further Information

Optimizer Fixes

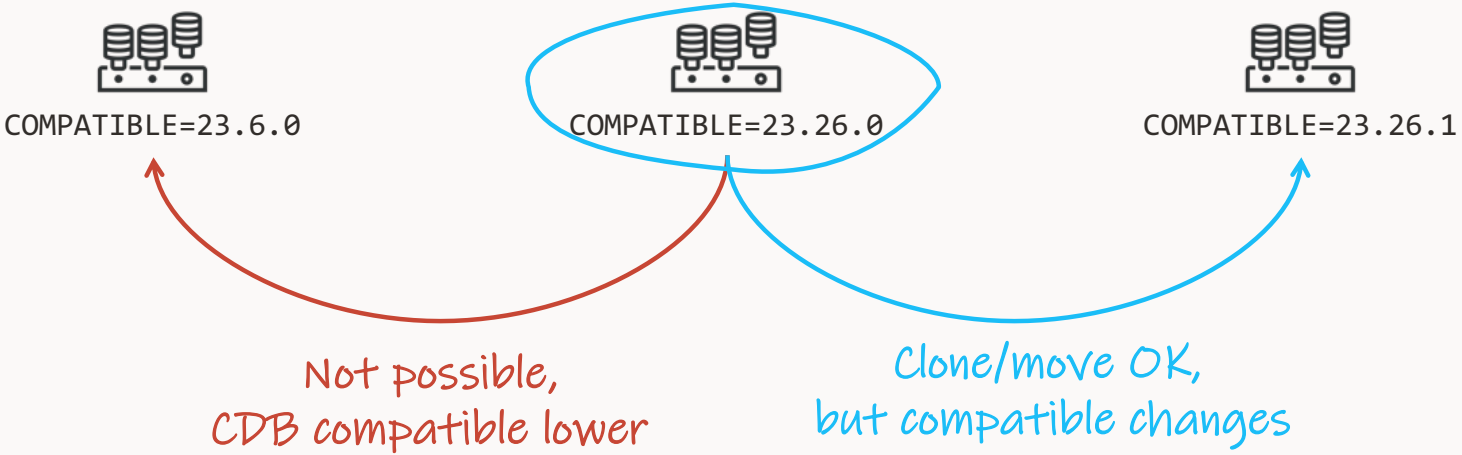
- Managing "installed but disabled" bug fixes in Database Release Updates using DBMS_OPTIM_BUNDLE (KB1[illegible]297)
- ORAdiff - Fix Control
- Blog post: Should you disable fix_controls with DBMS_OPTIM_BUNDLE?

Don't raise COMPATIBLE when you patch

In rare cases, new functionality requires that you raise `COMPATIBLE` after patching

- Vector functionality
- Blockchain and immutable tables

Compatible



New In 26ai

```
-- You can now update the COMPATIBLE parameter without a restart
-- Works within a release, e.g., from 23.9.0 to 23.26.0
-- Cross-release changes, e.g., 19.0.0 to 23.9.0, still requires a restart

alter database set downgrade compatibility to '23.9.0';
```

Purge old rollback scripts from the data dictionary

Rollback Scripts

Apply/rollback scripts

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

Rollback scripts:

```
INSERT INTO REGISTRY$SQLPATCH
VALUES ... ;

INSERT INTO REGISTRY$SQLPATCH_RU_INFO
VALUES ... ;
```

```
 PATCH_ID   RU_VERSION      RU_BUILD_TS          LOB_SIZE_MB
---------- --------------- -------------------- -----------
   29517242 19.3.0.0.0      04/10/2019 12:27:20            4
   30125133 19.5.0.0.0      09/09/2019 18:05:49           18
   30557433 19.6.0.0.0      12/17/2019 15:50:04           24
   30869156 19.7.0.0.0      04/04/2020 03:50:18           30
   31281355 19.8.0.0.0      07/03/2020 03:15:01           37
   31771877 19.9.0.0.0      09/30/2020 18:32:49           43
   32218454 19.10.0.0.0     01/08/2021 18:50:17           51
   32545013 19.11.0.0.0     04/13/2021 00:40:09           59
   32904851 19.12.0.0.0     07/16/2021 14:18:10           67
   33192793 19.13.0.0.0     10/04/2021 16:50:50           75
   33515361 19.14.0.0.0     12/25/2021 12:21:23           83
   34133642 19.16.0.0.0     07/03/2022 02:22:23           99
   34419443 19.17.0.0.0     09/24/2022 22:40:51          108
   34765931 19.18.0.0.0     01/11/2023 17:17:38          116
   35643107 19.21.0.0.0     09/30/2023 15:19:51          141

15 rows selected.
```

```
CON_ID LOB_SIZE_MB
------ -----------
     1         953
     2         953
     3         953

   ...         ...

  4098         953
```



```
--Available since 19.28.0. Purges no longer needed zip files.
--Run in off-peak period after patching

./datapatch -purge_old_metadata
```

Major retailer in the US

Saved 20 TB/year in total:

- *5000 DBs*
- 5 PDBs (3 PDBs + Root + Seed)
- *200 Mb in each per patch*
- *4 patches annually*

Datapatch Purge

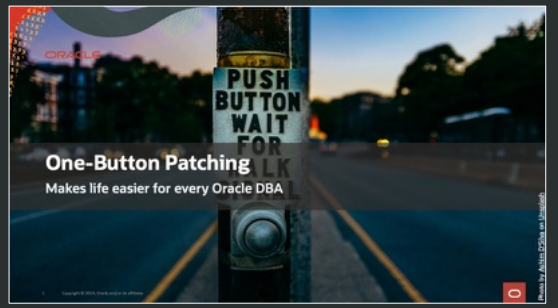
- Removes the rollback scripts for all patches
  (except the currently applied)
- Doesn't prevent rolling back the currently applied patches
- Doesn't remove the patching history, just the rollback scripts

Webinar

One-Button Patching

Makes life easier for every Oracle DBA

Recording on YouTube
Get the slides



Patch smarter, not harder

Makes life easier for every Oracle DBA

Recording on YouTube
Get the slides

Hands-on Lab

Patch Me If You Can

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

Access lab on Oracle Live Labs

Key Learnings

1. Apply the Release Update
2. Stay current
3. Use AutoUpgrade

BREAK

We start again at 13:30

Performance and Migrations

What's the Worst That Can Happen?

Photo by Ugi K. on Unsplash


Photo by Urip Dunker on Unsplash

Photo by Dave Hoefler on Unsplash

What's the worst that can happen after the migration?

Photo by Craig Pattenaude on Unsplash

What if we had a *one-button* tool that points out the bad statements…

SQL Performance Analyzer

Database Licensing Information User Manual

1 Licensing Information

1.1 Introduction

This Licensing Information document is a part of the product or program documentation under the terms of your Oracle license agreement and is intended to help you understand the program editions, entitlements, restrictions, prerequisites, special license rights, and/or separately licensed third party technology terms associated with the Oracle software program(s) covered by this document (the "Program(s)"). Entitled or restricted use products or components identified in this document that are not provided with the particular Program may be obtained from the Oracle Software Delivery Cloud website (https://edelivery.oracle.com) or from media Oracle may provide. If you have a question about your license rights and obligations, please contact your Oracle sales representative, review the information provided in Oracle's Software Investment Guide (http://www.oracle.com/us/

Oracle Real Application Testing	Extra cost option: **EE-ES** Included option: **BaseDB EE**, **BaseDB EE-HP**, **BaseDB EE-EP**, **ExaDB**	Oracle Real Application Testing includes the following features: • Database Replay • SQL Performance Analyzer (SPA) • Database Migration Planner • Database Migration Workbench **Database Replay** • The Oracle Real Application Testing license is required on both capture and replay systems for Database Replay and is charged by the total number of CPUs on those systems. Licensing is also charged by the total number of CPUs on both systems when the capture is done on any read-only standby database and the workload is replayed on a True Cache. • Use of Capture and Replay ASH Analytics Reports, Compare Period ADDM Reports, and Replay Compare Period Reports also requires an Oracle Diagnostics Pack license. • An Oracle Real Application Testing license permits you to access Database Replay functionality through Oracle Enterprise Manager, as well as through the following database server command-line APIs: `DBMS_WORKLOAD_CAPTURE` package and `DBMS_WORKLOAD_REPLAY` package. The use of the `DBMS_WORKLOAD_REPLAY.COMPARE_PERIOD_REPORT()` function also requires a license for Oracle Diagnostics Pack. **SQL Performance Analyzer (SPA)** An Oracle Real Application Testing license permits you to access SQL Performance Analyzer functionality through Oracle Enterprise Manager, as w as through the following database server command-line API: `DBMS_SQLPA`

PERFORMANCE STABILITY

1

CAPTURE

2

ANALYZE

3

FIX

4

REMEDY

1

CAPTURE

Capture workload information into SQL Tuning Set

2

ANALYZE

3

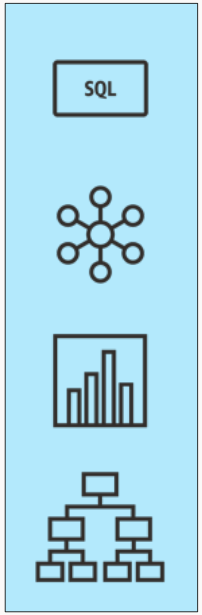
FIX

4

REMEDY

SQL Tuning Set | Definition

SQL Tuning Set



SQL statement

Context

Statistics

Plans

```
--Capture directly from cursor cache at regular intervals
exec DBMS_SQLSET.CAPTURE_CURSOR_CACHE ( ... );

--One time sample from cursor cache
exec DBMS_SQLSET.SELECT_CURSOR_CACHE ( ... );
```


```
--Capture directly from cursor cache at regular intervals
exec DBMS_SQLSET.CAPTURE_CURSOR_CACHE ( ... );

--One time sample from cursor cache
exec DBMS_SQLSET.SELECT_CURSOR_CACHE ( ... );

--Capture from AWR
SQL> exec DBMS_SQLSET.SELECT_WORKLOAD_REPOSITORY ( ... );
```

```
SQL> select name, statement_count from dba_sqlset;

NAME                              STATEMENT_COUNT
_______________________________ _____________________
SALES_APP_WORKLOAD                             43
```

```
SQL> select view_name from dba_views where view_name like
'DBA%SQLSET%';

VIEW_NAME

_____________________________
DBA_SQLSET
DBA_SQLSET_REFERENCES
DBA_SQLSET_STATEMENTS
DBA_SQLSET_BINDS
DBA_SQLSET_PLANS
```


Automatic SQL Tuning Set captures statements at regular intervals

- Off by default

```
SQL> select name, statement_count from dba_sqlset;

NAME                              STATEMENT_COUNT
_______________________________ ___________________
SALES_APP_WORKLOAD                             43
SYS_AUTO_STS                                 3320
```


Gather at least a full month of workload data

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

```
EXEC DBMS_SQLSET.PACK_STGTAB ( ... );

...

EXEC DBMS_SQLSET.UNPACK_STGTAB ( ... );
```

```
-- If you have many bind variables in your queries, increase the number of binds
-- to capture from 400 (default) to 3999 (max)

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

Further Information

SQL Tuning Set

- Blog post: Oracle SQL Tuning Sets (STS) – The foundation for SQL Tuning
- Blog post: What is the automatic SQL tuning set?

1

CAPTURE

2

ANALYZE

Analyze performance after migration using SQL Performance Analyzer

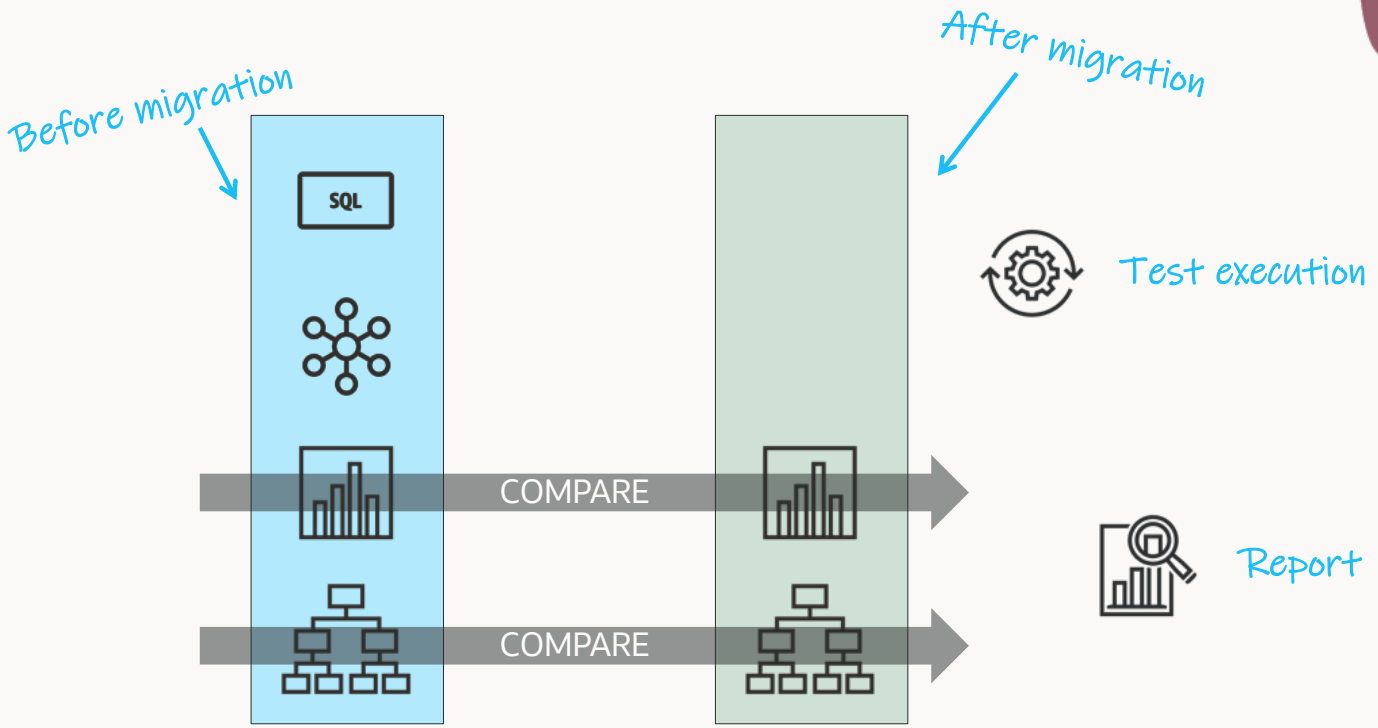
3

FIX

4

REMEDY

SQL Performance Analyzer



Report Summary

Projected Workload Change Impact:

Overall Impact	**4.64%**
Improvement Impact	**30.98%**
Regression Impact	**-26.35%**

SQL Statement Count

SQL Category	SQL Count	Plan Change Count
Overall	43	5
Improved	1	1
Regressed	1	1
Unchanged	30	3
Unsupported	11	0

Top 32 SQL Sorted by Absolute Value of Change Impact on the Workload

object_id	sql_id	Impact on Workload	Execution Frequency	Metric Before	Metric After	Impact on SQL	Plan Change
83	f90zn75aphu4w	30.98%	2828	139319.505304102	41950	69.89%	y
47	0cwuxyv314wcg	-26.35%	18254	981.459680070122	13809	-1306.99%	y
80	csv0xdm9c394t	-.36%	2734	4689.26664228237	5868	-25.14%	n
60	4hbzjyh4p336s	.21%	2818	668.862668559262	10	98.5%	n
76	a8ntu3081hfgw	-.18%	2818	262.609297374024	828	-215.3%	y

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80	csv0xdm9c394t	-.36%	2734	4689.26664228237	5868	-25.14%	n
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76	a8ntu3081hfgw	-.18%	2818	262.609297374024	828	-215.3%	y

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76	a8ntu3081hfgw	-.18%	2818	262.609297374024	828	-215.3%	y

SQL Details:

Object ID	: 47
Schema Name	: TPCC
Container Name	: Unknown (con_dbid: 344460545)
SQL ID	: 0cwuxyv314wcg
Execution Frequency	: 18254
SQL Text	: SELECT ROWID FROM CUSTOMER WHERE C_W_ID = :B3 AND C_D_ID = :B2 AND C_LAST = :B1

Bind Variables:

1 - (NUMBER): 3
2 - (NUMBER): 7
3 - (VARCHAR2): ESEEINGOUGHT

Execution Statistics:

Stat Name	Impact on Workload	Value Before	Value After	Impact on SQL
elapsed_time	-26.35%	.000981	.013809	-1306.99%
parse_time			.000477	
cpu_time	-106.5%	.000494	.013743	-2681.43%
user_io_time			0	
buffer_gets	-130.82%	253	7252	-2759.03%
cost	-745969.19%	255	1982	-677.25%
reads	0%	0	0	0%
writes	0%	0	0	0%

SQL Details:

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Schema Name : TPCC
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cpu_time	-106.5%	.000494	.013743	-2681.43%
user_io_time			0	
buffer_gets	-130.82%	253	7252	-2759.03%
cost	-745969.19%	255	1982	-677.25%
reads	0%	0	0	0%
writes	0%	0	0	0%

Execution Plan Before Change:

Plan Hash Value : 612465046

Id	Operation	Name	Rows	Bytes	Cost	Time
0	SELECT STATEMENT				255	
1	SORT ORDER BY		2	92	255	00:00:01
2	TABLE ACCESS BY INDEX ROWID BATCHED	CUSTOMER	2	92	254	00:00:01
3	INDEX RANGE SCAN	CUSTOMER_I1	3000		10	00:00:01

Execution Plan After Change:

Plan Id : 545
Plan Hash Value : 4040750106

Id	Operation	Name	Rows	Bytes	Cost	Time
0	SELECT STATEMENT		2	92	1982	00:00:01
1	SORT ORDER BY		2	92	1982	00:00:01
* 2	TABLE ACCESS FULL	CUSTOMER	2	92	1981	00:00:01

Predicate Information (identified by operation id):

- 2 - filter("C_LAST"=:B1 AND "C_D_ID"=:B2 AND "C_W_ID"=:B3)

Execution Plan Before Change:

Plan Hash Value : 612465046

Id	Operation	Name	Rows	Bytes	Cost	Time
0	SELECT STATEMENT				255	
1	SORT ORDER BY		2	92	255	00:00:01
2	TABLE ACCESS BY INDEX ROWID BATCHED	CUSTOMER	2	92	254	00:00:01
3	INDEX RANGE SCAN	CUSTOMER_I1	3000		10	00:00:01

Execution Plan After Change:

Plan Id : 545
Plan Hash Value : 4040750106

Id	Operation	Name	Rows	Bytes	Cost	Time
0	SELECT STATEMENT		2	92	1982	00:00:01
1	SORT ORDER BY		2	92	1982	00:00:01
* 2	TABLE ACCESS FULL	CUSTOMER	2	92	1981	00:00:01

Predicate Information (identified by operation id):

- 2 - filter("C_LAST"=:B1 AND "C_D_ID"=:B2 AND "C_W_ID"=:B3)

You don't need to connect your app to use SQL Performance Analyzer

You can use SQL Performance Analyzer to test any change to your database

Schema changes may interfere with SQL Performance Analyzer

Further Information

SQL Performance Analyzer

- Blog post: Smooth transition to Autonomous Database using SPA

1

CAPTURE

2

ANALYZE

3

FIX

Fix regressing statements

4

REMEDY

Fixing Statements

Most cloud offerings have access to a number of tools:

- SQL Tuning Advisor
- Real-time SQL Monitoring
- SQL Access Advisor

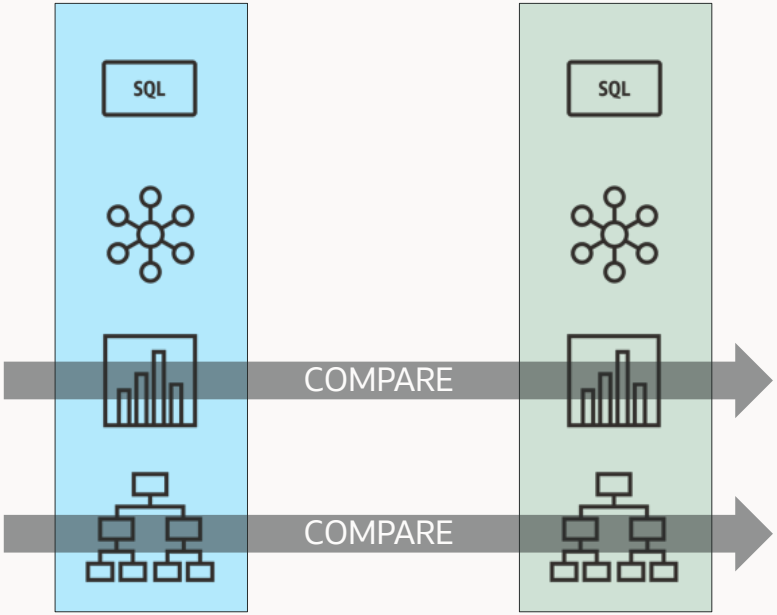
Perhaps you even have access to a DBA

You could also ask ChatGPT

What is the best fix?

- Does it have any side effects?

Continuous Improvement



Continuous Improvement

Implement change

Test execute

Check outcome

Repeat

1

CAPTURE

2

ANALYZE

3

FIX

4

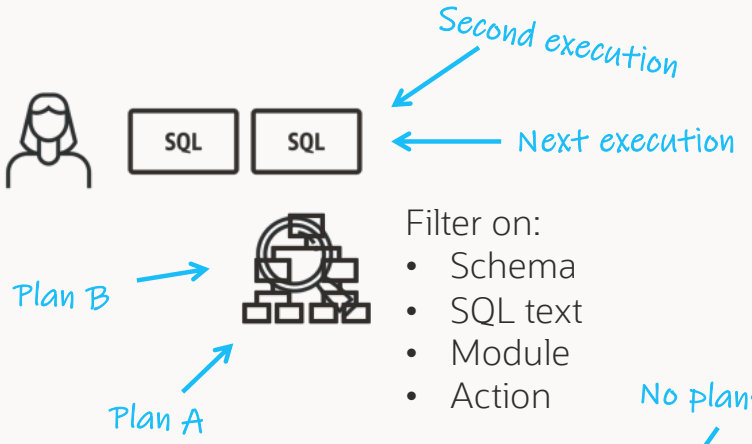
REMEDY

Stabilize performance
using
SQL Plan Management

SQL Plan Management is the best tool to ensure plan stability

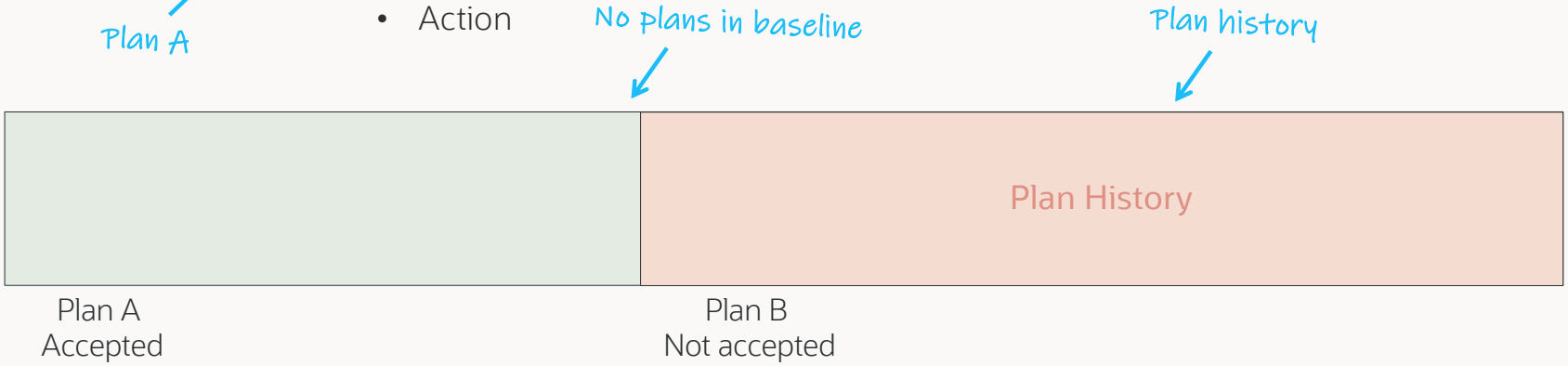
```
-- Toggles creation of SQL plan baselines for all repeatable statements
-- Usually, not recommended to capture and create baselines for all statements

alter system set optimizer_capture_sql_plan_baselines=true;
```

SQL Plan Management



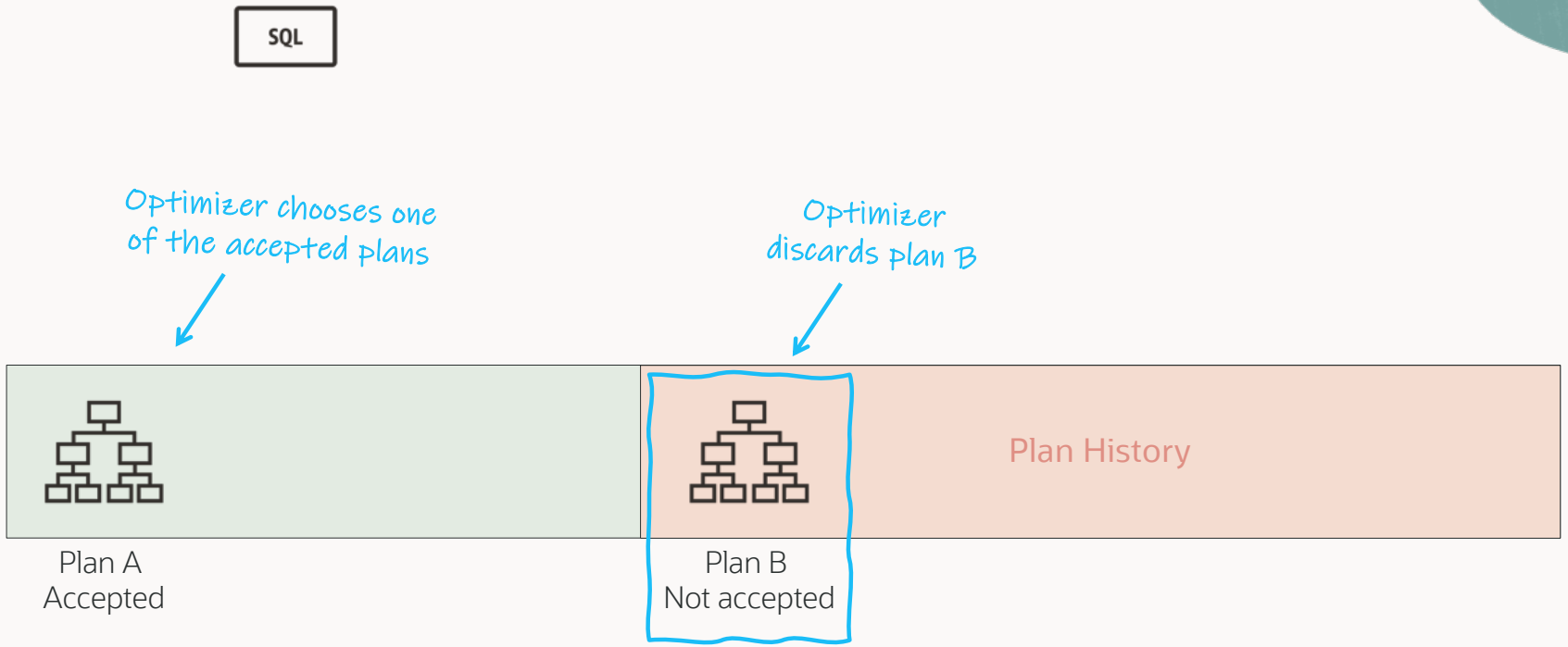
Filter on:
- Schema
- SQL text
- Module
- Action

Something changed:
- New statistics
- New parameters
- Upgrade

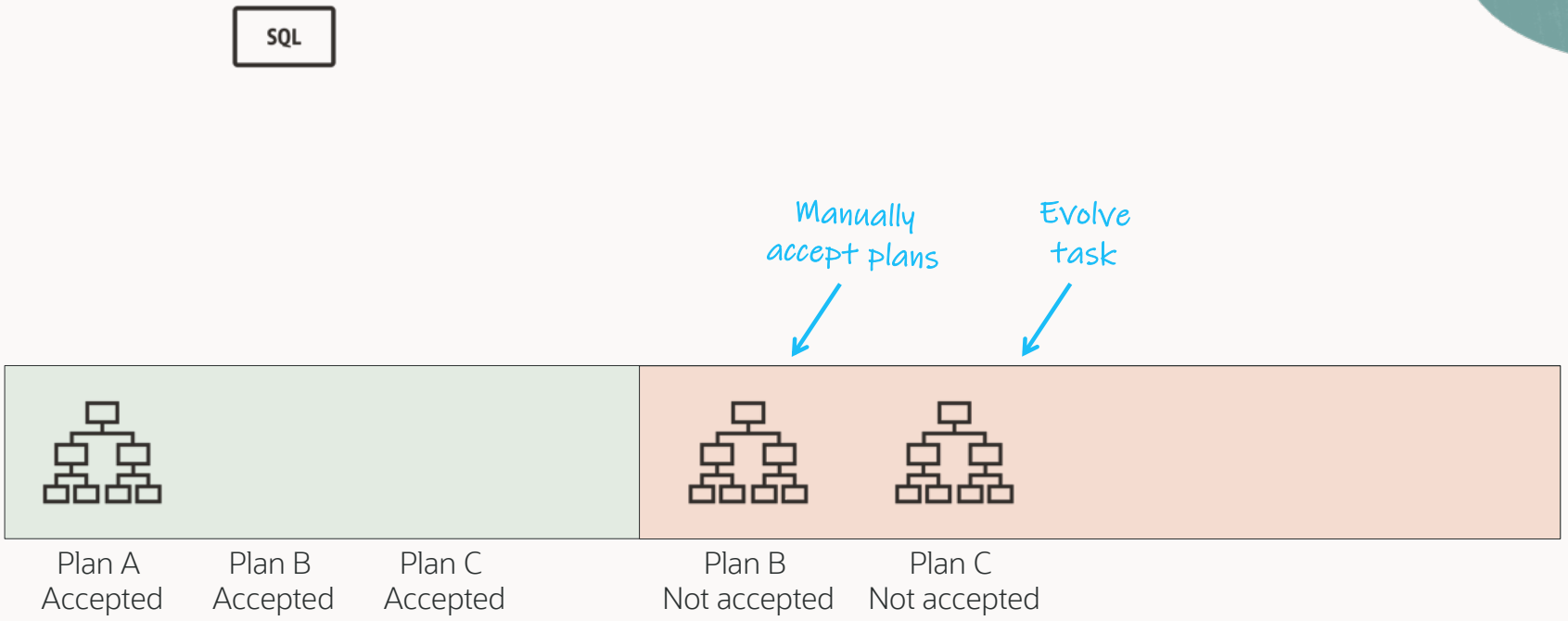


```
-- Restricts the optimizer to only use plans that are accepted
-- This is the default value

alter system set optimizer_use_sql_plan_baselines=true;
```

SQL Plan Management



SQL Plan Management



```
-- The database stores plans in the plan history for 53 weeks.
-- This might consume a lot of space. Consider lowering the limit.

exec dbms_spm.configure('plan_retention_weeks', 5);
```

You can manually create plan baselines for specific statements

- Don't capture all plans

```
-- Load all plans from a SQL tuning set into plan baselines
-- Plans are accepted automatically without test execution

var cnt number;
exec :cnt := DBMS_SPM.LOAD_PLANS_FROM_SQLSET(
                basic_filter => 'sql_id=''0cwuxyv314wcg''',
                ...
             );
```

Plan baselines are transportable; create in test, use in production

```
-- Pack baselines from "problematic" statements into staging table
exec DBMS_SPM.PACK_STGTAB_BASELINE(sql_handle => SQL_130f372d9ffe4df9, ...);
```


```
-- Pack baselines from "problematic" statements into staging table
exec DBMS_SPM.PACK_STGTAB_BASELINE(sql_handle => SQL_130f372d9ffe4df9, ...);
exec DBMS_SPM.PACK_STGTAB_BASELINE(sql_handle => SQL_51dc7232adc62849, ...);
exec DBMS_SPM.PACK_STGTAB_BASELINE(sql_handle => SQL_3f38bc33ae7086c9, ...);
```


```
-- Pack baselines from "problematic" statements into staging table
exec DBMS_SPM.PACK_STGTAB_BASELINE(sql_handle => SQL_130f372d9ffe4df9, ...);
exec DBMS_SPM.PACK_STGTAB_BASELINE(sql_handle => SQL_51dc7232adc62849, ...);
exec DBMS_SPM.PACK_STGTAB_BASELINE(sql_handle => SQL_3f38bc33ae7086c9, ...);

...

-- After production migration, import plan baselines to fix regressions
exec DBMS_SPM.UNPACK_STGTAB_BASELINE( ... );
```

Let's automate it

Automatic SQL Plan Management

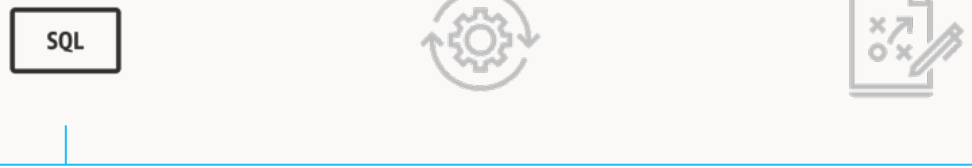
- Background job (30 min)
- Finds resource-intensive SQLs
- Evaluate execution statistics against previous executions

Automatic SQL Plan Management

- Creates a plan baseline with the best plan
- Next execution uses an accepted plan

- Oracle Database 19c Enterprise Edition, RU 19.22
- Exadata and Autonomous AI Database

Real-Time SQL Plan Management



- User executes SQL
- Optimizer chooses a different execution plan
- Executes with new plan

Real-Time SQL Plan Management

- Compares execution statistics with history
- Comparison is performed in the user foreground session

Real-Time SQL Plan Management

- Creates a plan baseline with the best plan
- Next execution uses an accepted plan

- Oracle AI Database 26ai Enterprise Edition
- Autonomous AI Database 19c

Here's one for the Top Gun DBA

```
--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.

var report clob;
exec :report := dbms_spm.add_verified_sql_plan_baseline('<sql_id>');
select :report report from dual;
```

Who said literals?

- SQL Plan Management is not a good fit for an application that doesn't use bind variables

```
--Application using literals creates many distinct statements
--You'd get 4 plan baselines
select * from sales where order_id=42;
select * from sales where order_id=56;
select * from sales where order_id=101;
select * from sales where order_id=220;
```


```
--Application using literals creates many distinct statements
--You'd get 4 plan baselines
select * from sales where order_id=42;
select * from sales where order_id=56;
select * from sales where order_id=101;
select * from sales where order_id=220;


--Ideally change the application to use literals
--You'd get only 1 plan baseline
select * from sales where order_id=:b1;
```


Generally, avoid setting CURSOR_SHARING=FORCE

- Advice from Real-World Performance Group

Use SQL Profiles

- Part of Tuning Pack included in most cloud offerings

Further Information

SQL Plan Management

- Blog post: SQL Plan Management Cheat Sheet – Part 1
- Blog post: SQL Plan Management Cheat Sheet – Part 2
- Blog post: What is automatic SQL plan management and why should you care?
- Blog post: What is Real-time SQL plan Management?
- My Oracle Support: Things to Consider to Avoid SQL Plan Management (SPM) Related Problems on 19c (KB139467)

1

CAPTURE

2

ANALYZE

3

FIX

4

REMEDY

A Word About Statistics

PHYSICAL

LOGICAL

PHYSICAL

LOGICAL

Statistics

Object Statistics

Statistics Preferences

Column Usage Information

Object Statistics

Statistics  Statistics Preferences

Column Usage Information

```
BEGIN
   DBMS_STATS.SET_TABLE_PREFS (
      OWNNAME => 'APPUSER',
      TABNAME => 'SALES',
      PNAME   => 'TABLE_CACHED_BLOCKS',
      PVALUE  => '42'
   );
END;
```


Table 171-131 SET_TABLE_PREFS Procedure Parameters

Parameter	Description
`ownname`	Owner name
`tabname`	Table name
`pname`	Preference name. You can set the default value for following preferences: • `APPROXIMATE_NDV_ALGORITHM` • `AUTO_STAT_EXTENSIONS` • `CASCADE` • `DEGREE` • `ESTIMATE_PERCENT` • `GRANULARITY` • `INCREMENTAL` • `INCREMENTAL_LEVEL` • `INCREMENTAL_STALENESS` • `METHOD_OPT` • `NO_INVALIDATE` • `OPTIONS` • `PREFERENCE_OVERRIDES_PARAMETER` • `PUBLISH` • `STALE_PERCENT` • `TABLE_CACHED_BLOCKS`
`pvalue`	Preference value. If `NULL` is specified, it will set the Oracle default value.

PL/SQL Packages and Types Reference, Oracle Database 19c

```
EXEC DBMS_STATS.EXPORT_TABLE_PREFS('APPUSER', 'SALES',
'STAGING_TAB');

...

EXEC DBMS_STATS.IMPORT_TABLE_PREFS('APPUSER', 'SALES',
'STAGING_TAB');
```

It is not possible to export or transport global statistics preference

- Define manually using `DBMS_STATS.SET_GLOBAL_PREFS`

You often use statistics preferences to solve a particular problem

- Evaluate whether that problem exists in the target environment

Statistics

Object Statistics

Statistics Preferences

Column Usage Information

Column Usage Information

- Information on how you join tables
- Stored internally in `SYS.COL_USAGE$`
- Used by the optimizer to determine when to create histograms
  `METHOD_OPT => ... SIZE AUTO`
- When missing, statistics gathering creates no or few histograms

1 Include statistics in Data Pump

2 Exclude statistics in Data Pump
Regather statistics after import

3 Exclude statistics in Data Pump
Import statistics using `DBMS_STATS`

Importing statistics using Data Pump is a convenient, but slow option

- Includes object statistics, table-level preferences and column usage information
- Not recommended

1 Include statistics in Data Pump

2 Exclude statistics in Data Pump
Regather statistics after import

3 Exclude statistics in Data Pump
Import statistics using DBMS_STATS

Be sure to gather statistics fast

- Use **DEGREE** and **CONCURRENT** options
- Blog post by Nigel Bayliss

You're missing preferences and column usage information

EXCLUDE

`EXCLUDE=STATISTICS`

`COL_USAGE$` empty

REGATHER

First time only

```
METHOD_OPT =>
SIZE SKEWONLY
```

GO LIVE

Column usage information is updated

REGATHER

Use default

```
METHOD_OPT =>
SIZE AUTO
```

Further Information

Transporting statistics

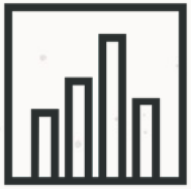
- Blog post: How to Export and Import Statistics Faster Using DBMS_STATS in Parallel
- Blog post: If Importing Statistics Using DBMS_STATS Is Slow
- Blog post: Does Exporting Database Statistics Include the Dictionary Statistics?
- Video: Transporting optimizer statistics - pro tips
- Video: Transporting optimizer statistics - demo
- Video: Transporting optimizer statistics - the concept

1 Include statistics in Data Pump

2 Exclude statistics in Data Pump
Regather statistics after import

3 Exclude statistics in Data Pump
Import statistics using `DBMS_STATS`

```
EXEC DBMS_STATS.EXPORT_SCHEMA_STATS('APPUSER', 'STAGING_TAB');

...

EXEC DBMS_STATS.IMPORT_SCHEMA_STATS('APPUSER', 'STAGING_TAB');
```

The database considers imported statistics as *current*

- Be sure those statistics are accurate

Importing or transporting statistics might be a bad idea…

When source and target database do not match

Statistics | When Importing Stats Is Bad

Fragmented table

Blocks	12000
Leaf blocks	11000
B-level	4
Clustering factor	10000

Compacted table

Blocks	12000
Leaf blocks	11000
B-level	4
Clustering factor	10000

```
DBMS_STATS.GATHER_TABLE_STATS(...
```

Blocks	5000
Leaf blocks	4000
B-level	2
Clustering factor	20000

Statistics | When Importing Stats Is Bad

- Potentially a problem
  - Fragmented tables
  - Changing block size
  - Changing character set
  - Compress or decompress
  - …
- Only a problem for table and index base statistics, column statistics remain accurate

Comparing STATISTICS options

	Import with Data Pump	Regather	Import with DBMS_STATS
Time	Significant	Significant	Short
Column usage information	Included	Missing	Missing
Accuracy	Potentially inaccurate	Accurate	Potentially inaccurate
Statistics preferences	Included	Missing	Optional

Our Favorite

1. Perform test migration
   - Regather in test database
   - Test and adjust
   - Export statistics using `DBMS_STATS`

2. Perform production migration
   - Import from test migration

Autonomous AI Database gathers statistics differently

Statistics and Migrations

Well-Kept Secrets Revealed

June 18 2026, 14:00 CET - Sign Up

Hands-on Lab

Hitchhiker's Guide for upgrading to Oracle AI Database 26ai

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

Access lab on Oracle Live Labs

Key Learnings

1. Gather workload information
2. Analyze with SQL Performance Analyzer
3. Use SQL Plan Management

BREAK

We start again at 15:15

Autonomous AI Database Migrations

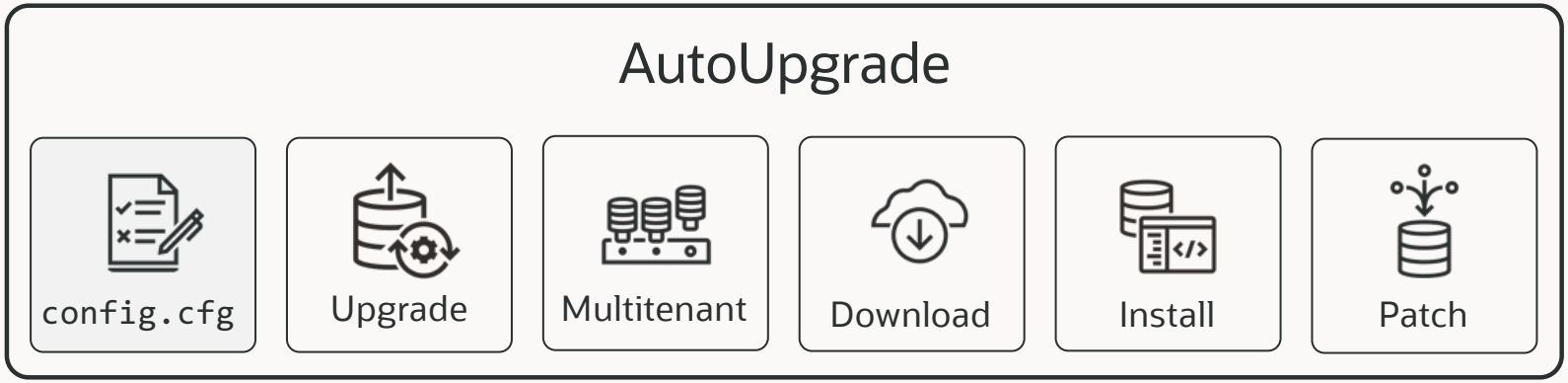
Made easy – a sneak preview

KEYNOTE
PRESENTATION

Oracle OpenWorld San Francisco 2017

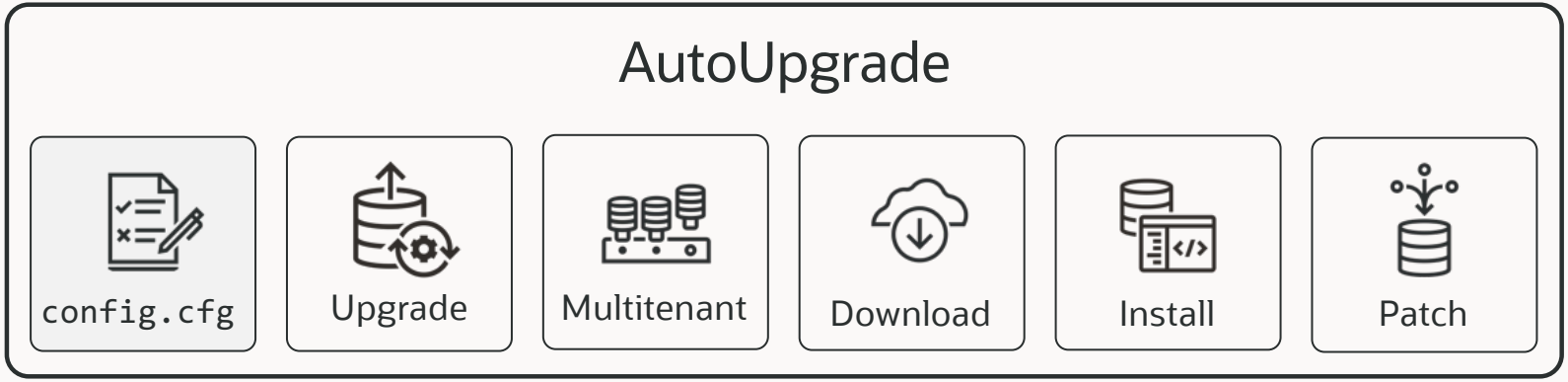
Recap AutoUpgrade

End-to-end automation



Recap AutoUpgrade

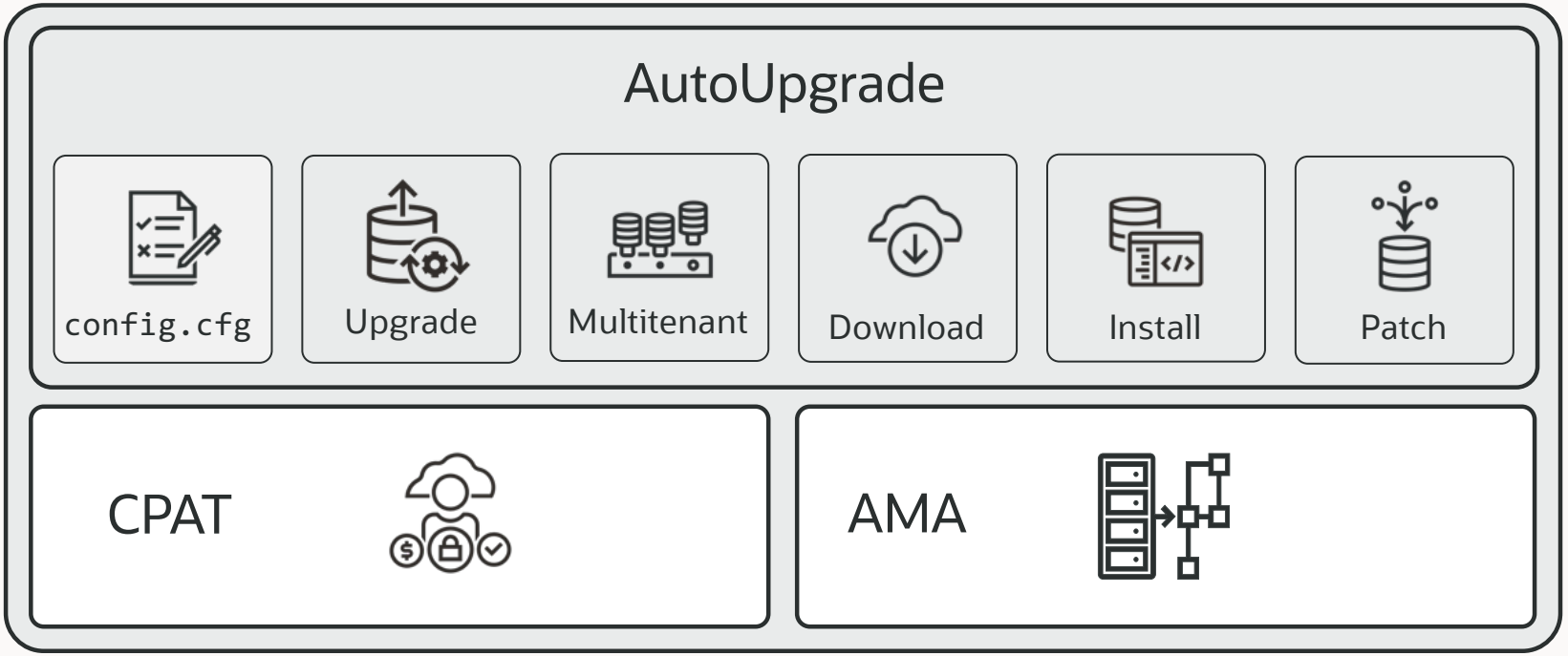
End-to-end automation



- Small, flexible, agile, available on all platforms
- Prechecks, pre/post-fixups
- Used by thousands of customers
- Deployed in every Oracle home

Why shouldn't AutoUpgrade migrate databases to Oracle Autonomous AI Database Serverless?

Overview



What if we combine these tools together?
And there it is, AutoMigrate!!

AutoMigrate

What we are going to do

ADB migrations for every DBA

Simple and well-known interface

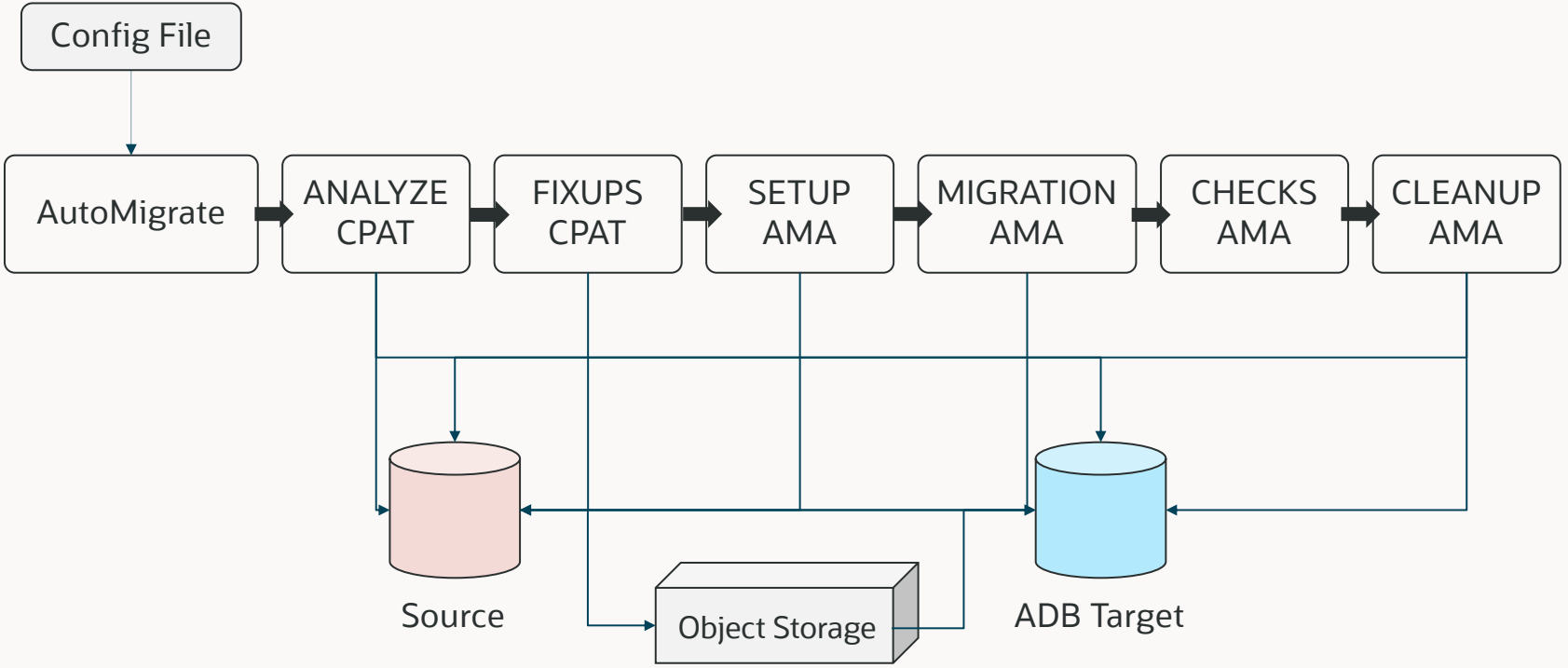
Available everywhere

Works with Windows as source platform

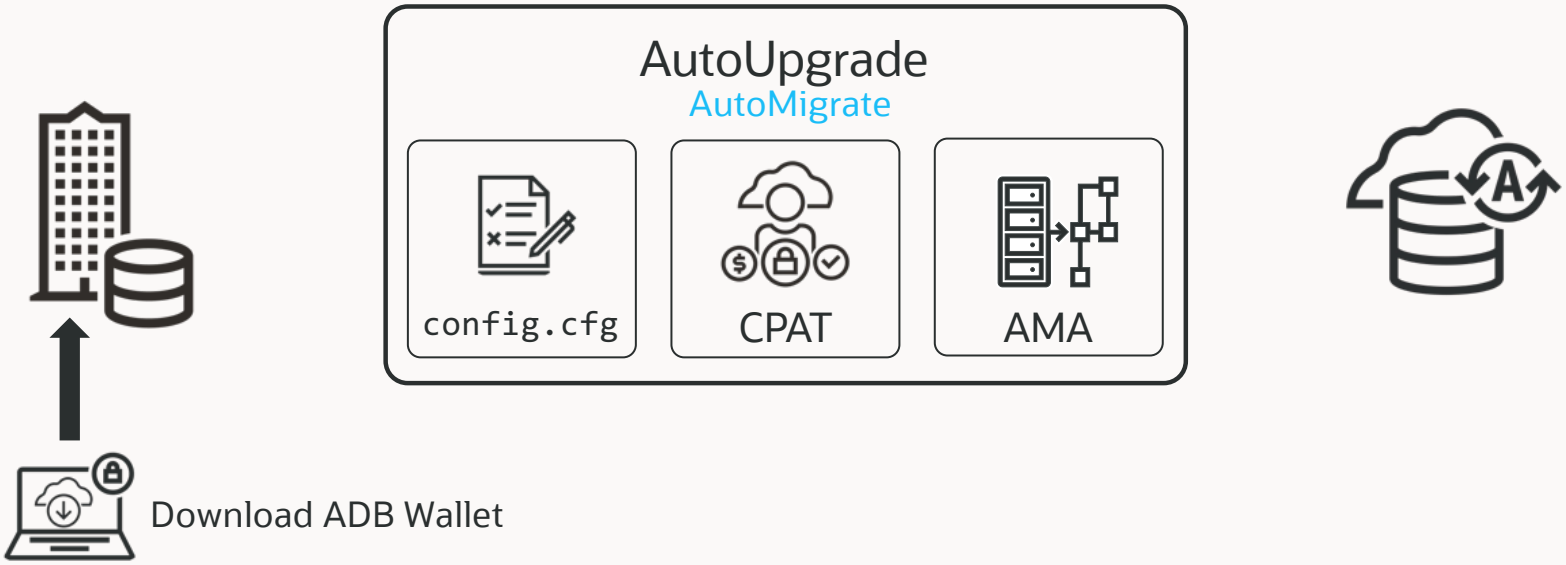
Can be embedded in any automation framework

Can be embedded into other tools

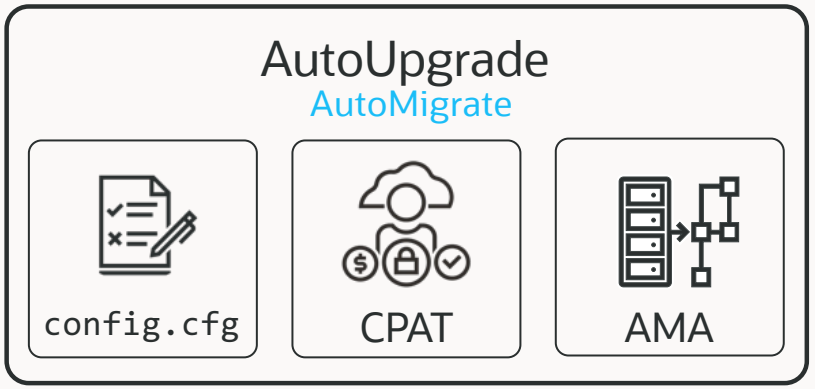
Conceptual Overview



Architecture Overview



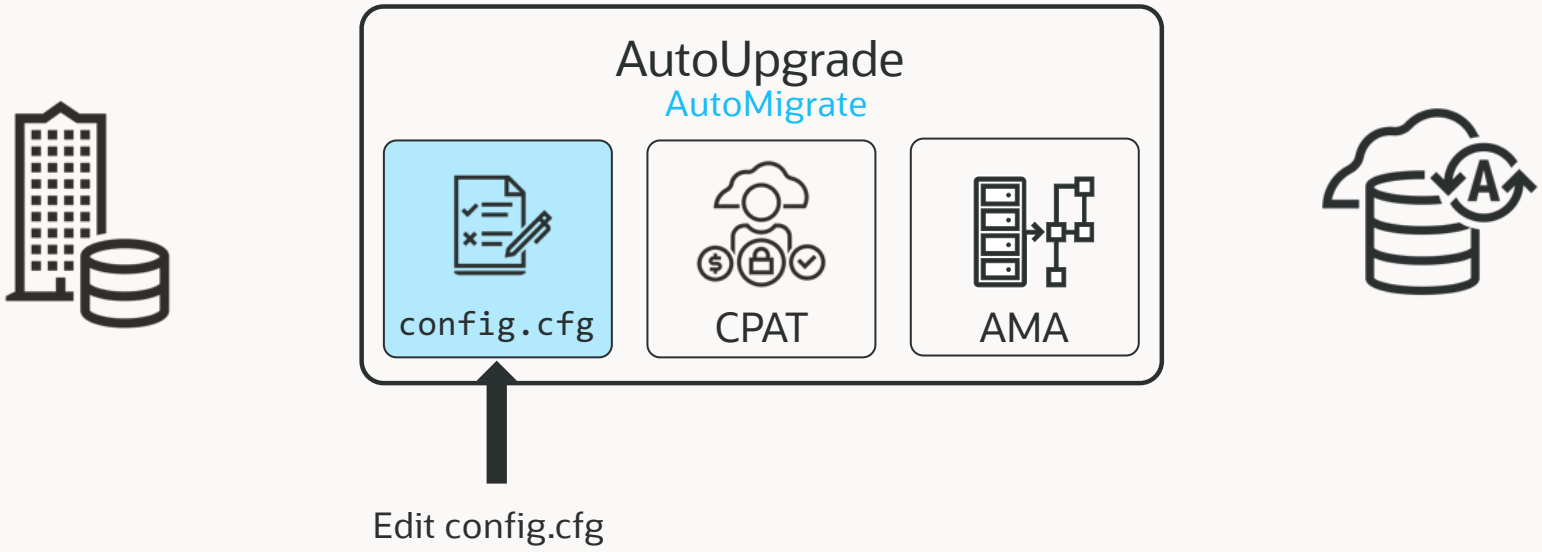
Architecture Overview



Load passwords into CPAT keystore (SEPS)

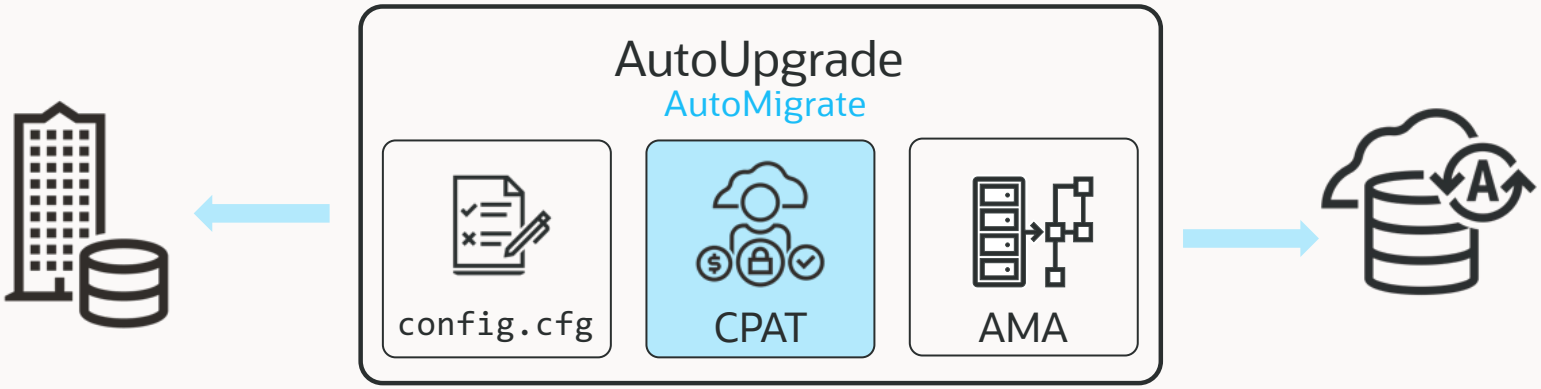
- ADMIN user
- Data Pump dump file encryption password (optional)
- Token for objectstore (if no pre-auth URL is used)

Architecture Overview

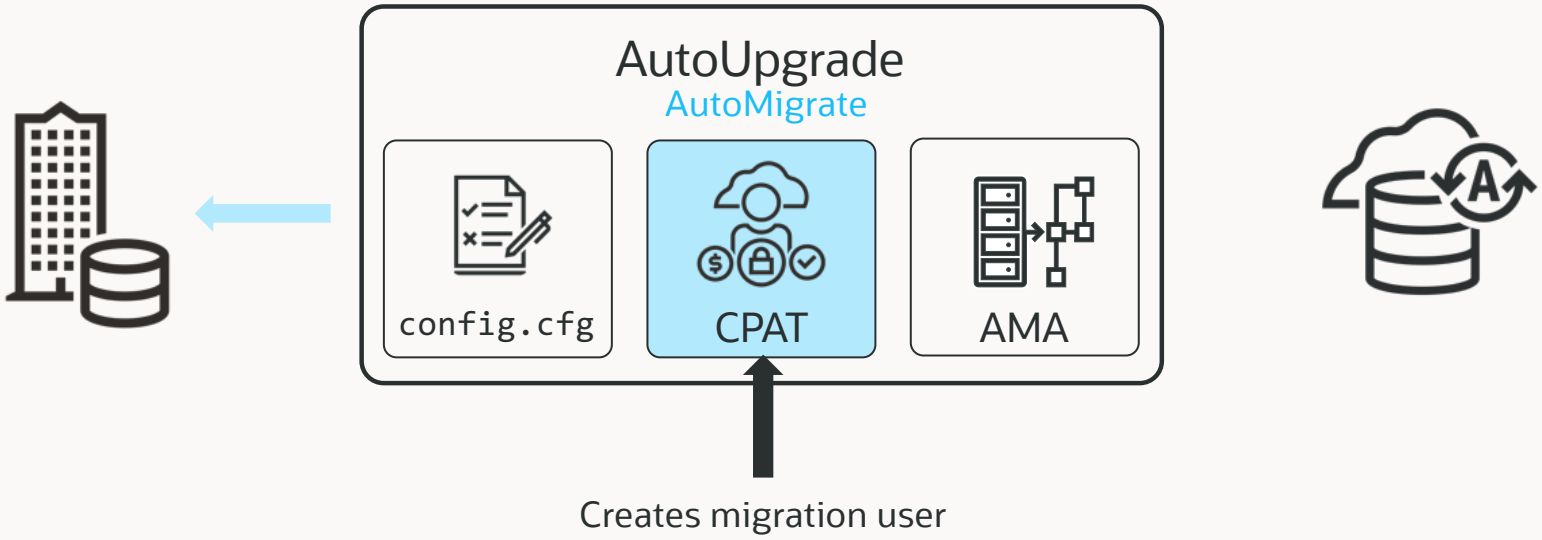


```
global.keystore=/home/oracle/AUTOMIGRATE_DEMO/KEYSTORE
global.username=ADMIN

demo26ai.source_home=/opt/oracle/product/26ai/dbhomeFree
demo26ai.sid=FREE
demo26ai.src_pdb_name=FREEPDB1
demo26ai.src_pdb_service_name=localhost:1521/FREEPDB1

demo26ai.target_service_name=amademo26_tpurgent
demo26ai.target_wallet_location=/home/oracle/AUTOMIGRATE_DEMO/WALLET

demo26ai.curl_target_url=https://swiftobjectstorage.eu-frankfurt-
1.oraclecloud.com/v1/oradbclouducm/AMADemo/
demo26ai.curl_target_user_name=ORACLE-SSO/klaus.gronau@oracle.com
```

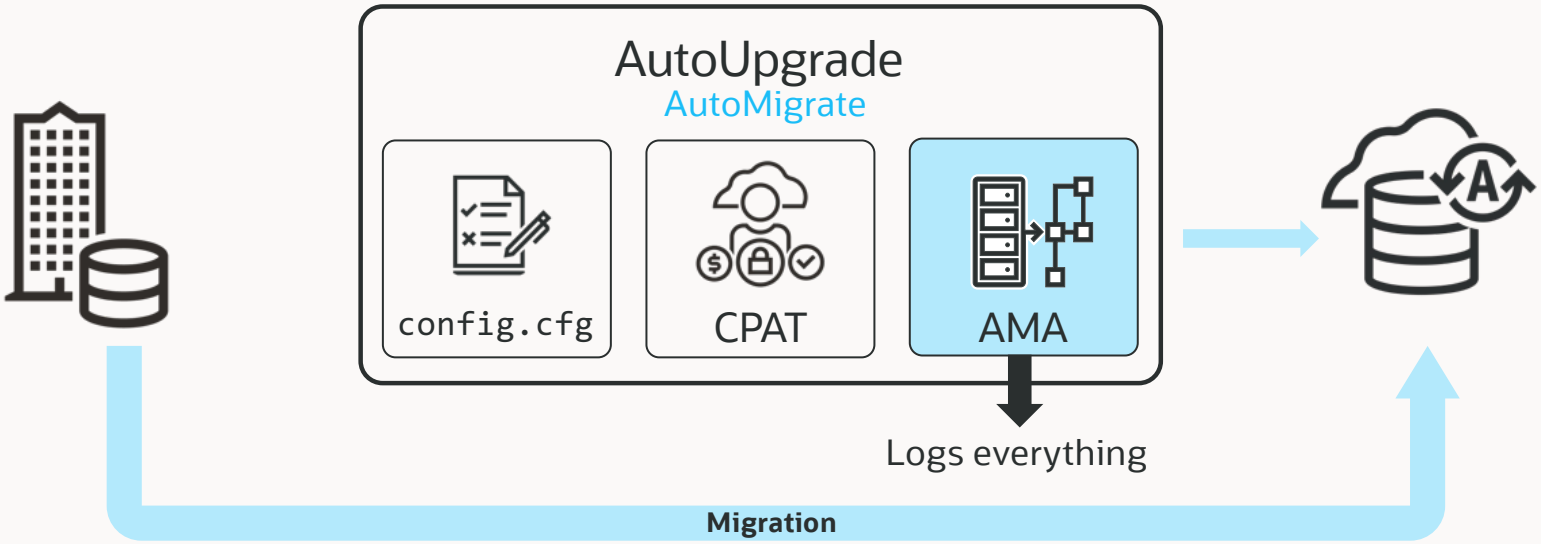
Architecture Overview



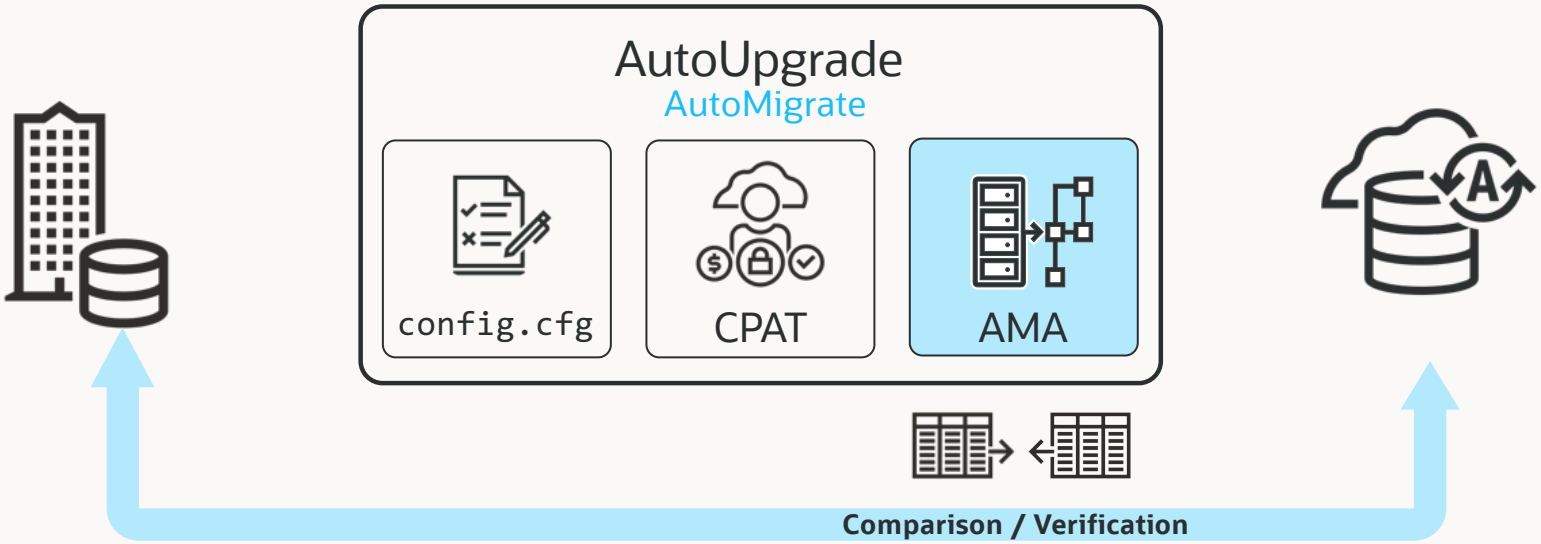
Architecture Overview



Architecture Overview



Architecture Overview



- Invalid objects
- Table row count
- Object count

AutoMigrate Sneak Preview

Download required

- **AutoUpgrade** from oracle.com or MOS
- **CPAT** from oracle.com or MOS
- **Wallet** for Autonomous Serverless from cloud.oracle.com
- **Token** for the Object Storage

DEMO

AutoMigrate

- Migrate a local database of 15GB into Oracle Autonomous AI Database

Demo

Regression testing DB with plenty of objects

- Size: 15GB
- Duration: 20 mins – end-to-end migration

```
[oracle@47544c5be592 100]$ more autoupgrade_20260310.log
2026-03-10 07:16:26.809 INFO [23]
build.MOS_LINK:https://support.oracle.com/support/?anchorId=&kmContentId=2485457&page=sptemplate&sptemplate=km-article
....
2026-03-10 07:32:44.057 INFO [27] Adding Job context key[dispatcher_stage] value[4] for job [100] - CommonBackBone.addJobContext#270
2026-03-10 07:32:44.057 INFO [27] Stopping background threads for Job - JobDefinition.stopJobThreads#132
2026-03-10 07:32:44.058 INFO [27] [0] threads have been stopped by JobDefinition - JobDefinition.stopJobThreads#134
2026-03-10 07:32:44.058 INFO [27] Dispatcher finished for 100 - RunJobDefinition.runJob#177
2026-03-10 07:32:44.058 INFO [27] End  - RunJobDefinition.runJob#178
2026-03-10 07:32:44.059 INFO [27] ----------------------Stages  Summary----------------------- - Utilities.writeStageSummary#1153
2026-03-10 07:32:44.059 INFO [27]     SETUP             <1 min                                - Utilities.writeStageSummary#1153
2026-03-10 07:32:44.059 INFO [27]     MIGRATIONCPATANALYZE   <1 min                           - Utilities.writeStageSummary#1153
2026-03-10 07:32:44.059 INFO [27]     MIGRATIONCPATFIXUPS   <1 min                            - Utilities.writeStageSummary#1153
2026-03-10 07:32:44.059 INFO [27]     MIGRATIONAMA      16 min                                - Utilities.writeStageSummary#1153
2026-03-10 07:32:44.059 INFO [27]     COMPLETED         <1 min                                - Utilities.writeStageSummary#1153
2026-03-10 07:32:44.059 INFO [27] End of dispatcher instance for N/A - CommonBackBone.finalJobLogging#436
```

Prototype is already fully operational

- If you want to beta test from July 1 on, send mail to: mike.dietrich@oracle.com

DBA vs. AI

Harvard Business Review

“AI won’t replace humans - but humans with AI will replace humans without AI”

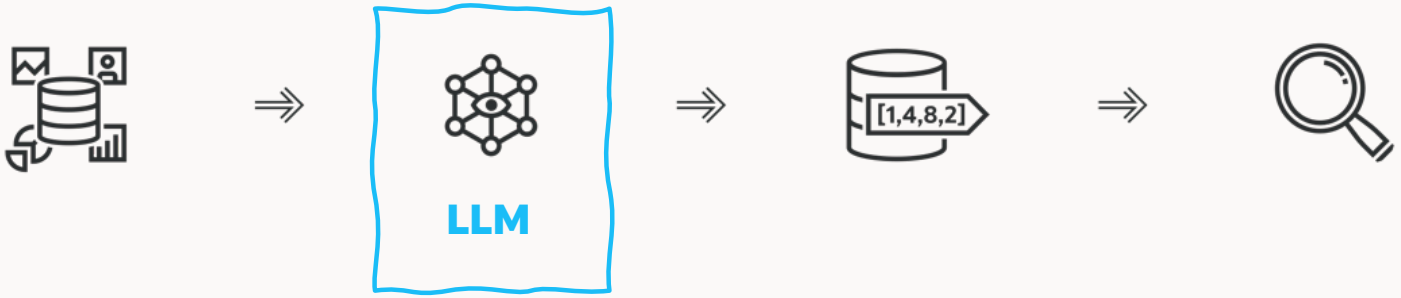
Karim Lakhani

AI Database

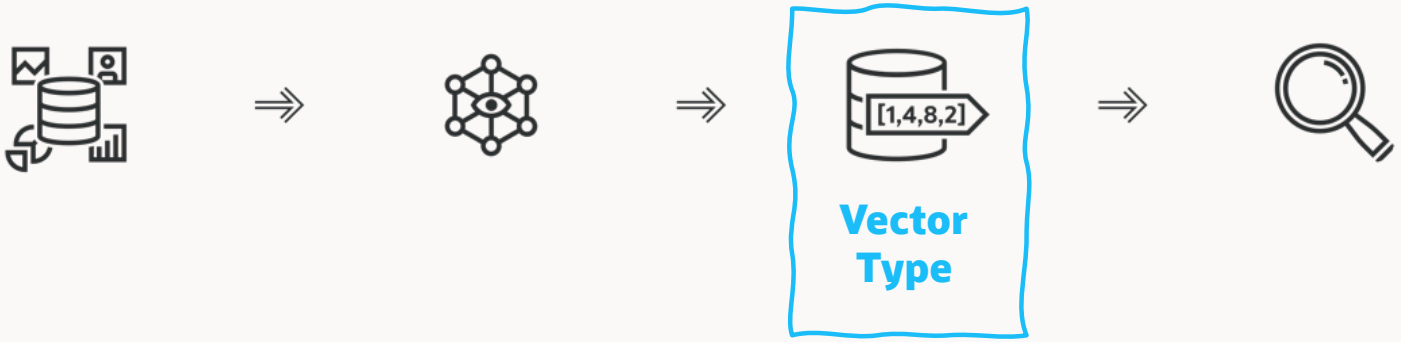
Using AI

Vector Database

Vector Database



Vector Database



Vector Database

AI Database

Using AI

Let us create an AutoMigrate Data Pump Log Analyzer using Oracle AI Database 26ai

What do we need?

Oracle AI Database 26ai

- On-premises or cloud or Oracle Autonomous AI Database

Transforming model

- Turning text into Vectors, e.g. Hugging Face's all_MiniLM_L12_v2.onnx

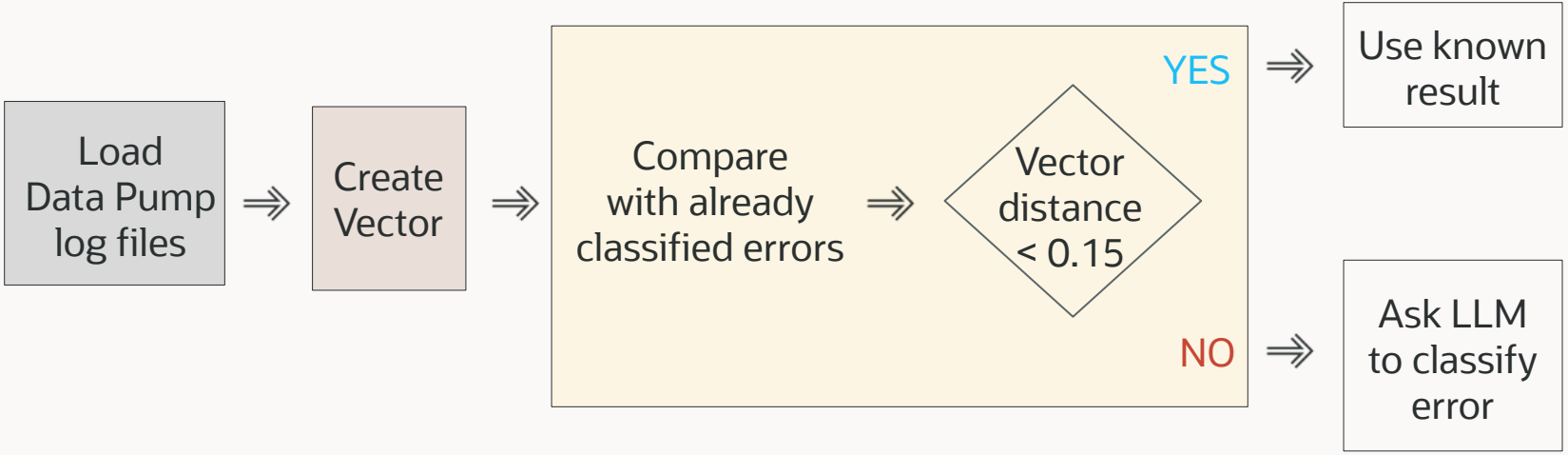
LLM

Table with VECTOR column and VECTOR index

Predefined rules for errors

Analyzing hundreds of Data Pump migration log files

Analyzing hundreds of Data Pump migration log files

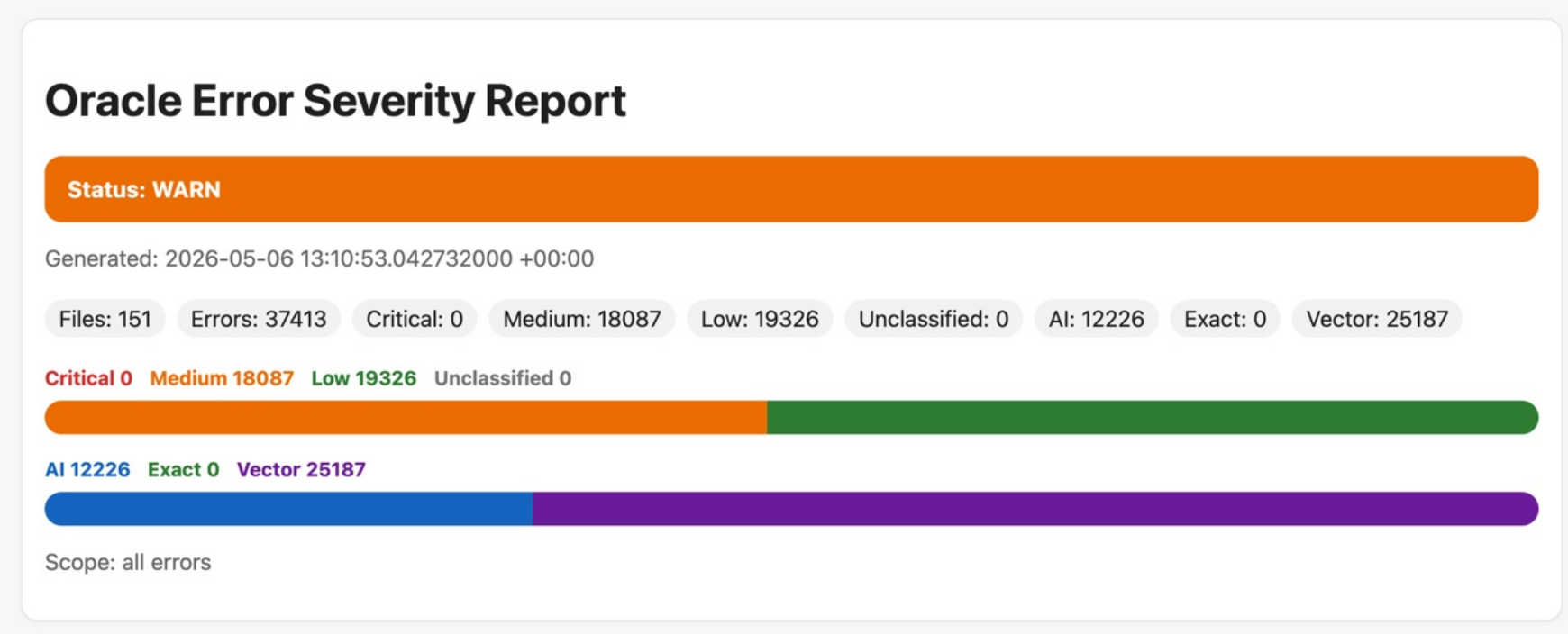


It may take a while to load, classify and report

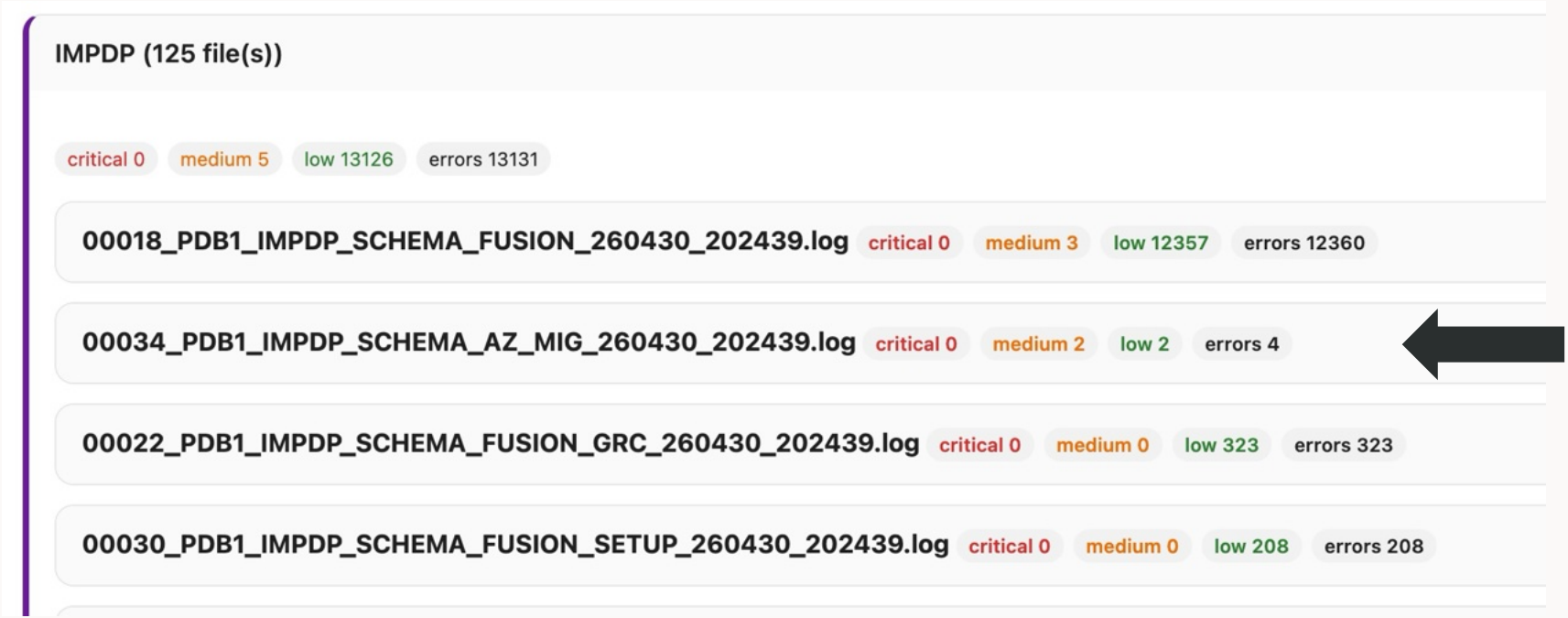
```
Processed 1000 rows; last severity=low
Processed 2000 rows; last severity=medium
Processed 3000 rows; last severity=low
Processed 4000 rows; last severity=medium
Processed 5000 rows; last severity=low
Processed 6000 rows; last severity=medium
Processed 7000 rows; last severity=low
Processed 8000 rows; last severity=medium
Processed 9000 rows; last severity=low
Processed 10000 rows; last severity=medium
Processed 11000 rows; last severity=low
Processed 12000 rows; last severity=medium
Processed 13000 rows; last severity=low
Processed 14000 rows; last severity=medium
Processed 15000 rows; last severity=low
Processed 16000 rows; last severity=low
Done. Total processed=16846

Elapsed: 00:32:01.43
```

```
Report uploaded successfully.
Object URI:
https://.../oracle_error_severity_report.html


Elapsed: 00:00:26.75
```


Example report from test migration with Fusion Apps (FA)



Example report from test migration with Fusion Apps (FA)



Example report from test migration with Fusion Apps (FA)

medium rows 2, messages 2

Seq	Error code	Error message	Source	Confidence	Action	Context / SQL snippet
1	ORA-31685	ORA-31685: Object type SYSTEM_GRANT:"AZ_MIG"."EXPORT FULL DATABASE" failed due to insufficient privileges. Failing sql is: GRANT EXPORT FULL DATABASE TO "AZ_MIG" W-1 Completed 11 SYSTEM_GRANT objects in 0 seconds W-1 Processing object type SCHEMA_EXPORT/ ROLE_GRANT	ai	.8	investigate	ORA-31685: Object type SYSTEM_GRANT:"AZ_MIG"."EXPORT FULL DATABASE" failed due to insufficient privileges. Failing sql is: GRANT EXPORT FULL DATABASE TO "AZ_MIG" W-1 Completed 11 SYSTEM_GRANT objects in 0 seconds W-1 Processing object type SCHEMA_EXPORT/ROLE_GRANT
2	ORA-39083	ORA-39083: Object type ROLE_GRANT failed to create with error:	ai	.8	investigate	ORA-39083: Object type ROLE_GRANT failed to create with error:

Example report from test migration with Fusion Apps (FA)

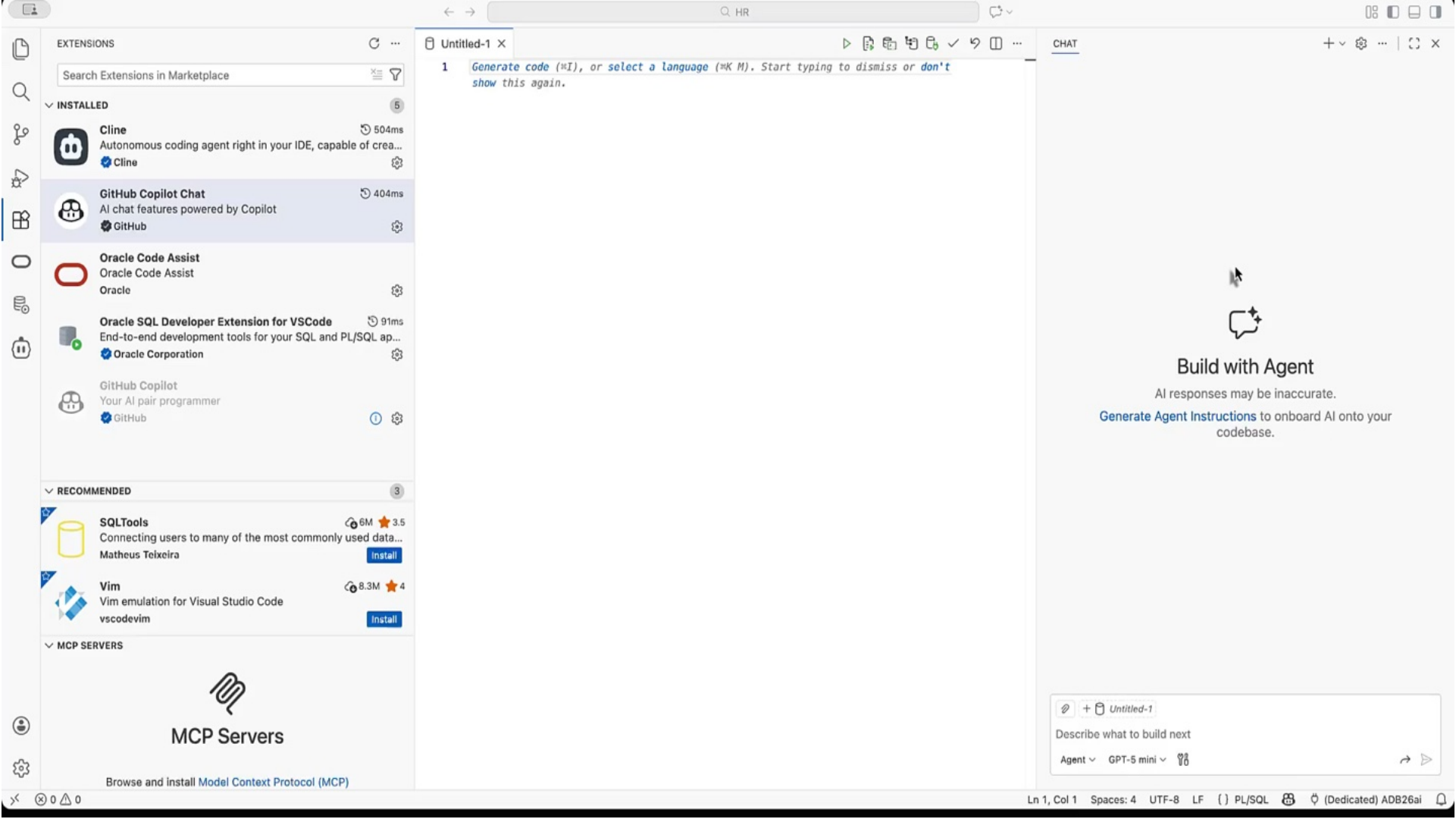
low rows 323, messages 323

Seq	Error code	Error message	Source	Confidence	Action	Context / SQL snippet
1	ORA-31684	ORA-31684: Object type FUNCTION:"FUSION_GRC"."GRC_ACCESS_TYPE_B=" already exists	vector_cache	.95	ignore	ORA-31684: Object type FUNCTION:"FUSION_GRC"."GRC_ACCESS_TYPE_B=" already exists
2	ORA-31684	ORA-31684: Object type FUNCTION:"FUSION_GRC"."GRC_ACCESS_TYPE_TL=" already exists	vector_cache	.95	ignore	ORA-31684: Object type FUNCTION:"FUSION_GRC"."GRC_ACCESS_TYPE_TL=" already exists

What would help you?

Quick Demo

- Microsoft VS Code
- Github Copilot Chat
- SQL Developer Web Extensions for VS Code
- Any LLM


HR
EXTENSIONS
Search Extensions in Marketplace
INSTALLED 5
Cline
504ms
Autonomous coding agent right in your IDE, capable of crea...
Cline
GitHub Copilot Chat
404ms
AI chat features powered by Copilot
GitHub
Oracle Code Assist
Oracle Code Assist
Oracle
Oracle SQL Developer Extension for VSCode
91ms
End-to-end development tools for your SQL and PL/SQL ap...
Oracle Corporation
GitHub Copilot
Your AI pair programmer
GitHub
RECOMMENDED 3
SQLTools
6M 3.5
Connecting users to many of the most commonly used data...
Matheus Teixeira
Install
Vim
8.3M 4
Vim emulation for Visual Studio Code
vscodevim
Install
MCP SERVERS
MCP Servers
Browse and install Model Context Protocol (MCP)
Untitled-1
1 Generate code (⌘I), or select a language (⌘K M). Start typing to dismiss or don't show this again.
CHAT
Build with Agent
AI responses may be inaccurate.
Generate Agent Instructions to onboard AI onto your codebase.
Untitled-1
Describe what to build next
Agent
GPT-5 mini
0 0
Ln 1, Col 1
Spaces: 4
UTF-8
LF
PL/SQL
(Dedicated) ADB26ai

Key Learnings

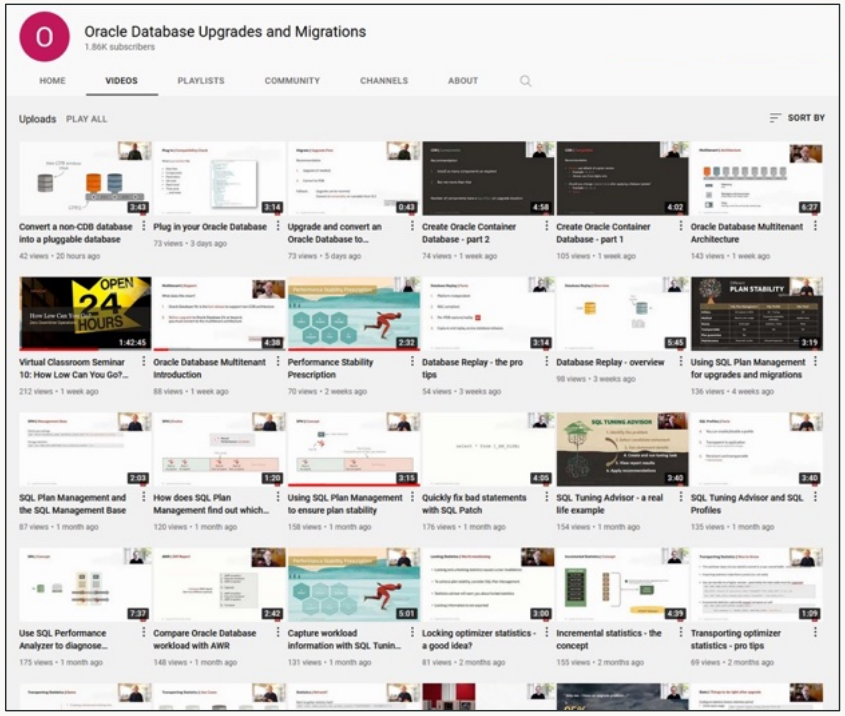
1. Precise prompting is important
2. Never use a read/write user
3. Keep your brain turned on – always!!

Oracle

DBAs

run the world

YouTube Channel



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- No marketing
- No buzzword
- All tech

SCAN ME


ORACLE