



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

Warsaw, September 2026

Photo by [Krzysztof Kotkowicz](#) on [Unsplash](#)

Oracle

DBAs

run the world





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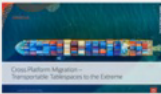
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Virtual Classroom Seminars	Slides
Episode 16 (replaces Episode 1 from Feb 2021) <u>Oracle Database Release and Patching Strategy for 19c and 23c</u> 115 minutes – May 10, 2023	
Episode 17 <u>From SR to Patch – Insights into the Oracle Database Development process</u> 55 minutes – June 22, 2023	
Episode 18 <u>Cross Platform Migration – Transportable Tablespaces to the Extreme</u> 145 min – February 22, 2024	
Episode 19 <u>Move to Oracle Database 23ai – Everything you need to know about Multitenant PART 1</u> 145 min – May 16, 2024	
Episode 20 <u>Move to Oracle Database 23ai – Everything you need to know about Multitenant PART 2</u> 100 min – June 28, 2024	
Episode 21 <u>One-Button Patching with AutoUpgrade – Easing every DBA's life</u> 55 min – October 24, 2024	

Recorded Web Seminars

<https://MikeDietrichDE.com/videos>

More than 45 hours of technical content
On-demand, anytime, anywhere

09:30

Welcome
Upgrade to 26ai
Internals

11:15

Next-level patching

13:30

Rolling upgrades
AutoMigrate
DBA vs. AI

15:15

Performance/migrations
Statistics

11:00

Coffee break

12:45

Lunch

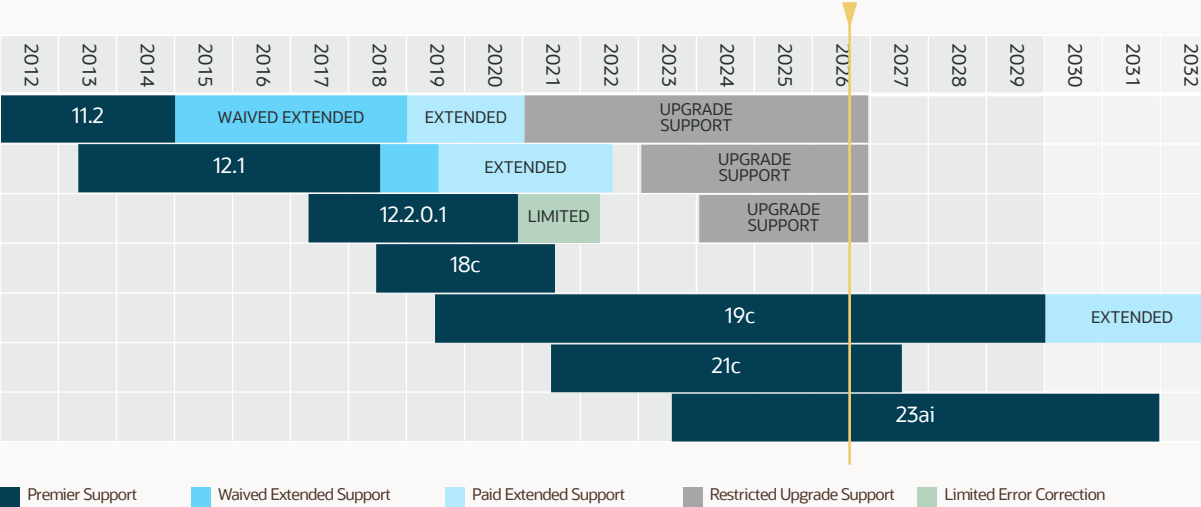
15:00

Coffee break

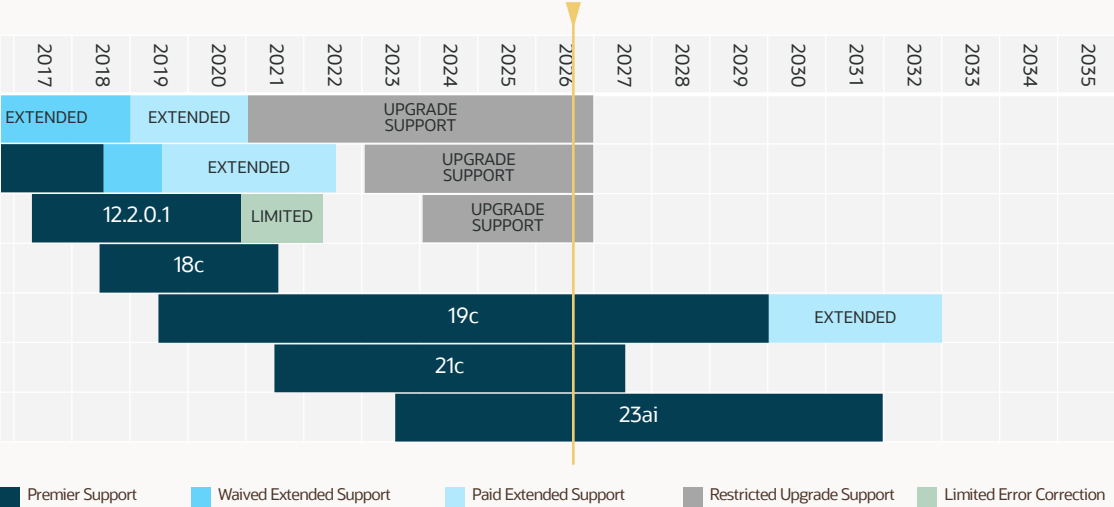


Upgrade to 26ai

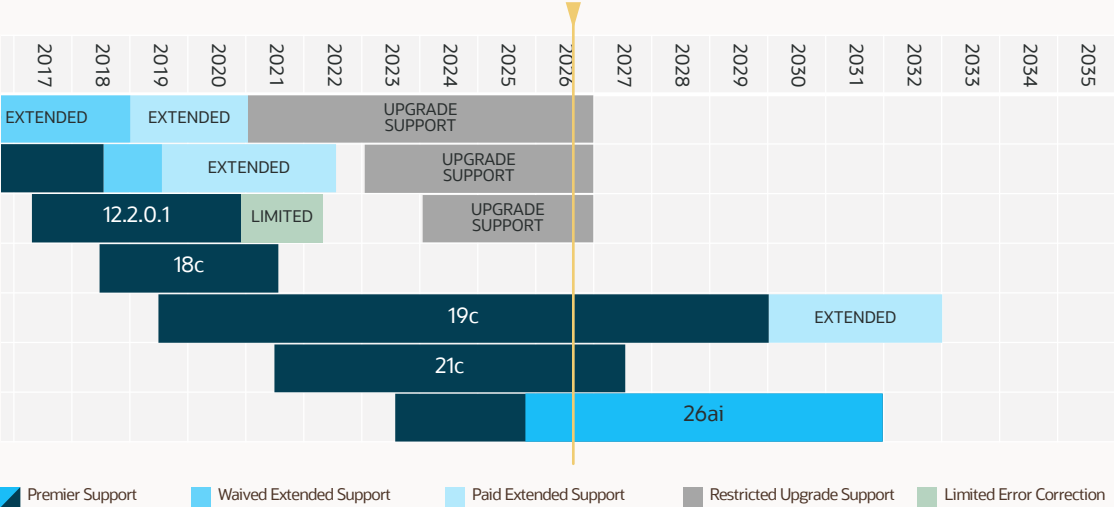
Lifetime Support Policy



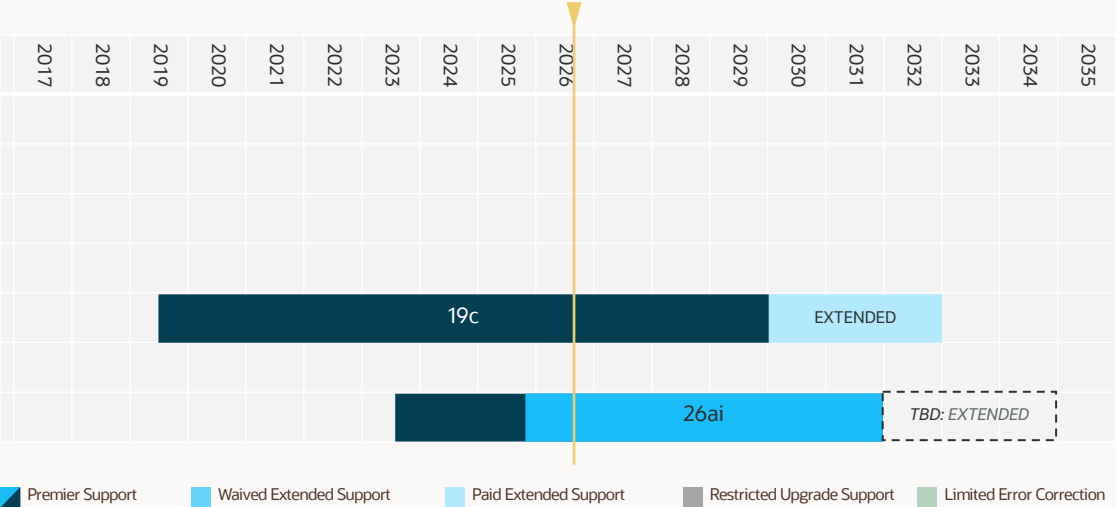
Lifetime Support Policy



Lifetime Support Policy



Lifetime Support Policy





You **must** upgrade
to a Long-Term Support Release – **NOW!!**

- Oracle Database 19c or Oracle AI Database 26ai

26^{ai}

When will it be available on-prem?

Oracle Database Enterprise Edition

Use these downloads for developing, prototyping, and testing in a non-production environment. If you have a commercial license for Oracle AI Database, you can download all supported versions from the [Oracle Software Delivery Cloud](#).

Database Version and Platform	Download	Related Resources
Oracle AI Database 26ai for Linux x86-64	 ZIP (2.2 GB)	Installation Guide
	 RPM (OL9) (2.0 GB)	Individual Component Downloads
Oracle Database 19c for Microsoft Windows x64 (64-bit)	 ZIP (2.9 GB)	Installation Guide Individual Component Downloads
Oracle Database 19c for Linux x86-64	 ZIP (2.8 GB)	Installation Guide
	 RPM (2.5 GB)	Individual Component Downloads
Oracle Database 19c for LINUX ARM (aarch64)	 ZIP (2.2 GB)	Installation Guide

[Link](#)

26^{ai}

What about the other platforms?

Release Schedule of Current Database Releases

PNEWS1360

Last Updated
Aug 24, 2026

Service
Autonomous Database
Dedicated, Autonomous
Database Serverless, Gen 2
Exadata Cloud at Customer,
Oracle Database - Enterprise
Edition, Oracle Database -
Personal Edition, Oracle
Database - Standard Edition,
Oracle Net Services



3.1

Platform	26ai * Long Term Support Release	21c Innovation Release	19c Long Term Support Release	18c	12.2.0.1	12.1.0.2	12.1.0.1	11.2.0.4
Linux x86-64	January 27, 2026	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-bit)	TBA	Not Planned	26-Apr-2019	30-Jul-2018	1-Mar-2017	22-Jul-2014	25-Jun-2013	29-Aug-2013
Microsoft Windows x64 (64-bit)	^{UPS} CY2027 (Instant Client is available today)	08-Oct-2021	08-Jun-2019	21-Aug-2018	16-Mar-2017	25-Sep-2014	9-Jul-2013	25-Oct-2013
IBM AIX on POWER Systems	^{UPS} CY2027	See PNEWS1389	28-May-2019	20-Nov-2018	13-Apr-2017	14-Nov-2014	9-Jan-2014	10-Oct-2013
IBM Linux on System z	CY2027	See PNEWS1389	06-June-2019	20-Nov-2018	6-Jun-2017	14-Nov-2014	9-Jan-2014	9-Jan-2014

26^{ai}

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

Next,
seed and user PDBs



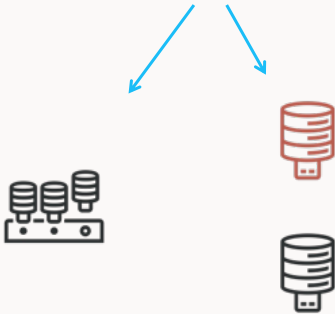
First,
upgrade root



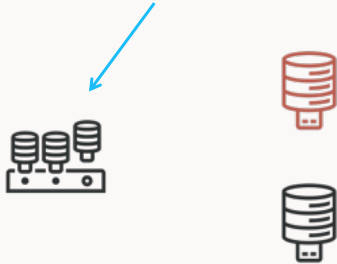
Proceed in batches



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/CDB1  
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 version must match exactly



Oracle Database 19c



Data dictionary 19c



Oracle AI Database 26ai



Data dictionary 26ai



Database Upgrade Guide

☒ This Book ☐ This Release

Table of Contents

Oracle Database

- ✚ Preface
- ✚ Introduction
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- ✚ Upgrading to the New Oracle Database 10g Release
- ✚ After Upgrading a Database
- ✚ Compatibility and Interoperability
- ✚ Upgrading Your Applications

3 Upgrading to the New Oracle Database 10g Release

This chapter guides you through the process of upgrading a database to the new Oracle Database 10g 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> SP00L 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 UGR26.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  
-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
```

```
$ 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 a lot 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
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
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
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
```

```
--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"
```

```
@@cdpls1.sql
```

```
@@cdsqlddl.sql
```

```
@@cdmanage.sql
```

```
@@cdtxnspc.sql
```

```
@@cdenv.sql
```

```
@@cdrac.sql
```

```
@@cdsec.sql
```

```
@@cdobj.sql
```

```
@@cdjava.sql
```

```
@@cdpart.sql
```

```
@@cdrep.sql
```

```
@@cdaw.sql
```

```
@@cdsumgmt.sql
```

```
@@cdtools.sql
```

```
@@cdexttab.sql
```

```
@@cddm.sql
```

```
@@cdclst.sql
```

```
--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"
```

```
@@cdplsqli.sql
```

```
@@cdsqlddl.sql
```

```
@@cdmanage.sql
```

```
@@cdtxnspc.sql
```

```
@@cdenv.sql
```

```
@@cdrac.sql
```

```
@@cdsec.sql
```

```
@@cdobj.sql
```

```
@@cdjava.sql
```

```
@@cdpart.sql
```

```
@@cdrep.sql
```

```
@@cdaw.sql
```

```
@@cdsumgmt.sql
```

```
@@cdtools.sql
```

```
@@cdexttab.sql
```

```
@@cddm.sql
```

```
@@cdclst.sql
```


--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"

@@cdp1sql.sql

@@cdsqlddl.sql

@@cdmanage.sql

@@cdtxnspc.sql

@@cdenv.sql

@@cdrac.sql

@@cdsec.sql

@@cdobj.sql

@@cdjava.sql

@@cdpart.sql

@@cdrep.sql

@@cdaw.sql

@@cdsumgmt.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
```

A middle-aged man with short grey hair and glasses, wearing a dark blue blazer over a light blue button-down shirt, stands on a stage. He is smiling and gesturing with his hands, holding a small black object in his right hand. The background is a simple stage backdrop with a light blue upper half and a dark blue lower half.

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  
Rem process):  
Rem APS, AMD, OLS, DV, CONTEXT, XDB, OWM, MGW, RAC  
Rem  
@@cmpupnjbv.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
```

```
$ 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
```

```
Serial Phase #:9 [CDB$ROOT] Files:1
```

```
Serial Phase #:10 [CDB$ROOT] Files:1
```

```
Serial Phase #:11 [CDB$ROOT] Files:1
```

```
Serial Phase #:12 [CDB$ROOT] Files:1
```

```
Serial Phase #:13 [CDB$ROOT] Files:1
```

```
Serial Phase #:14 [CDB$ROOT] Files:1
```

```
Serial Phase #:15 [CDB$ROOT] Files:1
```

```
Serial Phase #:16 [CDB$ROOT] Files:1
```

```
Serial Phase #:17 [CDB$ROOT] Files:1
```

```
Serial Phase #:18 [CDB$ROOT] Files:1
```

```
Serial Phase #:19 [CDB$ROOT] Files:1
```

```
Serial Phase #:20 [CDB$ROOT] Files:1
```

(output truncated)

```
*** End PDB Application Upgrade Post-Shutdown
```

```
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
```

```
Serial Phase #:106 [CDB$ROOT] Files:1
```

```
Serial Phase #:106 [CDB$ROOT] Files:1
```

```
Serial Phase #:106 [CDB$ROOT] Files:1
```

```
Serial Phase #:106 [CDB$ROOT] Files:1
```

```
--CATCTL -S -D "Catalog Core SQL" Initial scripts single process
```

```
@@cdctrl.sql
```

```
@@cdfixed.sql
```

```
@@catcdbviews.sql
```

```
@@catblock.sql
```

```
@@cdcore.sql
```

```
@@cdenv.sql
```

```
@@cdrac.sql
```

```
@@cdsec.sql
```

```
@@cdobj.sql
```

```
@@cdjava.sql
```

```
@@cdjava.sql
```

```
@@cdjava.sql
```

```
@@cdjava.sql
```

```
@@cdjava.sql
```

```
@@cdjava.sql
```

```
@@cdjava.sql
```

```
@@cdjava.sql
```

```
@@cdjava.sql
```

```
@@cdjava.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-Shutdown
```

```
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
```

```
--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
```

```
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-Shutdown
```

```
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
```

```
--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
```

```
Time: 24s
```



For parallel upgrade, AutoUpgrade

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

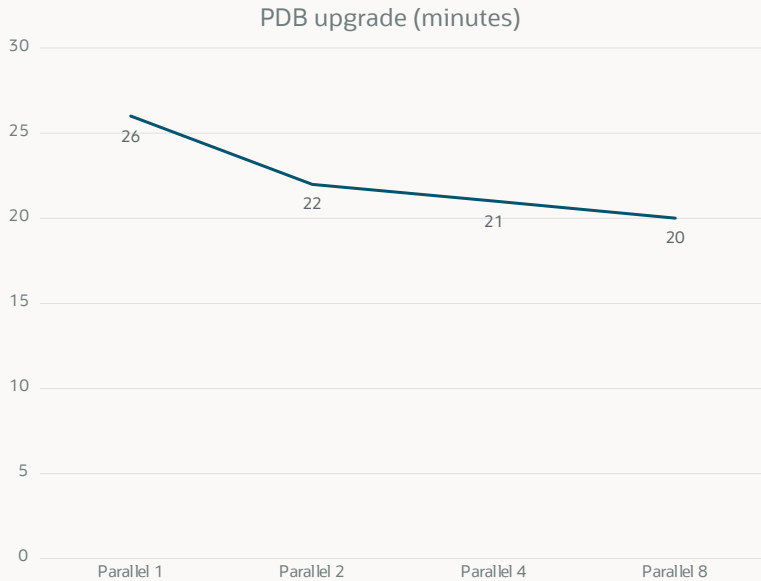


For parallel upgrade, AutoUpgrade

- 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 Oracle-maintained
- Ignores user-owned objects

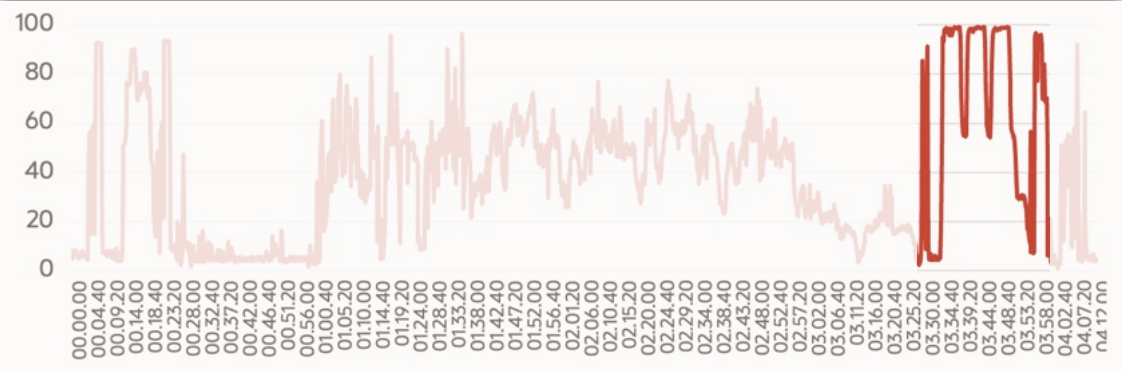
@?/rdbms/admin/utlrp

p parallel
r recom-
p pile
o Oracle
m maintained

@?/rdbms/admin/utlprp

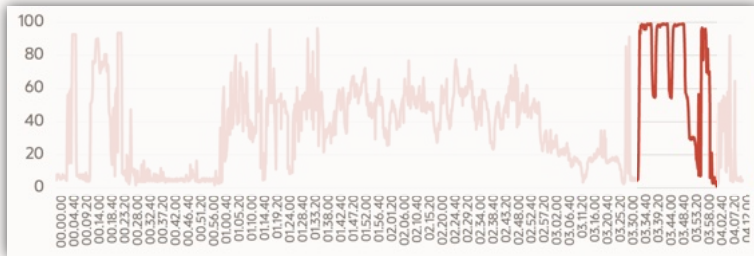
@?/rdbms/admin/utl**prpom**.sql <n>

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_text
CREATE TABLE TAB$( "OBJ#" NUMBER NOT NULL, "DATAOBJ#" NUMBER, "TS#" NUMBER NOT NULL, "FILE#" NUMBER NOT
CREATE TABLE CLUS$( "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_text
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

```



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
```

Bug 32004389 : XDK_DROP_PACKAGE CAN BE MORE EFFICIENT

 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 fullpdb.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 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 Concurr
latch: shared pool	518,161	2,127.7	4.11	3.1 Concurr
library cache: mutex X	180,079	436.2	2.42	.6 Concurr
cell list of blocks physical read	240,920	338.1	1.40	.5 User I/O
cell single block physical read	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 Concurr
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 Concurr
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 Concurr
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 Wait Time 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 Concurr
latch: shared pool	518,161	2,127.7	4.11	3.1 Concurr
library cache: mutex X	180,079	436.2	2.42	.6 Concurr
cell list of blocks physical read	240,920	338.1	1.40	.5 User I/O
cell single block physical read	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 Concurr
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 Concurr
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 Concurr
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

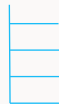
Phase 1

Phase 2

Phase 3

Phase 4

Phase 5



- @a2300932.sql
- @a2300933.sql
- @a23009xx.sql
- @c2300000.sql

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$cdb$pdonly$ncdbtopdb begin install '1.0.upgmode'
alter session set "_enable_view_pdb"=false
alter session set NLS_LENGTH_SEMANTICS=BYTE
INSERT INTO sys.utl_recomp_skip_list select obj# from obj$ 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 only 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



Replay upgrade **doesn't write** proper logfiles

- Logs into the **DIAG** destination only in case of error

```
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';

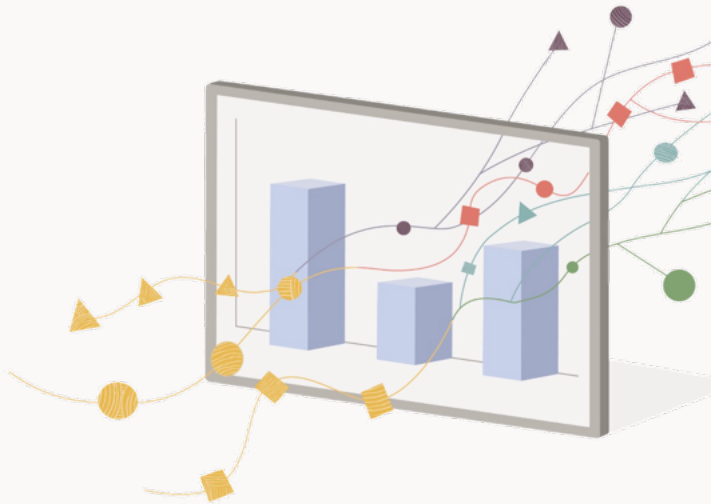


Replay upgrade
is **neither resumable nor restartable**

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



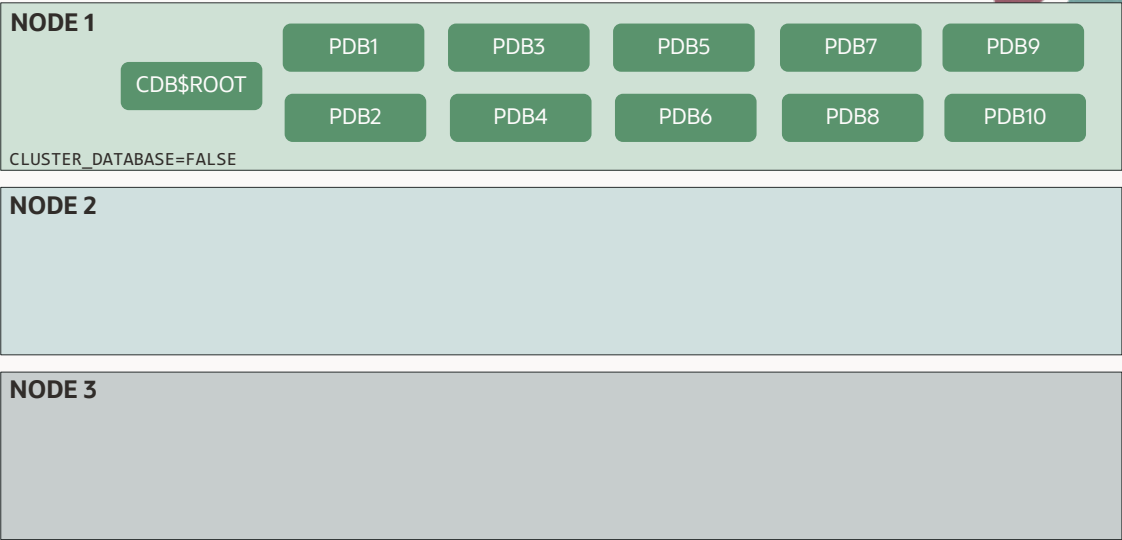
- `CLUSTER_DATABASE = FALSE`
- Upgrade root and all PDBs
- One instance active
- All other nodes are **idle**

Distributed Upgrade

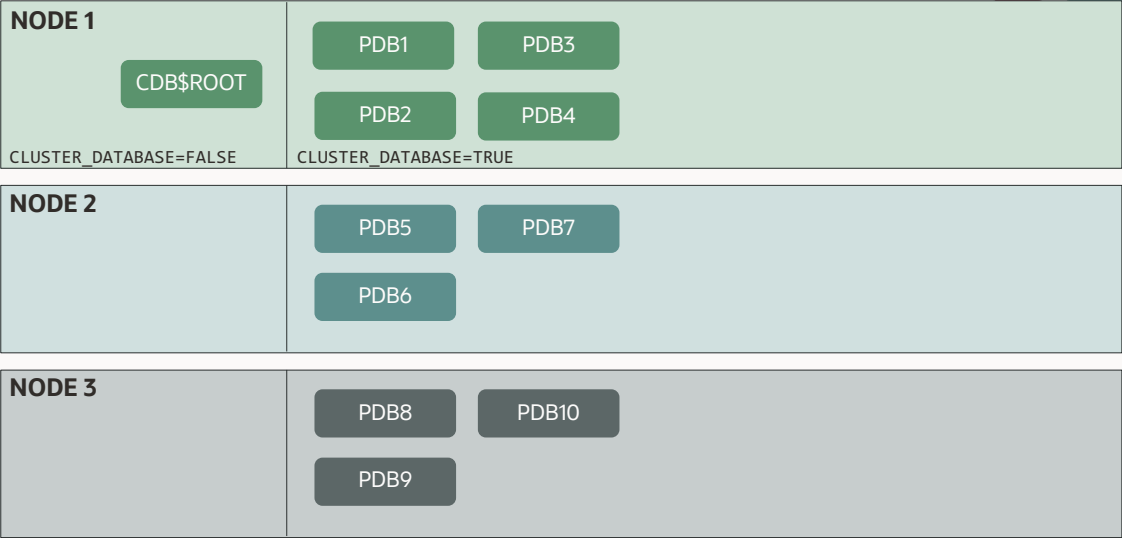


- `CLUSTER_DATABASE = FALSE`
- Upgrade root only
- `CLUSTER_DATABASE = TRUE`
- Upgrade all PDBs
- All instances **active**

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.autoupgrade_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.cffg -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.autoupgrade_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.pdbbs=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.pdbbs=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.pdbbs=PDB8,PDB9,PDB10
```

```
cat RACDB.cffg
```

```
global.autoupgrade_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.cffg -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.pdbbs=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.pdbbs=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.pdbbs=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 **fully 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



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



All initialization parameters			
 Update the initialization parameters only when it is required. Refer to the Oracle documentation to learn more about each initialization parameter and its valid set of values.			
(Storage related parameter(s) value is shown in MB) ☐ Show advanced parameters			
Name	Value	Include in spfile	Category
undo_tablespace	UNDOTBS1	☒	Cluster Database
sga_target	19202	☒	SGA Memory
db_block_size (bytes)	8192	☒	Cache and I/O
nls_language	AMERICAN	☒	NLS
control_files	{* {ORACLE_BASE}/oradata/...	☒	File Configuration
remote_login_passwordfile	EXCLUSIVE	☒	Security and Auditing
processes	640	☒	Processes and Sessions
pga_aggregate_target	6401	☒	Sort, Hash Joins, Bitmap Indexes
nls_territory	AMERICA	☒	NLS
open_cursors	300	☒	Cursors and Library Cache
db_domain	livelabs.oraclevcn.com	☒	Database Identification
compatible	23.6.0	☒	Miscellaneous
db_name	orcl	☒	Database Identification
cluster_database	FALSE	☐	Cluster Database
Description:			
compatible: Allows you to use a new release, while at the same time guaranteeing backward compatibility with an earlier release. Range of Values: Default to current release. Default Value: Release dependent			



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

- No data loss

Downgrade

19c
19.32.0



COMPATIBLE=19.0.0

26ai
23.26.3



COMPATIBLE=19.0.0



```
STARTUP & @<admin/utl<rp.sql q1 pdb1; UPGRADE; ml'; &ASE pdb1 UNPLUG INTO 'pdb1.xml';
```

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

Final Pointers



Use **ORAdiff** to learn about
data dictionary differences

- oradiff.oracle.com



Can you make upgrades run **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:

- 20 October 2026
- 19 January 2027
- 20 April 2027
- 20 July 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 - July 2026	Rev 7, 20 August 2026
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, 24 October 2025

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Critical Patch Update - January 2026	Rev 3, 02 February 2026
Critical Patch Update - October 2025	Rev 1, 24 October 2025

Oracle Critical Patch Update Advisory - July 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](#), [Critical Security 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 security patches without delay.

This Critical Patch Update contains 1448 new security patches across the product families listed below. Please note that a My Oracle Support (MOS) note summarizing the content of this Critical Patch Update and other Oracle Software Security Assurance activities is located at [July 2026 Critical Patch Update: Executive Summary and Analysis](#).

Affected Products and Patch Information

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

Oracle Communications Performance Intelligence Center, versions 10.5.0.1.0, 10.5.0.2.0	Oracle Communications Performance Intelligence Center
Oracle Communications Policy Management, version 15.0.0.0	Oracle Communications Policy Management
Oracle Communications Pricing Design Center, versions 15.0.0.0.0, 15.0.1.0.0, 15.1.0.0.0, 15.2.0.0.0	Oracle Communications Pricing Design Center
Oracle Communications Service Catalog and Design, versions 8.0.0.7.0-8.3.0.3.0	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 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, 7.7.0, 7.8.0, 8.0.1	Oracle Communications Unified Inventory Management
Oracle Communications User Data Repository, version 15.0	Oracle Communications User Data Repository
Oracle Data Integrator, versions 12.3.1.4.0, 14.1.2.0.0	Fusion Middleware
Oracle Database Server, versions 19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	Database
Oracle Demand Demand Management, versions 12.2.3-12.2.5	Oracle Supply Chain Products
Oracle E-Business Suite, versions 12.2.3-12.2.15, V16	Oracle E-Business Suite
Oracle Enterprise Communications Broker, versions 4.2.0, 5.0.0, 5.1.0	Oracle Enterprise Communications Broker
Oracle Enterprise Data Quality, versions 12.2.1.4.0, 14.1.2.0.0	Fusion Middleware
Oracle Enterprise Manager Base Platform, versions 13.5, 24.1	Oracle Enterprise Manager
Oracle Enterprise Manager for Fusion Middleware, version 13.5	Oracle Enterprise Manager
Oracle Enterprise Manager for MySQL Database, versions 13.5.4.0.0-13.5.5.0.0	Oracle Enterprise Manager

Oracle Critical Patch Update Advisory - July 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	Confidentiality	Integrity	Availability		
CVE-2026-61211	RDBMS	Execute DBMS_CLOUD	Oracle Net	No	9.9	Network	Low	Low	None	Changed	High	High	High	19.3-19.31, 23.4.0-23.26.2	
CVE-2026-47040	Oracle Net Services	Connection Manager	Oracle Net	Yes	9.1	Network	Low	None	None	Un-changed	High	None	High	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	
CVE-2026-4738	Oracle Spatial and Graph (gdal)	None	HTTPS	No	8.8	Network	Low	Low	None	Un-changed	High	High	High	19.3-19.31, 23.4.0-23.26.2	
CVE-2026-60175	RDBMS	Authenticated User	Oracle Net	No	8.8	Network	Low	Low	None	Un-changed	High	High	High	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	
CVE-2026-47046	RDBMS	None	Oracle Net	Yes	8.2	Network	Low	None	None	Un-changed	None	Low	High	23.4.0-23.26.2	
CVE-2026-7383	Database (OpenSSL)	None	TLS	Yes	8.1	Network	High	None	None	Un-changed	High	High	High	23.4.0-23.26.2	
CVE-2026-54518	Fleet Patching and Provisioning (jackson-databind)	None	Multiple	No	7.5	Network	High	Low	None	Un-changed	High	High	High	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	
CVE-2026-47045	JDBC	None	Oracle Net	No	6.8	Network	Low	High	Required	Un-changed	High	High	High	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	

Oracle Critical Patch Update Advisory - July 2026

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[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?

File Download

1 Click each file name to download the selected files.

Tip: Use a Download Manager [Learn More...](#)

DATABASE RELEASE UPDATE 19.28.0.0.0(Patch:Linux x86)

 ~~p37960098_190000_LINUX.zip~~ (299.3 MB)

Why a Password?



Unlock

Total Size 299.3 MB

Download File Metadata

View Digest Details

Download wget Script

Close



Oracle also recommends
applying monthly patches

Security Updates

May 4, 2026 | 1 minute read



Beginning May 28, 2026, Oracle will deliver a Critical Security Patch Update (CSPU) each month to address critical vulnerabilities in a smaller, more focused format, allowing customers to address high-severity issues more quickly. This new release model will allow customers to address high-severity vulnerabilities more quickly, reducing the time to patch and the risk of exposure.

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

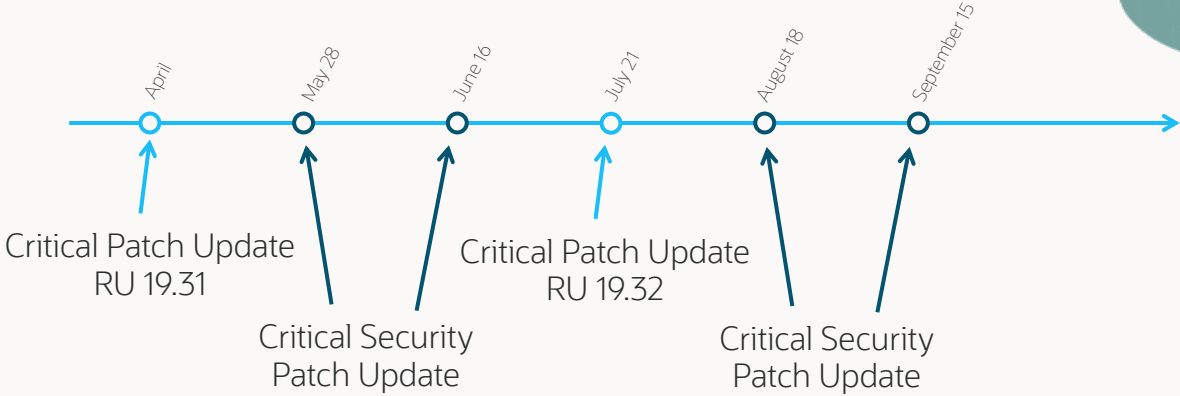
Date	Release Type
------	--------------

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 \(PNEWS3015\)](#)

Patching

Oracle AI Database

1

DOWNLOAD

2

INSTALL

3

PATCH

4

FINALIZE



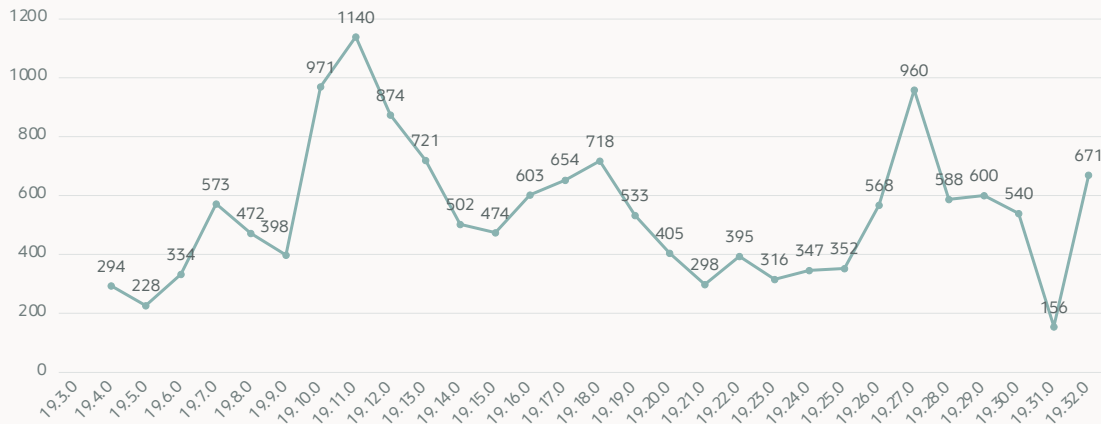
Why should you patch?



Release Updates are the primary vehicle for delivering **security** patches

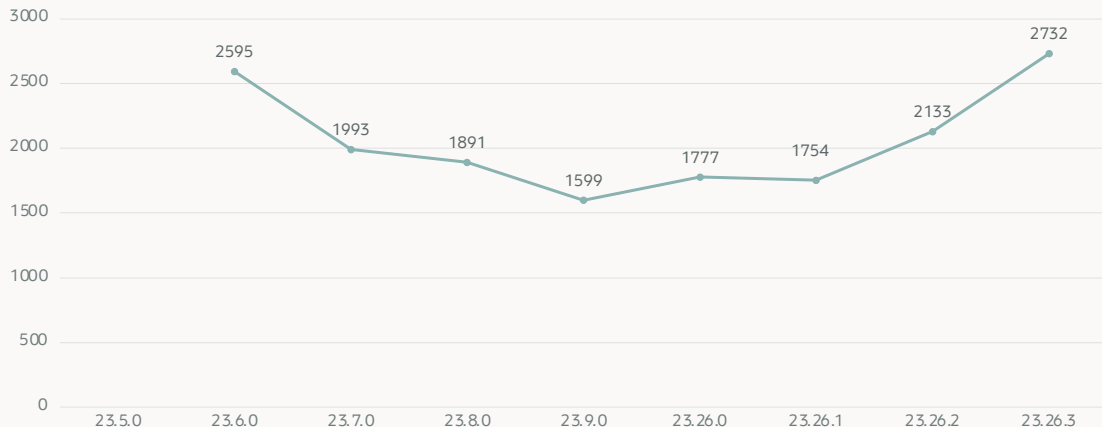
- Plus bug fixes, regression fixes and more

Release Update Contents – Oracle Database 19c



[Database 19 Release Updates and Revisions Bugs Fixed Lists \(KB850150\)](#)

Release Update Contents – Oracle AI Database 26ai



Source: oradiff.oracle.com

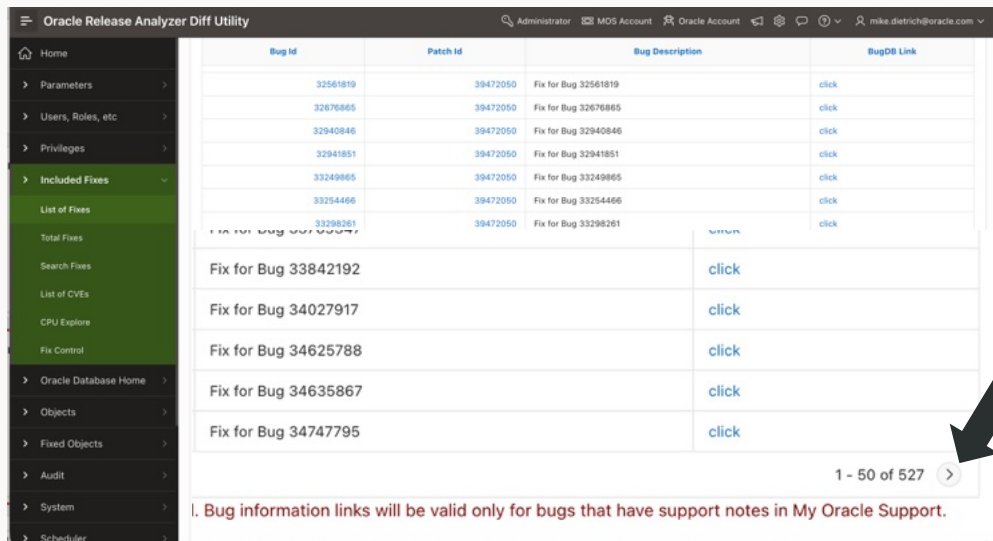




Let's ask
Rodrigo Jorge

oradiff.oracle.com

RU Security Patches – Oracle Database 19.31.0 → 19.32.0



The screenshot displays the Oracle Release Analyzer Diff Utility interface. The sidebar on the left contains navigation links: Home, Parameters, Users, Roles, etc., Privileges, Included Fixes (selected), List of Fixes, Total Fixes, Search Fixes, List of CVEs, CPU Explore, Fix Control, Oracle Database Home, Objects, Fixed Objects, Audit, System, and Scheduler. The main content area shows a table of patches with columns: Bug Id, Patch Id, Bug Description, and BugDB Link. The table lists several patches, including fixes for bugs 32561819, 32676865, 32940846, 32941851, 33249865, 33254466, 33298261, 33842192, 34027917, 34625788, 34635867, and 34747795. A large black arrow points to the '1 - 50 of 527' pagination control at the bottom right of the table. Below the table, a red text message states: 'Bug information links will be valid only for bugs that have support notes in My Oracle Support.'

Bug Id	Patch Id	Bug Description	BugDB Link
32561819	39472050	Fix for Bug 32561819	click
32676865	39472050	Fix for Bug 32676865	click
32940846	39472050	Fix for Bug 32940846	click
32941851	39472050	Fix for Bug 32941851	click
33249865	39472050	Fix for Bug 33249865	click
33254466	39472050	Fix for Bug 33254466	click
33298261	39472050	Fix for Bug 33298261	click
Fix for Bug 33842192			click
Fix for Bug 34027917			click
Fix for Bug 34625788			click
Fix for Bug 34635867			click
Fix for Bug 34747795			click

1 - 50 of 527 >

Bug information links will be valid only for bugs that have support notes in My Oracle Support.

RU Security Patches – Oracle Database 23.26.2 → 23.26.3

Oracle Release Analyzer Diff Utility

Administrator MOS Account Oracle Account mike.dietrich@oracle.com

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

Bug Id	Patch Id	Bug Description	BugDB Link
37858882	39578879	Fix for Bug 37858882	click
37889193	39578879	Fix for Bug 37889193	click
37900621	39578879	Fix for Bug 37900621	click
38012656	39578879	Fix for Bug 38012656	click
38012720	39578879	Fix for Bug 38012720	click
Fix for Bug 38167270		click	
Fix for Bug 38252930		click	
Fix for Bug 38321886		click	
Fix for Bug 38324435		click	
Fix for Bug 38358376		click	
Fix for Bug 38370855		click	

1 - 50 of 1,275

i. Bug information links will be valid only for bugs that have support notes in My Oracle Support.



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

- In total, almost 1,400 security fixes on 19.32.0
- In total, over 2,100 security fixes on 23.26.3

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) each month to address critical vulnerabilities in a smaller, more focused format, allowing customers to address high-priority issues more quickly. This new release model will allow customers to address high-priority issues more quickly.

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

Quarterly Release Updates

	2024				2025				2026				2027		
	January	April	July	October	January	April	July	October	January	April	July	October	January	April	July
19c	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	19.33.0	19.34.0	19.35.0	19.36.0
21c	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	21.24.0	21.25.0	21.26.0	21.27.0
23ai			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	23.26.4	23.27.1	23.27.2	23.27.3



Monthly Recommended Patches

	2025			2026										
	October	November	December	January	February	March	April	May	June	July	August	September	October	November
19.29.0	19.29.0	MRP1	MRP2	MRP3	MRP4	MRP5	MRP6							
19.30.0				19.30.0	MRP1	MRP2	MRP3	MRP4	MRP5	MRP6				
19.31.0							19.31.0	MRP1	MRP2	MRP3	MRP4	MRP5	MRP6	
19.32.0										19.32.0	MRP1	MRP2	MRP3	MRP4
19.33.0													19.33.0	MRP1



Critical Security Patch Updates



Content

MRP – Monthly Recommended Patch

- [KB188772](#)
 - Critical fixes
 - Regression fixes
 - 3rd party tools security fixes
- Security fixes

CSPU – Critical Security Patch Update

- Security fixes





MRPs and CSPUs are cumulative
but **only within one Release Update**

- MRPs => Oracle 19c and 26ai on Linux
- CSPUs => non-Linux platforms and Oracle 21c



MRPs and CSPUs will co-exist

Please wake up. This is **real!!**

Older Release Updates?

File Download

1 Click each file name to download the selected files.

Tip: Use a Download Manager [Learn More...](#)

DATABASE RELEASE UPDATE 19.28.0.0.0(Patch:Linux x86)

 ~~p37960098_190000_LINUX.zip~~ (299.3 MB)

Why a Password?



Unlock

Total Size 299.3 MB

Download File Metadata

View Digest Details

Download wget Script

Close



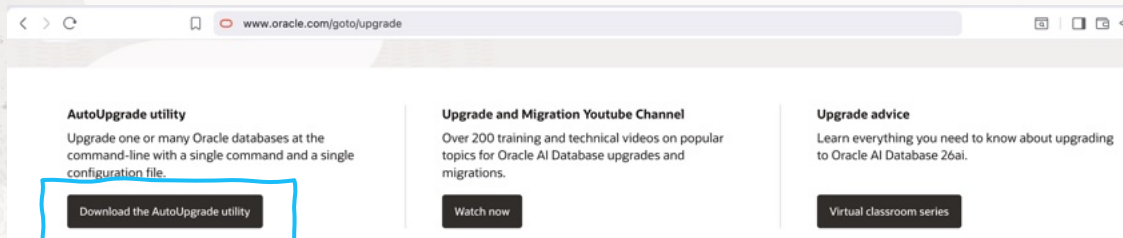
Downloading patches *still* the old way?



The easiest way you can **download patches**
and install them is by using AutoUpgrade

- Always use the latest version of AutoUpgrade
- Available via direct download from [oracle.com](https://www.oracle.com/goto/upgrade) or [KB123450](#)

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

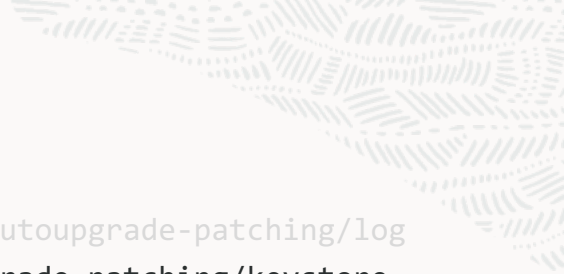




One single tool for everything
- on all platforms

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



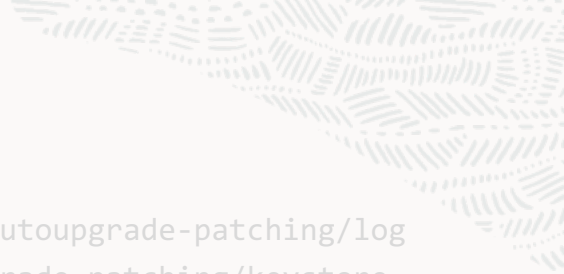


```
global.global_log_dir=/home/oracle/autoupgrade-patching/log  
global.keystore=/home/oracle/autoupgrade-patching/keystore
```

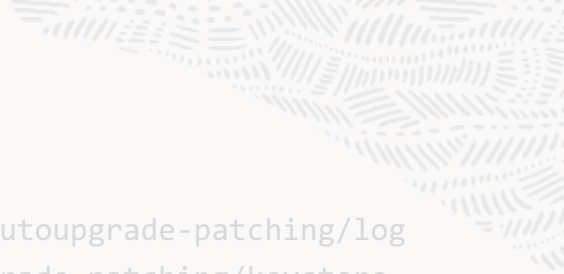



Learn how to configure the keystore
in our previous webinar

- [One-Button Patching – makes life easier for every Oracle DBA](#)

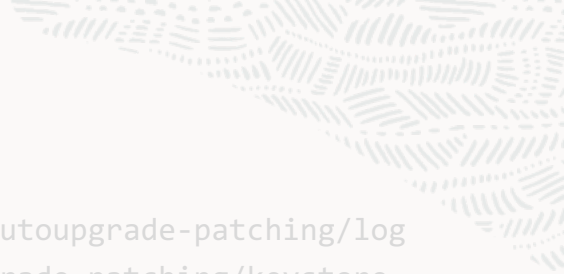


```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches
```



```
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
```

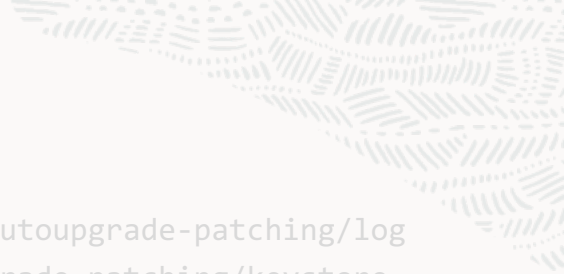
```
$ opatch apply
```

```
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.
```



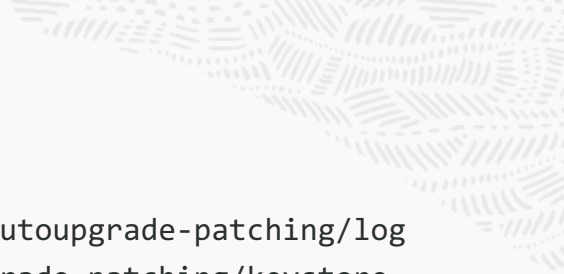
```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches
```

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



Consume the most important fixes for known issues, regressions and security

- MRPs on Linux for Oracle 19c and 26ai
- CSPUs for Oracle 21c and on all non-Linux ports

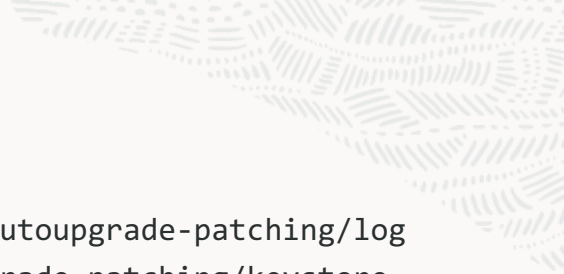


```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches
```

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




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=RU,OPATCH,MRP,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=RU,OPATCH,MRP,OJVM,DPBP
```



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=OPATCH,RU,MRP,OJVM,DPBP,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=OPATCH,RU,MRP,OJVM,DPBP,AU
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

MRP/CSPU

Latest available MRP/CSPU for this RU



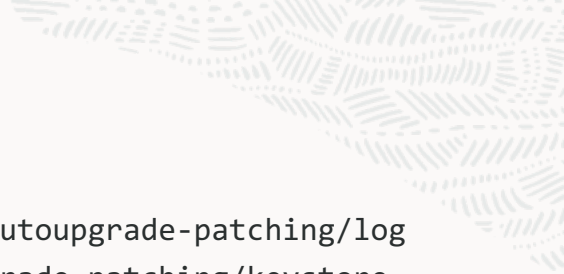
Apply latest JDK patch

```
$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)
```

```
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, JDK
```



Apply other patches
via patch number

Apply the Most Important Patches - [KB188772](#) / 555.1

Recommended Patches for 19.31 DB Home

Below is the list of important patches to consider applying on top of 19.31.

Special Note: As of 5/15/2026 Oracle Database 19.31 has been re-released due to an issue affecting environments running Exadata Software Release 25.2. and Oracle Database 19.31. For more information see Note [KB888427](#).*

Bug	KM Article	Fixed in RU	Fixed in MRP	Description	Patches	RAC Rolling Installable	Database Online Installable	Added
39370763	KB888427		DBMRP 19.31.0.0.260519	[OSS SRV LAYER] DB56: Disable Flash Cache Temp Reuse and ASM Partner Read in 19.31 (one off)	PATCH 39370763	YES	NO	14-MAY-2026
38238416 (replaces 37690446)	KI40882			[SQL EXECUTION] Bug 38238416 - ORA-600 [ktatmkref-rs] with RAC roll option for 19c	PATCH 38238416	YES	NO	30-APR-2026
38723830 (replaces 34672698)	KI55221	Not Eligible	Not Eligible	[VOS] DB50: ORA-800: soft external error, arguments: [set priority failed], [vktm] , dism(16) or ORA-7445 [__intel_sse2_strncmp()+379]	PATCH 38723830	YES	NO	31-MAR-2026
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 19.31_555.1: 39370763,38238416,38723830,34774667,29213893



```
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,JDK,38238416
```




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	DN FS	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,JDK,38238416,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,JDK,38238416,SDOBP,TEXT
```



Any other bundle patch
AutoUpgrade should download?



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,JDK,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

i

What else?



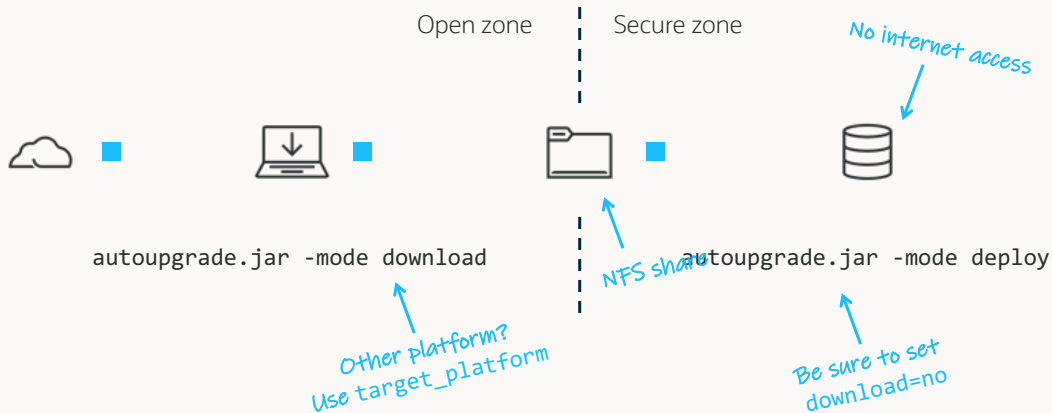
```
global.global_log_dir=/home/oracle/autoupgrade-patching/log
global.keystore=/home/oracle/autoupgrade-patching/keystore
global.folder=/home/oracle/autoupgrade/patches
```

```
patch1.target_version=19
patch1.patch=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 - July 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](#), [Critical Security 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 security patches without delay.

This Critical Patch Update contains 1448 new security patches across the product families listed below. Please note that a My Oracle Support (MOS) note summarizing the content of this Critical Patch Update and other Oracle Software Security Assurance activities is located at [July 2026 Critical Patch Update: Executive Summary and Analysis](#).

Affected Products and Patch Information

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

Oracle Communications Performance Intelligence Center, versions 10.5.0.1.0, 10.5.0.2.0	Oracle Communications Performance Intelligence Center
Oracle Communications Policy Management, version 15.0.0.0	Oracle Communications Policy Management
Oracle Communications Pricing Design Center, versions 15.0.0.0.0, 15.0.1.0.0, 15.1.0.0.0, 15.2.0.0.0	Oracle Communications Pricing Design Center
Oracle Communications Service Catalog and Design, versions 8.0.0.7.0-8.3.0.3.0	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 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, 7.7.0, 7.8.0, 8.0.1	Oracle Communications Unified Inventory Management
Oracle Communications User Data Repository, version 15.0	Oracle Communications User Data Repository
Oracle Data Integrator, versions 12.2.1.4.0, 14.1.2.0.0	Fusion Middleware
Oracle Database Server, versions 19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	Database
Oracle Demantra Demand Management, versions 12.2.3-12.2.15	Oracle Supply Chain Products
Oracle E-Business Suite, versions 12.2.3-12.2.15, V16	Oracle E-Business Suite
Oracle Enterprise Communications Broker, versions 4.2.0, 5.0.0, 5.1.0	Oracle Enterprise Communications Broker
Oracle Enterprise Data Quality, versions 12.2.1.4.0, 14.1.2.0.0	Fusion Middleware
Oracle Enterprise Manager Base Platform, versions 13.5, 24.1	Oracle Enterprise Manager
Oracle Enterprise Manager for Fusion Middleware, version 13.5	Oracle Enterprise Manager
Oracle Enterprise Manager for MySQL Database, versions 13.5.4.0.0-13.5.5.0.0	Oracle Enterprise Manager

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

CPU199

Last Updated
Yesterday 1:04 AM



2.8

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

My Oracle Support [CPU199](#)

Released July 21, 2026

This document contains the following sections:

- Critical Patch Update July 2026 Patch Availability Document (PAD)
 - 1 Overview
 - 1.1 How to Use This Document
 - 1.2 Terminology in the Tables
 - 1.3 On-Request Patches
 - 1.4 CPU Program and My Oracle Support Patch Recommendations
 - 1.5 My Oracle Support (MOS) Conflict Checker Tool
 - 2 What's New in July 2026
 - 2.1 Final CPU Information (Error Correction Policies)
 - 2.2 Post Release Patches
 - 2.3 Separate PADs for Separate Products
 - 2.4 Monthly Recommended Patches (MRPs)
 - 2.5 Critical Security Patch Updates (CSPUs)
 - 3 Patch Availability for Oracle Products
 - 3.1 Oracle Database
 - 3.2 Oracle Sun Middleware
 - 3.3 Tools
 - 4 Final CPU History
 - 5 Sources of Additional Information
 - 6 Modification History

Patch	Patch Number	Platform	Availability
21.23.0.0.260721 Database RU	39549189	Linux 32 bit	Available
21.23.0.0.260721 GI RU	39549137	Linux 32 bit	Available
21.23.0.0.260721 Database RU	39300496	Windows 64-bit	Available
		Windows 32-bit	Available
19.32.0.0.260721 DB RU	39472050	AIX	ETA: Aug 28, 2026
		All Other Platforms	Available
19.32.0.0.260721 DB RU COMBO	39618649	AIX	ETA: Aug 28, 2026
		All Other Platforms	Available
19.32.0.0.260721 GI RU	39467003	AIX	ETA: Aug 28, 2026
		All Other Platforms	Available
19.32.0.0.260721 GI RU COMBO	39618711	AIX	ETA: Aug 28, 2026
		All Other Platforms	Available
19.32.0.0.260721 OJVM RU	39222882	All Platforms	Available
19.32.0.0.260721 WIN BP & OJVM	39418910	Windows BP	Available
	39222882	OJVM	Available
23.26.3 QFSDP for Exadata	39619127	Linux x86-64	Available
19.32 QFSDP for Exadata	39619107	Linux x86-64	Available

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](#)

1

DOWNLOAD

2

INSTALL

3

PATCH

4

FINALIZE

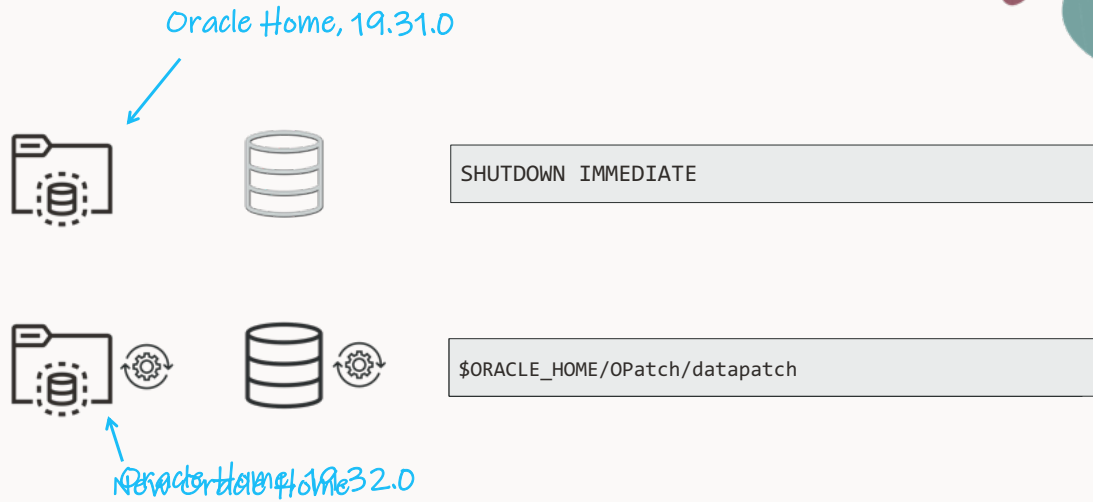
In-Place Patching

Oracle Home, 19.32.0



```
$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

- Don't argue with us 😊



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_31 ← Settings
```

```
patch1.target_home=/u01/app/oracle/product/dbhome_19_32
```

```
patch1.patch=RECOMMENDED
```

↑
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_31  
patch1.target_home=/u01/app/oracle/product/dbhome_19_32  
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_31  
patch1.target_home=/u01/app/oracle/product/dbhome_19_32  
patch1.patch=RECOMMENDED  
patch1.home_settings.home_name=OraDbHome1932
```

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

```
patch1.source_home=/u01/app/oracle/product/dbhome_19_31  
patch1.target_home=/u01/app/oracle/product/dbhome_19_32  
patch1.patch=RECOMMENDED  
patch1.home_settings.home_name=OraDbHome1932  
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_31  
patch1.target_home=/u01/app/oracle/product/dbhome_19_32  
patch1.patch=RECOMMENDED  
patch1.home_settings.home_name=OraDbHome1932  
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](#)

1

DOWNLOAD

2

INSTALL

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PATCH

4

FINALIZE



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_31  
patch1.target_home=/u01/app/oracle/product/dbhome_19_32
```

```
global.global_log_dir=/home/oracle/autoupgrade-patching/log  
patch1.sid=CDB19  
patch1.source_home=/u01/app/oracle/product/dbhome_19_31  
patch1.target_home=/u01/app/oracle/product/dbhome_19_32
```

```
$ 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_31
```

```
patch1.target_home=/u01/app/oracle/product/dbhome_19_32
```

```
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_31
```

```
patch1.target_home=/u01/app/oracle/product/dbhome_19_32
```

```
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_31  
patch1.target_home=/u01/app/oracle/product/dbhome_19_32  
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_31
patch1.target_home=/u01/app/oracle/product/dbhome_19_32
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

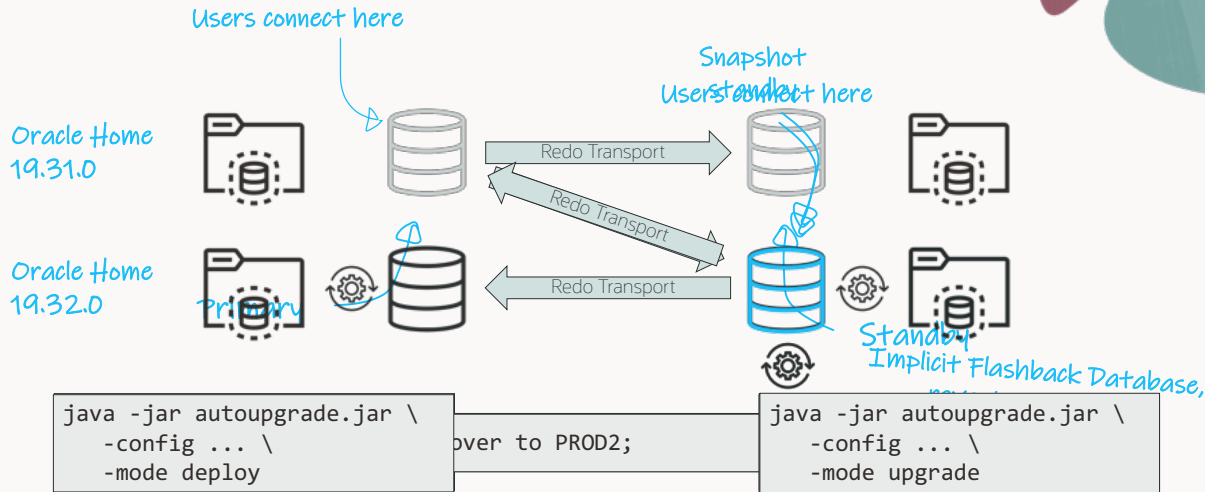


Reduce downtime to the time it takes
to perform a switchover



Safely test and verify patches with
Standby-First Patch Apply

Standby-First Patching



DEMO

Patch Data Guard

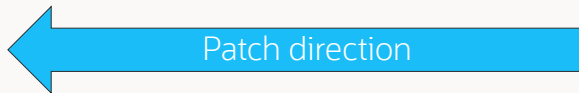
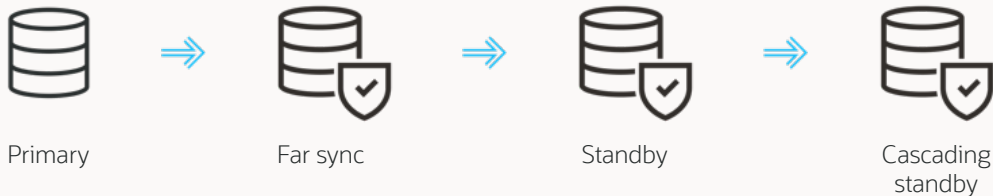
 [Watch on YouTube](#)



Patch must Standby-First installable

- Check the patch readme

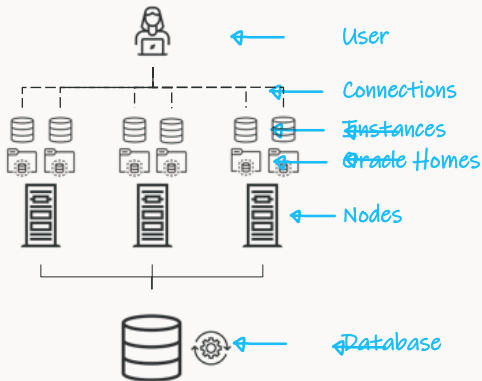
Data Guard Patching





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_31
```

```
patch1.target_home=/u01/app/oracle/product/dbhome_19_32
```

```
patch1.rac_rolling=auto
```



Default value

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_31
```

```
patch1.target_home=/u01/app/oracle/product/dbhome_19_32
```

```
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
```

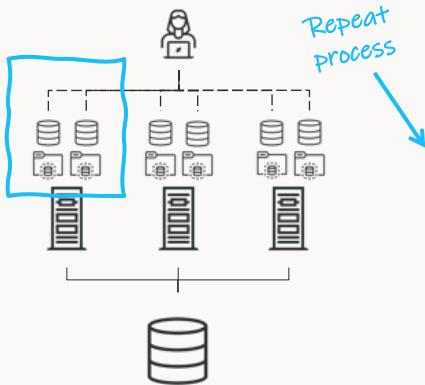
```
patch1.source_home=/u01/app/oracle/product/dbhome_19_31
```

```
patch1.target_home=/u01/app/oracle/product/dbhome_19_32
```

```
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](#)

1

DOWNLOAD

2

INSTALL

3

PATCH

4

FINALIZE



Don't forget the clients

Security Bug Fixes in Clients

CPU	Clients Affected
Jul 2026	Client-only, JDBC
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



Oracle Critical Patch Update Advisory - July 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](#), [Critical Security 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 security patches without delay.

This Critical Patch Update contains 1448 new security patches across the product families listed below. Please note that a My Oracle Support (MOS) note summarizing the content of this Critical Patch Update and other Oracle Software Security Assurance activities is located at [July 2026 Critical Patch Update: Executive Summary and Analysis](#).

Affected Products and Patch Information

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

CVE-2026-60175	RDBMS	Authenticated User	Oracle Net	No	8.8	Network	Low	Low	None	Un-changed	High	High	High	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	
CVE-2026-47046	RDBMS	None	Oracle Net	Yes	8.2	Network	Low	None	None	Un-changed	None	Low	High	23.4.0-23.26.2	
CVE-2026-7383	Database (OpenSSL)	None	TLS	Yes	8.1	Network	High	None	None	Un-changed	High	High	High	23.4.0-23.26.2	
CVE-2026-54518	Fleet Patching and Provisioning (jackson-databind)	None	Multiple	No	7.5	Network	High	Low	None	Un-changed	High	High	High	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	
CVE-2026-47045	JDBC	None	Oracle Net	No	6.8	Network	Low	High	Required	Un-changed	High	High	High	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	
CVE-2026-47039	Java VM	Create Session	Oracle Net	No	6.5	Network	Low	Low	None	Un-changed	None	High	None	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	
CVE-2026-47060	JDBC	None	Oracle Net	Yes	6.5	Network	Low	None	Required	Un-changed	None	High	None	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	
CVE-2026-46975	RDBMS	None	Oracle Net	Yes	5.8	Network	Low	None	None	Changed	None	Low	None	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	
CVE-2025-7962	Java VM (Jakarta Mail)	None	SMTP	No	5.7	Network	Low	Low	Required	Un-changed	None	High	None	19.3-19.30, 23.4.0-23.26.1	
CVE-2026-47061	JDBC	None	HTTP	Yes	5.6	Adjacent Network	High	None	Required	Changed	High	None	None	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	
CVE-2026-54515	Oracle Spatial and Graph (jackson-databind)	None	HTTP	No	4.3	Network	Low	Low	None	Un-changed	None	Low	None	21.3-21.22	
CVE-2026-47038	RDBMS	None	Oracle Net	No	2.7	Network	Low	High	None	Un-changed	None	Low	None	19.3-19.31, 21.3-21.22, 23.4.0-23.26.2	



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;  
}
```

```
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;  
}
```



```
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;  
}
```

```
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;
```

```
}
```



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 => 'YES'
);
```

```
-- List all optimizer fixes
```

```
set serveroutput on;
```

```
exec dbms_optim_bundle.getBugsforBundle;
```


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

```
-- Enable all optimizer fixes
```

```
exec dbms_optim_bundle.enable_optim_fixes('ON','BOTH', 'YES');
```



Until at least Oracle AI Database 23.26.3
optimizer fixes are **ON** by default

- This is different from Oracle Database 19c where they are OFF by default mostly

Further Information

Optimizer Fixes



- [Managing "installed but disabled" bug fixes in Database Release Updates using DBMS_OPTIM_BUNDLE \(KB148297\)](#)
- [ORAdiff - Fix Control](#)
- Blog post: [Should you enable _fix_controls with DBMS_OPTIM_BUNDLE?](#)



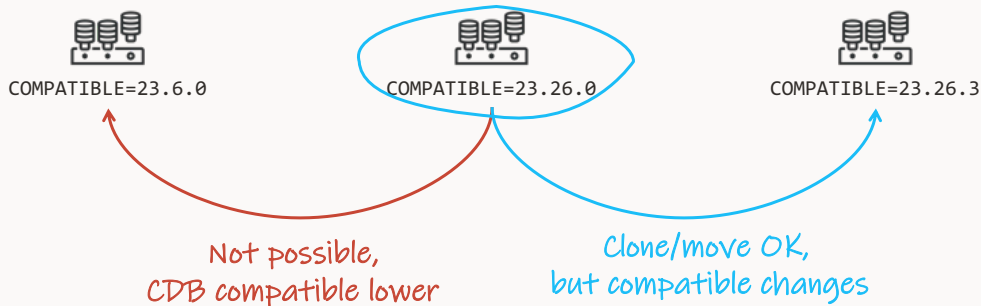
Don't raise COMPATIBLE when you patch



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

- Vector functionality
- Blockchain and immutable tables

Compatible



- 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 '23.26.3';
```




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

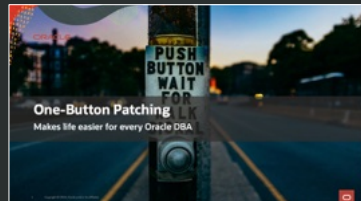
Webinar

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 Apply the most recent MRP / CSPU
- 3 Use AutoUpgrade

BREAK

We start again at 13:30

Rolling Upgrades



Reduce upgrade downtime to the time
it takes to perform a switchover

Rolling Upgrade | Standby Types

PHYSICAL

Redo apply

Updated by changing data block

Exact copy - block-by-block

LOGICAL

SQL apply

Updated by executing SQLs

Copy - data is the same

Rolling Upgrade | Concept

Guaranteed restore point

Users are
Start in new
connected here
Oracle Home



Flashback
Primary

LogMiner
Convert
dictionary

Upgrade
physical standby



LOGMINER



```
INSERT INTO ORDERS VALUES ...  
DELETE FROM CUSTOMERS WHERE ...  
UPDATE TRANSACTIONS SET ...
```



OPTIONAL

REDO

SQL

REDO

Apply SQL Upgrade



Physical
Standby

Convert
Logical Standby
Start in new
Oracle Home

```
SQL> alter database recover  
to logical standby keep identity;
```



Rolling Upgrade | Options



MANUAL

Part of Enterprise Edition

Source must be 11.1.0.7

Manual approach

Data Guard broker must be disabled

DBMS_ROLLING

Requires [Active Data Guard](#)

Source must be 12.1.0.2 or newer

Automated

Data Guard broker can be enabled

Rolling Upgrade | Options

MANUAL

Part of Enterprise Edition

Source must be 11.1.0.7

Manual approach

Data Guard broker must be disabled

No longer supported

DBMS_ROLLING

Requires Active Data Guard

Source must be 12.1.0.2 or newer

Automated

Data Guard broker can be enabled

Supported

Rolling Upgrade | Manual

[Oracle11g Data Guard: Database Rolling Upgrade Shell Script \(KB135176\)](#)

Oracle11g Data Guard: Database Rolling Upgrade Shell Script

- Potentially not adjusted for Oracle 12c and newer
- Requires source is 11.2.0.3 or newer
- Does not work with Multitenant
- Not supported in 19c

Rolling Upgrade | DBMS_ROLLING

```
SQL> exec dbms_rolling.init_plan;  
SQL> exec dbms_rolling.build_plan;  
SQL> exec dbms_rolling.start_plan;
```

6 SIMPLE STEPS

Upgrade database

```
SQL> exec dbms_rolling.switchover;  
SQL> exec dbms_rolling.finish_plan;
```

```
...  
Get current redo branch of the primary database  
Wait until recovery is active on the primary's redo  
branch  
Reduce to a single instance if database is a RAC  
Verify only a single instance is active if future  
primary is RAC  
Stop media recovery  
Execute dbms_logstdby.build  
Convert into a transient logical standby  
Open database including instance-peers if RAC  
Verify logical standby is open read/write  
Get redo branch of transient logical standby  
Get reset scn of transient logical redo branch  
Configure logical standby parameters  
Start logical standby apply
```

86 INSTRUCTIONS OR CHECKS

```
...  
Start logical standby apply  
Wait until apply lag has fallen below 600 seconds  
Notify Data Guard broker that switchover to logical  
standby database is starting  
Log post-switchover instructions to events table  
Switch database to a logical standby  
Notify Data Guard broker that switchover to logical  
standby database has completed  
Wait until end-of-redo has been applied  
...
```



Also useful for
other maintenance activities

Can I use it on my database?

Determine database readiness





Do not create the logical standby
on the **same** server as the primary



Supplemental logging is enabled automatically

- Introduces an overhead
- Increases amount of redo generated



When supplemental logging is enabled all DML cursors are invalidated

- Introduces an overhead
- Increases amount of redo generated



Not all data types and partitioning types are supported

- Introduces an overhead
- Increases amount of redo generated

Rolling Upgrade | Multitenant

- Rolling upgrade on container databases is fully supported
- Upgrade happens on CDB level - when you switchover - the entire CDB switches over
- The Transient Logical Standby can have a subset of the PDBs
- Adding new PDBs in primary after instantiating logical standby is possible, but cumbersome

Tips and tricks to **ease** your migration



For optimal performance all tables should have primary keys or unique keys



Use **ALTER DATABASE GUARD** to prevent accidental changes on logical standby



It is recommended to use three standbys
for maximum protection



Upgrade Grid Infrastructure to
new release before you start the process



Before starting rolling maintenance,
test your Data Guard config



After converting to logical standby database, **take a level 0 backup**



Plan your switchover
during an off-peak period

Rolling Upgrade | Additional Information - 1

Documentation:

- [Oracle Database Rolling Upgrades Using a Data Guard Physical Standby Database](#)
- [Data Guard Concepts and Administration](#)

MOS Notes:

- [Rolling upgrade using DBMS_ROLLING - Complete Reference \(KB148735\)](#)
- [MAA Technical Brief: SQL Apply Best Practices \(KB112017\)](#)
- [Step by Step How to Do Switchover/Failover on Logical Standby Environment \(KB123951\)](#)
- [How To Skip A Complete Schema From Application on Logical Standby Database \(KB142201\)](#)
- [How to monitor the progress of the logical standby \(KB126372\)](#)
- [How To Reduce The Performance Impact Of LogMiner Usage On A Production Database \(KB87280\)](#)
- [Upgrading to 19c Oracle Database with Reduced Downtime Using DBMS_ROLLING on Exadata Database Service \(ExaDB\) \(KB52602\)](#)

Rolling Upgrade | Additional Information - 2

MOS Notes:

- [Handling ORA-1403 ora-12801 on logical standby apply \(KB133579\)](#)
- [Troubleshooting Example - Rolling Upgrade using DBMS_ROLLING \(KB121779\)](#)
- [DBMS Rolling Upgrade Switchover Fails with ORA-45427: Logical Standby Redo Apply Process Was Not Running \(KB127726\)](#)
- [SRDC - Collect Logical Standby Database Information \(SRDC3608\)](#)
- [MRP fails with ORA-19906 after Flashback of Transient Logical Standby used for Rolling Upgrade \(KB179936\)](#)
- [What Causes High Redo When Supplemental Logging is Enabled \(KB151891\)](#)
- [Logical Standby SQL APPLY Tuning Tips \(KB124000\)](#)

ORACLE

Oracle Database 19c to 26ai: Reduced-Downtime Upgrade

Combining DBMS_ROLLING and distributed AutoUpgrade to move from 19c to 26ai with reduced downtime.

Sebastian Alasino

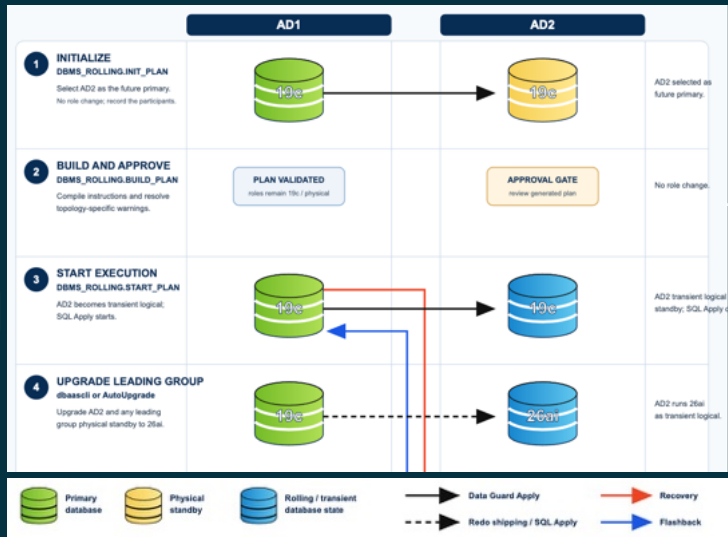
Master Principal Sales Consultant

Oracle AI Customer Excellence Center

www.linkedin.com/in/alasino

Upgrading Oracle Database 19c to 26ai with Reduced Downtime

Planning simulation: 200 PDBs; incoming REDO 12 GB/min. Validate duration and configured parallelism in rehearsal.



dba_rolling_unsupported

dba_logstdby_not_unique

```
SELECT instid, target, phase, exec_status, description
FROM dba_rolling_plan ORDER BY instid;
```

```
SELECT * FROM dba_rolling_events;
```

Protection Mode: MaxPerformance

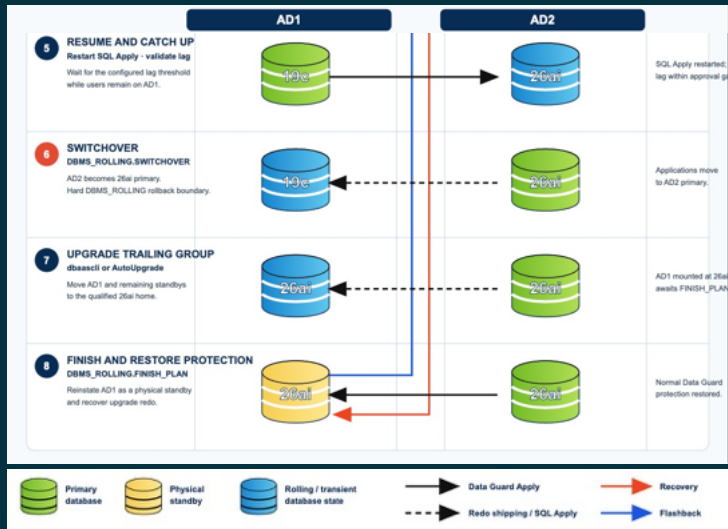
Members:

PMTCT1_AD1 - Primary database

PMTCT1_AD2 - Transient logical standby database

AutoUpgrade distributed-upgrade can use Clusterware member-node resources to upgrade PDBs more rapidly in a qualifying Oracle RAC CDB (PMTCT1_AD2)

Upgrading Oracle Database 19c to 26ai with Reduced Downtime



Backlog is the REDO accumulated while the future primary is upgrading. **SQL Apply - incoming REDO** is the capacity available to shrink it.

Qualified in-flight work (**19.30+**) can reconnect and replay on the upgraded primary instead of exposing every transition interruption to the user.

```
dbaascli database upgrade --dbname <db_name> /
--targetHome /
/u02/app/oracle/product/23.0.0.0/dbhome_1 /
--standBy
```

Protection Mode: MaxPerformance

Members:

PMTc1_AD2 - Primary database

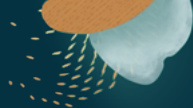
PMTc1_AD1 - Physical standby database

GoldenGate-enabled post-switchover fail-back

It is a prebuilt logical-replication architecture that can redirect applications to an independent, synchronized 19c database after the switchover boundary. GoldenGate cannot be introduced reactively after the 26ai failure.



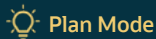
Rolling upgrade with Application Continuity



WHAT IT IS	Application Continuity, Transparent Application Continuity, draining, and Transaction Guard can protect eligible requests during the DBMS_ROLLING switchover.
WHY IT MATTERS	Qualified in-flight work can reconnect and replay on the upgraded primary instead of exposing every transition interruption to the user.
PRINCIPAL INTERFACE	DBMS_ROLLING, role-based services, AC/TAC attributes, Transaction Guard, FAN, and Broker DrainTimeout.
QUALIFICATION	The service, client or pool, request boundaries, session state, replay safety, and drain behavior must be qualified. It does not preserve a physical connection or make every request replayable.

Requires a 19c RU 19.30 or later source database and a 26ai target database. The service, client or pool, request boundaries, session state, replay safety, and drain behavior must be qualified.

REDO stress test calibrates demand



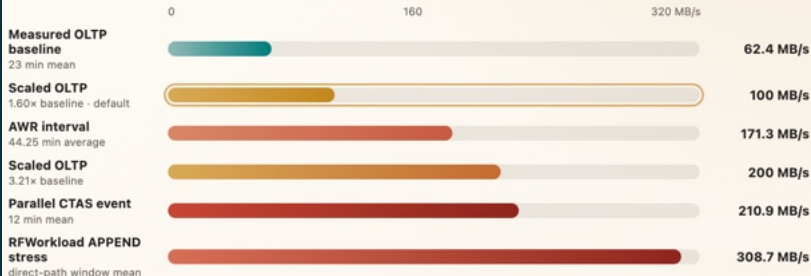
ExaDB-X11M: a two-node Oracle RAC 19.29 cluster with two 64-CPU database hosts, three Exadata cells, and four open PDBs

Sustained REDO rose from **62 MB/s** OLTP baseline to 309 MB/s during direct-path APPEND stress; P95 was 568 MB/s with a brief 1.0 GB/s peak.

Transaction throughput remained resilient: **8.82k TPS** during APPEND stress (91.6% of baseline), with zero workload errors.

RAC hosts were **~67–71% busy**; REDO was unevenly distributed (~75% from one instance). **Cell CPU averaged about 4%** across three cells.

Sustained REDO rates used for planning comparison



APPEND-STRESS MEDIAN
306.4 MB/s

APPEND-STRESS P95
567.6 MB/s

APPEND HIGHEST ~30 S SAMPLE
1,002 MB/s

These values belong to the RFWorkload direct-path scan-data phase. Use the mean as a measured stress-window input; keep the median, p95, and single-sample peak as distribution and headroom evidence.



AutoUpgrade Distributed OFF

💡 Plan Mode

How the **6 hours** window
builds the
modeled SQL
Apply backlog

AutoUpgrade distributed

Off: 32 modeled PDB slots on the primary node - RAC node count does not change the baseline

PARTICIPATING RAC NODES

4 nodes

NUMBER OF PDBS

200

CPU_COUNT PER NODE

64

Off

200 PDBs use 32 active modeled upgrade slots (up to 32: 32 per active node from CPU_COUNT ÷ 2) across 7 waves. This is a planning simulation; validate configured -n/-N and duration in rehearsal.

**CDB
phase**
45 min

PDB phase

7 waves × 45 min = 315 min

INCOMING REDO

200 MB/s — Scaled 0

≈

PER MINUTE

12 GB/min

× 315 min =

MODELED BACKLOG

4.32 TB

Scaled OLTP scenario derived from the 62.4 MB/s baseline; validate the same workload mix in rehearsal.

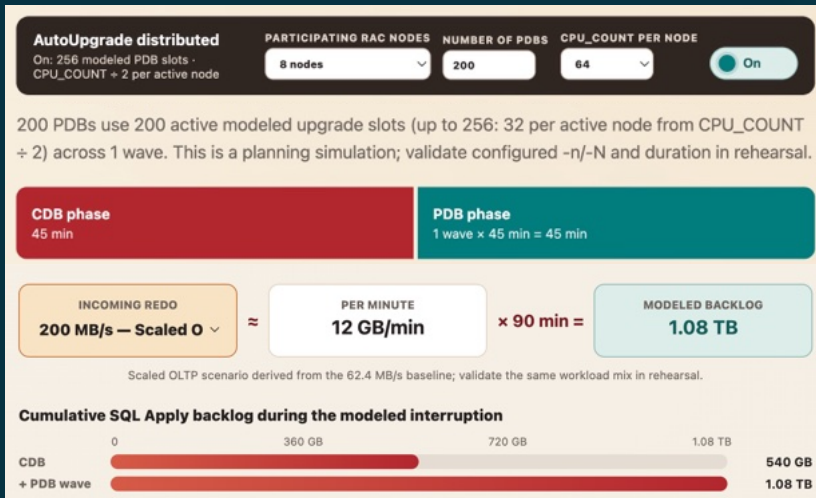
Cumulative SQL Apply backlog during the modeled interruption



AutoUpgrade Distributed ON

Plan Mode

How the **1 hour 30 minutes** window builds the modeled SQL Apply backlog



AutoUpgrade Distributed OFF

Incoming redo
continues while SQL
Apply catches up

Distributed off - 32 modeled slots on the primary node. Shorter bars are better; SQL Apply at or below incoming REDO never reaches switchover readiness.

$$\begin{array}{|c|c|c|c|c|} \hline \text{MODELED BACKLOG} & + & \text{SQL APPLY} & - & \text{INCOMING REDO / MIN} \\ \hline 4.32 \text{ TB} & + & A & - & 12 \text{ GB/min} \\ \hline & & & = & \text{CATCH-UP TIME} \\ & & & & \text{Backlog} \div (A - R) \\ \hline \end{array}$$

Scaled OLTP scenario derived from the 62.4 MB/s baseline; validate the same workload mix in rehearsal.

How to read this

Modeled backlog is the REDO accumulated while the future primary is upgrading. **SQL Apply – incoming REDO** is the capacity available to shrink it. For example, with 100 MB/s incoming REDO and 200 MB/s SQL Apply, net closure is 100 MB/s. SQL Apply must be greater than incoming REDO: an equal rate holds the backlog flat, and a lower rate makes it grow.

Illustrative catch-up time for 4.32 TB



AutoUpgrade Distributed ON

Incoming redo
continues while
SQL Apply
catches up

Distributed on • 8 RAC nodes • 256 modeled slots. Shorter bars are better; SQL Apply at or below incoming REDO never reaches switchover readiness.

$$\begin{array}{|c|c|c|c|c|} \hline \text{MODELED BACKLOG} & + & \text{SQL APPLY} & - & \text{INCOMING REDO / MIN} \\ \hline 1.08 \text{ TB} & & A & & 12 \text{ GB/min} \\ \hline & & & & = \\ \hline & & & & \text{CATCH-UP TIME} \\ & & & & \text{Backlog} \div (A - R) \\ \hline \end{array}$$

Scaled OLTP scenario derived from the 62.4 MB/s baseline; validate the same workload mix in rehearsal.

How to read this

Modeled backlog is the REDO accumulated while the future primary is upgrading. **SQL Apply – incoming REDO** is the capacity available to shrink it. For example, with 100 MB/s incoming REDO and 200 MB/s SQL Apply, net closure is 100 MB/s. SQL Apply must be greater than incoming REDO: an equal rate holds the backlog flat, and a lower rate makes it grow.

Illustrative catch-up time for 1.08 TB



AutoUpgrade Distributed upgrade cuts SQL Apply backlog by 75%

Planning simulation: 200 PDBs; incoming REDO 12 GB/min. Validate duration and configured parallelism in rehearsal.

Upgrade window

CDB work stays constant at 45 minutes. Distributed upgrade compresses the PDB phase from 7 waves to 1.

Distributed OFF

4 RAC nodes · 32 modeled slots · 7 PDB waves

6 hours

CDB 45m

PDBs 5h 15m

75% shorter

Distributed ON

8 nodes · 200 slots · 1 PDB wave

CDB 45m

PDBs 45m

1 hour 30 min

4 hr 30 min less upgrade exposure

SQL Apply backlog accumulated during the upgrade

The SQL Apply rate is unchanged; the smaller backlog comes entirely from the shorter upgrade interval.

Distributed OFF

75% less backlog

4.32 TB

Distributed ON

1.08 TB

3.24 TB less REDO to close after switchover

Illustrative model from the AI-CEC DBMS_ROLLING + AutoUpgrade deck. At 500 MB/s SQL Apply, catch-up falls from ~4 hours to ~60 minutes.

AutoUpgrade Distributed reduce upgrade exposure and SQL Apply

Planning simulation: 200 PDBs; incoming REDO 12 GB/min. Validate duration and configured parallelism in rehearsal.

Dimension	Distributed OFF	Distributed ON	Improvement
RAC capacity used for PDB upgrade	32 modeled slots; 7 PDB waves	200 active slots; 1 PDB wave	Eliminates 6 modeled PDB waves
Upgrade window	6 hours (45 min CDB + 315 min PDBs)	1 hr 30 min (45 min CDB + 45 min PDBs)	4 hr 30 min / 75% shorter
PDB-upgrade phase	315 min	45 min	270 min / 86% shorter
Incoming REDO (model)	12 GB/min (204.8 MB/sec)	12 GB/min (204.8 MB/sec)	Same workload pressure
SQL Apply backlog at switchover	4.32 TB	1.08 TB	3.24 TB / 75% less
Catch-up at 300 MB/s SQL Apply	~12 hours	~3 hours	~9 hours / 75% shorter
Catch-up at 500 MB/s SQL Apply	~4 hours	~60 min	~3 hours / 75% shorter
Catch-up at 750 MB/s SQL Apply	~2 hr 11 min	~32.7 min	~98 min / 75% shorter
Catch-up at 1,250 MB/s SQL Apply	~69 min	~17.1 min	~52 min / 75% shorter

Technical expertise. Real workloads. Validated outcomes.

A global engineering organization
that turns complex architecture
questions into measurable,
customer-ready evidence



Cross-domain technical expertise

Oracle and partner specialists collaborate across cloud, AI, data, applications, infrastructure, networking and security.



Customer workload validation

Real configurations and operating scenarios are exercised for performance, resilience, scalability, security and operational fit.



Connected centers, faster outcomes

Interconnected facilities, reusable test assets and remote collaboration accelerate workshops, proof points and customer decisions.

CONNECTED CENTERS & ENGINEERING ENVIRONMENTS

Physical and virtual environments designed for secure, collaborative validation.



Customer, Oracle and partner teams work as one — from design scenario to board-ready decision.

No Blind Spots: Proven Troubleshooting for Every Customer Scenario



Jul 26, 2026 4 min read Oracle AutoUpgrade Research

Oracle AutoUpgrade Distributed Upgrade: Parallel PDB Work, Clear Boundaries

A public-safe research guide to Oracle AutoUpgrade distributed upgrade for qualifying RAC CDBs, including its tuning decisions, outage boundary, and evidence model.

oracle-ai-database

oracle-autoupgrade

oracle-rac

multitenant

planned-maintenance

database-upgrade



Jul 23, 2026 5 min read Oracle AI Database 26ai - Reduced-downtime major upgrade

Upgrading Oracle Database 19c to 26ai with Reduced Downtime

A public, deployment-aware DBMS_ROLLING guide for a direct 19c CDB to Oracle AI Database 26ai upgrade, with Application Continuity, evidence gates, and a hard switchover boundary.

oracle-database

database-26ai

dbms-rolling

active-data-guard

application-continuity

autoupgrade



Aug 23, 2026 12 min read RedForge - Oracle AI Database - Governed AI Retrieval

RedForge Evidence Lakehouse: Approved Report Retrieval Through MCP

A private-first AI Research project for preserving approved RedForge reports as governed vector records in Autonomous AI Database Serverless and exposing them through a retrieval-only OCI MCP boundary.

redforge

autonomous-ai-database

lakehouse

ai-vector-search

mcp

aidp

chatgpt

governed-ai



Aug 12, 2026 26 min read RedRoot Digital Twin Research

RedRoot Digital Twin: Evidence-Bound Resilience Scenario Research

A Phase 0 research charter for an evidence-aware digital twin that estimates platform resilience scenarios, communicates uncertainty, and defines the next validation test.

digital-twin

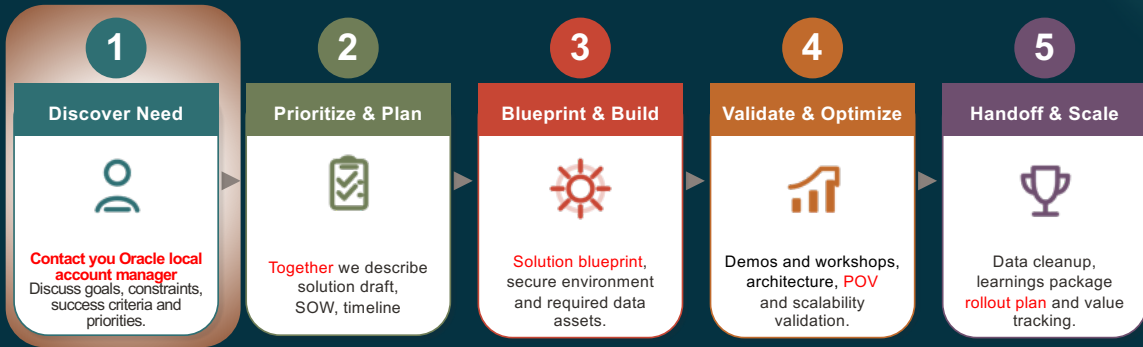
resilience-research

redforge-evidence

oracle-data-guard

scenario-modeling

How Do We Bring It To Life



Secure by Design

Security, data handling and compliance in every phase.



Fast Response

Regional prioritization, SLA and escalation path.



Customer Partnership

Customer teams and AI CEC act as one team.



Reusable Knowledge

Best practices, reference architectures and assets.

ORACLE

AI Customer
Excellence Center

Thank you

Sebastian Alasino

Master Principal Sales Consultant
Oracle AI Customer Excellence Center
www.linkedin.com/in/alasino



Autonomous AI Database Migrations

Made easy – a sneak preview

Flashback ...

KEYNOTE PRESENTATION

Oracle OpenWorld San Francisco 2017





Will the DBA's be fired?

<https://www.complexsql.com/oracle-18c-impact-on-dbas/>

Cloud Cyber Center (ICC)

tion of AI is transforming how software vulnerabilities are identified and fixed, increasing the speed and scale of remediation.

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.

to leading frontier AI models, including Anthropic's Claude Mythos Preview and OpenAI's most capable models through

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



No time for patching?

Overview



Migration to Autonomous AI Database is always a **logical** migration

- Move the data, not the database



How do we migrate our 500 databases to Oracle Autonomous AI Database?

- And which ones are **good candidates**?

Getting an Overview

1

Estate Explorer



2

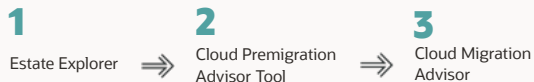
Cloud Premigration
Advisor Tool



3

Cloud Migration
Advisor

Getting an Overview



- Data Pump
- Database Migration Service
- Zero Downtime Migration
- Autonomous Migration Automation
- O2O / OOO
- GoldenGate

CPAT

Cloud PreMigration Advisor Tool



Evaluate an Oracle AI Database for **compatibility** with Oracle Autonomous AI Database

- Use Cloud Premigration Advisor Tool (CPAT)

Overview



Connects



Checks



Reports



Fixes

(optional)

Download CPAT from [KB139585](#)



Patch 32613591: Cloud Premigration Advisor Tool (CPAT) for version 11.2.0.4 and Higher

Last Updated 11-Feb-2025 17:31 (12 days ago)

Product Oracle Database Upgrade Assistant

Release Oracle 11.2.0.4.8

Platform Generic Platform

Size 8.6 MB

Download Access Software

Classification General

Patch Tag

Release Oracle 11.2.0.4.8

Platform Generic Platform

Language American English

Bugs Resolved by This Patch

List of bugs fixed is not available. Consult the Readme.

View Related Knowledge to this Patch

Read Me

Download



Add to Plan



Analyze with OPatch...

All-time Downloads **50**

[View Trends](#)



Discuss this patch in the community

One or more report formats separated by spaces

json html text

./premigration.sh \

--connectstring jdbc:oracle:thin:@<host>:<port>/<service> \

--username CPAT_CHECK \

--pdbname PDB_COMPLEX \

--schemas appuser,reportuser \

--outdir /home/oracle/cpat-db \

--targetcloud atps \

--migrationmethod goldengate \

--reportformat html



Too many options?

CPAT COMPOSER

<https://macsdata.com/oracle/cpat-composer>

- Free to use
- Available online
- Not an official Oracle tool
- Created by Marcus Doeringer
Migration Specialist @Oracle



CLOUD PREMIGRATION ADVISOR TOOL (CPAT) COMPOSER

Version: 25.2.0 (Default) ▾

Template: SA: Recommended Settings ▾

 Reset

 Search

 About

 Valid

Input Form

★ Recommended
🟢 Default

Operating System

Select the operating system to run CPAT



Linux

Use for Linux operating system



Windows

Use for Windows operating system

CPAT Mode

Select the mode you want to run CPAT



Source Analysis

Run CPAT on the source database for analysis



Target Properties

Generate a properties file from the target database

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Output



★ Set Recommended

👁 Use Placeholder

Status Info

All required options set

★ Recommended Options have been applied

Recommended Options

Analysis Mode: SCHEMA

File Prefix

🔍 Command

📄 Parameter File

Command Line

```
./premigration.sh --connectstring 'jdbc:oracle:thin:@myhost:1521:ORCL' --
username sys --targetcloud ATPS --migrationmethod DATAPUMP --reportformat HTML
JSON TEXT --full --zip
```


Cloud Premigration Advisor Tool (CPAT) Report

CPAT Version: 25.2.1-1

Version Date: Feb 17, 2025

Days Since Last CPAT Update: 38 days

Table of Contents

- [Premigration Advisor Report Summary](#)
- [Report Details](#)
- [Report Analysis Notes](#)
- [Source Database Details](#)
- [Source Database Version Information](#)
- [Source Database Patch Information](#)
- [Source Database Redo Information](#)
- [Source Database Supplemental Information](#)
- [Source Database Schema Summary Information](#)
- [Premigration Advisor Check Details List](#)
- [Report Legend](#)

Expand All

Close All

▼ Premigration Advisor Report Summary

Report Result

Action Required

Number of schemas analyzed:

4

List of schemas analyzed:

[ORCLUSER, CO, HR, MYAPP]

- [Premigration Advisor Check Details List](#)
- [Report Legend](#)

[Expand All](#)[Close All](#)

▼ Premigration Advisor Report Summary

Report Result

Action Required

Number of schemas analyzed:

4

List of schemas analyzed:

[PDBUSER, CO, HR, MYAPP]

▼ Report Results Overview

Source Database		Target Database		Migration Method		Additional Tasks	
Action Required	2	Action Required	10	Action Required	1	Action Required	0
Review Required	1	Review Required	7	Review Required	2	Review Required	0
Review Suggested	2	Review Suggested	4	Review Suggested	1	Review Suggested	4
Passed	16	Passed	17	Passed	4	Passed	16

[Return to Table of Contents](#)

▼ Report Details

▼ Report Details

CPAT
Application
Version:

25.2.1-1

Report
Generated On:

Sat Feb 22 20:59:44 UTC 2025

Analysis
Property File:

premigration_advisor_analysis.properties

Analysis Mode:

FULL

Target Cloud
Type:

ALL

Migration
Method(s):

[DATAPUMP, DATAPUMP_DBLINK, GOLDENGATE]

Command Line
Options:

--connectstring jdbc:oracle:thin:@dbssystemaz:1521/pdb_complex.sub07021512520.upgradeteam.oraclevcn.com --targetcloud ALL --username SYS --sysdba
--analysisprops premigration_advisor_analysis.properties --outdir /home/oracle/cpat_22_feb_2025 --logginglevel FINE --migrationmethod ALL --reportformat
JSON HTML TEXT --resultlevel R0 --zip --gatherdetails ALL

More Details

› Report Analysis Notes

[More Details](#)

[Return to Table of Contents](#)

› **Report Analysis Notes**

› **Source Database Details**

› **Source Database Version Information**

› **Source Database Patch Information**

› **Source Database Redo Information**

› **Source Database Supplemental Information**

› **Source Database Schema Summary Information**

▼ **Premigration Advisor Check Details List**

Source Database

Source Database Details

Source Cloud Vendor:	Oracle Cloud Infrastructure (Database)
Source Database Host Name:	dbssystemaz
Source Oracle SID:	ORCL
Source Database Created Date:	Fri Jan 24 22:23:51 UTC 2025
Source Database DBID:	1719058167
Source Database Unique Name:	ORCL_5tr_iad
Source Instance Name:	ORCL
Source Database Name:	ORCL
Source Database Username:	SYS
Source Database Port String:	x86_64/Linux 2.4.xx
Source Database Platform ID:	13
Source Database Container Name:	PDB_COMPLEX
Source DB Block Size in KB:	8
Source DB Combined Size of DATA, TEMP, LOG, and CONTROL File Usage in GB:	5.044
Source DB Size of DATA File Usage in GB:	1.856
Source DB Size of TEMP File Usage in GB:	0.17

[More Details](#)

[Return to Table of Contents](#)

› **Report Analysis Notes**

› **Source Database Details**

› **Source Database Version Information**

› **Source Database Patch Information**

› **Source Database Redo Information**

› **Source Database Supplemental Information**

› **Source Database Schema Summary Information**

▼ **Premigration Advisor Check Details List**

Source Database

✓ **Action Required (2 checks)**

✓ **OGG Minimal Supplemental Logging Not Enabled**

Description: Minimal supplemental logging is not enabled on the Database.

Action: Make sure minimal supplemental logging data is enabled by using executing the SQL command ALTER DATABASE ADD SUPPLEMENTAL LOG DATA; This command can be done while the database is online and no restart is required.

More Details

> **Relevant Objects (1 relevant object)**

✓ **OGG Replication Not Enabled**

Description: ENABLE_GOLDENGATE_REPLICATION init.ora parameter is not set.

Action: Make sure ENABLE_GOLDENGATE_REPLICATION is set to TRUE by using executing the SQL command: ALTER SYSTEM SET ENABLE_GOLDENGATE_REPLICATION=TRUE SCOPE=BOTH; This command can be done while the database is online and no restart is required.

More Details

> **Relevant Objects (1 relevant object)**





The documentation has additional information on each CPAT check

[Utilities Guide, Oracle AI Database 26ai](#)

Episode 23

[Migration to Oracle Autonomous Database – Phase 2: Preparation](#)

92 min – May 22, 2025





--Generates fixup scripts whenever possible
--Stores the scripts on disk for review

./premigration.sh ... --genfixups



You can run CPAT in any live database.
It is completely **non-intrusive**.

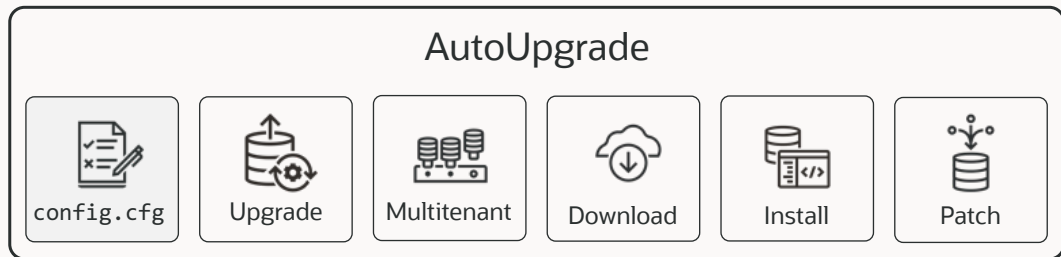
ADB Migration



Migrations to ADB are a little bit like directing a movie

- You need a script
- You need actors
- You need staging
- You need catering (and beer)
- You need to edit your movie ...

End-to-end automation



Why shouldn't AutoUpgrade also migrate databases?

AutoUpgrade



config.cfg



Upgrade



Multitenant



Download



Install



Patch

CPAT



AMA



Let's combine these tools together, and create

AutoMigrate

AutoMigrate



config.cfg



Upgrade



Multitenant



Download



Install



Patch

CPAT



AMA

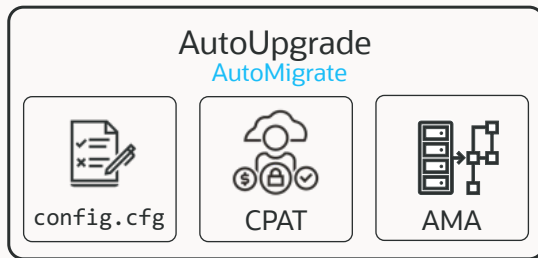




Every Oracle DBA should be able to migrate a database into ADB - anytime

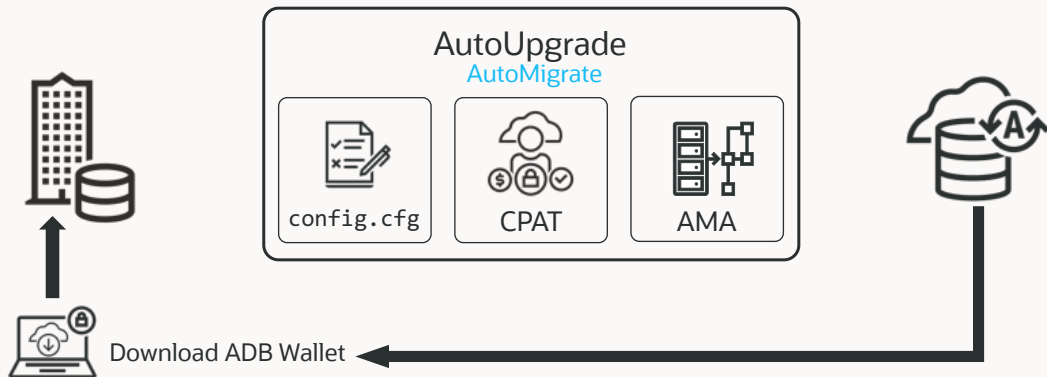
Let's demo it

Unzip AutoMigrate





Download ADB Wallet



[← Autonomous AI Databases](#)

MIKE_TEST_ADBD

Autonomous AI Database

Available

Primary

Database actions ▾

Database connection

Performance Hub

More actions ▾

Autonomous AI Database information

Tool configuration

Backups

Key history

Disaster recovery

Refreshable clones

Security

Monitoring

Work requ >

General information

Database name	AUTOMIG
Workload type	Transaction Processing
Compartment	oradbclouducm (root)/UpgradeTeam
OCID	...smzftiro44xzbnrxma
Created	Aug 7, 2026, 11:24:4...
License type	Bring your own license (BYOL), Enterprise Edition

Copy

Disaster recovery

Disaster recovery protects your database instance by providing peer databases in a different availability domain or region. [Learn more](#)

Role	Primary
Local	Backup-based
Cross-region	Not enabled
Full Stack DR	Configure

Enable

The list of DR protection groups that have this database as a member. This list may be incomplete due to insufficient policy permissions to access.

Backup



← Autonomous AI Databases

MIKE_TEST_ADB

Autonomous AI Database

Autonomous AI Database information

General information

Database name

Workload type

Compartment

OCID

Created

License type

Database version

Database connection

Autonomous AI Database is preconfigured to support Oracle Net Services (a TNS listener is installed and configured to use secure TCPS). [Learn more](#)

Warning

Connections to your Autonomous AI Database are secured, and can be authorized using TLS or mTLS authentication options. TLS authentication is easier to use, provides better connection latency, and does not require you to download client credentials (wallet) if any of these is true for your connections:

You are using JDBC Thin Client (version 12.2.0.1 or higher) with JDK 8(u163+) or higher.

You are using the Python python-oracledb driver.

You are using ODP.NET version 19.14 (or higher), or 21.5 (or higher).

You are using an Oracle Call Interface based driver with Oracle Client libraries version 19.14 (or higher), or 21.5 (or higher).

[Learn more](#) about TLS authentication and how to enable it.

Download client credentials (Wallet)

To download your client credentials, select the wallet type, and click **Download wallet**. You then enter a password for the wallet. This client credential download only contains information for mTLS connections.

You do not need a wallet for TLS connections.

Wallet type
Instance wallet

Download wallet

Rotate wallet

Wallet last rotated: -

Cancel



← Autonomous AI Databases

MIKE_TEST_ADB

Autonomous AI Database

Autonomous AI Database information

General information

Database name

Workload type

Compartment

OCID

Created

License type

Database version

Download wallet

Autonomous AI Database is preconfigured to support Oracle Net Services (a TNS listener is installed and configured to use secure TCP/S). [Learn more](#)

Warning

Connections to use, provide
You are using
You are using
You are using
[Learn more](#)

Please create a password
clients will auto-load

Password

.....

Confirm password

.....

cloud.oracle.com wants to save

Save As: Wallet_AUTOMIG.zip

Tags:



KEY



Search

Name

Date Modified



> ama_regression_tests

Today at 17:06



AUTOMIGRATE.zip

Today at 17:04



> oracle_load_kit

Today at 11:32



Wallet_AUTOMIG.zip

7. Aug 2026 at 13:30



ssh-key-2026-07-24.key.pub

24. Jul 2026 at 12:17



ssh-key-2026-07-24.key

24. Jul 2026 at 12:17

New Folder

Cancel

Save

tion options. TLS authentication is easier
of these is true for your connections:

or higher).

ord to connect to your database (other

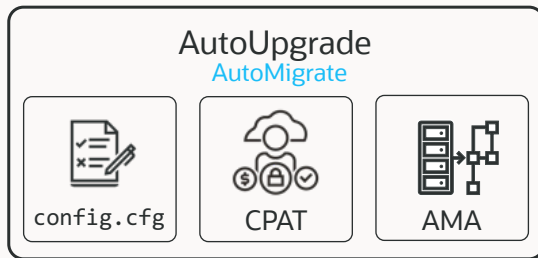


Cancel

Download



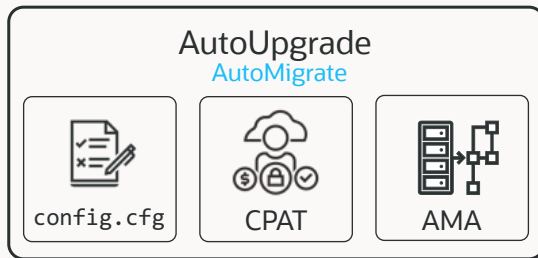
Create ADMIN user



[UPGR:oracle@holserv1:~/AUTOMIGRATE]\$

1

Bucket



Prepare Bucket



Storage

Object Storage & Archive
Storage

Buckets

Private Endpoints



Search and Filter



Search

Applied filters

Compartment UpgradeTeam

HOL

Standard

Private

Feb 8, 2023, 20:17 UTC



LiveLabs-Install

Standard

Private

May 28, 2024, 14:50 UTC



MIKEADBTEST

Standard

Private

Aug 21, 2026, 10:14 UTC



O2O_MIG

Standard

Private

Aug

open-bucket

Standard

Public

Aug

oracle-jet

Standard

Public

Oct

Oracle9iVB

Standard

Private

Aug

TestAZB

Standard

Private

Jan

TestAZDEV

Standard

Private

Jan

TTSDemo_BACKUP

Standard

Private

Apr

TTSDemo_METADATA

Standard

Private

Apr



View bucket details

Create pre-authenticated request

Move resource

Edit visibility

Edit bucket scope

Manage tags

Delete



Create pre-authenticated request

Name

MIKEBUCKETPREAUTH

Pre-authenticated request target

Bucket

Create a pre-authenticated request that applies to all objects in the bucket.

Object

Create a pre-authenticated request that applies to a specific object.

Objects with prefix

Create a pre-authenticated request that applies to all objects with a specific prefix.

Access type

☐ Permit object reads☐ Permit object writes☒ Permit object reads and writes

Enable object listing



Let users list objects with the specified prefix.

Expiration
8/23/2030



Expiration
18:30

UTC

Cancel

Create pre-authenticated request



Create pre-auth

Pre-authenticated request details

Name
MIKEBUCKETPREAUTH

Pre-authenticated request target

Bucket

Create a pre-authenticated request for objects in the bucket.

Access type

- ☐ Permit object reads
- ☐ Permit object writes
- ☒ Permit object reads and writes

Enable object listing



Let users list objects with the specified permissions

Expiration
8/23/2030

Warning

Copy **Pre-authenticated request URL** for your records. It will not be shown again.

Warning

We recommend you use dedicated endpoints with the below URL, however, your current URL is still supported. [Learn more about dedicated endpoints](#)

`https://oradbclouducm.objectstorage.eu-frankfurt-1.oci.customer-oci.com/p/gQ6exQ5H-QkRjVjQuaCXqrPhpuvkiVAL5XZcC5rOjplSj5LHZb5KlghQxwGJCHCI/n/oradbclouducm/b/MIKEADBTST/o/`

Name

MIKEBUCKETPREAUTH

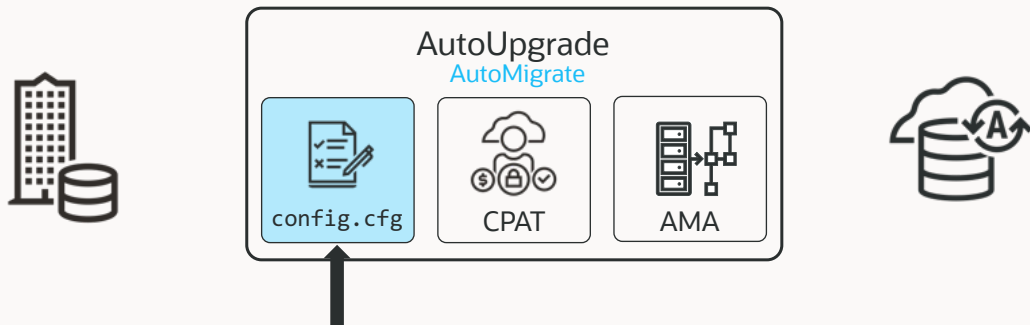
Pre-authenticated request URL

`https://objectstorage.eu-frankfurt-1.oraclecloud.com/p/gQ6exQ5H-QkRjVjQuaCXqrPhpuvkiVAL5XZcC5rOjplSj5L...`

Copy

Close

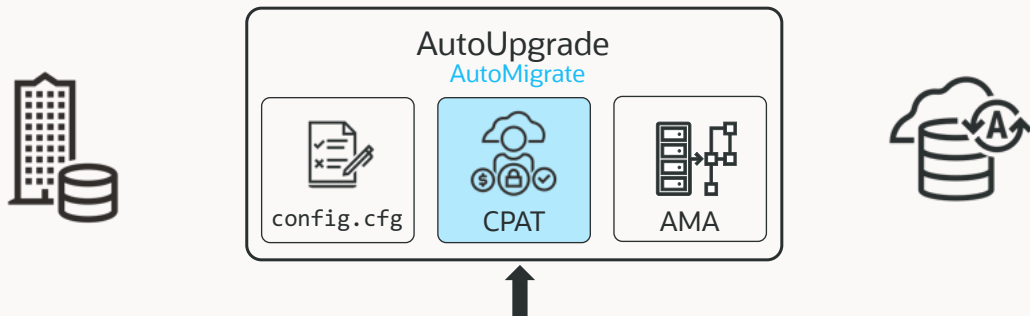
Config File



Edit config.cfg interactively with:
`generate_automigrate_config.sql`

[UPGR:oracle@hol1serv1:~/AUTOMIGRATE]\$

Load Passwords



Load passwords into CPAT keystore (SEPS)

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

```
[UPGR:oracle@holserv1:~/AUTOMIGRATE]$
```

```
=====
```

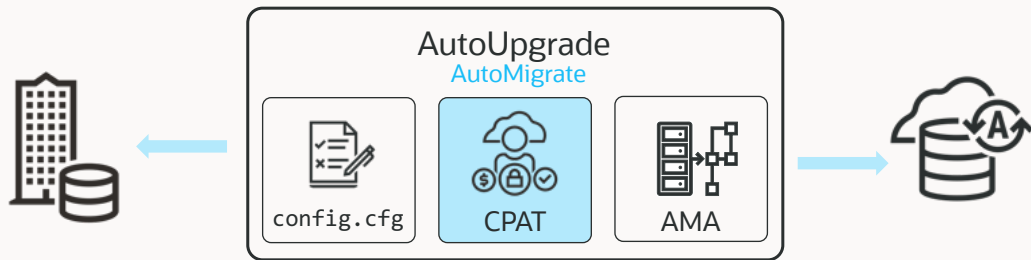
Next, create the CPAT keystore that holds the migration passwords.

Run step 1 and enter the requested passwords. At the CPAT keystore prompt, execute steps 2 through 5:

1. `/home/oracle/AUTOMIGRATE/CPAT/premigration.sh -parfile /home/oracle/AUTOMIGRATE/CONFIG/automigrate_config_upgr.cfg --loadpassword`
2. `add upgr -user ADMIN -nocheck`
3. `add upgr -user ama_curl_token -nocheck` (use ANONYMOUS as the token for this PAR URL)
4. Optional (Enterprise Edition with encryption license): `add upgr -user ama_dp_enc -nocheck`
5. Type exit to save the keystore and create its auto-login keystore.

```
=====
```

Checks





What is in **my** database?



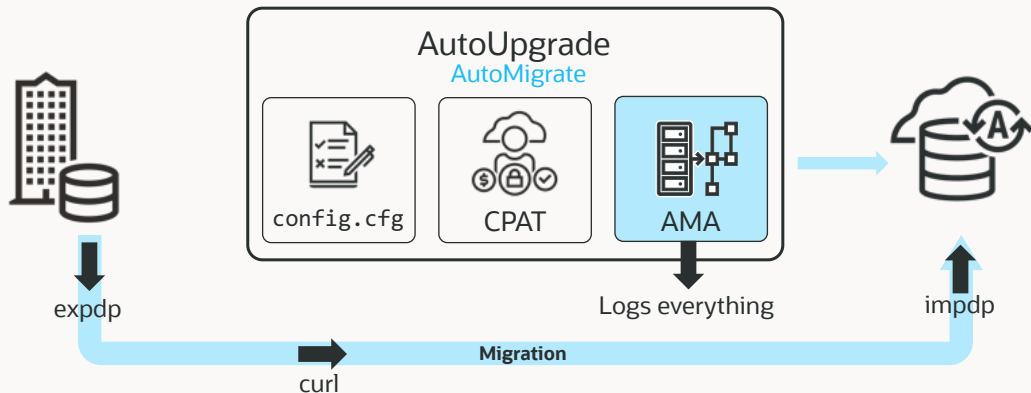
USERNAME	TOTAL_SPACE_GB	LOB_SPACE_GB
ADMIN	0,0	0,0
DEMO	22,9	21,7
TPCC	0,3	0,0



OBJECT_TYPE	OBJECT_COUNT
TABLE	5
INDEX	9
CONSTRAINT	57
FUNCTION	1
INDEX PARTITION	19
INDEX SUBPARTITION	112
LOB	1
LOB PARTITION	5
LOB SUBPARTITION	20
TABLE PARTITION	18
TABLE SUBPARTITION	112



Migration



[UPGR:oracle@holserv1:~/AUTOMIGRATE]\$

=====
6. Start the AutoMigrate deployment:

java -jar autoupgrade.jar -config CONFIG/automigrate_config_upgr.cfg -migrate -mode deploy -noconsole

=====

=====

Autoupgrade Summary Report

=====

[Date] Wed Sep 02 21:38:47 GMT 2026

[Number of Jobs] 1

=====

[Job ID] 100

=====

[DB Name] N/A

[Version Before Upgrade] N/A

[Version After Upgrade] N/A

[Stage Name] CPATANALYZE

[Status] SUCCESS

[Start Time] 2026-09-02 21:15:48

[Duration] 0:00:20



[Stage Name]	CPATFIXUPS
[Status]	SUCCESS
[Start Time]	2026-09-02 21:16:08
[Duration]	0:00:12

[Stage Name]	AMA
[Status]	SUCCESS
[Start Time]	2026-09-02 21:16:21
[Duration]	0:22:25



[Stage Name]	CPATFIXUPS
[Status]	SUCCESS
[Start Time]	2026-09-02 21:16:08
[Duration]	0:00:12

[Stage Name]	AMA
[Status]	SUCCESS
[Start Time]	2026-09-02 21:16:21
[Duration]	0:22:25

[← Buckets](#)**MIKEADBTEST**

Bucket

Actions ▾

[Details](#) **[Objects](#)** [Management](#) [Monitoring](#) [Policies](#) [Work requests](#) [Tags](#)

Objects

Q Search object by name or prefix

Upload objects

Actions ▾

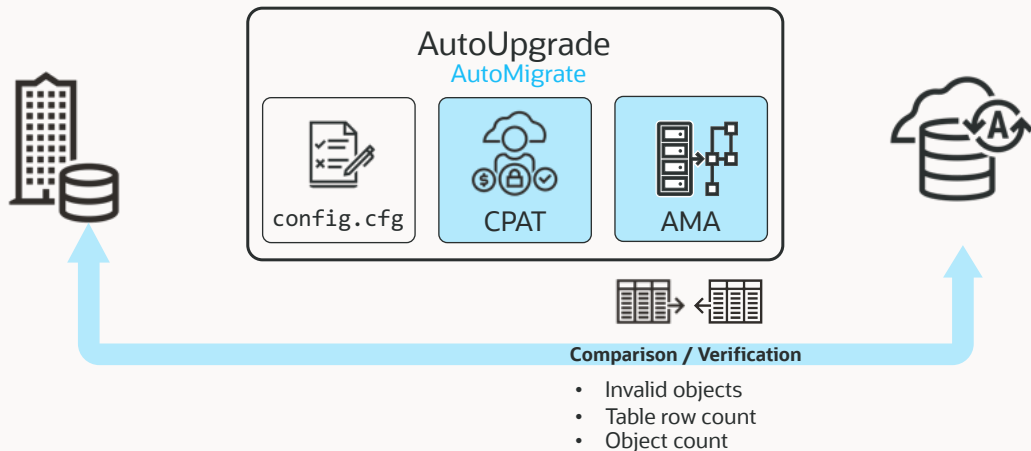
☐	Name/Prefix	Last modified	Size	Storage tier
☐	00012_upgr_EXPDP_OSS_FSS_CHECK_260902_211622_DMP	Sep 2, 2026, 21:17 UTC	18 bytes	Standard
☐	00013_upgr_EXPDP_ROLE_260902_211622_01.DMP	Sep 2, 2026, 21:17 UTC	472 KiB	Standard
☐	00014_upgr_EXPDP_PROFILE_260902_211622_01.DMP	Sep 2, 2026, 21:17 UTC	472 KiB	Standard
☐	00015_upgr_EXPDP_USR_DEF_260902_211622_01.DMP	Sep 2, 2026, 21:18 UTC	268 KiB	Standard
☐	00017_upgr_EXPDP_FUNCTION_260902_211622_01.DMP	Sep 2, 2026, 21:18 UTC	276 KiB	Standard
☐	00018_upgr_EXPDP_SCHEMA_DEMO_260902_211622_01.DMP	Sep 2, 2026, 21:23 UTC	1.84 GiB	Standard
☐	00018_upgr_EXPDP_SCHEMA_DEMO_260902_211622_02.DMP	Sep 2, 2026, 21:24 UTC	2.46 GiB	Standard
☐	00018_upgr_EXPDP_SCHEMA_DEMO_260902_211622_03.DMP	Sep 2, 2026, 21:24 UTC	1.84 GiB	Standard
☐	00018_upgr_EXPDP_SCHEMA_DEMO_260902_211622_04.DMP	Sep 2, 2026, 21:24 UTC	1.84 GiB	Standard
☐	00018_upgr_EXPDP_SCHEMA_DEMO_260902_211622_05.DMP	Sep 2, 2026, 21:25 UTC	1.9 GiB	Standard
☐	00019_upgr_EXPDP_SCHEMA_TPCC_260902_211622_01.DMP	Sep 2, 2026, 21:20 UTC	204.86 MiB	Standard



23 GB migration to ADB-S in 23 minutes

- Fixups
- **expdp**
- File copy to object storage
- **impdp**
- Comparison and reporting

Logging, Comparison and Reporting



/home/oracle/AUTOMIGRATE/LOGS

```
|— cfgtoollogs
|   |— upgrade
|       |— auto
|— cmd
|   |— console.lock
|— UPGR
|   |— 100
|       |— autoupgrade_20260902.log
|       |— autoupgrade_20260902_user.log
|       |— autoupgrade_err.log
|       |— migrate_analyze
|       |— migrate_data
|       |— migrate_fixups
|— cpat_cli_mode_premigration_advisor.log
|— temp
```

AutoMigrate Comparison Report

CPAT Version: 26.5.0

CPAT Build Date: Aug 13, 2026

Table of Contents

- [AMA Comparisons](#)
- [Directories](#)
- [Database Links](#)
- [External Tables for Serverless](#)

Expand All

Close All

Automigrate Report Summary

Review the migration health at a glance, then select a card to open its detailed comparison.

AMA Comparisons

Migration Successful

No AMA differences require review.

AMA Comparisons compare source and target objects to identify migration differences, then select a card to open its detailed comparison.

INVALID OBJECTS

No differences found
Successful

OBJECT COUNTS

No differences found
Successful

ROW COUNTS

No differences found
Successful

Objects which cannot be migrated to a serverless target

Review suggested

6 objects require review.

Review those migration objects that currently cannot be migrated into ADB-S, then select a card to open its detailed relevant objects list.

DIRECTORIES

6 Relevant Objects
Review Suggested

DATABASE LINKS

No differences found
Successful

EXTERNAL TABLES FOR SERVERLESS

No differences found
Successful

Automigrate Report Summary

Review the migration health at a glance, then select a card to open its detailed comparison.

AMA Comparisons

Migration Successful

No AMA differences require review.

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DIRECTORIES

6 Relevant Objects
Review Suggested

DATABASE LINKS

No differences found
Successful

EXTERNAL TABLES FOR SERVERLESS

No differences found
Successful

▼ AMA Comparisons

▼ Invalid Objects

🔍 Search...

> Source Relevant Objects

> Target Relevant Objects

▼ Difference View

0 rows across 0 pages.

No differences detected. All compared data matches successfully.

[Return to Table of Contents](#)

▼ Object Counts

> Source Relevant Objects

> Target Relevant Objects

▼ Difference View

0 rows across 0 pages.

No differences detected. All compared data matches successfully.

[Return to Table of Contents](#)

▼ Row Counts

> Source Relevant Objects

> Target Relevant Objects

▼ Difference View

0 rows across 0 pages.

No differences detected. All compared data matches successfully.

[Return to Table of Contents](#)

▼ Directories

▼ Review Suggested (6 relevant objects)

Description

Directory objects with an absolute path will be converted to a relative path and appended to the target's PATH_PREFIX

Action

Review and change any references to hardcoded directory paths, as absolute paths will be converted to relative paths.
As an example, if /mypath/mysubdirectory exists as a directory, and the PATH_PREFIX at target is /u01/oracle/db, then the resulting migrated directory will be: /u01/oracle/db/mypath/mysubdirectory

Failure Impact

Directories in the target database may not be created in the expected place and applications may need modifications if paths are hardcoded.

▼ Relevant Objects

Owner	Directory Name	Directory Path
SYS	DBMS_OPTIM_ADMINDIR	/u01/app/oracle/product/19/rdbms/admin
SYS	DBMS_OPTIM_LOGDIR	/u01/app/oracle/product/19/cfgtoollogs
SYS	ORACLE_OCM_CONFIG_DIR	/u01/app/oracle/product/19/ccr/state
SYS	ORACLE_OCM_CONFIG_DIR2	/u01/app/oracle/product/19/ccr/state
SYS	XMLDIR	/u01/app/oracle/product/19/rdbms/xml
SYS	XSDDIR	/u01/app/oracle/product/19/rdbms/xml/schema

Recap



- 1** You need AutoMigrate? [Mail us ...](#)
- 2** ADB instance, bucket and passwords
- 3** Let it do the migration for you

DBA vs. AI

Harvard Business Review

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

Karim Lakhani



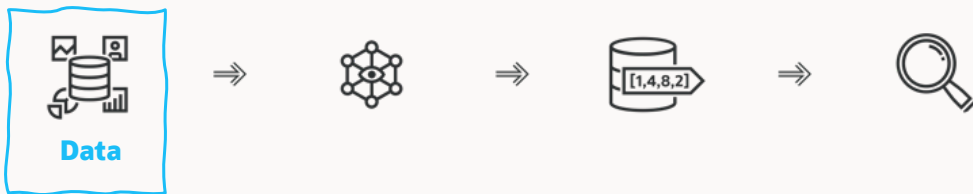


AI Database



Using AI

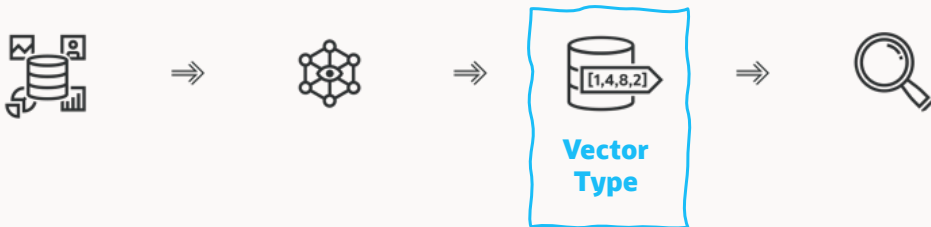
Vector Database



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

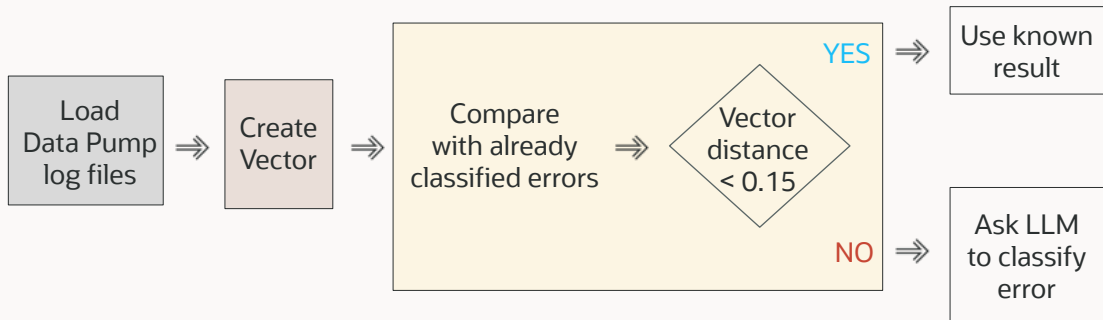
Table with VECTOR column and VECTOR index

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)

Oracle Error Severity Report

Status: WARN

Generated: 2026-05-06 13:10:53.042732000 +00:00

Files: 151

Errors: 37413

Critical: 0

Medium: 18087

Low: 19326

Unclassified: 0

AI: 12226

Exact: 0

Vector: 25187

Critical 0 Medium 18087 Low 19326 Unclassified 0



AI 12226 Exact 0 Vector 25187



Scope: all errors

Example report from test migration with Fusion Apps (FA)

IMPDP (125 file(s))				
critical	0	medium	5	low 13126 errors 13131
00018_PDB1_IMPDP_SCHEMA_FUSION_260430_202439.log critical 0 medium 3 low 12357 errors 12360				
00034_PDB1_IMPDP_SCHEMA_AZ_MIG_260430_202439.log critical 0 medium 2 low 2 errors 4				
00022_PDB1_IMPDP_SCHEMA_FUSION_GRC_260430_202439.log critical 0 medium 0 low 323 errors 323				
00030_PDB1_IMPDP_SCHEMA_FUSION_SETUP_260430_202439.log critical 0 medium 0 low 208 errors 208				



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:"FU SION_GRC"."G RC_ACCESS_TY PE_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:"FU SION_GRC"."G RC_ACCESS_TY PE_TL=" already exists



What would help you?



Quick Demo

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

EXTENSIONS

Search Extensions in Marketplace

INSTALLED



Cline

Autonomous coding agent right in your IDE, capable of crea...

Cline

504ms



GitHub Copilot Chat

AI chat features powered by Copilot

GitHub

404ms



Oracle Code Assist

Oracle Code Assist

Oracle



Oracle SQL Developer Extension for VSCode

End-to-end development tools for your SQL and PL/SQL ap...

Oracle Corporation

91ms



GitHub Copilot

Your AI pair programmer

GitHub

RECOMMENDED



SQLTools

Connecting users to many of the most commonly used data...

Matheus Teixeira

6M

3.5

Install



Vim

Vim emulation for Visual Studio Code

vscodevim

8.3M

4

Install

MCP SERVERS



MCP Servers

Browse and install [Model Context Protocol \(MCP\)](#)

Untitled-1 X

1 Generate code (=I), or select a language (N 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

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!!

BREAK

We start again at 15:15

Performance and Migrations

What's the Worst That Can Happen?







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



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

- [Introduction](#)
- [Oracle AI Database Offerings](#)
- [Permitted Features, Options, and Management Packs by Oracle AI Database Offering](#)
- [Oracle AI Database Options and Their Permitted Features](#)
- [Oracle Management Packs and Their Permitted Features](#)
- [Checking for Feature, Option, and Management Pack Usage](#)
- [Special License Rights](#)
- [Restricted Use Licenses](#)

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 well 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

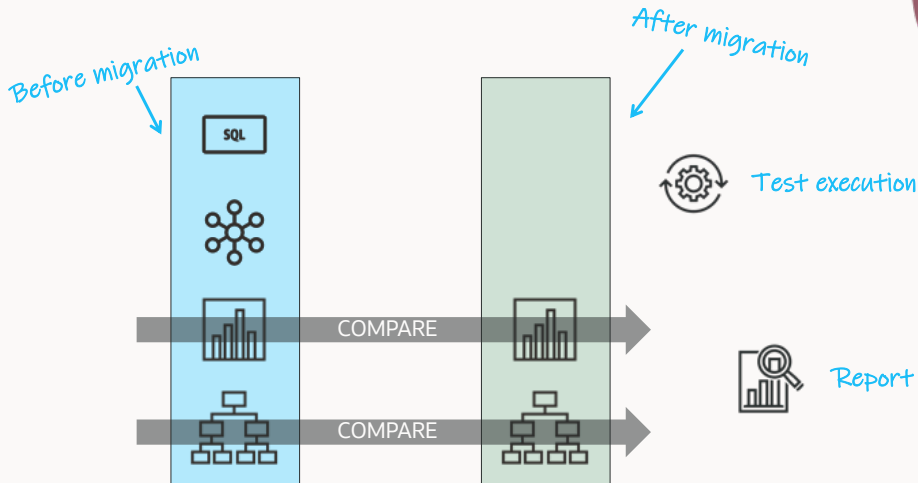
3

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
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
60	4hbzjyh4p336s	.21%	2818	668.862668559262	10	98.5%	n
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:

Object ID : 47
Schema Name : TPCC
Container Name : Unknown (con_dbid: 344460545)
SQL ID : 0cwuxyv314wcg
Execution Frequency : 18254
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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%

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



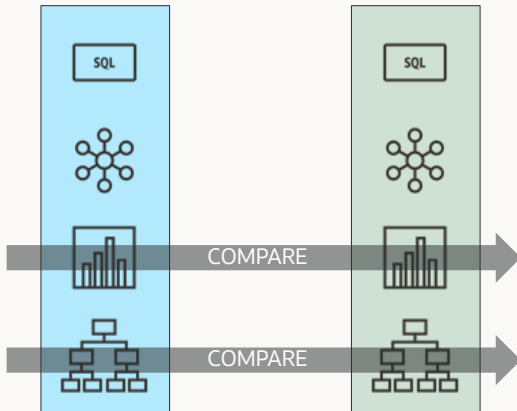
You could also ask ChatGPT



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

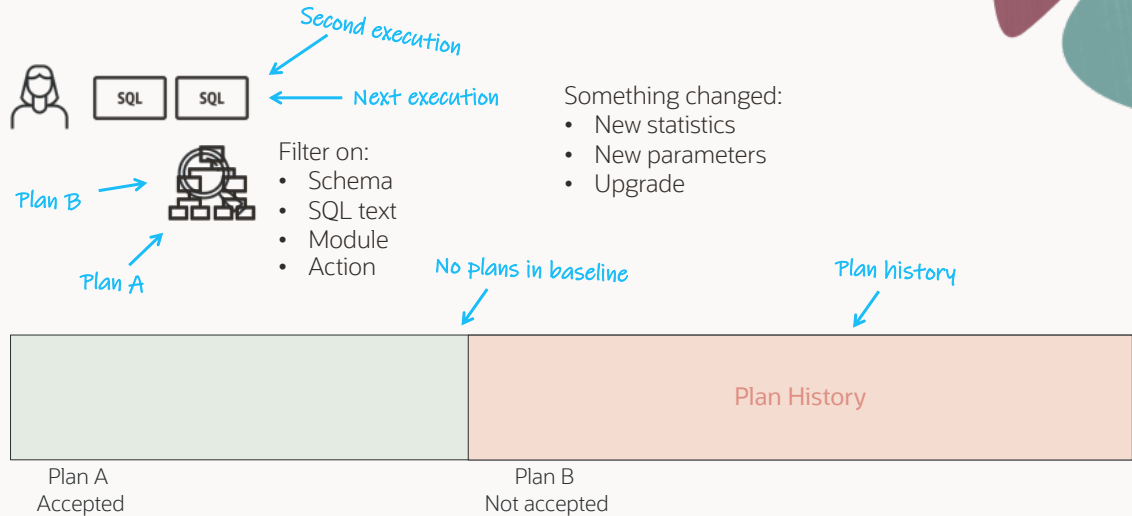


SQL Plan Management is the best tool
to ensure plan stability

-- 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



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

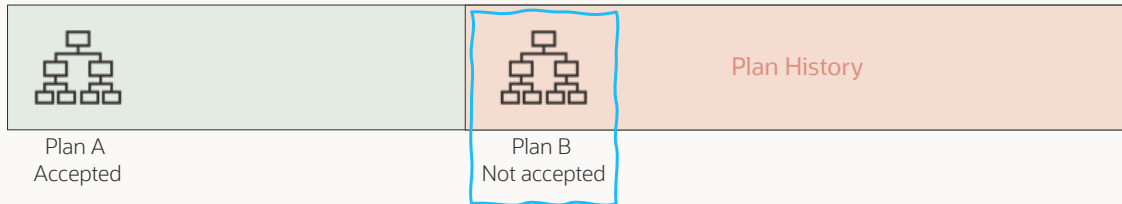
```
alter system set optimizer_use_sql_plan_baselines=true;
```

SQL Plan Management

SQL

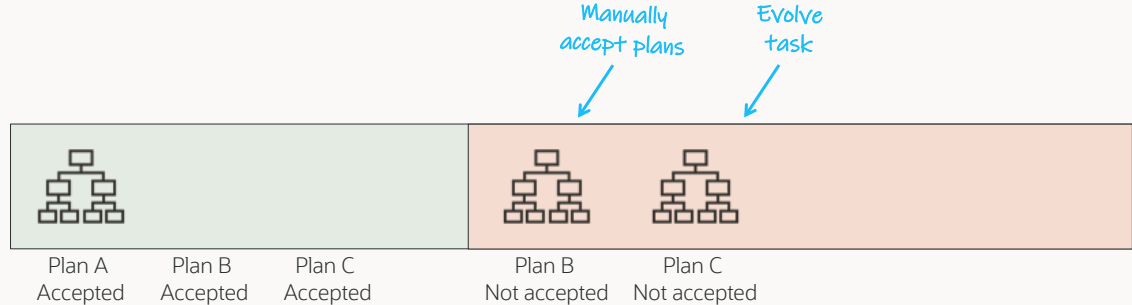
Optimizer chooses one
of the accepted plans

Optimizer
discards plan B



SQL Plan Management

SQL



-- 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;
```


SQL

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

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FIX

4

REMEDY

A Word About Statistics



PHYSICAL



LOGICAL



PHYSICAL



LOGICAL

Statistics



Object Statistics

Statistics Preferences

Column Usage Information

Statistics



Object 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.



```
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

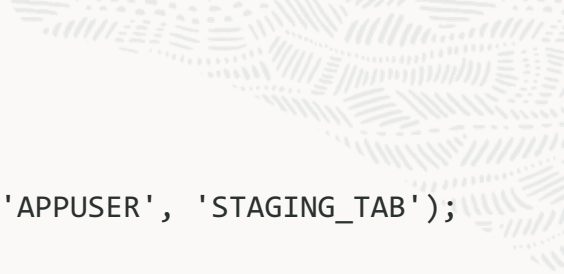
Include statistics in Data Pump

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...

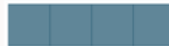
When source and target database do not match

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 in production



[Access lab on Oracle Live Labs](#)

Key Learnings



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

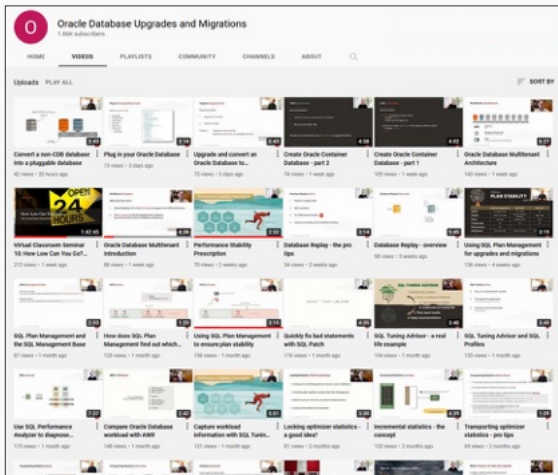
Oracle

DBAs

run the world



YouTube Channel



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

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



ORACLE