

26 Ways to Upgrade to Oracle AI Database 26ai

EMEA Tour, nlOUG, November 2026

Photo by Ishan @seefromthesky on Unsplash



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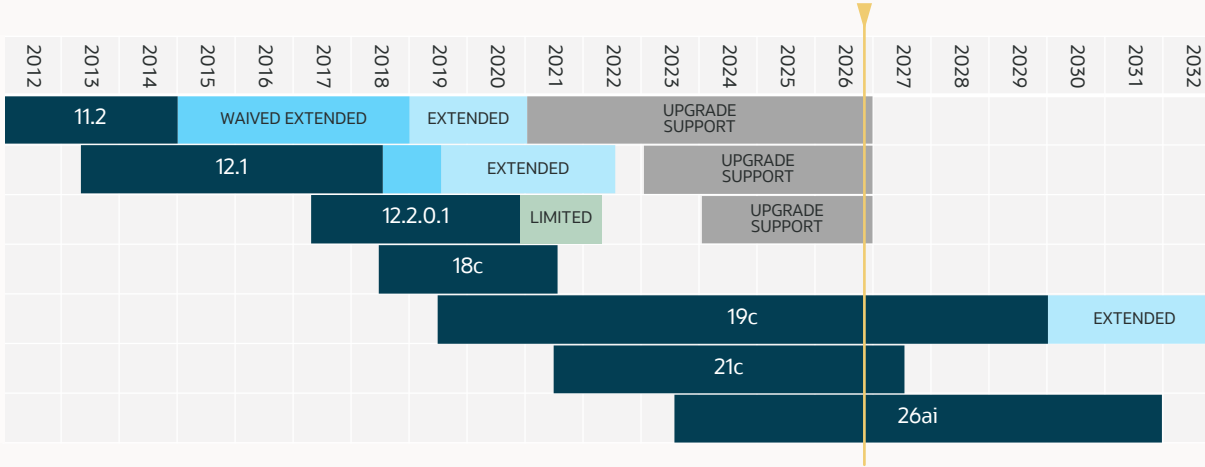
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Episode 18 Cross Platform Migration – Transportable Tablespaces to the Extreme *145 min – February 22, 2024*	
Episode 19 Move to Oracle Database 23ai – Everything you need to know about Multitenant PART 1 *145 min – May 16, 2024*	
Episode 20 Move to Oracle Database 23ai – Everything you need to know about Multitenant PART 2 *100 min – June 28, 2024*	

Recorded Web Seminars

https://MikeDietrichDE.com/videos

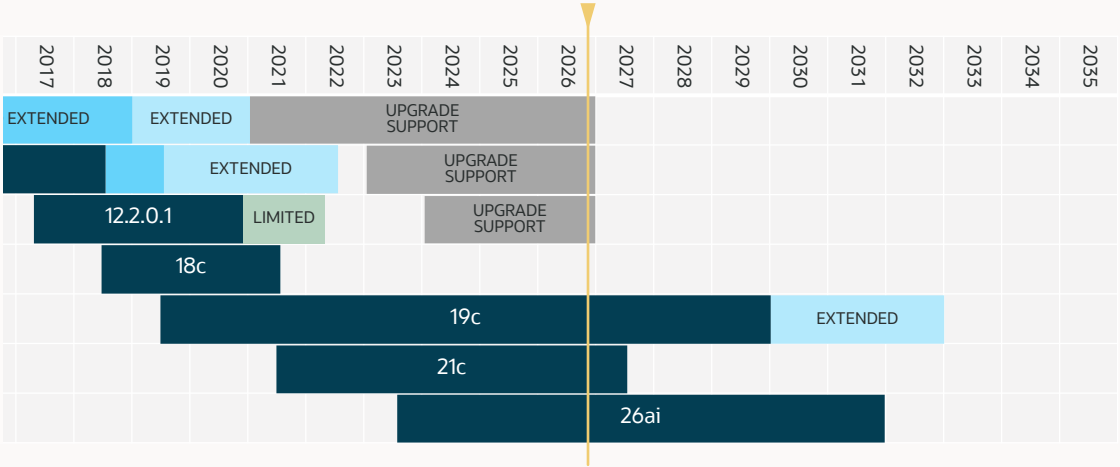
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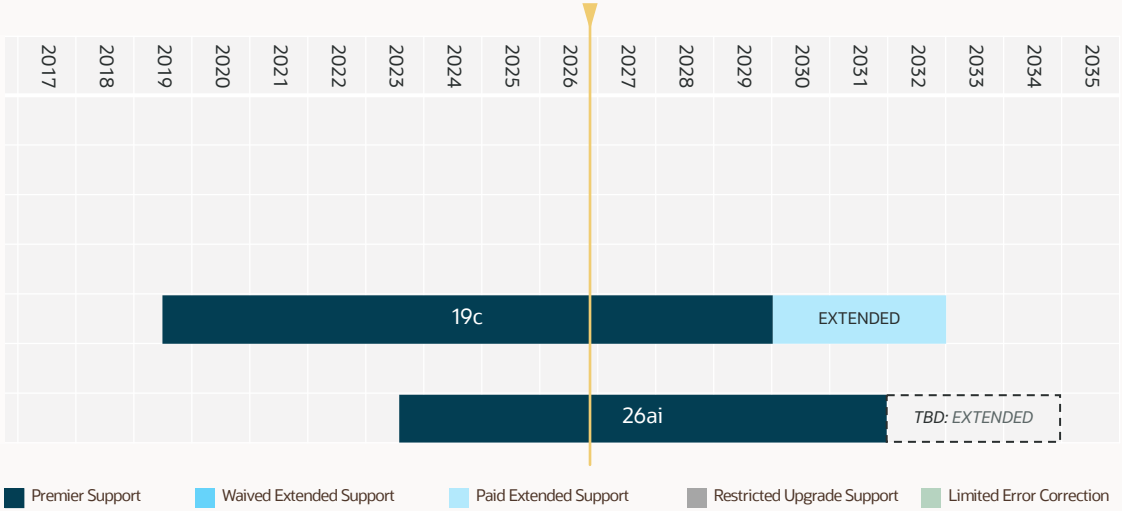
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Lifetime Support Policy



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Lifetime Support Policy



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It is urgent that you upgrade to a Long-Term Support Release

- Oracle Database 19c
- Oracle AI Database 26ai

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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

Security Updates

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April 29, 2026 | 3 [illegible] read

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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

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It starts with an Oracle home

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DEMO

Download patches
Install Oracle home
Create gold image

Watch on YouTube

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Further Information

Download patches



- Webinar: Database Patching for DBAs – Patch smarter, not harder
- Blog post series: AutoUpgrade Patching – From Zero to Hero – Part 1: Download AutoUpgrade
- Blog post: The easiest way to download 19.27 Release Update

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… and a container database

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Create Container Database



1 Character set

2 Components

3 `COMPATIBLE`

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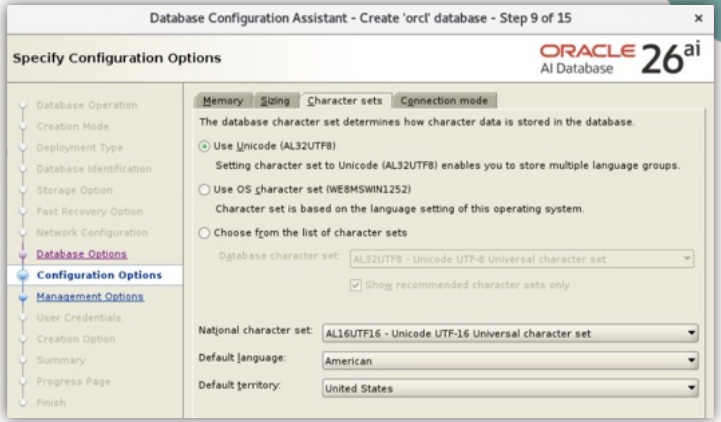
Create Container Database

1 Character set

- Always choose AL32UTF8
- Allows PDBs with any character set

2 Components

3 COMPATIBLE



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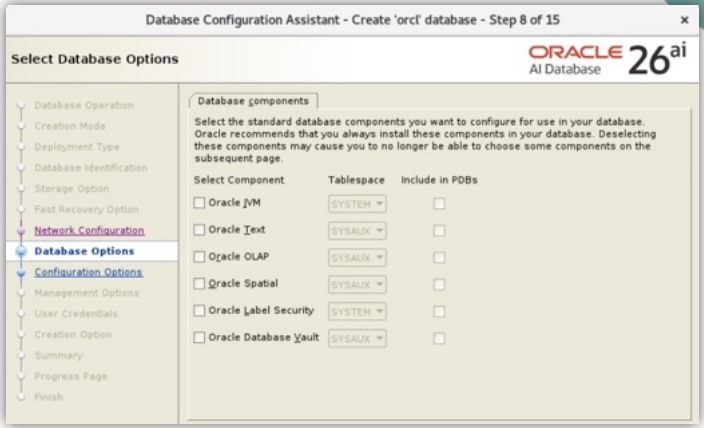
Create Container Database

1 Character set

2 Components

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

3 COMPATIBLE

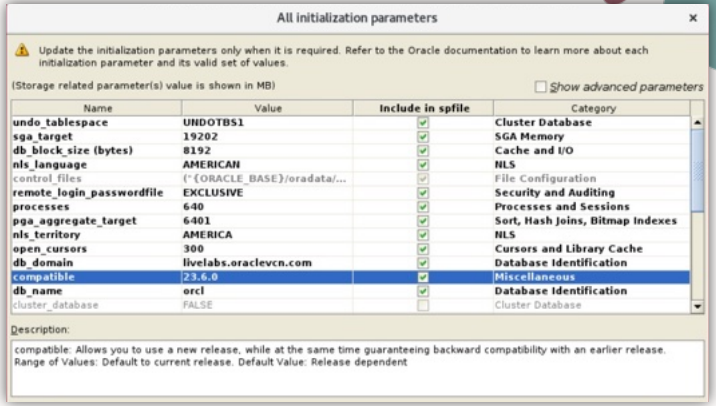


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Create Container Database

1 Character set

2 Components

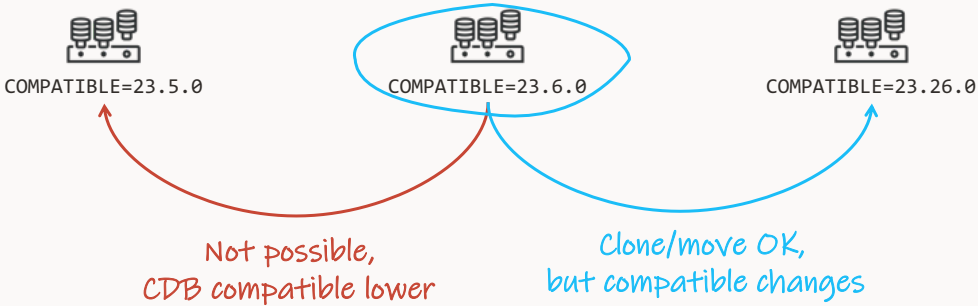


3 COMPATIBLE

- Keep at `23.6.0` to benefit from AI Vector Search features
- Unless you want the option of downgrade

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Compatible



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Further Information

Container Database



- YouTube: Create CDB in Oracle AI Database
- Blog post: How I Think You Should Create Your Container Databases
- COMPATIBLE Parameter - Documentation
- Blog post: Online COMPATIBLE raise starting with 23.9

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```
SQL> select con$name, comp_id, status from cdb_registry;

CON$NAME COMP_ID   STATUS
-------- --------- -----------
CDB$ROOT CATALOG   VALID
CDB$ROOT CATPROC   VALID
CDB$ROOT XDB       VALID
RED      CATALOG   VALID
RED      CATPROC   VALID
RED      XDB       VALID
```



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```
alter system set "_exclude_seed_cdb_view"=false;
```


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```
alter system set "_exclude_seed_cdb_view"=false;

SQL> select con$name, comp_id, status from cdb_registry;

CON$NAME COMP_ID   STATUS
-------- --------- -----------
CDB$ROOT CATALOG   VALID
CDB$ROOT CATPROC   VALID
CDB$ROOT XDB       VALID
PDB$SEED CATALOG   VALID
PDB$SEED CATPROC   VALID
PDB$SEED XDB       VALID
RED      CATALOG   VALID
RED      CATPROC   VALID
RED      XDB       VALID
```


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Types of Upgrades



Types of Upgrades



CDB
upgrade



PDB
unplug-plug



Non-CDB
upgrade and convert

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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

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CDB Upgrade



- Less control
- Common SLAs needed

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PDB Upgrade



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

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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 require pre-plugin backups

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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 require pre-plugin backups

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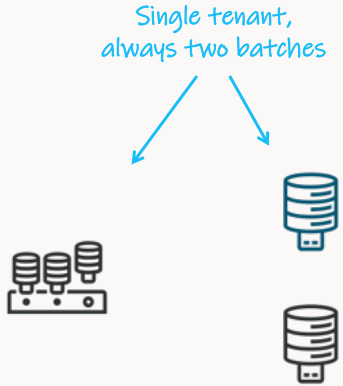


Comparing CDB and PDB upgrades

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Oracle Database 19c



Oracle AI Database 26ai



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Unplug-plug upgrades are faster than upgrading an entire CDB

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How long time does it take?

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Things that

Matter a lot

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

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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

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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

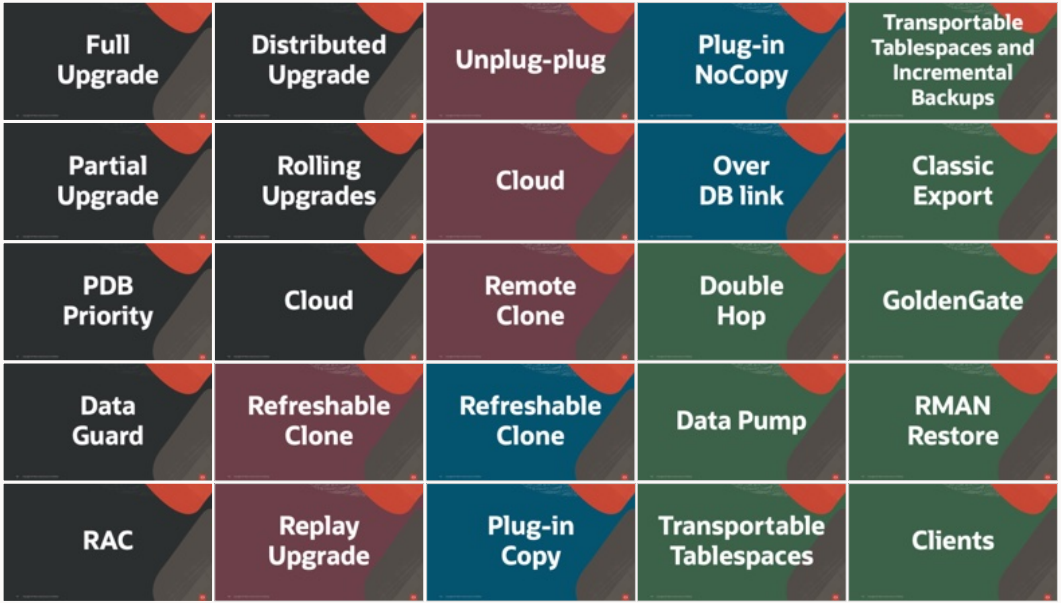
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Comparing **UPGRADE** types

	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

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Full Upgrade

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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.raise_compatible=no
```


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Wait one or two weeks before raising the `COMPATIBLE` parameter

- If you can afford a short outage
- Preserves the downgrade option

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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.raise_compatible=no
upg1.drop_grp_after_upgrade=yes
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.raise_compatible=no
upg1.drop_grp_after_upgrade=yes
upg1.emcli_path=/u01/app/oracle/oem
upg1.em_target_name=CDB1_myhost.domain.int
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.raise_compatible=no
upg1.drop_grp_after_upgrade=yes
upg1.emcli_path=/u01/app/oracle/oem
upg1.em_target_name=CDB1_myhost.domain.int
upg1.rman_catalog_connect_string=catalogdb
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.raise_compatible=no
upg1.drop_grp_after_upgrade=yes
upg1.emcli_path=/u01/app/oracle/oem
upg1.em_target_name=CDB1_myhost.domain.int
upg1.rman_catalog_connect_string=catalogdb
upg1.run_dictionary_health=critical
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.raise_compatible=no
upg1.drop_grp_after_upgrade=yes
upg1.emcli_path=/u01/app/oracle/oem
upg1.em_target_name=CDB1_myhost.domain.int
upg1.rman_catalog_connect_string=catalogdb
upg1.run_dictionary_health=critical
upg1.timezone_upg=yes
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.raise_compatible=no
upg1.drop_grp_after_upgrade=yes
upg1.emcli_path=/u01/app/oracle/oem
upg1.em_target_name=CDB1_myhost.domain.int
upg1.rman_catalog_connect_string=catalogdb
upg1.run_dictionary_health=critical
upg1.timezone_upg=yes
upg1.remove_underscore_parameters=yes
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

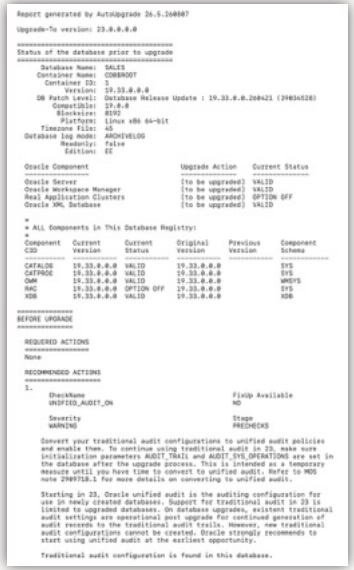
upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.raise_compatible=no
upg1.drop_grp_after_upgrade=yes
upg1.emcli_path=/u01/app/oracle/oem
upg1.em_target_name=CDB1_myhost.domain.int
upg1.rman_catalog_connect_string=catalogdb
upg1.run_dictionary_health=critical
upg1.timezone_upg=yes
upg1.remove_underscore_parameters=yes
upg1.add_after_upgrade_pfile=/home/oracle/scripts/CDB1_add.ora
upg1.delete_before_upgrade_pfile=/home/oracle/scripts/CDB1_remove.ora
```


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```
-- Start the pre-upgrade analysis to determine the upgrade readiness
-- Non-intrusive and lightweight check of the database

java –jar autoupgrade.jar –config cdb1.cfg –mode analyze
```


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```
Report generated by AutoUpgrade 26.5.260807

Upgrade-To version: 23.0.0.0.0

=====================================
Status of the database prior to upgrade
=====================================
        Database Name:  SALES
      Container Name:  CDBROOT
       Container ID:  3
            Version:  19.33.0.0.0
  DB Patch Level:  Database Release Update : 19.33.0.0.260421 (39036528)
         Compatible:  19.0.0
         Blocksize:  8192
          Platform:  Linux x86 64-bit
       Timezone File:  46
Database log mode:  ARCHIVELOG
          Readonly:  false
           Edition:  EE

Oracle Component                       Upgrade Action   Current Status
----------------                       --------------   --------------
Oracle Server                          [to be upgraded]  VALID
Oracle Workspace Manager               [to be upgraded]  VALID
Real Application Clusters              [to be upgraded]  OPTION OFF
Oracle XML Database                    [to be upgraded]  VALID

>
> ALL Components in This Database Registry:
>
Component    Current    Current    Original    Previous    Component
CID          Version    Status     Version     Version     Schema
---------    -------    -------    --------    --------    ---------
CATALOG      19.33.0.0.0  VALID    19.33.0.0.0             SYS
CATPROC      19.33.0.0.0  VALID    19.33.0.0.0             SYS
OWM          19.33.0.0.0  VALID    19.33.0.0.0             WMSYS
RAC          19.33.0.0.0  OPTION OFF  19.33.0.0.0         SYS
XDB          19.33.0.0.0  VALID    19.33.0.0.0             XDB

============
BEFORE UPGRADE
============

  REQUIRED ACTIONS
  ================
None.

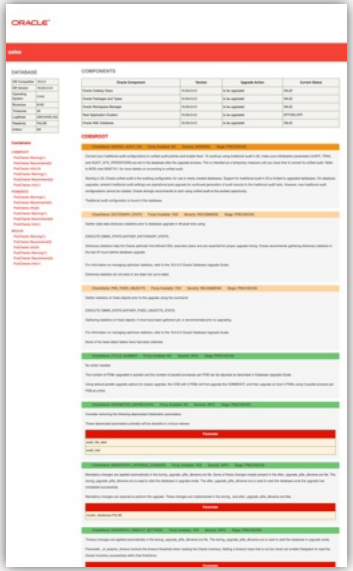
  RECOMMENDED ACTIONS
  ===================
1.
        CheckName                                  FixUp Available
        UNIFIED_AUDIT_ON                           NO

        Severity                                   Stage
        WARNING                                    PRECHECKS

    Convert your traditional audit configurations to unified audit policies
    and enable them. To continue using traditional audit in 23, make sure
    initialization parameters AUDIT_TRAIL and AUDIT_SYS_OPERATIONS are set in
    the database after the upgrade process. This is intended as a temporary
    measure until you have time to convert to unified audit. Refer to MOS
    note 2909718.1 for more details on converting to unified audit.

    Starting in 23, Oracle unified audit is the auditing configuration for
    use in newly created databases. Support for traditional audit in 23 is
    limited to upgraded databases. On database upgrades, existent traditional
    audit settings are operational post upgrade for continued generation of
    audit records to the traditional audit trails. However, new traditional
    audit configurations cannot be created. Oracle strongly recommends to
    start using unified audit at the earliest opportunity.

    Traditional audit configuration is found in this database.
```



ORACLE

sales

DATABASE

DB Unique Name	SALES
DB Version	19.33.0.0.0
Database Type	Single Instance
System	Linux
Shared Server	DISABLED
Timezone	+00:00
Logfiles	3
Archivelog	ARCHIVELOG
Flashback	FALSE
Edition	EE

Containers

CDBROOT
- PDB$SEED Warning(1)
- PDB$SEED Recommended(1)
- PDB$SEED Info(1)
- PDB$SEED Warning(1)
- PDB$SEED Recommended(1)
- PDB$SEED Info(1)

SALES
- PDB$SEED Warning(1)
- PDB$SEED Recommended(1)
- PDB$SEED Info(1)

COMPONENTS

Oracle Component	Version	Upgrade Action	Current Status
Oracle Database Vault	19.33.0.0.0	to be upgraded	VALID
Oracle Text	19.33.0.0.0	to be upgraded	VALID
Oracle Workspace Manager	19.33.0.0.0	to be upgraded	VALID
Real Application Clusters	19.33.0.0.0	to be upgraded	OPTION OFF
Oracle XML Database	19.33.0.0.0	to be upgraded	VALID

CDBROOT

Preupgrade Warning(1) Preupgrade Recommended(1) Preupgrade Info(1)

SALES

Preupgrade Warning(1) Preupgrade Recommended(1) Preupgrade Info(1)



```
{
  "SID": "SALES",
  "containers": [
    {
      "containerName": "CDBROOT",
      "checks": [
        {
          "checkname": "CYCLE_NUMBER",
          "fixup_available": "NO",
          "runfix": "N/A",
          "severity": "INFO",
          "action": "No action needed.",
          "broken_rule": "Using default parallel upgrade options for classic upgrade, this CDB
          with 2 PDBs will first upgrade the CDBROOT, and then upgrade at most 4 PDBs using 2
          parallel process per PDB at a time.",
          "rule": "The number of PDBs upgraded in parallel and the number of parallel processes
          per PDB can be adjusted as described in Database Upgrade Guide."
        },
        {
          "checkname": "DICTIONARY_STATS",
          "fixup_available": "YES",
          "runfix": "YES",
          "severity": "RECOMMEND",
          "action": "Gather stale data dictionary statistics prior to database upgrade in
          off-peak time using:    EXECUTE DBMS_STATS.GATHER_DICTIONARY_STATS();",
          "broken_rule": "Dictionary statistics do not exist or are stale (not up-to-date).",
          "rule": "Dictionary statistics help the Oracle optimizer find efficient SQL execution
          plans and are essential for proper upgrade timing. Oracle recommends gathering
          dictionary statistics in the last 24 hours before database upgrade.  For information
          on managing optimizer statistics, refer to the 19.33.0 Oracle Database Upgrade Guide."
        },
        {
          "checkname": "POST_DICTIONARY",
          "fixup_available": "NO",
          "runfix": "YES",
          "action": "GATHER dictionary statistics after the upgrade using the commands:
          EXECUTE DBMS_STATS.GATHER_DICTIONARY_STATS();",
          "broken_rule": "Oracle recommends gathering dictionary statistics after upgrade.",
          "rule": "Dictionary statistics provide essential information to the Oracle optimizer
          to help it find efficient SQL execution plans. After a database upgrade, statistics
          during the upgrade or new tables that do not have statistics gathered yet."
        },
        {
          "checkname": "POST_FIXED_OBJECTS",
          "fixup_available": "NO",
          "severity": "RECOMMEND",
          "action": "Gather statistics on fixed objects after the upgrade and when there is a
          representative workload on the system using the command:    EXECUTE DBMS_STATS.
          GATHER_FIXED_OBJECTS_STATS();",
          "broken_rule": "Oracle recommends gathering fixed object statistics after upgrade.",
          "rule": "Fixed object statistics provide essential information to the Oracle optimizer
          to help it find efficient SQL execution plans. Those statistics are specific to the
          Oracle Database release that generates them, and can be stale upon database upgrade.
          For information on managing optimizer statistics, refer to the 19.0.0.0 Oracle
          "
        },
        {
          "checkname": "PRE_FIXED_OBJECTS",
          "fixup_available": "YES",
          "runfix": "YES",
          "action": "Gather statistics on fixed objects prior to the upgrade using the
          command:    EXECUTE DBMS_STATS.GATHER_FIXED_OBJECTS_STATS();",
          "broken_rule": "None of the fixed object tables have had stats collected.",
          "rule": "Gathering statistics on fixed objects, if none have been gathered yet, is
          recommended prior to upgrading.  For information on managing optimizer statistics,
          "
        },
        {
          "checkname": "PARAMETER_DEPRECATED",
          "fixup_available": "NO",
          "runfix": "N/A",
          "action": "Consider removing the following deprecated initialization parameters.",
          "broken_rule": "",
          "rule": "These deprecated parameters probably will be obsolete in a future release."
        },
        {
          "checkname": "[illegible]",
          "fixup_available": "YES",
          "runfix": "YES",
```


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ORACLE

sales

DATABASE

DB Compatible	19.0.0
DB Version	19.33.0.0.0
Operating System	Linux
Blocksize	8192
Timezone	45
LogMode	ARCHIVELOG
Readonly	FALSE
Edition	EE

Containers

CDB$ROOT
- PreChecks Warning(1)
- PreChecks Recommend(2)
- PreChecks Info(10)
- PostChecks Warning(1)
- PostChecks Recommend(3)
- PostChecks Info(1)

PDB$SEED
- PreChecks Warning(1)
- PreChecks Recommend(2)
- PreChecks Info(5)
- PostChecks Warning(1)
- PostChecks Recommend(3)
- PostChecks Info(1)

MOCHA
- PreChecks Warning(1)
- PreChecks Recommend(2)
- PreChecks Info(5)
- PostChecks Warning(1)
- PostChecks Recommend(3)
- PostChecks Info(1)

COMPONENTS

Oracle Component	Version	Upgrade Action	Current Status
Oracle Catalog Views	19.33.0.0.0	to be upgraded	VALID
Oracle Packages and Types	19.33.0.0.0	to be upgraded	VALID
Oracle Workspace Manager	19.33.0.0.0	to be upgraded	VALID
Real Application Clusters	19.33.0.0.0	to be upgraded	OPTION OFF
Oracle XML Database	19.33.0.0.0	to be upgraded	VALID

CDB$ROOT

CheckName: UNIFIED_AUDIT_ON FixUp Available: NO Severity: WARNING Stage: PRECHECKS

Convert your traditional audit configurations to unified audit policies and enable them. To continue using traditional audit in 23, make sure initialization parameters AUDIT_TRAIL and AUDIT_SYS_OPERATIONS are set in the database after the upgrade process. This is intended as a temporary measure until you have time to convert to unified audit. Refer to MOS note 2909718.1 for more details on converting to unified audit.

Starting in 23, Oracle unified audit is the auditing configuration for use in newly created databases. Support for traditional audit in 23 is limited to upgraded databases. On database upgrades, existent traditional audit settings are operational post upgrade for continued generation of audit records to the traditional audit trails. However, new traditional audit configurations cannot be created. Oracle strongly recommends to start using unified audit at the earliest opportunity.

Traditional audit configuration is found in this database.

CheckName: DICTIONARY_STATS FixUp Available: YES Severity: RECOMMEND Stage: PRECHECKS

Gather stale data dictionary statistics prior to database upgrade in off-peak time using:

EXECUTE DBMS_STATS.GATHER_DICTIONARY_STATS;

Dictionary statistics help the Oracle optimizer find efficient SQL execution plans and are essential for proper upgrade timing. Oracle recommends gathering dictionary statistics in the last 24 hours before database upgrade.

For information on managing optimizer statistics, refer to the 19.0.0.0 Oracle Database Upgrade Guide.

Dictionary statistics do not exist or are stale (not up-to-date).

```
-- AutoUpgrade "deploy" mode starts the upgrade incl. all pre- and post-tasks

java –jar autoupgrade.jar –config cdb1.cfg –mode deploy
```

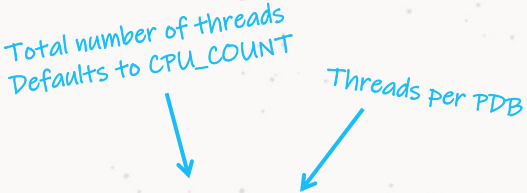

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Upgrade faster by processing more PDBs concurrently

- Finetune the upgrade

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```
upg1.catctl_options=-n 16 -N 2
```


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~~16~~ ~~2~~

```
upg1.catctl_options=-n 24 -N 1
```

More threads than CPU_COUNT

Just one thread per PDB

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Further Information

Full Upgrade



- Blog post: Upgrade Oracle Database 19c CDB to Oracle AI Database 26ai

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Partial Upgrade

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Upgrade CDB and a subset of PDBs

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The first wave

- Analyze all PDBs, fixups in all PDBs
- Upgrade selected PDBs

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```
global.global_log_dir=/home/oracle/autoupgrade/logs
upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs
upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
```

```
java -jar autoupgrade.jar -config cdb1.cfg -mode analyze
java -jar autoupgrade.jar -config cdb1.cfg -mode fixups
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs
upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.pdbs=SALES,REPORTING
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs
upg1.sid=CDB1
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.pdbs=SALES,REPORTING
```

```
java -jar autoupgrade.jar -config cdb1.cfg -mode deploy
```


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The next wave

- Upgrade remaining PDBs

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```
global.global_log_dir=/home/oracle/autoupgrade/logs
upg1.sid=CDB1
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.pdbs=DEV,TEST,UAT
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs
upg1.sid=CDB1
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.pdbs=DEV,TEST,UAT
```

```
java -jar autoupgrade.jar -config cdb1.cfg -mode upgrade
```


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Think about your rollback plans.
Flashback Database protects wave 1 only

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Until upgraded, the PDBs are not usable

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PDB Priority

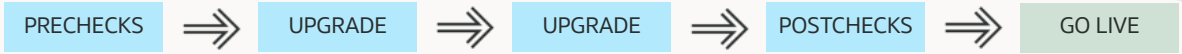
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Make specific PDBs upgrade faster

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Default Flow



CDB$ROOT
PDB$SEED
PDB1
PDB2
PDB3
PDB4

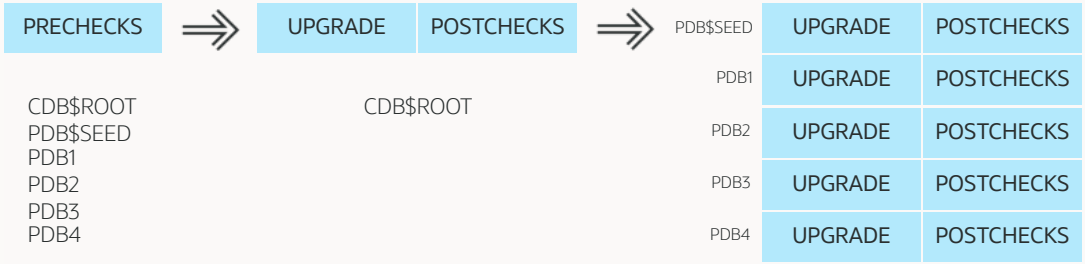
CDB$ROOT

PDB$SEED
PDB1
PDB2
PDB3
PDB4

CDB$ROOT
PDB$SEED
PDB1
PDB2
PDB3
PDB4

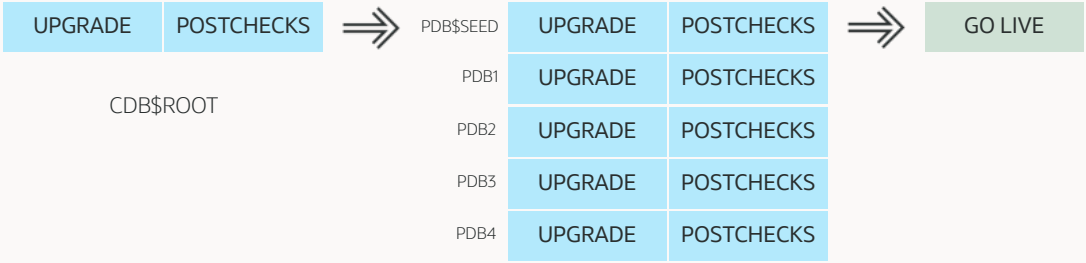
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Proactive Fixups



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Proactive Fixups



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```
-- Enables the use of "proactive fixups"

upg1.tune_setting=proactive_fixups=true
```


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Benchmark - 16 PDBs / 8 CPUs

Default

INFO	PREUPGRADE	<1 min
INFO	PRECHECKS	<1 min
INFO	PREFIXUPS	<1 min
INFO	DRAIN	2 min
INFO	DBUPGRADE	210 min
INFO	POSTCHECKS	3 min
INFO	POSTFIXUPS	46 min
INFO	POSTUPGRADE	<1 min
	TOTAL	259 min

Proactive Fixups

INFO	PREUPGRADE	<1 min
INFO	PRECHECKS	<1 min
INFO	PREFIXUPS	14 min
INFO	DRAIN	2 min
INFO	DBUPGRADE	195 min
INFO	POSTCHECKS	<1 min
INFO	POSTFIXUPS	<1 min
INFO	POSTUPGRADE	1 min
	TOTAL	195 min

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The more PDBs, the greater the benefit

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Fault Isolation

DEFAULT



Error in a PDB upgrade:
- Entire job halts
- Job can't complete

PROACTIVE FIXUPS



Error in a PDB upgrade:
- Other upgrades continue
- Job completes

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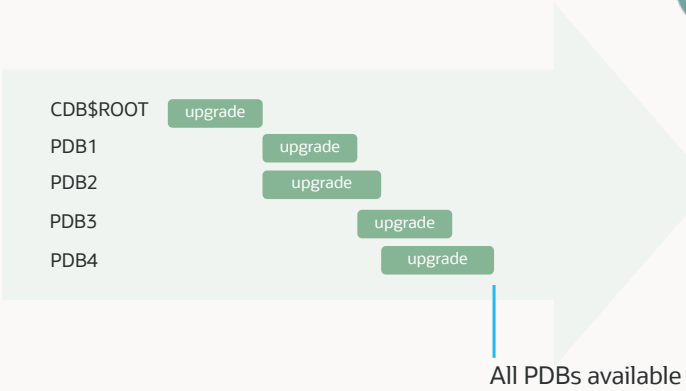
Restore point protects on CDB level only
Only entire CDB can be flashed back

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Proactive Fixups | Availability

DEFAULT

`make_pdbs_available=false`

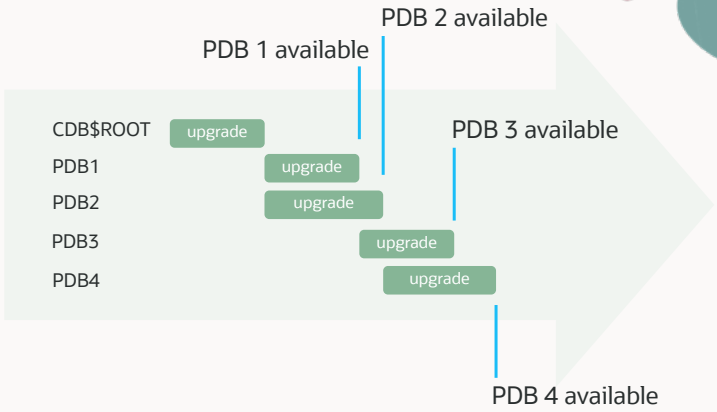


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Proactive Fixups | Availability

IMMEDIATELY AVAILABLE

`make_pdbs_available=true`



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```
ALTER PLUGGABLE DATABASE PDB1 PRIORITY 1;
ALTER PLUGGABLE DATABASE PDB2 PRIORITY 1;

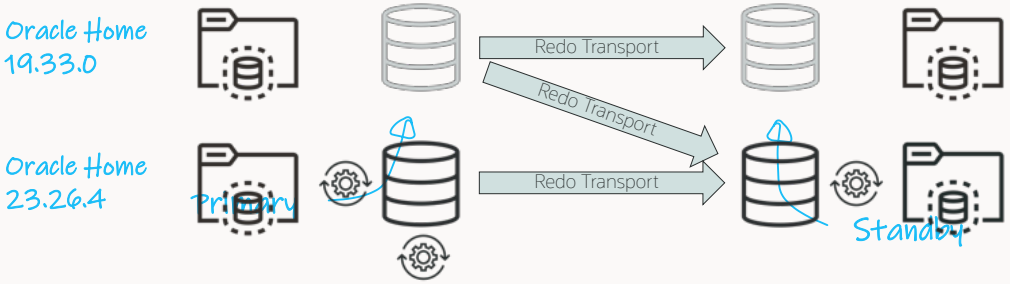
ALTER PLUGGABLE DATABASE PDB3 PRIORITY 2;
ALTER PLUGGABLE DATABASE PDB4 PRIORITY 2;
```


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Data Guard

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Upgrade Data Guard | MAA Method




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

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

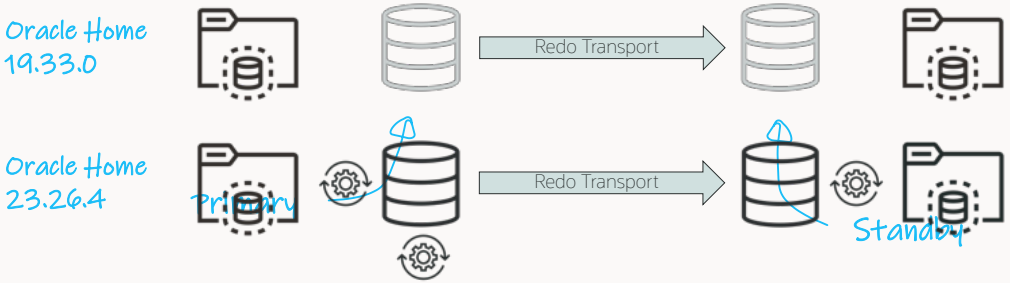

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Upgrade Data Guard | MAA Method

- Complies with MAA architecture
- Database is protected during upgrade
- Standby applies logs throughput the process
- Shortest possible downtime

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Upgrade Data Guard | Standby Offline




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

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

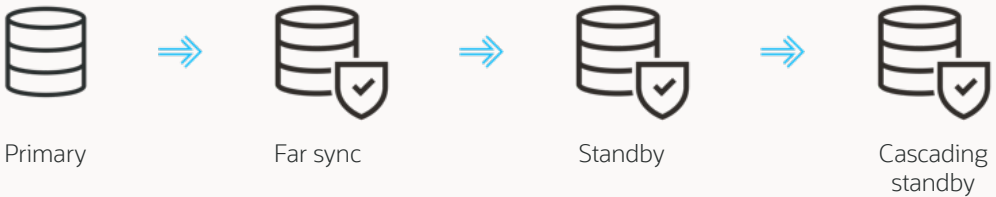

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Upgrade Data Guard | Standby Offline

- Use AutoUpgrade parameter `defer_standby_log_shipping`
- Database is protected during upgrade
- Standby remains on old release until after upgrade
- Longer downtime until standby has caught up

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Data Guard Upgrade



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You must disable Fast-Start Failover during the upgrade

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Don't go live until you've checked your standbys

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```
-- Performs a comprehensive check of Data Guard configuration
-- Check primary and all standbys

DGMGRL> VALIDATE DATABASE db_unique_name;
```


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```
-- Optionally, perform a Data Guard switchover to not only verify,
-- but also test the switchover. Switchover to all standbys.

DGMGRL> SWITCHOVER TO <db_unique_name>;
```


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Further Information

Data Guard



- Blog post: Upgrade Oracle Database 19c CDB to 26ai with Data Guard – MAA Method
- Blog post: Upgrade Oracle Database 19c CDB to 26ai with Data Guard – Standby Offline Method

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RAC

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Upgrade to Oracle Grid Infrastructure 26ai

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

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```
--Grid Infrastructure 26ai requires a minimum compatible setting
--Databases older than 19c may not use this disk group anymore

alter diskgroup DATA set attribute 'compatible.rdbms' = '19.0.0.0.0';
```


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26ai GI home disk space greatly reduced to 3 GB

- 12 GB in 19c

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Keep GI and DB patch levels in sync

- This is what we test and run in our Cloud

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GI and DB Patch Levels

Method	Status	Example
In sync	Recommended, best practice	GI 26.4 + DB 26.4
Within two Release Updates	Supported, good practice	GI 26.4 + DB 26.2 GI 26.2 + DB 26.4
Within three or more Release Updates	Supported, not recommended	GI 26.4 + DB 26.1 GI 26.1 + DB 26.4
Different releases	Supported, use mostly for upgrades	GI 26.4 + DB 19.33

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GI and DB Patch Levels

Method	Status	Example
In sync	Recommended, best practice	GI 26.4 + DB 26.4
Within two Release Updates	Supported, good practice	GI 26.4 + DB 26.2 GI 26.2 + DB 26.4
Within three or more Release Updates	Supported, not recommended	GI 26.4 + DB 26.1 GI 26.1 + DB 26.4
Different releases	Supported, use mostly for upgrades	GI 26.4 + DB 19.33

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GI and DB Patch Levels

Method	Status	Example
In sync	Recommended, best practice	GI 26.4 + DB 26.4
Within two Release Updates	Supported, good practice	GI 26.4 + DB 26.2 GI 26.2 + DB 26.4
Within three or more Release Updates	Supported, not recommended	GI 26.4 + DB 26.1 GI 26.1 + DB 26.4
Different releases	Supported, use mostly for upgrades	GI 26.4 + DB 19.33

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GI and DB Patch Levels

Method	Status	Example
In sync	Recommended, best practice	GI 26.4 + DB 26.4
Within two Release Updates	Supported, good practice	GI 26.4 + DB 26.2 GI 26.2 + DB 26.4
Within three or more Release Updates	Supported, not recommended	GI 26.4 + DB 26.1 GI 26.1 + DB 26.4
Different releases	Supported, use mostly for upgrades	GI 26.4 + DB 19.33

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AutoUpgrade fully supports RAC

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```
$ cat get-patches.cfg

global.autoupg_log_dir /home/oracle/autoupgrade/logs
global.keystore=/home/oracle/autoupgrade/keystore
global.folder=/home/oracle/patches

upg1.patch=GI,MRP
upg1.target_version=26
upg1.platform=LINUX.X64
```


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```
$ cat get-patches.cfg

global.autoupg_log_dir /home/oracle/autoupgrade/logs
global.keystore=/home/oracle/autoupgrade/keystore
global.folder=/home/oracle/patches

upg1.patch=GI,MRP
upg1.target_version=26
upg1.platform=LINUX.X64
```

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


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```
$ cat RACCDB1.cfg

global.autoupg_log_dir /home/oracle/autoupgrade/logs

upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.sid=RACCDB1
upg1.patch=RECOMMENDED
```


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```
$ cat RACCDB1.cfg

global.autoupg_log_dir /home/oracle/autoupgrade/logs

upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.sid=RACCDB1
upg1.patch=RECOMMENDED
```

```
java -jar autoupgrade.jar -config RACCDB1.cfg -mode create_home
```


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```
$ cat RACCDB1.cfg

global.autoupg_log_dir /home/oracle/autoupgrade/logs

upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.sid=RACCDB1
upg1.patch=RECOMMENDED
```

~~java -jar autoupgrade.jar -config RACCDB1.cfg -mode create_home~~

```
java -jar autoupgrade.jar -config RACCDB1.cfg -mode deploy
```


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RAC Upgrade

AutoUpgrade handles all RAC-specific tasks

- `CLUSTER_DATABASE = FALSE`
- Stops all but one instance
- Updates Clusterware registration

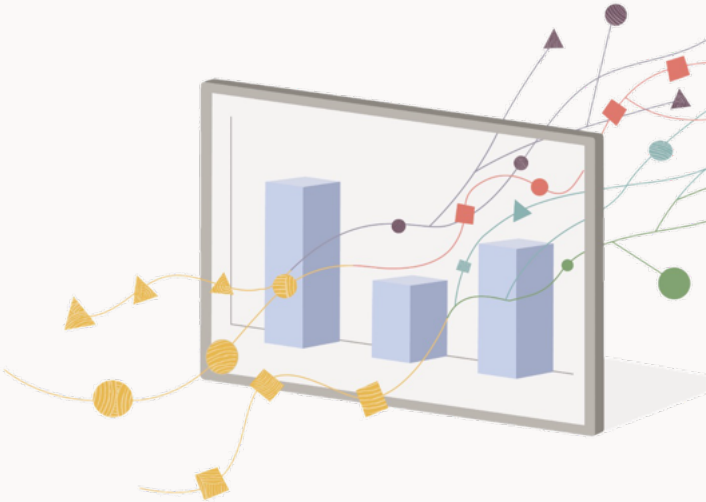
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Distributed Upgrade

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41%

faster



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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.

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Regular RAC Database Upgrade



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

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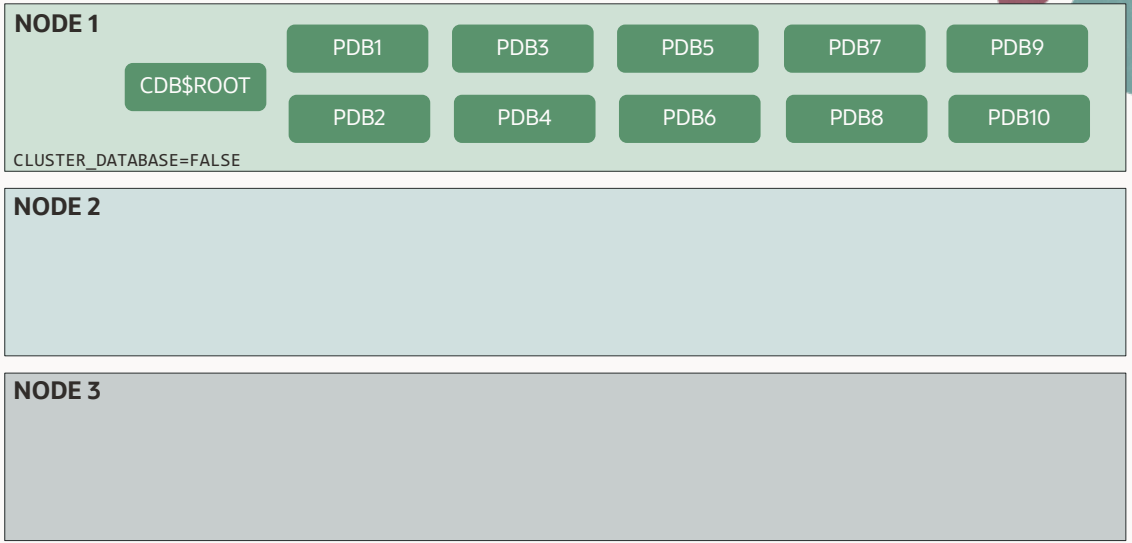
Distributed Upgrade



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

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Distributed Upgrade



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Distributed Upgrade



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```
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/26
upg1.sid=RACDB
upg1.tune_setting=distributed_upgrade=true
```


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


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```
cat RACDB.cffg

global.autoupg_log_dir=/u01/app/oracle/autoupgrade
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/26
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/26
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/26
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/26
batch3.sid=RACDB3
batch3.upgrade_node=NODE3
batch3.pdbs=PDB8,PDB9,PDB10
```


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```
cat RACDB.cffg

global.autoupg_log_dir=/u01/app/oracle/autoupgrade
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/26
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/26
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/26
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/26
batch3.sid=RACDB3
batch3.upgrade_node=NODE3
batch3.pdbs=PDB8,PDB9,PDB10
```


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```
cat RACDB.cffg

global.autoupg_log_dir=/u01/app/oracle/autoupgrade
upg1.source_home=/u01/app/oracle/product/19
upg1.target_home=/u01/app/oracle/product/26
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/26
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/26
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/26
batch3.sid=RACDB3
batch3.upgrade_node=NODE3
batch3.pdbs=PDB8,PDB9,PDB10
```


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```
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
```


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```
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
```


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```
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
```


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```
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|
    +--------+---------+--------+-------------+
```


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

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


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Rolling Upgrades

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

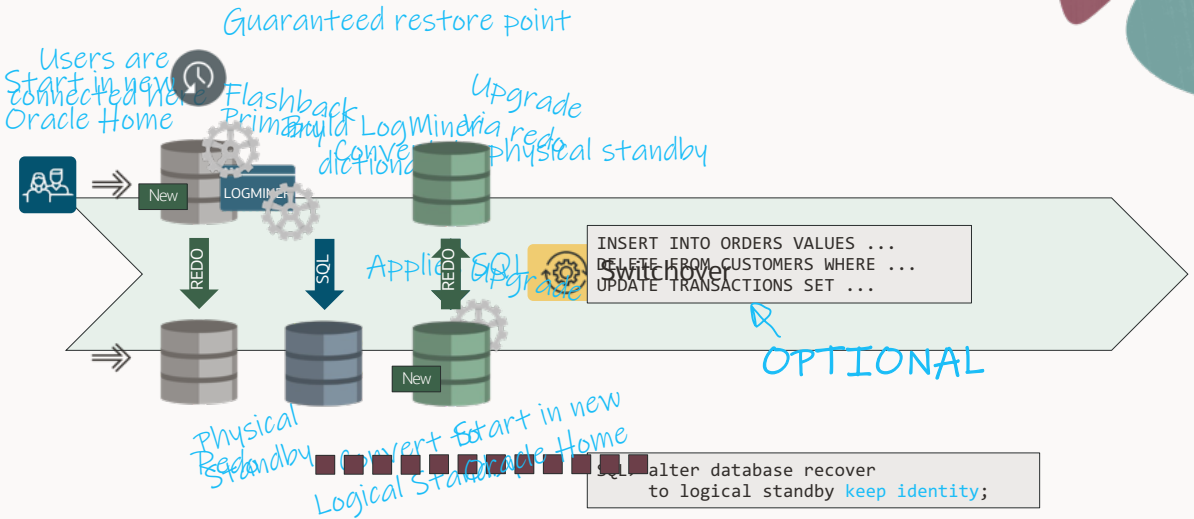
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Rolling Upgrade | Standby Types

PHYSICAL	LOGICAL
Redo apply	SQL apply
Updated by changing data block	Updated by executing SQLs
Exact copy - block-by-block	Copy - data is the same

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Rolling Upgrade | Concept



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Rolling Upgrade | Options

MANUAL	DBMS_ROLLING
Part of Enterprise Edition	Requires Active Data Guard
Source must be 11.1.0.7	Source must be 12.1.0.2 or newer
Manual approach	Automated
Data Guard broker must be disabled	Data Guard broker can be enabled

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Rolling Upgrade | Options

MANUAL	DBMS_ROLLING
Part of Enterprise Edition	Requires Active Data Guard
Source must be 11.1.0.7	Source must be 12.1.0.2 or newer
Manual approach	Automated
Data Guard broker must be disabled	Data Guard broker can be enabled
No longer supported	Supported

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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

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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;
```


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```
...
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
...
```


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Also useful for
other maintenance activities

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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

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Sessions can start transaction in 19c and commit in 26ai

- Application Continuity supports rolling upgrades when source is 19.30

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Can I use it on my database?

Determine database readiness





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

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Not all data types and partitioning types are supported

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Supplemental logging is enabled automatically

- Introduces an overhead
- Increases amount of redo generated

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When supplemental logging is enabled all DML cursors are invalidated

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Tips and tricks to ease your migration

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

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

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It is recommended to use three standbys for maximum protection

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Upgrade Grid Infrastructure to
new release before you start the process

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Before starting rolling maintenance, test your Data Guard config

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

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Plan your switchover during an off-peak period

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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 Swithcover/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)

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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)

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Cloud

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Upgrade by pressing a button

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Before Upgrade

- Ensure ASM diskgroup `compatible.rdbms` is 19.0.0 or higher
- Upgrade Grid Infrastructure
- Take a backup and disable automatic backup
- Gather dictionary and fixed objects statistics
- Run a *Precheck*

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```
-- Always check the logs from the Precheck even if it returns no issues found

cd /u01/app/oracle/cfgtoollogs/dbua/$ORACLE_UNQNAME/$ORACLE_SID/100/prechecks
cat *_preupgrade.log
```


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Upgrade

- The upgrade uses Database Upgrade Assistant
- No customization
- Always runs the timezone file upgrade

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```
dbcli list-jobs
dbcli describe-job -i <job-id>
```


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```
dbcli list-jobs
dbcli describe-job -i <job-id>
```

```
cd /u01/app/oracle/cfgtoollogs/dbua/<job-id>
tail -100f silent.log
```


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After Upgrade

- Take backup and re-enable automatic backup
- Make a plan for raising the `COMPATIBLE` parameter

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Use unplug-plug upgrades to minimize downtime

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Further Information

Cloud



- Blog post series: Upgrade to Oracle AI Database 26ai

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Refreshable Clone

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Upgrade via Refreshable Clone PDB



CREATE

In CDB on Oracle AI Database 26ai, create a copy of PDB over a database link



REFRESH

Apply redo from source to keep PDB up-to-date



OUTAGE

Disconnect users and refresh PDB for the last time



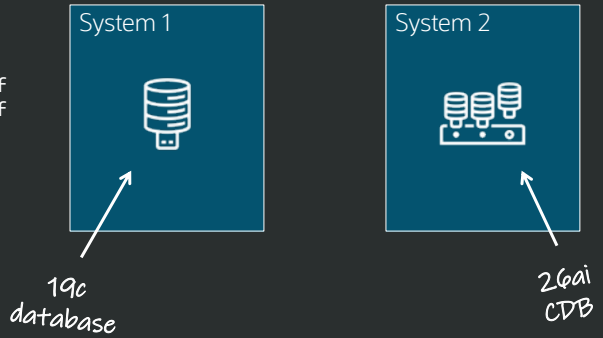
UPGRADE

Upgrade PDB to Oracle AI Database 26ai

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Upgrade via Refreshable Clone PDB

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



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Upgrade via Refreshable Clone PDB

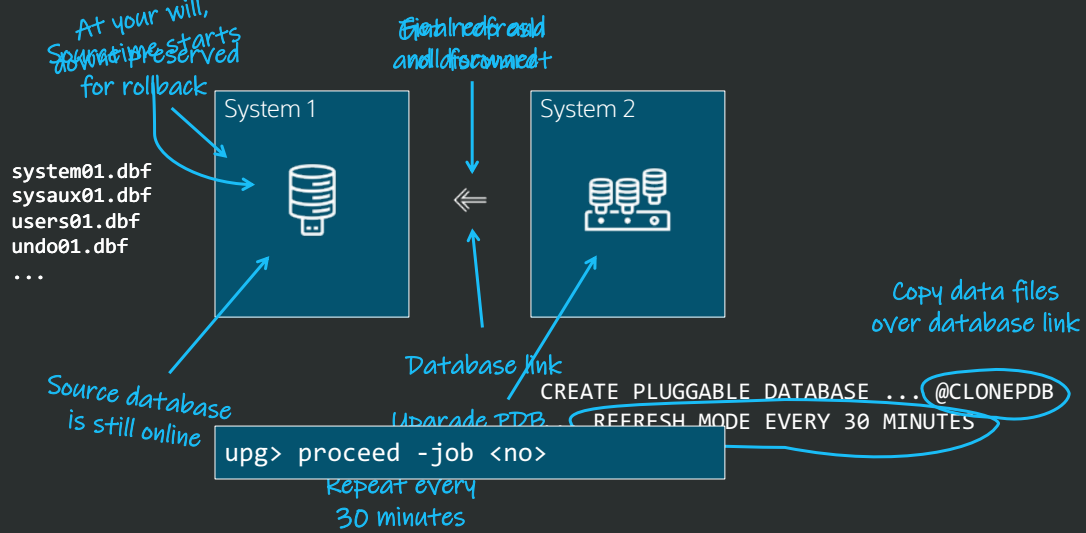
```
system01.dbf
sysaux01.dbf
users01.dbf
undo01.dbf
...
```



Could be same system as well

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Upgrade via Refreshable Clone PDB



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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink.SALES=CLONEPDB 1800
upg1.drop_dblink=yes
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink.SALES=CLONEPDB 1800
upg1.drop_dblink=yes
upg1.target_pdb_name.SALES=SALES26
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink.SALES=CLONEPDB 1800
upg1.drop_dblink=yes
upg1.target_pdb_name.SALES=SALES26
upg1.parallel_pdb_creation_clause.SALES=2
upg1.target_pdb_copy_option.SALES=file_name_convert=NONE
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink.SALES=CLONEPDB 1800
upg1.drop_dblink=yes
upg1.target_pdb_name.SALES=SALES26
upg1.parallel_pdb_creation_clause.SALES=2
upg1.target_pdb_copy_option.SALES=file_name_convert=NONE
upg1.start_time=19/01/2038 03:14:07
```


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Refreshable Clone

1

Run on source

```
autoupgrade.jar ... –mode analyze
autoupgrade.jar ... –mode fixups
```

2

Run on target

```
autoupgrade.jar ... –mode deploy
```


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Key Benefits



1. Less downtime
2. Excellent rollback option
3. For PDBs and non-CDBs

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Check your standby database

- Check webinar for details

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We used AutoUpgrade and refreshable clone to move a mission-critical 76 TB database to Oracle Database 23ai in less than 45 minutes - while preserving the source as rollback option

Portuguese Government Agency

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Works everywhere

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Works everywhere



- Base Database Service
- Exadata Database Service
- Exadata Cloud@Customer
- On-prem and other clouds
- Exascale migration
- Non-CDB to PDB migration
- PDB upgrade
- On-prem to cloud migration

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Further Information

Refreshable Clone



- Blog post series: Upgrade to Oracle AI Database 26ai

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Replay Upgrade

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```
--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
```


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```
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
```


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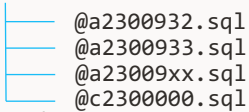
Classic Upgrade

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

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Classic Upgrade

Phase 1
Phase 2
Phase 3
Phase 4
Phase 5



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

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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
```


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Classic Upgrade

```
@@&init_file
```

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


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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 ...
```


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```
select sqlstmt from pdb_sync$;


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


(output truncated)
```


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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

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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
```


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

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

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Replay upgrade doesn't write proper logfiles

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

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


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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`)

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```
--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';
```


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Replay upgrade
is neither resumable nor restartable

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Unplug-plug

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Oracle Database 19c



Oracle AI Database 26ai



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```
CREATE PLUGGABLE DATABASE ... COPY
```

```
CREATE PLUGGABLE DATABASE ... NOCOPY
```


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```
CREATE PLUGGABLE DATABASE ... COPY
```

```
CREATE PLUGGABLE DATABASE ... NOCOPY
```

```
CREATE PLUGGABLE DATABASE ... MOVE
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
```

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


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Unplug-Plug Upgrade | Benefits

- Less downtime
- More flexibility
- Fully managed by AutoUpgrade

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Unplug-Plug Upgrade | Considerations

- Think about your rollback strategy
- An OS-level file copy takes time - consider storage snapshots/copies
- Target CDB must be *compatible*
- Update to connection services and possibly connect strings
- Implications for backups and Data Guard

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Further Information

Unplug-plug



- Blog post series: Upgrade to Oracle AI Database 26ai

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Cloud

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Cloud tooling upgrades entire CDB

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Unplug-plug upgrades are always faster than a full CDB upgrade

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Upgrade via Refreshable Clone PDB



CREATE

In CDB on Oracle AI Database 26ai, create a copy of PDB over a database link



REFRESH

Apply redo from source to keep PDB up-to-date



OUTAGE

Disconnect users and refresh PDB for the last time



UPGRADE

Upgrade PDB to Oracle AI Database 26ai

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Base Database Service

- Create a new DB System - already on 26ai
- Create a refreshable clone PDB using AutoUpgrade
- Perform the upgrade
- Terminate the 19c system when upgrade completes

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Exadata Database Service

- Provision new 26ai CDB using cloud tooling
- Use AutoUpgrade and refreshable clone PDB
- Rename the PDB to avoid name collision
- Drop 19c PDB after upgrade

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Cloud tooling *adopts* the new PDB within 15 minutes

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Considerations

- Update your database connect strings
- Take care of your standbys
- Take new backups

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Further Information

Cloud



- Blog post series: Upgrade to Oracle AI Database 26ai

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Remote Clone

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Similar to refreshable clone PDB
- but without the refresh

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Upgrade via Remote Clone



CREATE

In CDB on Oracle AI Database 26ai, create a copy of PDB over a database link



REFRESH

Apply redo from source to keep PDB up-to-date



OUTAGE

Disconnect users and refresh PDB for the last time



UPGRADE

Upgrade PDB to Oracle AI Database 26ai

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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink.SALES=CLONEPDB 1800
upg1.drop_dblink=yes
upg1.target_pdb_name.SALES=SALES26
upg1.parallel_pdb_creation_clause.SALES=2
upg1.target_pdb_copy_option.SALES=file_name_convert=NONE
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink.SALES=CLONEPDB 1800
upg1.drop_dblink=yes
upg1.target_pdb_name.SALES=SALES26
upg1.parallel_pdb_creation_clause.SALES=2
upg1.target_pdb_copy_option.SALES=file_name_convert=NONE
```


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Without the refresh
it's mostly suitable for test upgrades

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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.pdbs=SALES
upg1.sid=CDB19
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink.SALES=CLONEPDB
upg1.drop_dblink=yes
upg1.target_pdb_name.SALES=SALES26
upg1.parallel_pdb_creation_clause.SALES=2
upg1.target_pdb_copy_option.SALES=file_name_convert=NONE
upg1.close_source=no
```


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Further Information

Remote Clone



- Blog post series: Upgrade to Oracle AI Database 26ai

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Refreshable Clone

Copyright © 2026, Oracle and/or its affiliates

1 Plug in

2 Upgrade

3 Convert



Irreversible!
Flashback no good

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ROLLBACK



Backup / restore

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



Copy data files

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

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ROLLBACK

Backup / restore

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

Copy data files

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



Refreshable clone PDB

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

Requires Oracle Database 12.2 or newer

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Upgrade via Refreshable Clone PDB



CREATE

In CDB on Oracle AI Database 26ai, create a copy of PDB over a database link



REFRESH

Apply redo from source to keep PDB up-to-date



OUTAGE

Disconnect users and refresh PDB for the last time



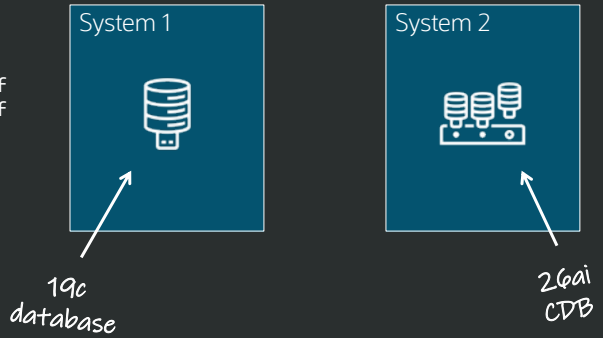
UPGRADE

Upgrade PDB to Oracle AI Database 26ai

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Upgrade via Refreshable Clone PDB

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



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Upgrade via Refreshable Clone PDB

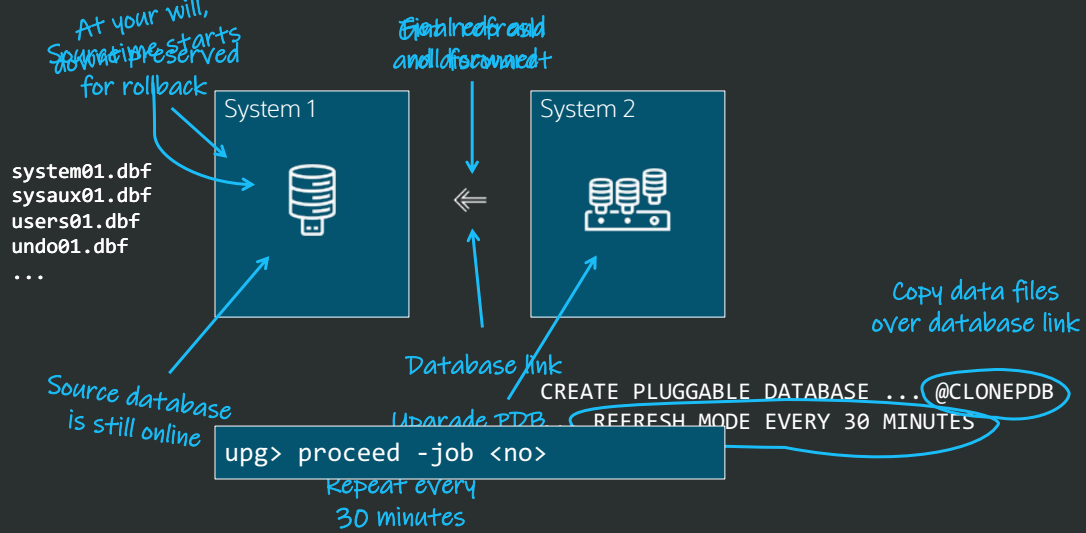
```
system01.dbf
sysaux01.dbf
users01.dbf
undo01.dbf
...
```



Could be same system as well

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Upgrade via Refreshable Clone PDB



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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=SALES
upg1.target_cdb=CDB26
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=SALES
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=SALES
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink=CLONEPDB 1800
upg1.drop_dblink=yes
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=SALES
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink=CLONEPDB 1800
upg1.drop_dblink=yes
upg1.target_pdb_name=SALES26
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=SALES
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink=CLONEPDB 1800
upg1.drop_dblink=yes
upg1.target_pdb_name=SALES26
upg1.parallel_pdb_creation_clause=2
upg1.target_pdb_copy_option=file_name_convert=NONE
```


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```
global.global_log_dir=/home/oracle/autoupgrade/logs

upg1.sid=SALES
upg1.target_cdb=CDB26
upg1.source_home=/u01/app/oracle/product/dbhome_19_33
upg1.target_home=/u01/app/oracle/product/dbhome_26_4
upg1.source_dblink=CLONEPDB 1800
upg1.drop_dblink=yes
upg1.target_pdb_name=SALES26
upg1.parallel_pdb_creation_clause=2
upg1.target_pdb_copy_option=file_name_convert=NONE
upg1.start_time=19/01/2038 03:14:07
```


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Refreshable Clone

1

Run on source

```
autoupgrade.jar ... –mode analyze
autoupgrade.jar ... –mode fixups
```

2

Run on target

```
autoupgrade.jar ... –mode deploy
```


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Key Benefits



1. Less downtime
2. Excellent rollback option
3. Also for PDBs

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Check your standby database

- Check webinar for details

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We used AutoUpgrade and refreshable clone to move a mission-critical 76 TB database to Oracle Database 23ai in less than 45 minutes - while preserving the source as rollback option

Portuguese Government Agency

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Works everywhere

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Works everywhere



- Base Database Service
- Exadata Database Service
- Exadata Cloud@Customer
- On-prem and other clouds
- Exascale migration
- Non-CDB to PDB migration
- PDB upgrade
- On-prem to cloud migration

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Further Information

Refreshable Clone



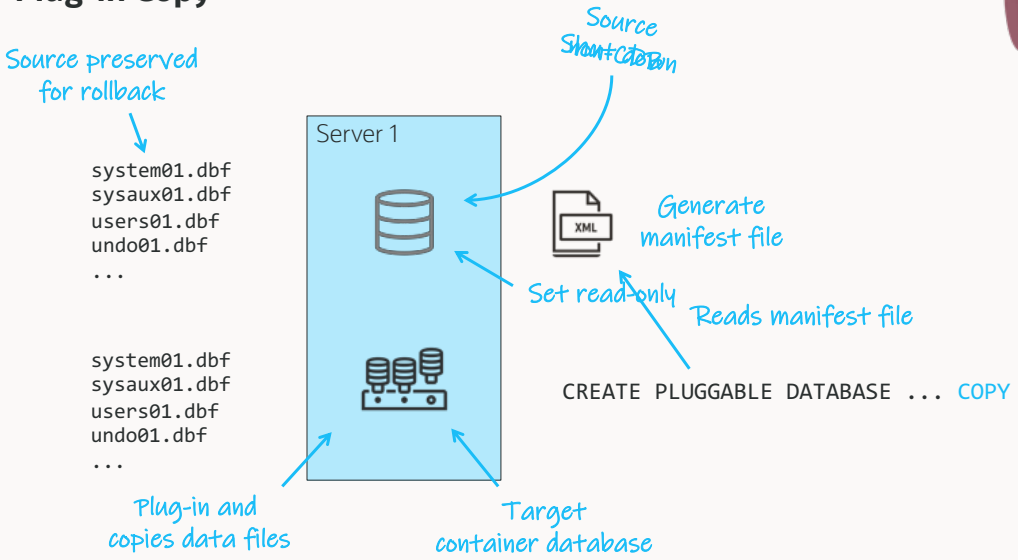
- Webinar: Move to Oracle Database 23ai – Everything you need to know about Oracle Multitenant – Part 1
- Blog post series: Upgrade to Oracle AI Database 26ai

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Plug-in Copy

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Plug-in Copy



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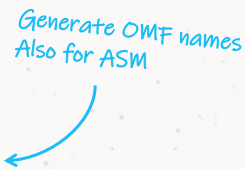
```
#AutoUpgrade config file
#Convert SALES to PDB in CDB1 - copy data files
upg1.source_home=/u01/app/oracle/product/dbhome_1933
upg1.target_home=/u01/app/oracle/product/dbhome_264
upg1.sid=SALES
upg1.target_cdb=CDB1
upg1.target_pdb_copy_option.SALES=file_name_convert('/u01', '/u02')

#Fully automated migration
java -jar autoupgrade.jar -config sales.cfg -mode deploy
```


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```
#AutoUpgrade config file
#Convert SALES to PDB in CDB1 - copy data files
upg1.source_home=/u01/app/oracle/product/dbhome_1933
upg1.target_home=/u01/app/oracle/product/dbhome_264
upg1.sid=SALES
upg1.target_cdb=CDB1
upg1.target_pdb_copy_option.SALES=file_name_convert=none

#Fully automated migration
java -jar autoupgrade.jar -config sales.cfg -mode deploy
```



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Be sure to shut down the source database

- Use `upg1.close_source=yes`

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What happens during plug-in with Oracle Data Guard

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Data Guard



Plug-in on primary propagates to standby database via redo

1 Enabled recovery

2 Deferred recovery

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Data Guard

1

Enabled recovery

```
create pluggable database ... standbys=all
```

Standby records PDB creation

Standby locates data files

MRP applies redo to PDB

PDB is immediately protected

2

Deferred recovery

```
create pluggable database ... standbys=none
```

Standby records PDB creation

Standby ignores data files

MRP skips redo

PDB protected after restore

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```
#AutoUpgrade config file
#Convert SALES to PDB in CDB1 - copy data files
upg1.source_home=/u01/app/oracle/product/dbhome_1933
upg1.target_home=/u01/app/oracle/product/dbhome_264
upg1.sid=SALES
upg1.target_cdb=CDB1
upg1.target_pdb_copy_option.SALES=file_name_convert=none
upg1.manage_standbys_clause=none
```


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Further Information

Plug-in Copy



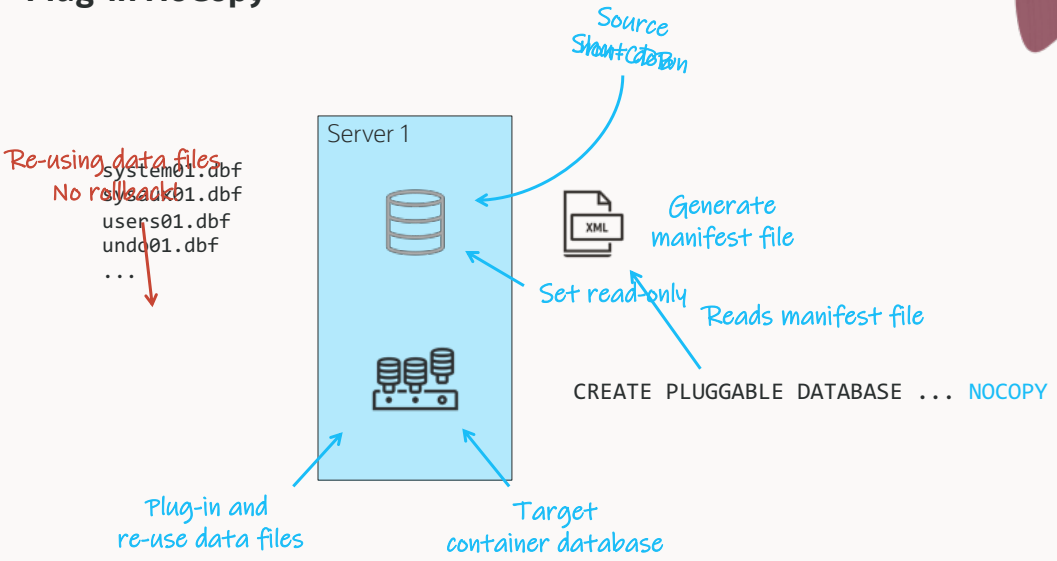
- Webinar: Move to Oracle Database 23ai – Everything you need to know about Oracle Multitenant – Part 1
- Blog post series: Upgrade to Oracle AI Database 26ai

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```
#AutoUpgrade config file
#Convert SALES to PDB in CDB1 - copy data files
upg1.source_home=/u01/app/oracle/product/dbhome_1933
upg1.target_home=/u01/app/oracle/product/dbhome_264
upg1.sid=SALES
upg1.target_cdb=CDB1

#Fully automated migration
java -jar autoupgrade.jar -config sales.cfg -mode deploy
```


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DEMO

Multitenant migration Including upgrade Using AutoUpgrade



Watch on YouTube

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Consider using `MOVE` instead of `NOCOPY` to move files into proper directory

- Use `FILE_NAME_CONVERT` clause
- Not supported by AutoUpgrade

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What happens during plug-in with Oracle Data Guard

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Data Guard



Plug-in on primary propagates to standby database via redo

1 Enabled recovery

2 Deferred recovery

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Data Guard

1

Enabled recovery

```
create pluggable database ... standbys=all
```

Standby records PDB creation

Standby locates data files

MRP applies redo to PDB

PDB is immediately protected

Default

2

Deferred recovery

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Further Information

Plug-in NoCopy



- Webinar: Move to Oracle Database 23ai – Everything you need to know about Oracle Multitenant – Part 1
- Blog post series: Upgrade to Oracle AI Database 26ai

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Over DB link

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```
CREATE PLUGGABLE D                    ON$CDB@DBLINK ... ;
```



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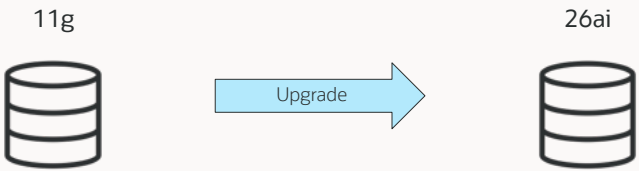
Double Hop

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In-place upgrade from a very old release

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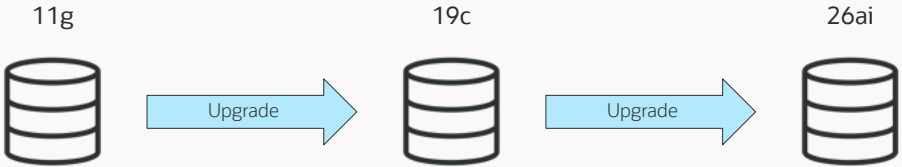
Current Release	Upgrade Options
21c, 19c (all releases)	**Direct upgrade is supported.** Perform the upgrade using the current Oracle Database Upgrade Guide, which is this guide.
18c 12.2 12.1.0.2 12.1.0.1 11.2.0.1, 11.2.0.2, 11.2.0.3, 11.2.0.4 11.1.0.6, 11.1.0.7 10.2 or earlier releases	**Direct upgrade to Oracle AI Database is not supported.** **Solution:** Upgrade to an intermediate Oracle Database release that can be directly upgraded to the current release. Upgrade Oracle Database releases that are not supported for direct upgrade in this release to an intermediate Oracle Database release that is supported for direct upgrade. When upgrading to an intermediate Oracle Database release, follow the instructions in the intermediate release documentation, including running the preupgrade scripts for that release. After upgrading to the intermediate release, upgrade to the current Oracle Database release. This restriction does not apply if you use Oracle Data Pump export/import to migrate data to the new release. For example: • Releases 12.2.0.1, 12.2.0.2. 12.2.0.3, 12.2.0.4, 18c: Upgrade to Oracle Database 21c, and then upgrade to Oracle AI Database. • Releases 12.1.0.1, 12.1.0.2, 11.2.0.3, 11.2.0.4: Upgrade to Oracle Database 12c Release 2 (12.2), upgrade to Oracle Database 21c, and then upgrade to Oracle AI Database. **Note:** Always update to the most recent intermediate release to which you can upgrade directly. Your case can be different from that of the examples provided here.

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Upgrade as *far* as possible
in each intermediate upgrade

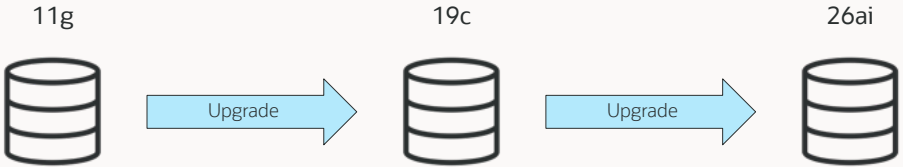
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- GI upgrade
- Preupgrade analysis
- DB Upgrade

- GI upgrade
- Preupgrade analysis
- DB Upgrade

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- Linux 4
- Linux 5
- Linux 6
- Linux 7
- Linux 8

- Linux 7
- Linux 8
- Linux 9
- Linux 10

Premier support ends 2029

- Linux 8
- Linux 9
- Linux 10

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Client / Server Interoperability Support Matrix

	Server Version																	
Client Version	26ai	21c	19c	18c	12.2.0	12.1.0	11.2.0	11.1.0	10.2.0	10.1.0	9.2.0	9.0.1	8.1.7	8.1.6	8.1.5	8.0.6	8.0.5	7.3.4
26ai	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
21c	Yes	Yes	Yes	Was	Was	Yes#12	No	No	No	No	No	No	No	No	No	No	No	No
19c	Yes	Yes	Yes	Was	Was	Yes#12	Yes#9	No	No	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3
18c	No	Was	Was	Was	Was	Was	Was	No	No	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3
12.2.0	No	Was	Was	Was	Was	Was	Was	No	No	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3
12.1.0	No	Yes#12	Yes#12	Was	Was	Yes#12	Yes#12	Was	Was#7	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3
11.2.0	No	No	Yes#9	Was	Was	Yes#12	Yes#9	Was	Was#7	No	Was#5	No#3	No#3	No#3	No#3	No#3	No#3	No#3
11.1.0	No	No	No	No	No	Was	Was	Was	Was#7	Was#6	Was#5	No#3	No#3	No#3	No#3	No#3	No#3	No#3
10.2.0	No	No#10	No#10	No#10	No#10	Was#7	Was#7	Was#7	Was	Was	Was#5	No	Was	No#3	No#3	No#3	No#3	No#3
10.1.0#4	No	No	No	No	No	No	Was#6	Was#6	Was	Was	Was	Was	Was#2	No#3	No#3	No#3	No#3	No#3
9.2.0	No	No	No	No	No	No#8	Was#5	Was#5	Was#5	Was	Was	Was	Was	No	No	Was	No	No#1
9.0.1	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	No	Was	No	Was
8.1.7	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was	Was	Was	Was
8.1.6	No	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was
8.1.5	No	No	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was
8.0.6	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was	Was
8.0.5	No	No	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was
7.3.4	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was	Was

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Client / Server Interoperability Support Matrix

	Server Version																
Client Version	**26ai**	21c	19c	18c	12.2.0	12.1.0	11.2.0	11.1.0	10.2.0	10.1.0	9.2.0	9.0.1	8.1.7	8.1.6	8.1.5	8.0.6	8.0.5	7.3.4
26ai	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
21c	Yes	Yes	Yes	Was	Was	Yes#12	No	No	No	No	No	No	No	No	No	No	No	No
19c	Yes	Yes	Yes	Was	Was	Yes#12	Yes#9	No	No	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3
18c	No	Was	Was	Was	Was	Was	Was	No	No	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3
12.2.0	No	Was	Was	Was	Was	Was	Was	No	No	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3
12.1.0	No	Yes#12	Yes#12	Was	Was	Yes#12	Yes#12	Was	Was#7	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3	No#3
11.2.0	No	No	Yes#9	Was	Was	Yes#12	Yes#9	Was	Was#7	No	Was#5	No#3	No#3	No#3	No#3	No#3	No#3	No#3
11.1.0	No	No	No	No	No	Was	Was	Was	Was#7	Was#6	Was#5	No#3	No#3	No#3	No#3	No#3	No#3	No#3
10.2.0	No	No#10	No#10	No#10	No#10	Was#7	Was#7	Was#7	Was	Was	Was#5	No	Was	No#3	No#3	No#3	No#3	No#3
10.1.0#4	No	No	No	No	No	No	Was#6	Was#6	Was	Was	Was	Was	Was#2	No#3	No#3	No#3	No#3	No#3
9.2.0	No	No	No	No	No	No#8	Was#5	Was#5	Was#5	Was	Was	Was	Was	No	No	Was	No	No#1
9.0.1	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	No	Was	No	Was
8.1.7	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was	Was	Was	Was
8.1.6	No	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was
8.1.5	No	No	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was
8.0.6	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was	Was
8.0.5	No	No	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was
7.3.4	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was	Was

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Now, consider your rollback options

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The older the database, the more complex it becomes

Other options might be more attractive:

- Data Pump
- Transportable tablespaces
- Classic export

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Perhaps Oracle Autonomous AI Database is the right platform for you

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Data Pump

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You can use Data Pump to move data into a newer release of Oracle AI Database

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Data Pump works across platforms, endianness, architecture and releases

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Upgrade via Data Pump

Suitable when:

- Source is a very old release
- Small amount of data
- Less complex schemas
- Coming from non-CDB
- Restructuring data
- Changing character set

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Upgrade via Data Pump

Considerations:

- Longer downtime
- Logical migration requires validation of data
- Statistics, SQL management objects, etc.
- Doesn't work on CDB level

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To migrate your data, you typically use Data Pump in schema or full mode

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SCHEMA

Individual schemas and what they own



FULL

All schemas plus
more or less everything in the database

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Full Export

Objects exported only in full export:

- Audit trail and policies
- Database Vault
- Directories
- Profiles and password verify function
- Public database links
- Public synonyms
- Roles
- SQL Management Objects (plan histories, SQL plan baselines, SQL profiles, etc.)
- Tablespaces
- Users (other than those specified in SCHEMAS parameter)
- Workspace manager (for schema export you need to use DBMS_WM.Export_Schemas)

...

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Data Pump never exports grants on SYS objects

- Not even in a full export
- Add them manually following the import

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Data Pump never exports AWR

- Not even in a full export
- Use `rdbms/admin/awrextr.sql`

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Mode Comparison

DUMP FILE

- Requires access to file system
- Requires disk space for dump files
- Full functionality

NETWORK

- SQL*Net connectivity
- No extra disk space needed
- Restricted functionality

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For network imports, remember the limitation of client/server interoperability

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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

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Further Information

Cross-platform Transportable Tablespaces



- Webinar: Data Pump Best Practices and Real World Scenarios
- Webinar: Data Pump Extreme – Deep Dive with Development

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Transportable Tablespaces

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You can use Transportable Tablespaces to move data into a newer release

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Transportable Tablespaces | Concept

Your data





Rows

```
insert into ...
update ...
delete from ...
```



Metadata

```
grant select on ...
create package ...
create view ...
```


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Transportable Tablespaces | Concept



Rows

Stored in a user tablespace



Copy the data files



Metadata

Stored in SYSTEM tablespace



Recreate using Data Pump

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Transportable Tablespaces | Concept



Rows

Stored in a user tablespace

Copy the data files



Metadata

Stored in SYSTEM tablespace



Recreate using Data Pump

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Transportable Tablespaces | Concept



Recreate using Data Pump

1 Traditional transportable tablespace

- Selected tablespaces
- Manual metadata recreation
- Complex and error-prone
- Requires 10g (8i in some cases)

2 Full Transportable Export/Import (FTEX)

- Entire database
- Fully automated metadata recreation
- Easy and standardized
- Source ≥ 11.2.0.3, target ≥12.1

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Transportable Tablespaces works across endianness, architecture and releases

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Upgrade via Transportable Tablespaces

Suitable when:

- Source is a very old release
- Data Pump export is too slow
- Less complex schemas
- Coming from non-CDB

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Upgrade via Transportable Tablespaces

Considerations:

- Longer downtime
- Copying data files takes time - reusing data files leaves no rollback option
- No restructuring data
- Different endianness requires data file conversion
- Logical migration requires validation of data
- Doesn't work on CDB level

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Oracle AI Database 26ai offers faster metadata import

- Can't be backported to Oracle Database 19c

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Parallel Transportable Benchmark

Oracle E-Business Suite database

600.000+ objects

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

Export parallel 1	2h 2m
Import parallel 16	1h 23m
Total	**3h 25m**

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```
--Metadata export from 19c is non-parallel
expdp ... full=y transportable=always


--Metadata import into 26ai can happen in parallel
impdp ... transport_datafiles='...' parallel=16
```


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Further Information

Cross-platform Transportable Tablespaces



- Webinar: Cross Platform Migration – Transportable Tablespaces to the Extreme
- Slide deck: Cross Platform Migration – Transportable Tablespaces to the Extreme

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Transportable Tablespaces and Incremental Backups

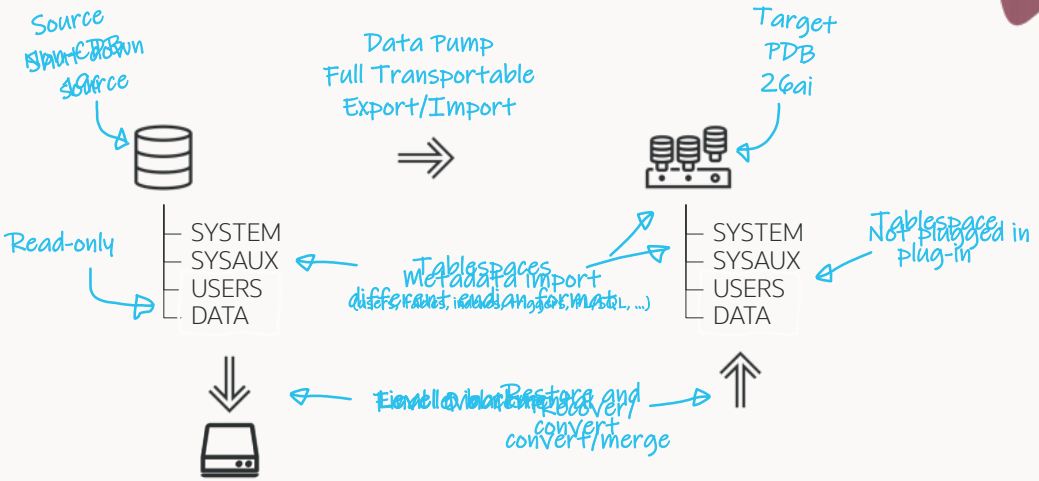
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Minimize time needed
to copy (and convert) data files

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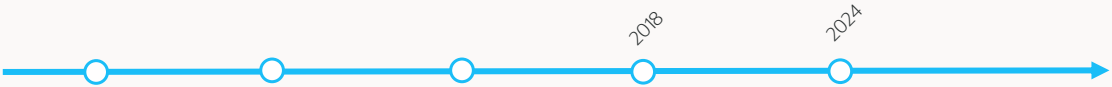
M5 Concept



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Scripts for Incremental Backup Automation

Backup / restore / recover



XTTS v1

XTTS v2

XTTS v3
KB134922

XTTS v4
KB147608

M5
KB144840

- No multisection backups
- No encrypted tablespaces
- Inefficient parallelism
- Incomplete multitenant support

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M5 is the next-generation cross-platform transportable tablespace procedure

- New RMAN functionality combined with Full Transportable Export/Import
- MOS KB144840

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```
# source database
RUN
{
ALLOCATE CHANNEL d1 DEVICE TYPE DISK FORMAT '...';
ALLOCATE CHANNEL d2 DEVICE TYPE DISK FORMAT '...';
BACKUP
       FILESPERSET 1
       SECTION SIZE 64G
       TAG UP19_L0_240206101548
       TABLESPACE <list-of-tablespace>;
}
```


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```
# source database
RUN
{
ALLOCATE CHANNEL d1 DEVICE TYPE DISK FORMAT '...';
ALLOCATE CHANNEL d2 DEVICE TYPE DISK FORMAT '...';
BACKUP
      FILESPERSET 1
      SECTION SIZE 64G
      TAG UP19_L0_240206101548
      TABLESPACE <list-of-tablespace>;
}
```

```
# target database
RUN
{
ALLOCATE CHANNEL DISK1 DEVICE TYPE DISK FORMAT '...';
ALLOCATE CHANNEL DISK2 DEVICE TYPE DISK FORMAT '...';
RESTORE ALL FOREIGN DATAFILES TO NEW FROM BACKUPSET
'<backup-set-1>',
'<backup-set-2>',
...
'<backup-set-n>'
};
```


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Use Block Change Tracking for faster incremental backups

- Check the License Guide for details

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Benefits

M5 procedure supports:

- Encrypted tablespaces
- Multisection backups
- Migrating multiple databases into the same CDB simultaneously
- Compressed backup sets
- Better parallelism

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Requirements

- Source and target database must
  - be 19.18.0 or higher
  - use Data Pump Bundle Patch

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M5 Workflow

Configure | Level 0 | Level 1 | Outage | Final Backup | Final restore | Export Import



SPARC
SuperCluster



ZDLRA



Exadata
X9M Extreme Flash

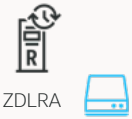
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M5 Workflow

Configure | **Level 0** | Level 1 | Outage | Final Backup | Final restore | Export Import



SPARC
SuperCluster



ZDLRA



Exadata
X9M Extreme Flash

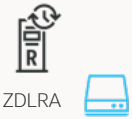
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M5 Workflow

Configure | Level 0 | **Level 1** | Outage | Final Backup | Final restore | Export Import



SPARC
SuperCluster



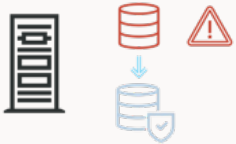


Exadata
X9M Extreme Flash

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M5 Workflow

Configure | Level 0 | Level 1 | **Outage** | Final Backup | Final restore | Export Import



SPARC
SuperCluster



ZDLRA





Exadata
X9M Extreme Flash

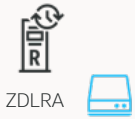
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M5 Workflow

Configure | Level 0 | Level 1 | Outage | **Final Backup** | **Final restore** | Export Import



SPARC
SuperCluster





Exadata
X9M Extreme Flash

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M5 Workflow

Configure | Level 0 | Level 1 | Outage | Final Backup | Final restore | Export Import



SPARC SuperCluster

Exadata X9M Extreme Flash

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Real-life checkpoint

Moving an 180 TB database generating 15 TB redo every day from SPARC SuperCluster til Exadata Database Machine.

Running on Oracle RAC Database with 5 standbys across 2 data centers.

Database migration time: 5h 17m - Total outage: 9h 15m

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Further Information

Cross-platform Transportable Tablespaces



- Webinar: Cross Platform Migration – Transportable Tablespaces to the Extreme
- Slide deck: Cross Platform Migration – Transportable Tablespaces to the Extreme

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Classic Export

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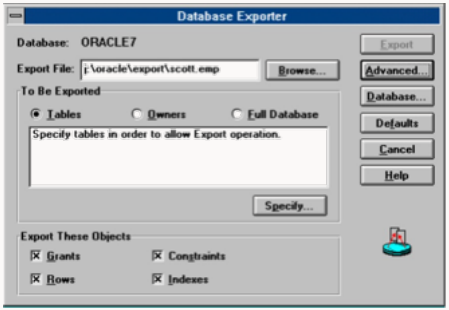
Press Any Key To Continue..._

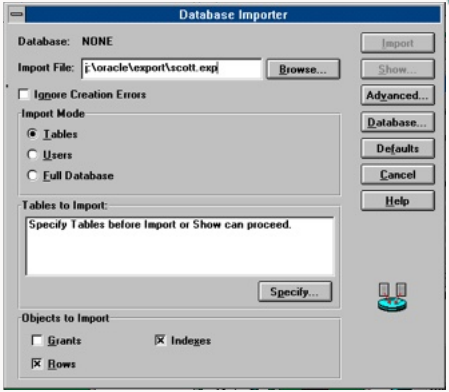


You can export from Oracle V5 and directly into Oracle AI Database 26ai

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Original Export and Import





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The import is the easy part ...

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```
$ sqlplus appuser@db26ai

SQL*Plus: Release 8.1.7.0.0 - Production on Sat Aug 19 16:04:48 2023

(c) Copyright 2000 Oracle Corporation.  All rights reserved.

ERROR:
ORA-28040 No matching authentication procotol error
ORA-03134: Connections to this server version are no longer supported
```


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Client / Server Interoperability Support Matrix

	Server Version																	
Client Version	**23c**	**21c**	**19c**	**18c**	**12.2.0**	**12.1.0**	**11.2.0**	**11.1.0**	**10.2.0**	**10.1.0**	**9.2.0**	**9.0.1**	**8.1.7**	**8.1.6**	**8.1.5**	**8.0.6**	**8.0.5**	**7.3.4**
23c[#11]	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No	No	No	No	No	No	No
21c	Yes	Yes	Yes	Was	Was	Yes[#12]	No	No	No	No	No	No	No	No	No	No	No	No
19c	Yes	Yes	Yes	Was	Was	Yes[#12]	Yes[#9]	No	No	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]
18c	No	Was	Was	Was	Was	Was	Was	No	No	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]
12.2.0	No	Was	Was	Was	Was	Was	Was	No	No	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]
12.1.0	No	Yes[#12]	Yes[#12]	Was	Was	Yes[#12]	Yes[#12]	Was	Was[#7]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]
11.2.0	No	No	Yes[#9]	Was	Was	Yes[#12]	Yes[#9]	Was	Was[#7]	No	Was[#5]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]
11.1.0	No	No	No	No	No	Was	Was	Was	Was[#7]	Was[#6]	Was[#5]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]
10.2.0	No	No[#10]	No[#10]	No[#10]	No[#10]	Was[#7]	Was[#7]	Was[#7]	Was	Was	Was[#5]	No	Was	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]
10.1.0[#4]	No	No	No	No	No	No	Was[#6]	Was[#6]	Was	Was	Was	Was	Was[#2]	No[#3]	No[#3]	No[#3]	No[#3]	No[#3]
9.2.0	No	No	No	No	No	No[#8]	Was[#5]	Was[#5]	Was[#5]	Was	Was	Was	Was	No	No	Was	No	No[#1]
9.0.1	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	No	Was	No	Was
8.1.7	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was	Was	Was	Was
8.1.6	No	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was
8.1.5	No	No	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was
8.0.6	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was	Was
8.0.5	No	No	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was
7.3.4	No	No	No	No	No	No	No	No	No	No	Was	Was	Was	Was	Was	Was	Was	Was

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"If we upgrade our old database to Oracle AI Database 26ai,

can you make it behave as if it was still on the old version?"

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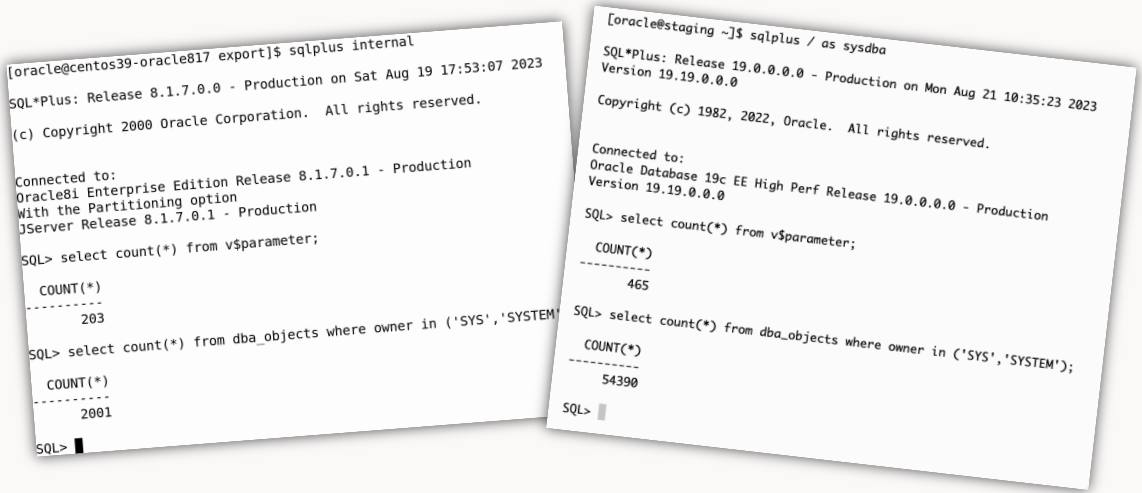
Backward Compatibility

There is no magic parameter!

- `COMPATIBLE` governs the use of new functionality
- `OPTIMIZER_FEATURES_ENABLE` governs the use of new optimizer functionality, but the new code is still used
- But … I bet there is a secret underscore parameter!

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Backward Compatibility



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Perhaps Oracle Autonomous AI Database is the right platform for you

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Demo

DEMO

Migrating from Oracle Database 8i to Autonomous AI Database

Watch on YouTube

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Further Information

Classic Export



- Slide deck: Help! My Database Is Still on 8i!

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GoldenGate

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GoldenGate offers true zero downtime upgrades

- Combined with excellent fallback capabilities and extreme flexibility

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GoldenGate | Benefits

- Suitable for zero or near-zero downtime
- Works across endianness, architecture, character set and releases
- Restructuring of data
- Test on production before go-live
- Offload extract from production using downstream databases
- Reverse replication offers excellent fallback capabilities

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GoldenGate | Considerations

- Strongly recommended to apply GoldenGate bundle patch
- DDL replication complicates migration
- Most but not all data types are supported
- Logical migration requires validation of data
- Doesn't work on CDB level
- Very high redo generation might be too much

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Will it work on my database?

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```
SQL> select * from dba_goldengate_support_mode;

OWNER OBJECT_NAME    SUPPORT_MODE
----- -------------- ------------
CO    CUSTOMERS      ID KEY
CO    ORDERS         FULL
CO    ORDER_ITEMS    FULL
CO    PRODUCTS       NONE
CO    STORES         PLSQL
```


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

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```
SQL> select * from dba_goldengate_not_unique;

OWNER TABLE_NAME                    BAD_COLUMN
----- ------------------------- ----------
IX    AQ$_ORDERS_QUEUETABLE_L     N
IX    AQ$_STREAMS_QUEUE_TABLE_L   N
SH    SALES                       N
SH    COSTS                       N
SH    SUPPLEMENTARY_DEMOGRAPHICS  N
SH    CAL_MONTH_SALES_MV          N
SH    FWEEK_PSCAT_SALES_MV        N
```


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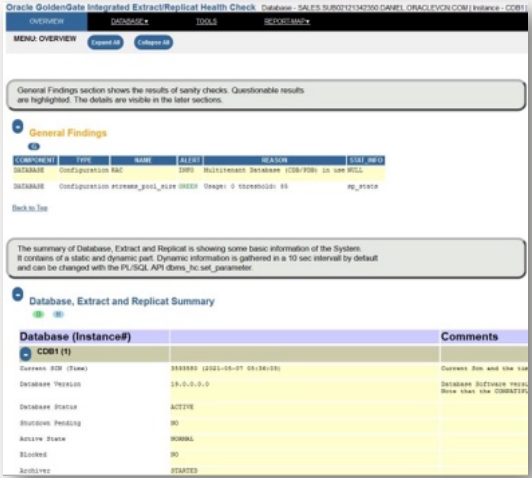
Requires minimal supplemental logging which imposes an insignificant overhead

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GoldenGate | Health Check

Generate report:

- Check prerequisites
- Database characteristics
- Find database objects of interest
- Extract/replicat statistics
- Check database readiness



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OCI GoldenGate offers a very attractive pricing model

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Further Information

GoldenGate



- Webinar: How Low Can You Go? Zero Downtime Operations

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RMAN Restore

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A database can restore backups created by any prior Oracle Database release

- RMAN Compatibility Matrix

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But you must be within the limits of a *direct upgrade*

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Current Release	Upgrade Options
21c, 19c (all releases)	**Direct upgrade is supported.** Perform the upgrade using the current Oracle Database Upgrade Guide, which is this guide.
18c 12.2 12.1.0.2 12.1.0.1 11.2.0.1, 11.2.0.2, 11.2.0.3, 11.2.0.4 11.1.0.6, 11.1.0.7 10.2 or earlier releases	**Direct upgrade to Oracle AI Database is not supported.** **Solution:** Upgrade to an intermediate Oracle Database release that can be directly upgraded to the current release. Upgrade Oracle Database releases that are not supported for direct upgrade in this release to an intermediate Oracle Database release that is supported for direct upgrade. When upgrading to an intermediate Oracle Database release, follow the instructions in the intermediate release documentation, including running the preupgrade scripts for that release. After upgrading to the intermediate release, upgrade to the current Oracle Database release. This restriction does not apply if you use Oracle Data Pump export/import to migrate data to the new release. For example: • Releases 12.2.0.1, 12.2.0.2. 12.2.0.3, 12.2.0.4, 18c: Upgrade to Oracle Database 21c, and then upgrade to Oracle AI Database. • Releases 12.1.0.1, 12.1.0.2, 11.2.0.3, 11.2.0.4: Upgrade to Oracle Database 12c Release 2 (12.2), upgrade to Oracle Database 21c, and then upgrade to Oracle AI Database. **Note:** Always update to the most recent intermediate release to which you can upgrade directly. Your case can be different from that of the examples provided here.

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```
global.global_log_dir=/home/oracle/autoupgrade-logs
upg1.source_home=/u01/app/oracle/product/dbhome_19
upg1.target_version=26
upg1.sid=CDB1
```


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```
global.global_log_dir=/home/oracle/autoupgrade-logs
upg1.source_home=/u01/app/oracle/product/dbhome_19
upg1.target_version=26
upg1.sid=CDB1
```

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


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```
global.global_log_dir=/home/oracle/autoupgrade-logs
upg1.source_home=/u01/app/oracle/product/dbhome_19
upg1.target_version=26
upg1.sid=CDB1
```

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


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```
RMAN> DUPLICATE DATABASE ... NOOPEN ... ;
```


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~~RMAN> DUPLICATE DATABASE ... NOOPEN ... ;~~

```
RMAN> RESTORE DATABASE ... ;
RMAN> RECOVER DATABASE ... ;
```


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~~RMAN> DUPLICATE DATABASE ... NOOPEN ... ;~~

RMAN> RESTORE DATABASE ... ;
RMAN> RECOVER DATABASE ... ;

SQL> ALTER DATABASE OPEN RESETLOGS UPGRADE;

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


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RMAN Restore

Useful when:

- Replacing hardware and/or operating system
- You can't install source and target Oracle home on same machine
- Data Guard is not an option

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Also works on a single PDB

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Further Information

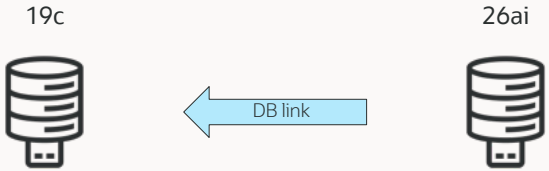
RMAN Restore

- Blog post: Upgrade Oracle Database 11g to 19c Using RMAN Incremental Backups
- Blog post: RMAN NOOPEN Clause DUPLICATE FOR UPGRADE
- MOS: Upgrade using RMAN Duplicate with Noopen clause and Backup Location (KB125924)
- Documentation: Duplicating a PDB to an Existing CDB by Using Active Duplication
- Documentation: Transport a PDB Using Multiple Incremental Backups In NOCATALOG Mode

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CTAS
DB Link

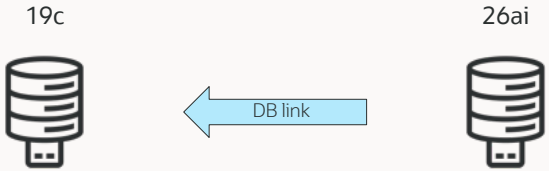
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```
CREATE TABLESPACE ... ;
CREATE USER ... ;
GRANT CONNECT, RESOURCE ... ;
ALTER USER ... QUOTA ... ;

...
```

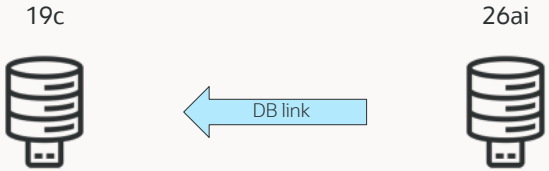

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```
CREATE TABLE t1 AS SELECT t1@dblink;
CREATE TABLE t2 AS SELECT t2@dblink;
CREATE TABLE t3 AS SELECT t3@dblink;

...
```


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```
CREATE INDEX ... ;
ALTER TABLE ADD CONSTRAINT ... ;
GRANT SELECT ON ... ;
CREATE VIEW ... ;
CREATE PACKAGE ....;

...
```


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CTAS over DB Link

- Suitable for small, simple databases
- Complex restructuring of data
- Cross-platform, cross-endian, cross-architecture
- Cross-release (but within the limits of client/server interoperability)

- Error prone
- Manually needs to rebuild indexes and other dependent objects
- Data Pump is a better option

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Clients

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Don't forget your clients

- Ensure they are compatible with Oracle AI Database 26ai

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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

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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

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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

Security Updates

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April 29, 2026 | 3 [illegible] read

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

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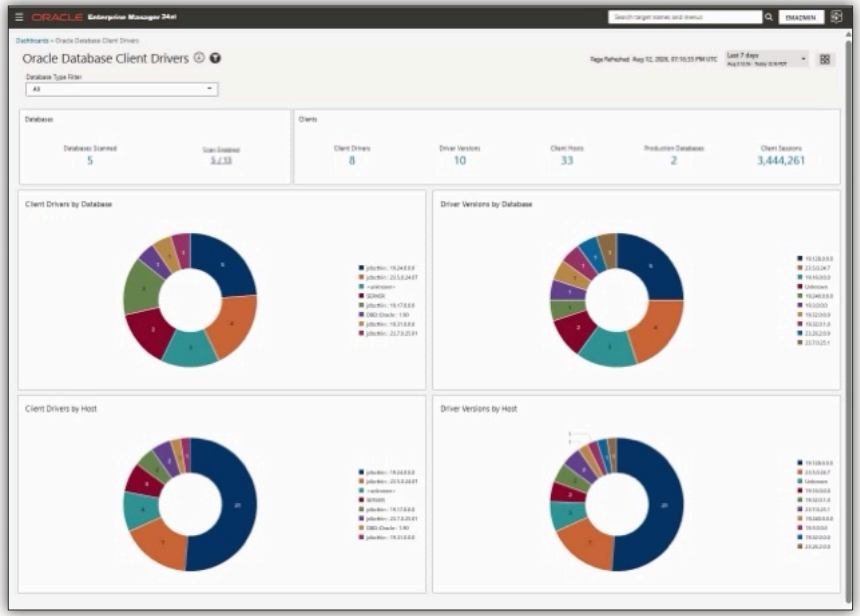
If you must use a 19c driver, update to the latest version

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```
--List current connections and their driver details
--Join to gv$session for more details.

select * from gv$session_connect_info;
```


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The same certification matrix applies to database links as well

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Read the documentation for instructions

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Further Information

Client / Server Interoperability



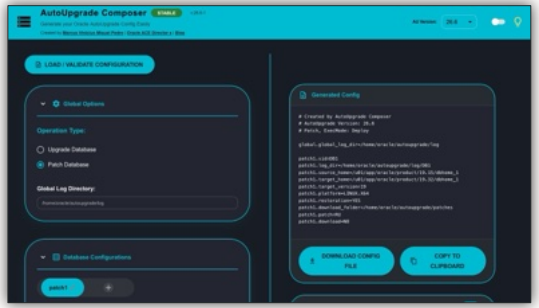
- Client / Server Interoperability Support Matrix (KB141043)
- Blog post: Are Your Oracle Database Clients Ready for the next Database Upgrade?
- Blog post: Oracle Enterprise Manager 24ai RU11: Introducing the Oracle Database Client Drivers Dashboard

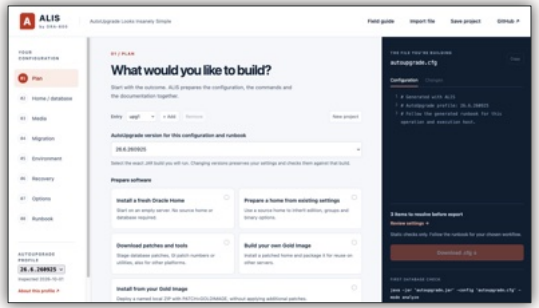
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That's a lot of

CONFIG FILE PARAMETERS

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AutoUpgrade Composer

https://autoupgrade-composer.com

ALIS

https://ora600pl.github.io/alis

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Marcus Vinicius Miguel Pedro

ACE Director



Kamil Stawiarski

ACE Director

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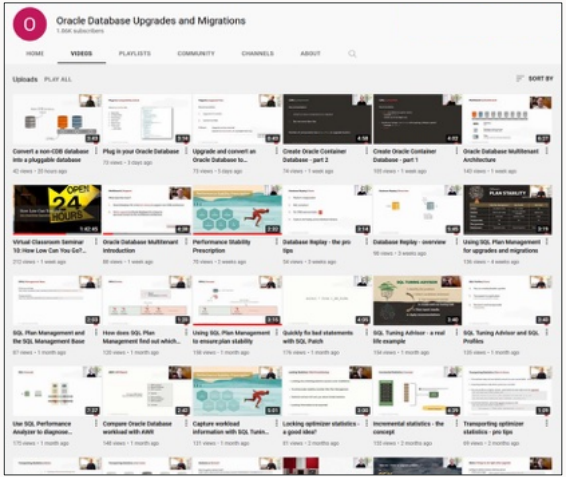
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DBAs

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

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