



Oracle Database Upgrade and Migration Best Practices

For Oracle Database 23ai

Safe Harbor Statement

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The development, release, timing, and pricing of any features or functionality described for Oracle's products may change and remains at the sole discretion of Oracle Corporation.



\$ who -u



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20+ years in IT Industry

- Cloud Architect
- Database Administrator
- EBS Applications DBA
- Support Engineer
- Partner Enablement



 /alexandre-b-fagundes

Database Upgrade and Migration

Moving successfully to Oracle Database 23ai

Honour where Honour is due



MIKE DIETRICH

Senior Director Product Management
Database Upgrade, Migrations & Patching

 mikedietrich

 @mikedietrichde

 <https://mikedietrichde.com>



DANIEL OVERBY HANSEN

Senior Principal Product Manager
Database Upgrade, Migrations & Patching

 dohdatabase

 @dohdatabase

 <https://dohdatabase.com>



Find much more slides and much more information on their blogs

MikeDietrichDE.com

The screenshot shows the homepage of MikeDietrichDE.com. At the top, there's a banner with three cards: "June 2023 version of A...", "Going to India: Oracle C...", and "ORAdiff is live – compa...". Below the banner, a large image of a person wearing a beanie and sunglasses is displayed. A headline reads "Restricted Upgrade Support added for several releases of Oracle Database". Below the headline, it says "Posted on August 23, 2023 by Mike.Dietrich" and "Release Schedule". A note at the bottom says "You may have read my blog post from yesterday about the additional second year of Waived Extended Support for Oracle Database 19c. But there are more news such as Restricted Upgrade Support added for several releases of Oracle Database."

DOHdatabase.com

The screenshot shows the homepage of DOHdatabase.com. The header features a background image of a mountain landscape with a small circular profile picture of a man. The title "Databases Are Fun" is prominently displayed, along with the URL "dohdatabase.com" and social media links. Below the header, there's a navigation bar with links to "Blog", "Webinars", "Slides", "Videos", "Categories", and "About". The main content area has a section titled "Blog" with a sub-section "Sign up for Our Sessions at Oracle DatabaseWorld at CloudWorld". It includes a note about the session catalog being ready and a "Follow" button.

What the manual says | Steps for upgrading your database

1. Prepare to upgrade
2. Test the upgrade process
3. Test the upgraded database(s)
4. Prepare and preserve the Production database
5. Upgrade the Production database
6. Tune and adjust the new Production database



Step 1 | Prepare to upgrade the database

Become familiar with the features of the new release of Oracle Database.

Determine the upgrade path to the new release.

Select an upgrade method.

Select an Oracle home directory for the new release.

Develop a testing plan.

Prepare a backup strategy.

Follow preupgrade recommendations.

Run UTLRP.sql

Run preupgrade fixups, or carry out manual preupgrade system updates.



Step 2 | Test the upgrade process

Perform a test upgrade using a test database|

- Conduct the test upgrade in an environment created for testing that does not interfere with the production database|
- Oracle recommends that your test environment is on a server that is, as much as possible, a replica of your production environment|

For example: Oracle recommends that the server uses

- The same operating system
- The same patch level on both database and OS level
- The same packages installed
- Any other details of your production system configuration



Step 3 | Test the upgraded test database

Perform the tests that you planned in Step 1 on the test database

- Review the results, noting anomalies in the tests
- Investigate ways to correct any anomalies that you find and then implement the corrections

Repeat Step 1, Step 2, and the first parts of Step 3

- Until the test upgrade is successful and works with any required applications

If needed, use SQL Plan Management to correct anomalies

- We will discuss SQL Plan Management in a later section of this presentation



Step 4 | Prepare and preserve the Production Database

Complete the following tasks before you upgrade your existing production database:

- Prepare the current production database as appropriate to ensure that the upgrade to the new release of Oracle Database is successful.
- Schedule the downtime required for backing up and upgrading the production database.
- Back up the current production database

Think about a fallback strategy or at least

- Test your backup strategy, and ensure that it works.
- If you need a backup strategy, then plan for the time required to apply it during your maintenance window.
- To perform plan stability checks in preparation for upgrade and carry out SQL plan management.

We will discuss Fallback Strategies in a later section of this presentation



Step 5 | Upgrade the Production Database

Upgrade the production database to the new release of Oracle Database.

- Execute the same steps as tested on the test environment

After the upgrade

- Perform the post-upgrade steps as indicated by the manual
- Perform a full backup of the production database



Step 6 | Tune and adjust the new Production database

Tune the new production database for the new release|

- Typically, the new production Oracle Database performs to the same standards, or better

Determine which features of the new Oracle Database release that you want to use

- And update your applications accordingly

Develop new database administration procedures as needed based on new options

- Pluggable database Standby
- Refreshable clones



Prepare our hands-on



We will use Oracle LiveLabs

Showcasing how Oracle's solutions solve your business problems



3+ million

people have
already visited
LiveLabs

435+

free workshops,
available or in
development

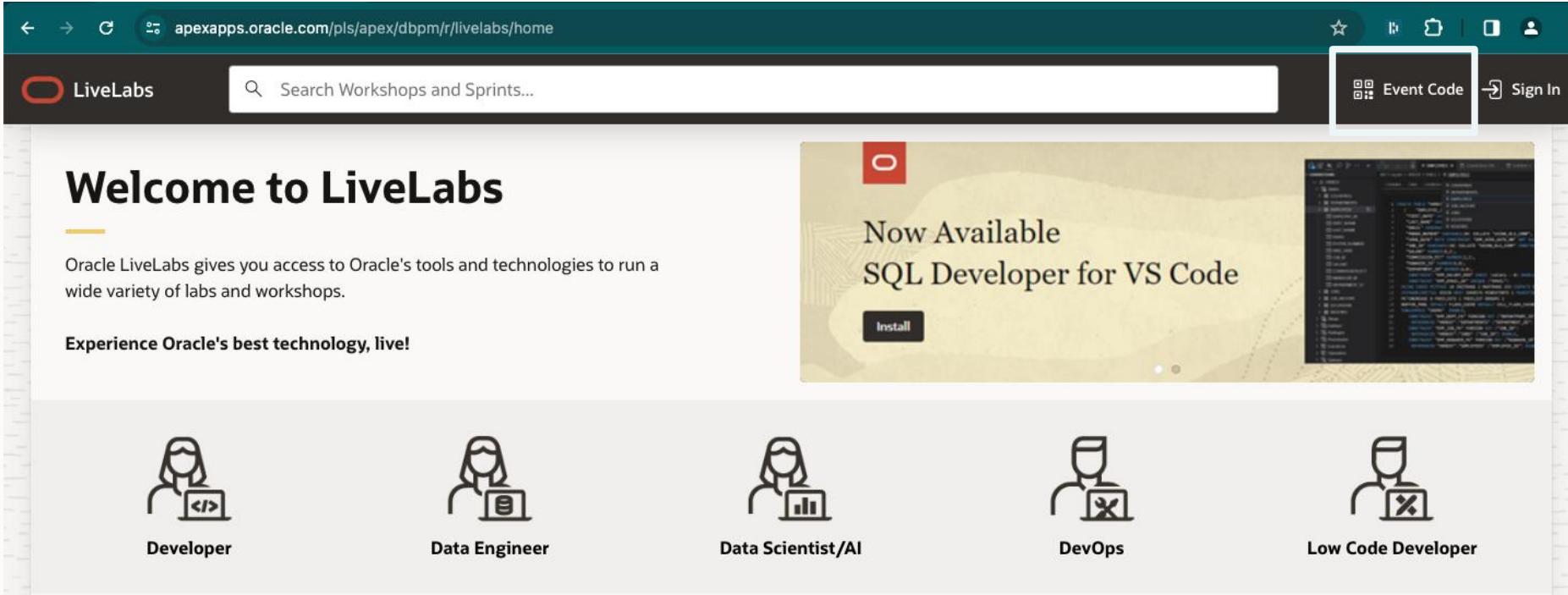
1.5k+

events run
using LiveLabs
workshops

Head over to
**developer.oracle.com/
livelabs**
and learn something
new ...at your pace!

How to start your environment

Navigate to <https://developer.oracle.com/livelabs>



The screenshot shows the Oracle LiveLabs homepage. At the top, there's a navigation bar with a back/forward button, a search bar containing "apexapps.oracle.com/pls/apex/dbpm/r/livelabs/home", and a "LiveLabs" logo. To the right of the search bar are "Event Code" and "Sign In" buttons. A red curved arrow points from the text "click on Event Code" to the "Event Code" button. Below the navigation bar, the main content area has a heading "Welcome to LiveLabs". It includes a paragraph about Oracle LiveLabs providing access to tools and technologies for various labs and workshops, followed by the text "Experience Oracle's best technology, live!". To the right of this text is a promotional banner for "SQL Developer for VS Code", featuring an "Install" button and a screenshot of the software interface. Below the welcome section are five icons representing different developer profiles: "Developer" (person with laptop), "Data Engineer" (person with database icon), "Data Scientist/AI" (person with chart icon), "DevOps" (person with server icon), and "Low Code Developer" (person with code editor icon).

click on Event Code



Event Code

Event Code: 08083-HMOK-PICY

Direct URL: <https://apexapps.oracle.com/pls/apex/dbpm/r/livelabs/view-workshop?wec=08083-HMOK-PICY>

Moving successfully to Oracle Database 23ai

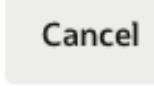
Fill in the supplied Event code

1 
Enter the supplied
event code by your host

Enter Event Code 

If you've been provided with an event code by Oracle, enter it below

Event Code Required

Press Submit to continue 

2

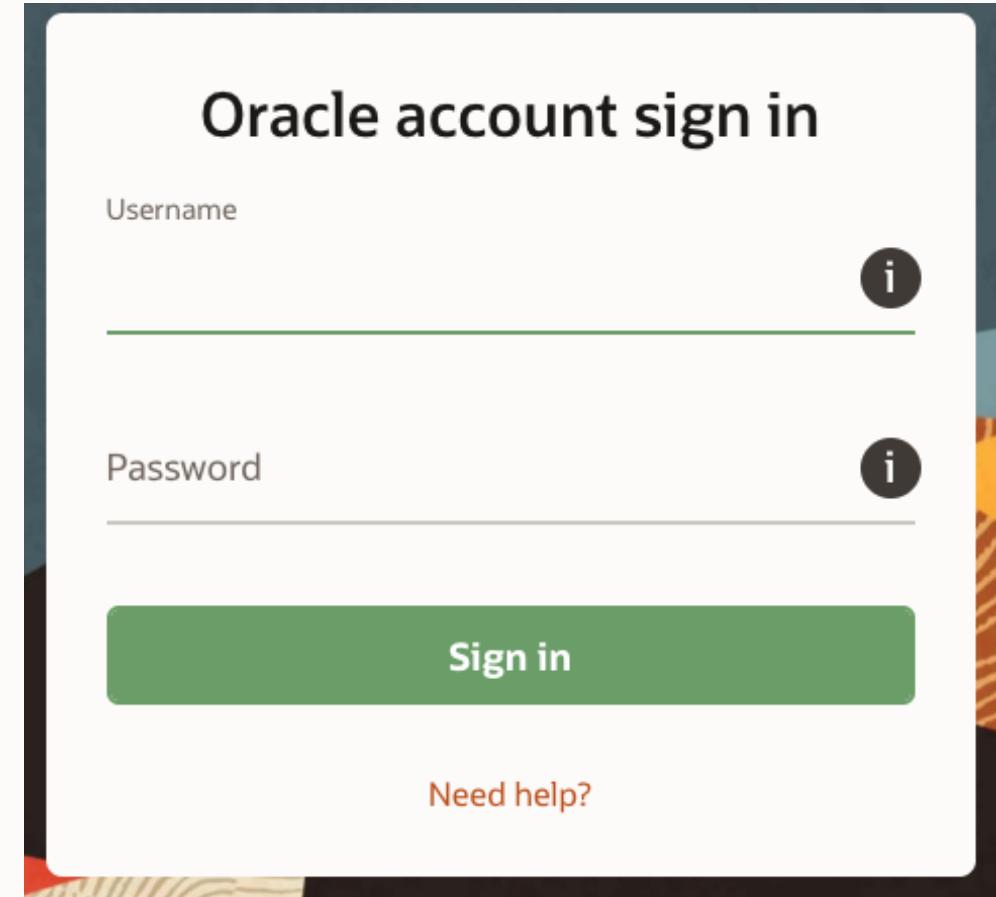


Login if needed

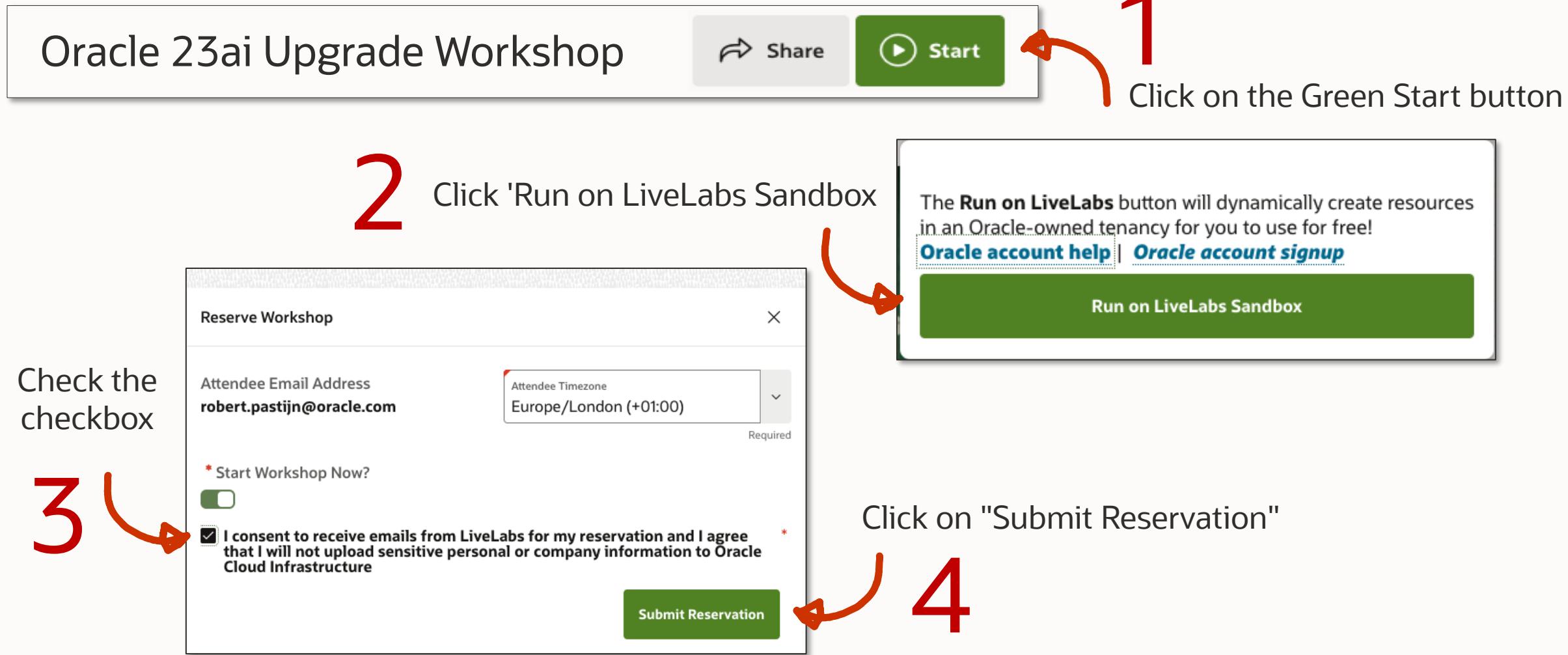
Use your Oracle SSO username and password

- This is the same username and password as MyOracle Support and other Oracle sites
- If you do not have an account, you can create one on this page

Of course, press Sign in to continue



Click on the Green buttons



The Livelabs Reservations Status Page

My Reservations

All your current workshop reservations are shown below. You can edit active or pending reservations, view workshop details, attend an available workshop, or delete a reservation.

Note: The status of your reservations will be emailed to you. Check your mail for any status updates.

Database 23c ai Upgrade (PTS Version)
Monday April 8th, 2:48pm (14:48) Europe/London 

Launch Workshop  

Reservation submitted 

To access this page again click the user dropdown in the top right corner and select **My Reservations**

After an automatic refresh, the Click on the "Launch Workshop" page will show you the Button to continue to your remaining time until the workshop environment environment is ready

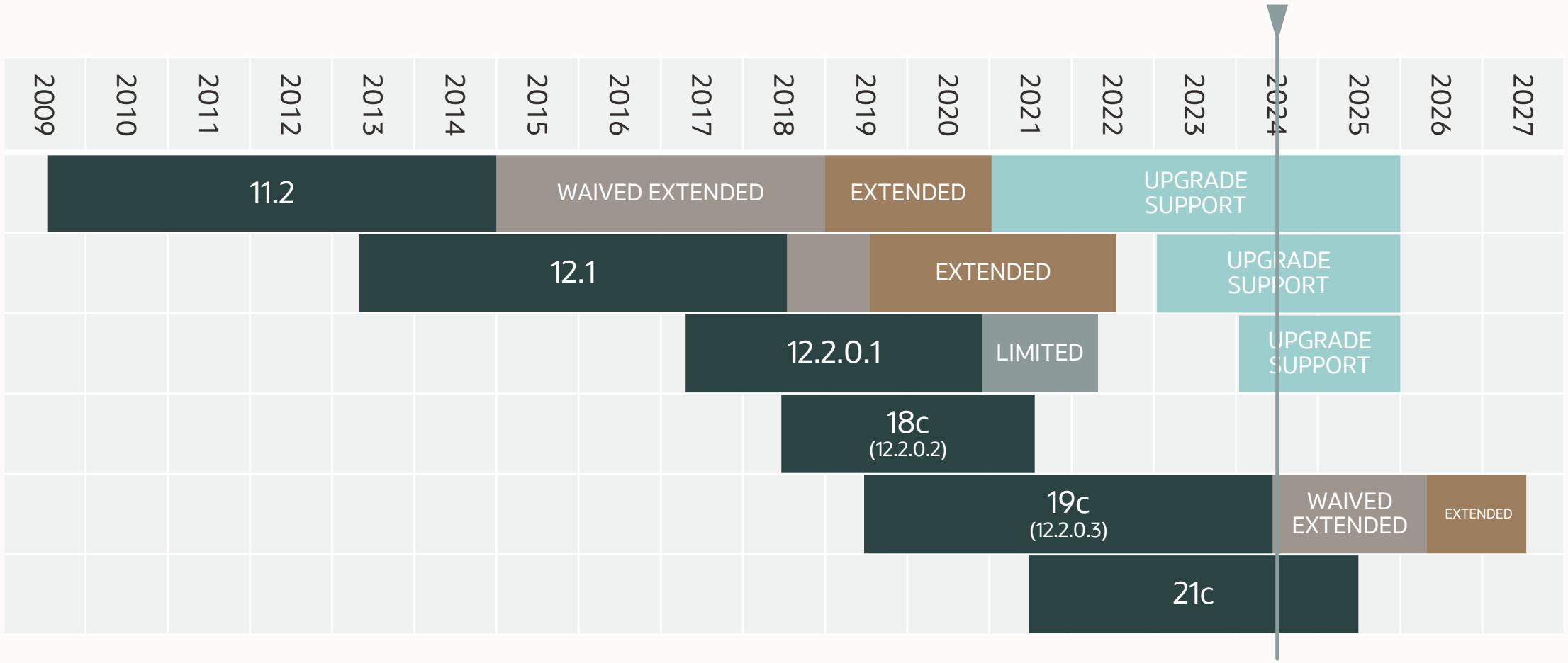
Before upgrade

How to upgrade and convert

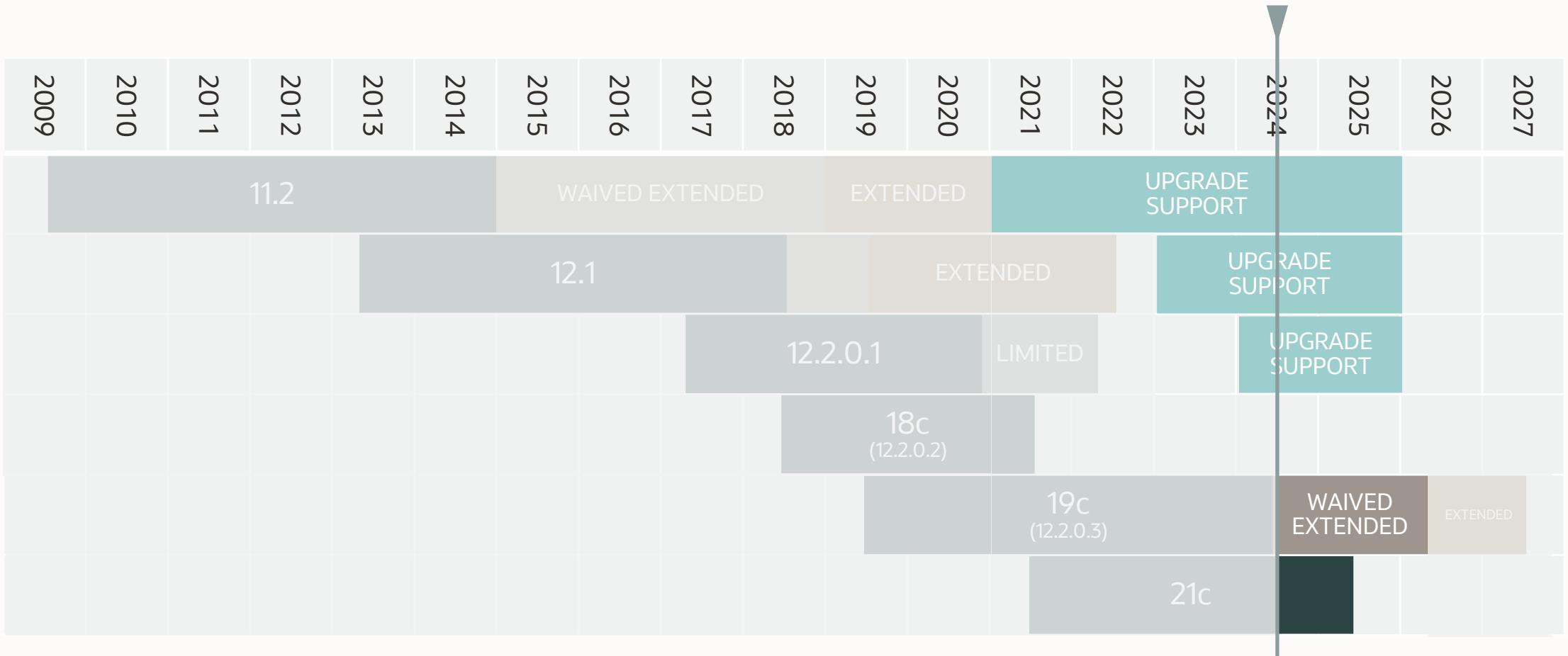
After upgrade



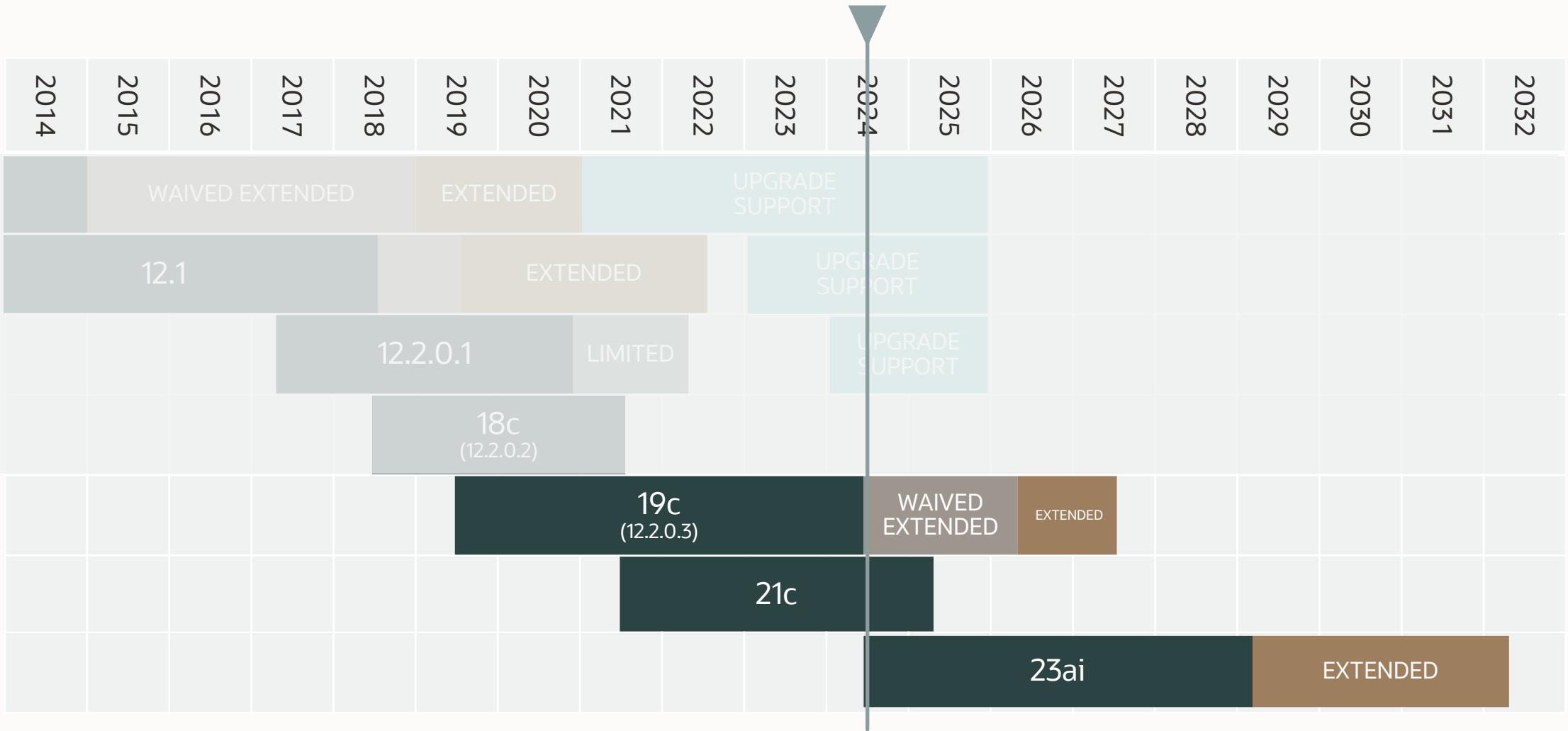
Lifetime Support Policy



Lifetime Support Policy



Lifetime Support Policy





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

- Release Schedule of Current Database Releases
(Doc ID [742060.1](#))

Next Long Term Support release

Oracle Database 23ai

Upgrade possible only from:

- Oracle Database 19c
- Oracle Database 21c



Do you want to upgrade?

Oracle Database 11.2.0.4

Oracle Database 12.1.0.2

Oracle Database 12.2.0.1

Oracle Database 18c



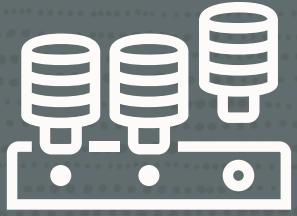
Oracle Database 11.2.0.4
Oracle Database 12.1.0.2
Oracle Database 12.2.0.1
Oracle Database 18c



Oracle Database 19c



Oracle Database 23ai



Oracle Database 23ai supports
the multitenant architecture only

- You must convert your database to a PDB

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

```
alter system set max_pdbs=3;
```





Ensure your clients can connect to Oracle Database 23ai

- Upgrade your clients well in advance of the upgrade

Client / Server Interoperability

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

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



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

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





On important databases,
execute a dictionary check before upgrade

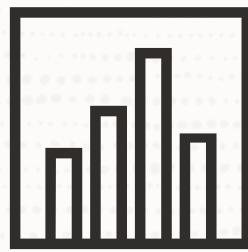
- Formerly known as *Health Check*
- MOS Doc ID [136697.1](#)

```
upg1.sid=DB19  
upg1.source_home=/opt/oracle/product/19c  
upg1.target_home=/opt/oracle/product/23ai  
upg1.target_cdb=CDB1  
upg1.run_dictionary_health=full  
#To run only the critical checks  
#upg1.run_dictionary_health=critical
```

```
upg1.sid=DB19
upg1.source_home=/opt/oracle/product/19c
upg1.target_home=/opt/oracle/product/23ai
upg1.target_cdb=CDB1
upg1.run_dictionary_health=full
#To run only the critical checks
#upg1.run_dictionary_health=critical
```

```
dbms_dictionary_check on 05-SEP-2023 09:41:30
-----
Catalog Version 19.0.0.0.0 (1900000000)
db_name: DB19
Is CDB?: NO
Trace File: /opt/oracle/diag/rdbms/db19/DB19/trace/DB19_ora_25104_DICTCHECK.trc
          Catalog      Fixed
Procedure Name          Version   Vs Release   Timestamp   Result
-----  ...  -----
.. OIDOnObjCol          ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
.. LobNotInObj          ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
.. SourceNotInObj       ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
.. OversizedFiles        ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
.. PoorDefaultStorage    ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
.. PoorStorage           ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
*** 2023-09-05T09:41:30.934258+00:00
PASS
.. TabPartCountMismatch  ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
.. TabComPartObj         ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
.. Mview                 ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
.. ValidDir              ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
.. DuplicateDataobj      ... 1900000000 <= *All Rel* 09/05 09:41:30
PASS
.. ObjSyn                ... 1900000000 <= *All Rel* 09/05 09:41:31
PASS
.. ObjSeq                ... 1900000000 <= *All Rel* 09/05 09:41:31
PASS
```





Ensure dictionary and fixed objects statistics are accurate

- Save downtime by gathering in advance

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



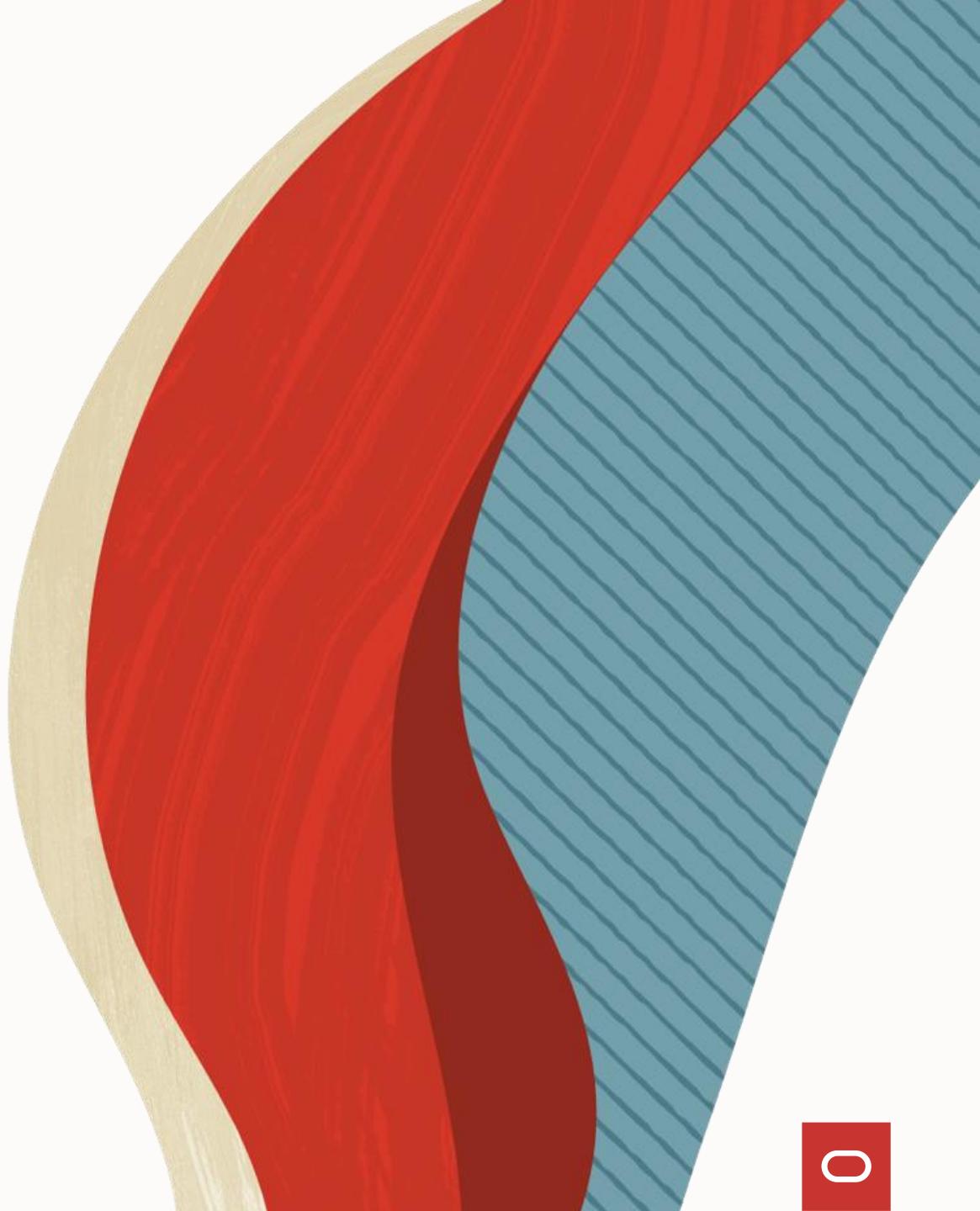
```
begin
    dbms_stats.gather_schema_stats('SYS');
    dbms_stats.gather_schema_stats('SYSTEM');
    dbms_stats.gather_fixed_objects_stats;
end;
/
```

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

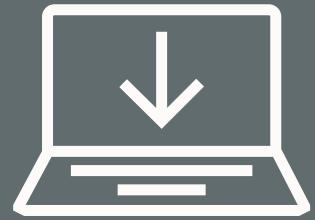
Before upgrade

How to upgrade and convert

After upgrade



How Do You Start?



Installation

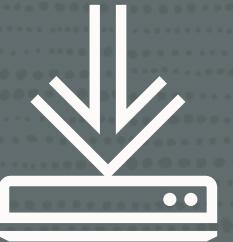
Download and install
Oracle Database 23ai



Container Database



AutoUpgrade



Installation of Oracle Home is simpler

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



Simplified Installation

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



Simplified Installation

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

Simplified Installation

1

Download software

2

Unzip



3

Install



Fully updated
Oracle Home



In Oracle Database 23ai an Oracle Home
is read-write by default

- Reverting behavior change from Oracle Database 21c
- Read-only Oracle Home is now an optional configuration



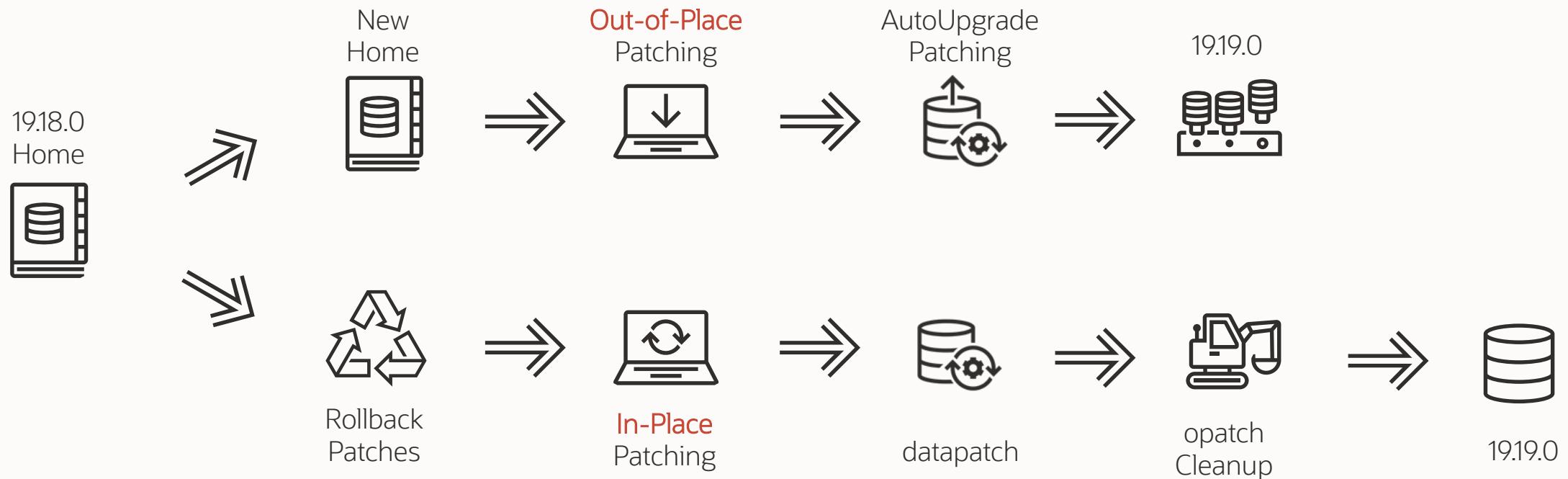
Use Out-Of-Place Patching

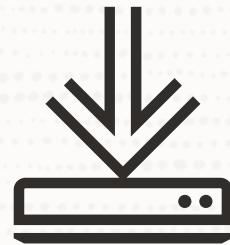
- Minimize downtime
- Minimize risk during outage
- Easier rollback

Exercise Patching?

Use our Patch Me If You Can LiveLabs

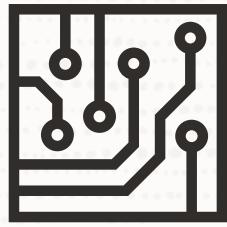
- <https://apexapps.oracle.com/pls/apex/dbpm/r/livelabs/view-workshop?wid=3740>





23ai GI home disk space
greatly reduced to 3 GB

- 12 GB in 19c



Use golden images

- [Blog post](#)



Keep GI and DB patch levels in synch

- This is what we test and run in our Cloud



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

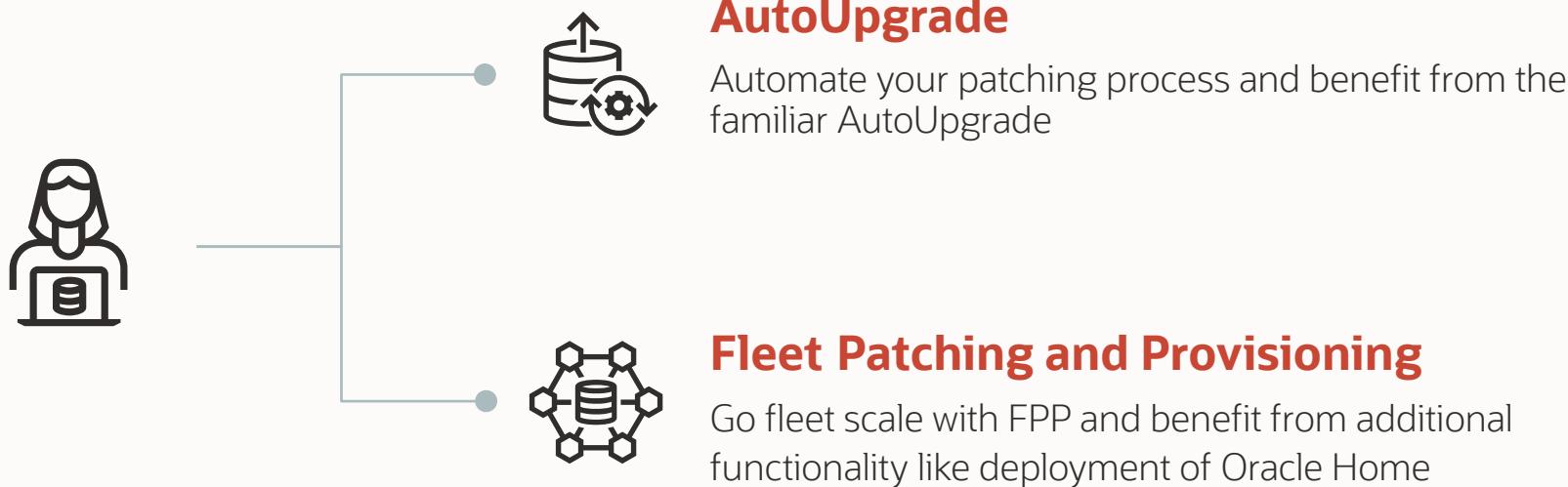
AutoUpgrade functionality extended to patching

```
$ cat DB23.cfg
```

```
patch1.source_home=/u01/app/oracle/product/23/dbhome_23_4_0  
patch1.target_home=/u01/app/oracle/product/23/dbhome_23_5_0  
patch1.sid=DB23
```

```
$ java -jar autoupgrade.jar -config DB23.cfg -mode deploy
```

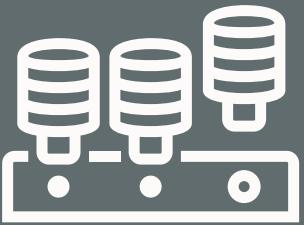
Fleet Patching



How Do You Start?



Installation



Container Database

Create a new CDB in
Oracle Database 23ai



AutoUpgrade

Create Container Database



1 Character set

2 Components

3 COMPATIBLE

Create Container Database

1

Character set

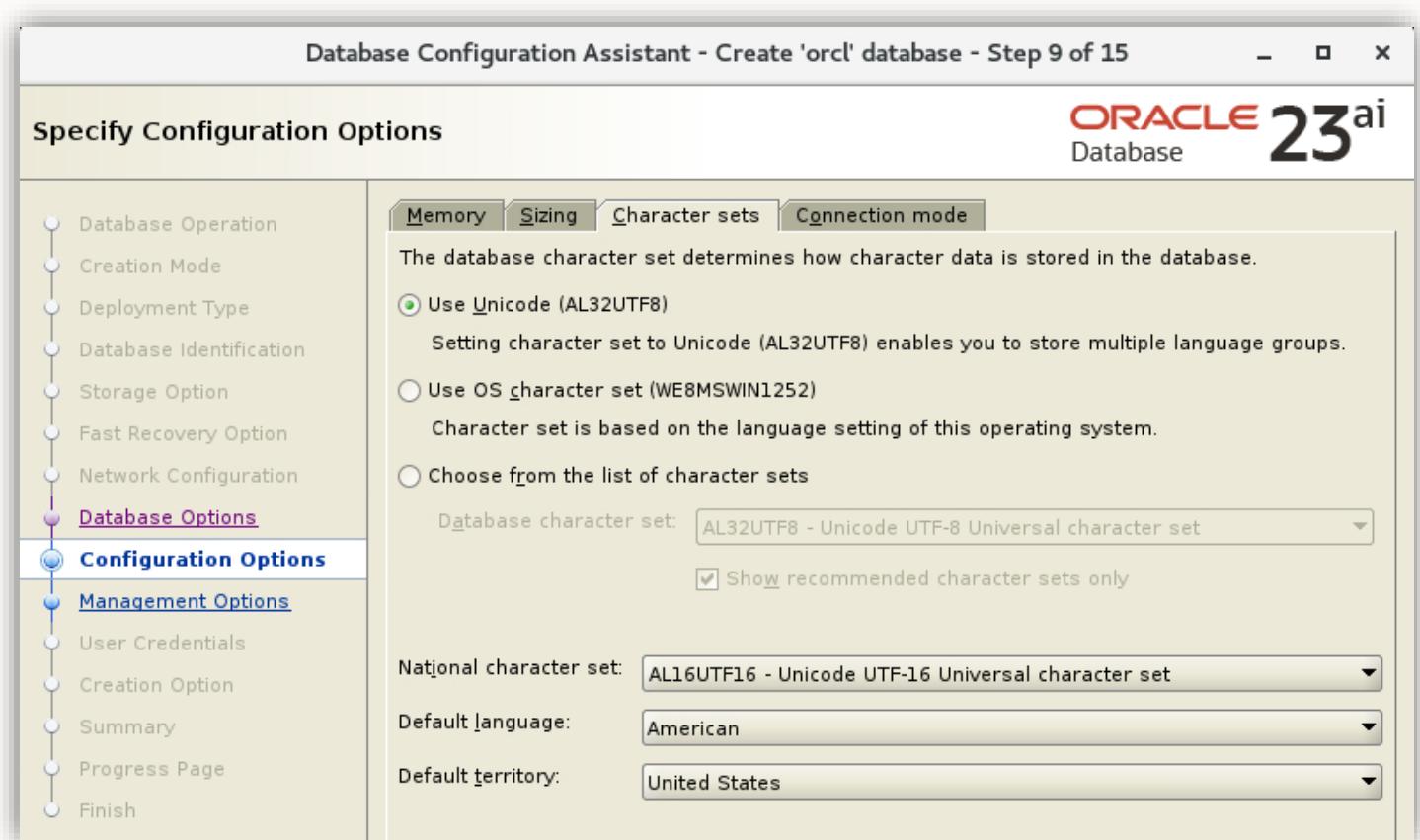
- Always choose AL32UTF8
- Allows PDBs with any character set

2

Components

3

COMPATIBLE



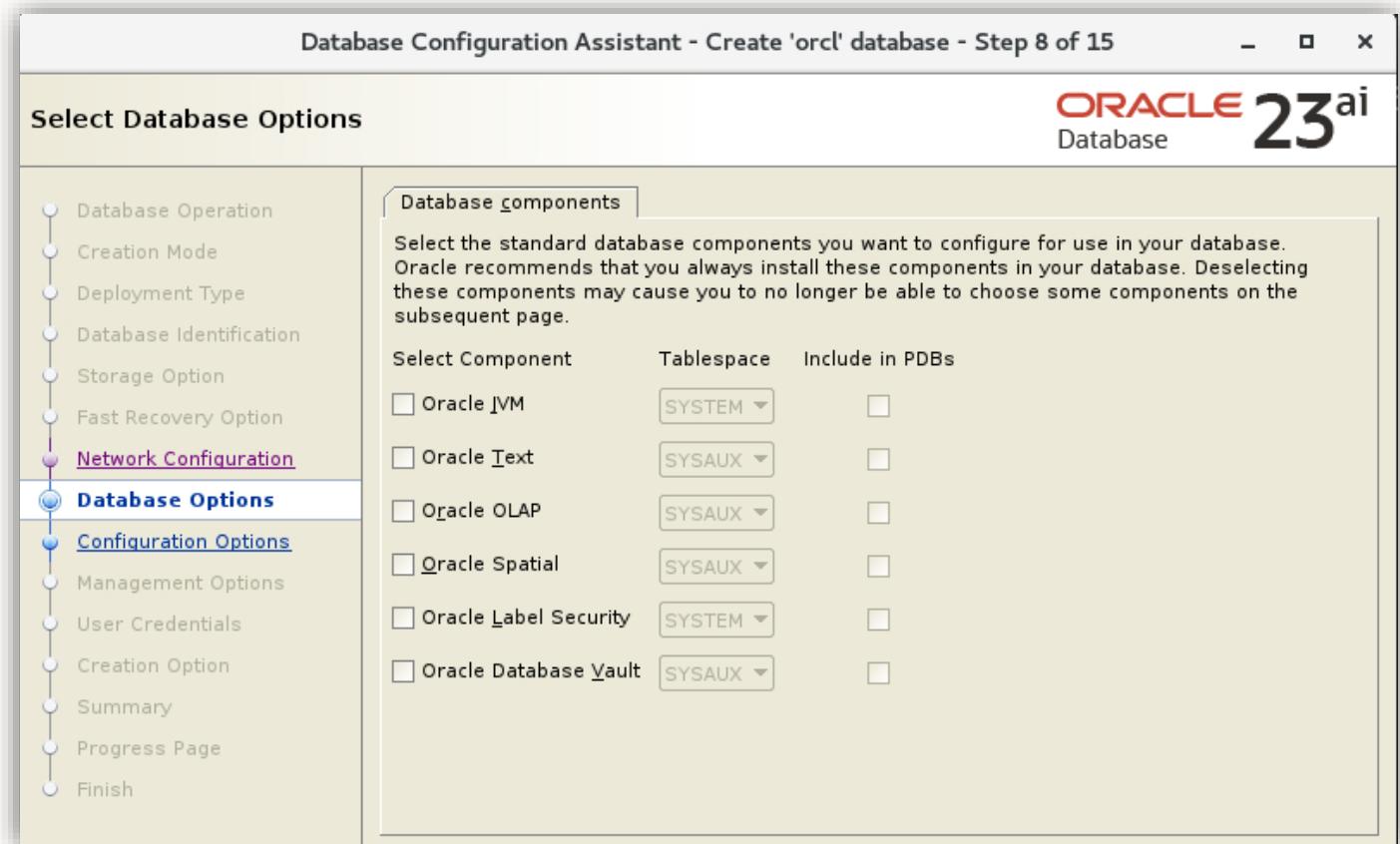
Create Container Database

1 Character set

2 Components

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

3 COMPATIBLE



Create Container Database

1 Character set

2 Components

3 COMPATIBLE

- Keep at the default setting, 23.0.0
- Unless you want the option of downgrade

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

Description:

compatible: Allows you to use a new release, while at the same time guaranteeing backward compatibility with an earlier release.
Range of Values: Default to current release. Default Value: Release dependent

--Allows CDB views to include information on PDB\$SEED objects.
--By default, such information is hidden.

--https://mikedietrichde.com/2017/07/21/why-exclude_seed_cdb_view-is-now-an-underscore-in-oracle-12-2/

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



How Do You Start?



Installation



Container Database



AutoUpgrade

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



Always download
the latest version of AutoUpgrade

- My Oracle Support Doc ID 2485457.1

```
$ java -jar autoupgrade.jar -version
```

```
build.version 24.3.240419
```

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

```
build.hash a1ea950cc
```

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

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

```
build.type production
```

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



Flow

1

Plug in

2

Upgrade

3

Convert



23^{ai}

Demo

Upgrade to Oracle Database 23ai

- Using AutoUpgrade
- Including PDB conversion

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

```
VERSION_FULL
```

```
-----
```

```
23.4.0.24.05
```

Non-CDB to PDB conversion is irreversible

What are your rollback options?

ROLLBACK



Backup / restore

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

Copy data files

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

ROLLBACK



Backup / restore

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

Copy data files

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

Refreshable clone

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

Requires Oracle Database 12.2 or newer

Refreshable Clone



CREATE

Create PDB from non-CDB over a database link



REFRESH

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



OUTAGE

Disconnect users and refresh PDB for the last time

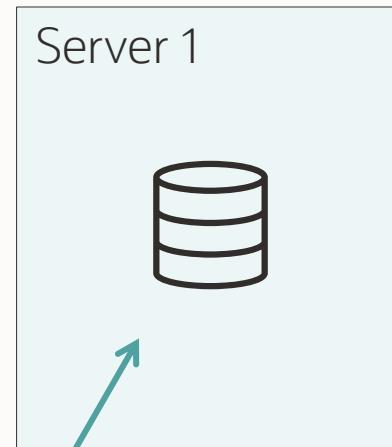


CONVERT

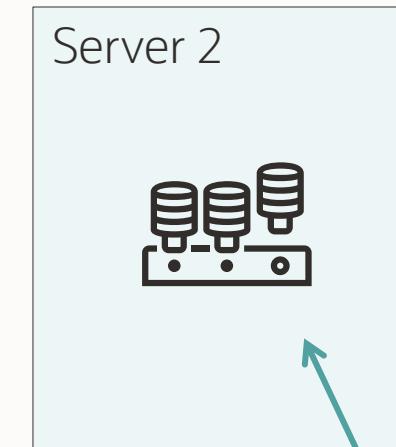
To become a proper PDB, it must be converted

Refreshable Clone

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



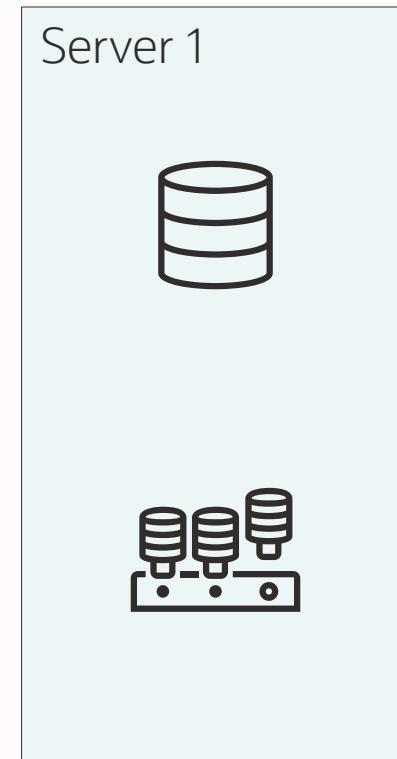
Source
non-CDB



Target
CDB

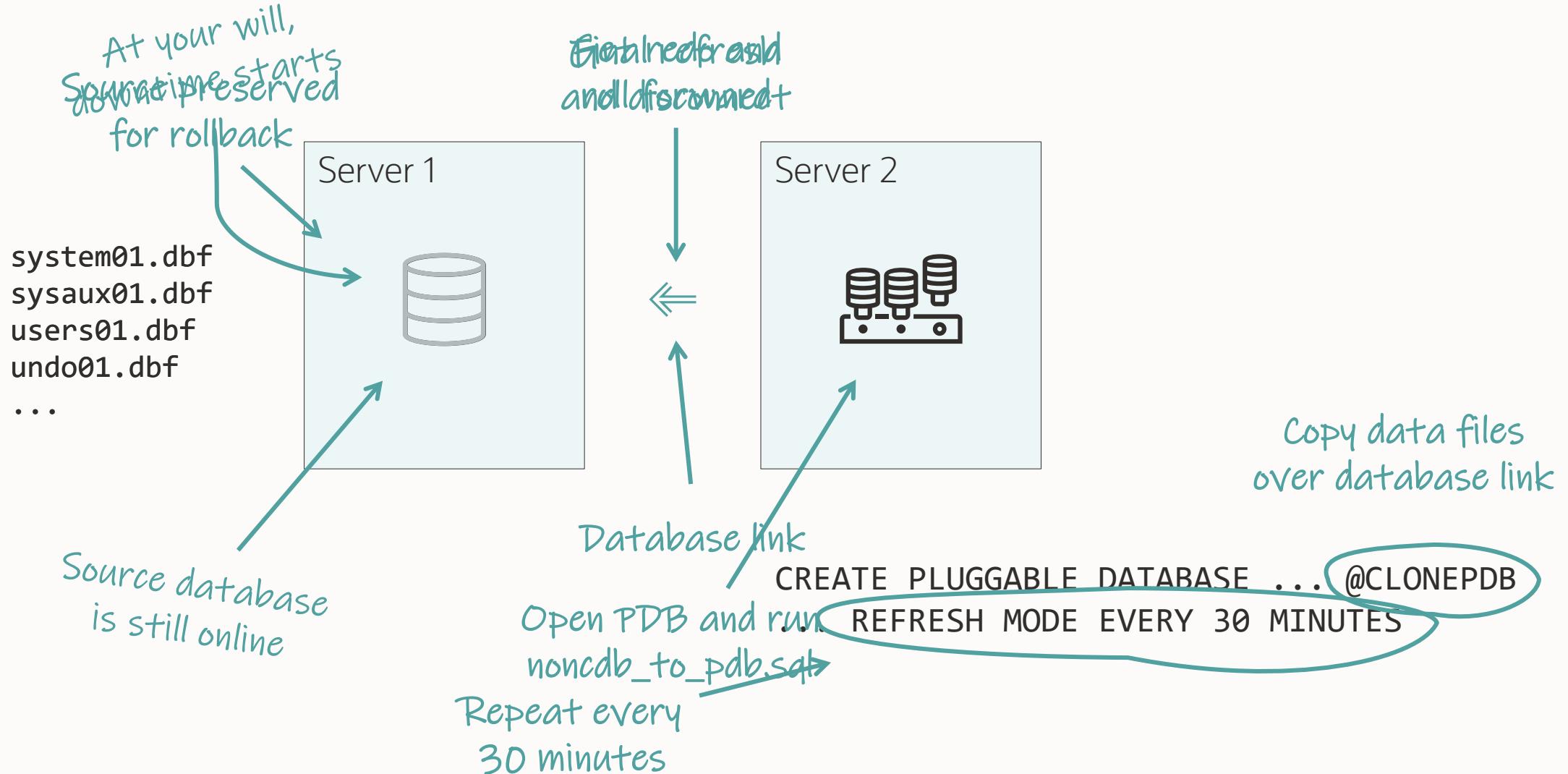
Refreshable Clone

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



Could be same
server as well

Refreshable Clone

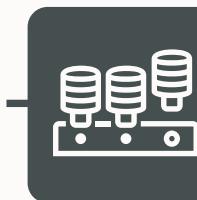


Refreshable Clone

Source non-CDB



Target CDB



```
CREATE USER dblinkuser  
    IDENTIFIED BY ... ;  
  
GRANT CREATE SESSION,  
    CREATE PLUGGABLE DATABASE,  
    SELECT_CATALOG_ROLE TO dblinkuser;  
  
GRANT READ ON sys.ENC$ TO dblinkuser;
```

```
CREATE DATABASE LINK CLONEPDB  
    CONNECT TO dblinkuser  
    IDENTIFIED BY ...  
    USING 'noncdb-alias';
```



You can drop user and database link
after migration



Refreshable Clone

Source non-CDB

Target CDB



```
upg1.source_home=/u01/app/oracle/product/12.2.0.1  
upg1.target_home=/u01/app/oracle/product/19  
upg1.sid=NONCDB1  
upg1.target_cdb=CDB1  
upg1.source_dblink.NONCDB1=CLONEPDB  
upg1.target_pdb_name.NONCDB1=PDB1
```

Refreshable Clone

Source non-CDB

Target CDB



```
upg1.source_home=/u01/app/oracle/product/12.2.0.1  
upg1.target_home=/u01/app/oracle/product/19  
upg1.sid=NONCDB1  
upg1.target_cdb=CDB1  
upg1.source_dblink.NONCDB1=CLONEPDB 300  
upg1.target_pdb_name.NONCDB1=PDB1
```

Refreshable Clone

Source non-CDB

Target CDB



```
upg1.source_home=/u01/app/oracle/product/12.2.0.1  
upg1.target_home=/u01/app/oracle/product/19  
upg1.sid=NONCDB1  
upg1.target_cdb=CDB1  
upg1.source_dblink.NONCDB1=CLONEPDB 300  
upg1.target_pdb_name.NONCDB1=PDB1  
upg1.start_time=18/05/2024 02:00:00  
--Specify relative start time  
--upg1.start_time=+1h30m
```

Refreshable Clone

Source non-CDB

Target CDB



```
upg1.source_home=/u01/app/oracle/product/12.2.0.1  
upg1.target_home=/u01/app/oracle/product/19  
upg1.sid=NONCDB1  
upg1.target_cdb=CDB1  
upg1.source_dblink.NONCDB1=CLONEPDB 300  
upg1.target_pdb_name.NONCDB1=PDB1  
upg1.start_time=18/05/2024 02:00:00  
upg1.parallel_pdb_creation_clause=4
```



Refreshable Clone

1

Run on source

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

2

Run on target

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



Refreshable Clone

1.
PDB
is created

2.
Data files
are copied

3.
Redo is
applied

4.
Final refresh

5.
Disconnect
and convert

autoupgrade.jar ... -mode deploy

upg1.start_time=18/05/2024 02:00:00



Works for unplug-plug upgrades as well



You can also migrate with
Data Pump or Transportable Tablespaces

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

Data Pump Top Tips

Supercharge data loading/unloading



Always use
Data Pump Bundle Patch



Almost 200 functional
and performance fixes

- Data Pump Recommended Proactive Patches For 19.10 and Above (Doc ID [2819284.1](#))

Importing a complete application with data drops from almost 2.5 hours to 48 minutes – by just applying the Data Pump bundle patch

A global provider of financial services



Always convert to
SecureFile LOBs

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

impdp ... transform=lob_storage:securefile





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

- Alternatively, trick Data Pump with fake stats



Boost performance even more
with partitioning



Do you still have BasicFile LOBs?

- Use DIY parallelism during export
- Be sure to convert to SecureFile LOB on import



Use parallel and multiple dump files



--Apply parallelism by simply specifying a degree

expdp ... parallel=8

--Use different parallel degree on import

impdp ... parallel=32

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

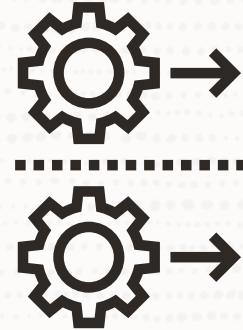
--Split dump files into minor files for easier transport
expdp ... parallel=8 dumpfile=exp%L.dmp **filesize=10G**

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

expdp ... checksum=yes

**impdp ... verify_checksum=yes
verify_only=yes**



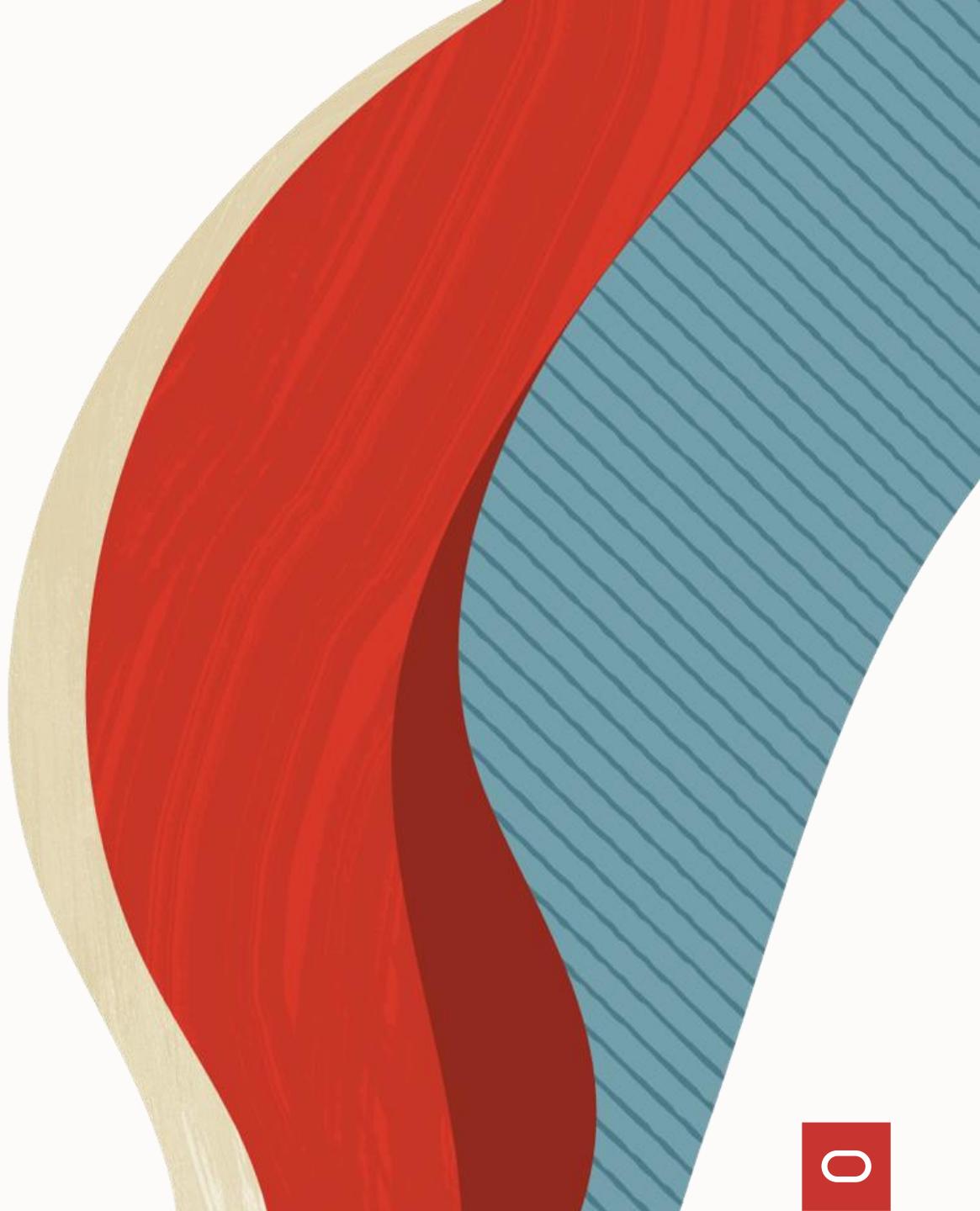


Set parallel to 2 x physical cores
or number of OCPUs

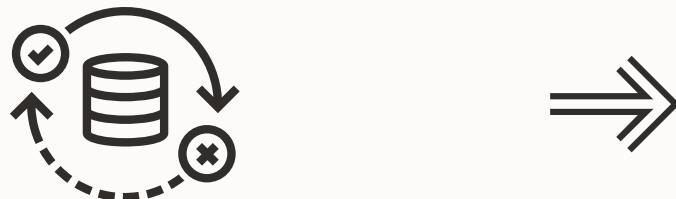
Before upgrade

How to upgrade and convert

After upgrade

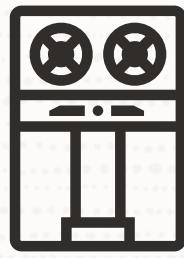


Fallback Options | After Go-Live



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

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



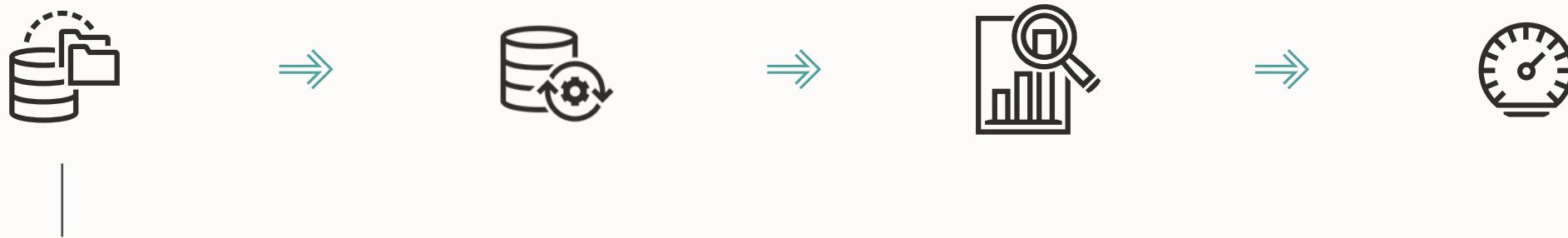
Backup your database after migration

- Level 0
- Practice restore with pre-plugin backups



Performance Stability Prescription

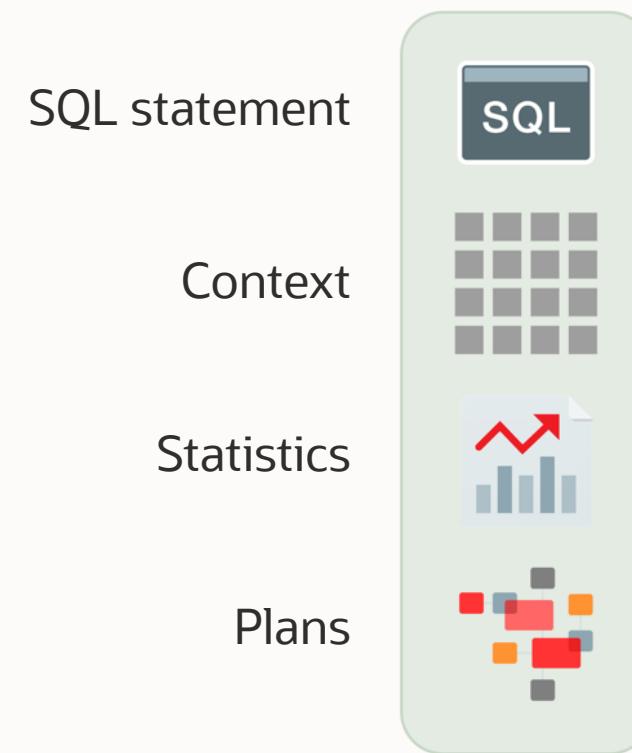
Performance Stability Prescription



Collect workload information

- Sample from cursor cache
- Gather from AWR

SQL Tuning Set | Definition



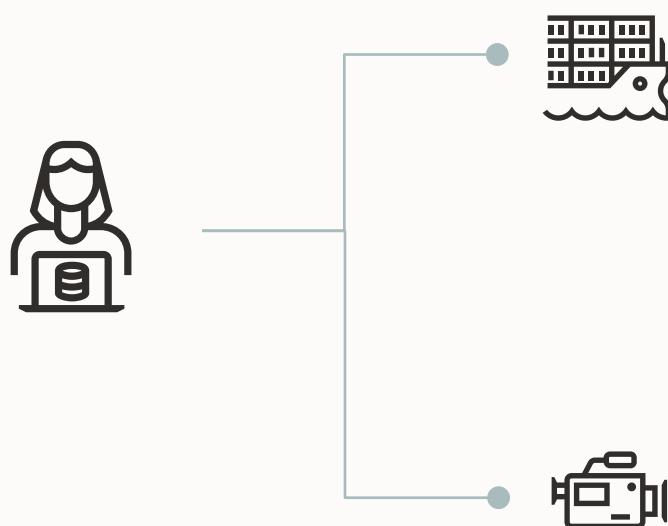


Gather at least a full month of workload data

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



Workload Information



AWR – Automatic Workload Repository

Change the retention to a minimum of 40 days

```
exec dbms_workload_repository.modify_snapshot_settings(  
    retention=>57600,  
    interval=>30);
```

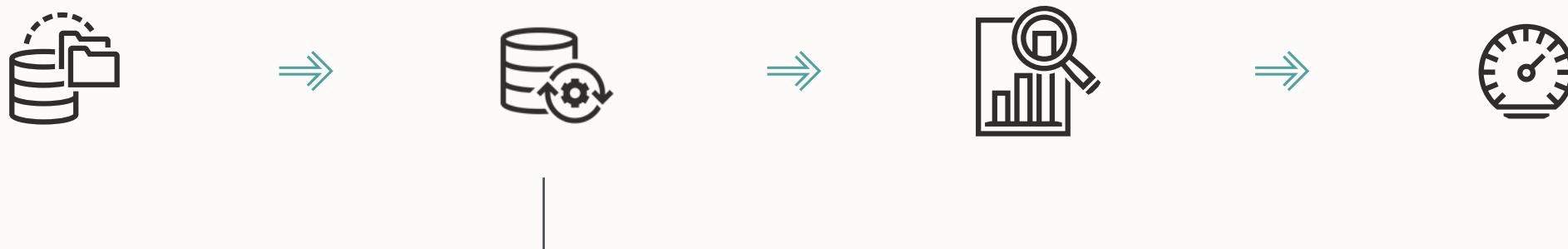
Collect SQL statements and plans

Use AWR as main source

Capture from Cursor Cache for OLTP

Collect statements, plans and stats in SQL Tuning Sets

Performance Stability Prescription



Upgrade test database

Load workload data
(SQL Tuning Set)

Performance Stability Prescription



AWR Diff Report

SQL Performance Analyzer* tests your workload

Report with all regressing statements

* Real Application Testing license required

AWR | Diff Report

Use script awrddrpt.sql

Top Timed Events

- Events with a "-" did not make the Top list in this set of snapshots, but are displayed for comparison purposes

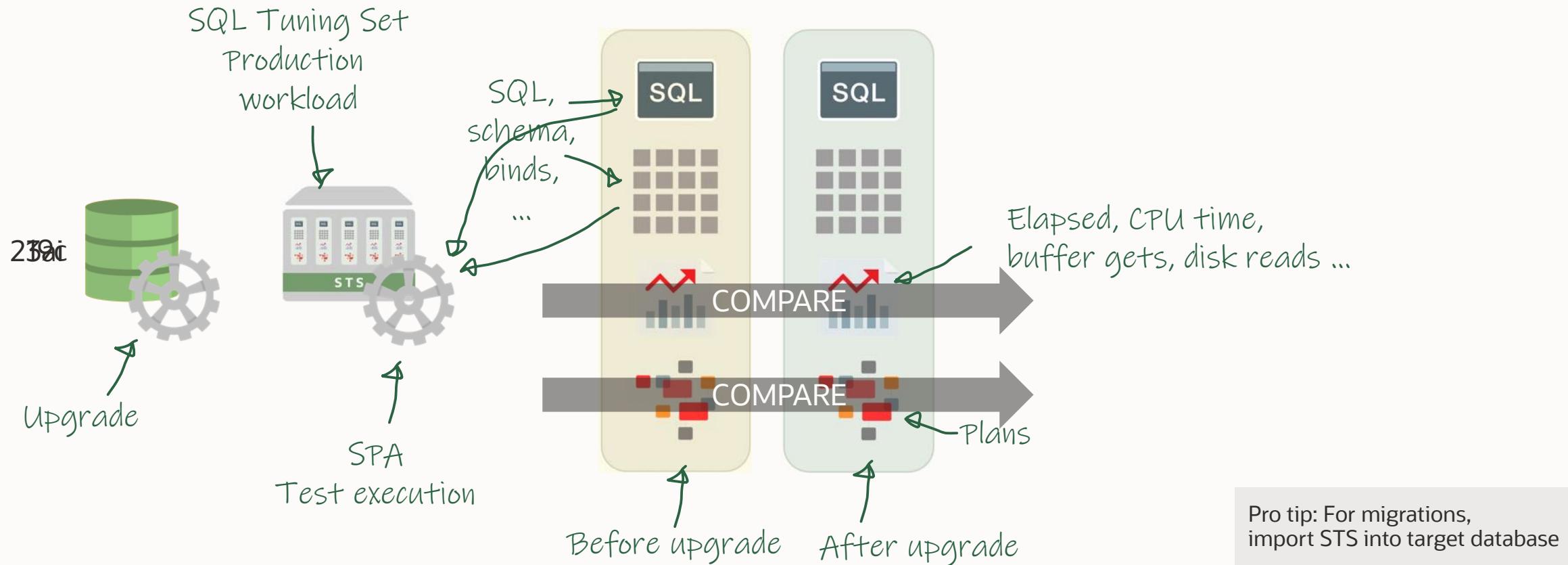
1st						2nd					
Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time	Event	Wait Class	Waits	Time(s)	Avg Time(ms)	%DB time
CPU time			68,289.05		43.73	db file sequential read	User I/O	22,193,998	114,919.21	5.18	23.17
db file sequential read	User I/O	6,686,953	37,737.81	5.64	24.17	enq: SS - contention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

Requires Enterprise Edition + Diagnostic pack

Pro tip: For migrations, you can [transport AWR data](#)



SQL Performance Analyzer | Concept



SQL Performance Analyzer | Report

Regressed SQL Statements		Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
SQL ID			SQL Trial 1	SQL Trial 2		
3fv28gf9y0aq		-0.050	26,504	29,573	-11.580	Y
czzzubf8fjz96		-0.030	1,410	1,981	-40.500	Y

From production
workload



From test
execution



SQL Performance Analyzer | Report

Regressed SQL Statements						
	SQL ID	Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
			SQL Trial 1	SQL Trial 2		
⬇️	3fv28gf9y0aq	-0.050	26,504	29,573	-11.580	Y
⬇️	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y



SQL Performance Analyzer | Report

Regressed SQL Statements		Net Impact on Workload (%)	Buffer Gets		Net Impact on SQL (%)	New Plan
	SQL ID		SQL Trial 1	SQL Trial 2		
⬇️	3fv28gfu9y0aq	-0.050	26,504	29,573	-11.580	Y
⬇️	czzzubf8fjz96	-0.030	1,410	1,981	-40.500	Y

SQL Details: czzzubf8fjz96						
Parsing Schema APPS		Execution Frequency 3				
SQL Text		Execution Frequency 3				
<pre>SELECT /* my_query_21 */ /*+ ORDERED INDEX(t1) USE_HASH(t1) */ 'B' t2.take_02 take_02, 'B' t2.take_15 take_15, 'B' t2.take_08 take_08, 'r' t3.record_nr price_eur_id,...</pre>						
Single Execution Statistics		Net Impact on Workload (%)	Execution Statistic Collected		Net Impact on SQL (%)	New Plan
Execution Statistic Name			SQL Trial 1	SQL Trial 2		
⬇️	Elapsed Time (sec)	-0.240	0.112	0.164	-46.170	Y
⬆️	Parse Time (sec)	0.220	0.001	0.001	14.490	Y
⬇️	CPU Time (sec)	-0.030	0.108	0.114	-5.040	Y
➡️	User I/O Time (sec)	0.000	0.000	0.000	0.000	Y
⬇️	Buffer Gets	-0.030	1,410	1,981	-40.500	Y



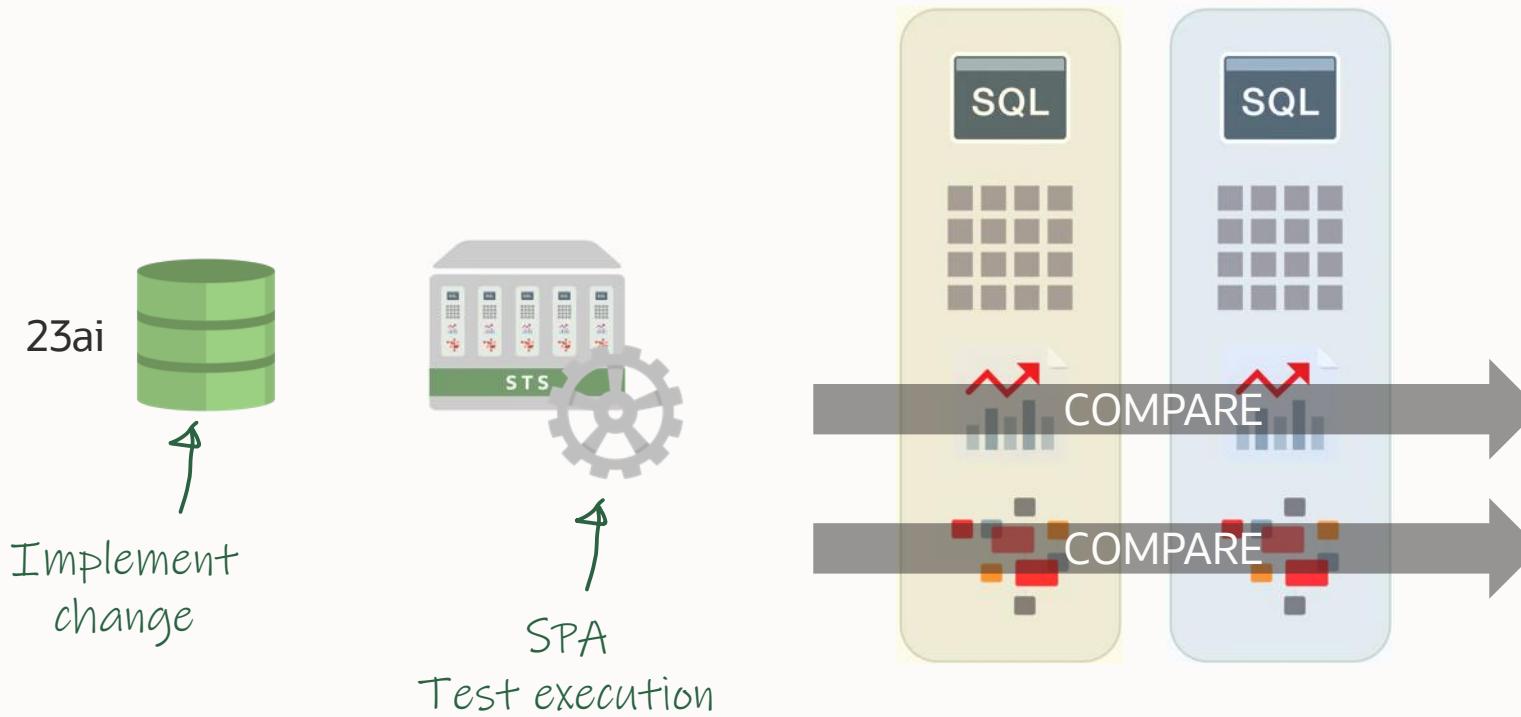
SQL Performance Analyzer | Report

Regressed SQL Statements			Buffer Gets		Net Impact on SQL (%)		New Plan
	SQL ID	Net Impact on Workload (%)	SQL Trial 1	SQL Trial 2			
⬇️	3fv28gfu9y0aq	-0.050	26,504	29,573		-11.580	Y
⬇️	czzzubf8fjz96	-0.030	1,410	1,981		-40.500	Y

Plan Comparison						
SQL_TRIAL_1353942463446						
Plan Hash Value 1165613724						
Expand All Collapse All						
Operation						
▽ SELECT STATEMENT		0			1	9,830
▽ HASH GROUP BY		1			1	9,830
▽ MERGE JOIN		2			1	9,829
▽ SORT JOIN		3			8	9,795
▽ HASH JOIN		4	→		8	9,794 "T1"."PERIOD_CODE"="T4"."FLYER..."
INDEX RANGE SCAN		5	APPS.IDX\$\$_080F0004		1	2 "T4"."EXPORT_LIC_NR"=14659
▽ HASH JOIN		6			14,210	9,792 "T1"."SKU_NR"="T2"."SKU_NR" AN...



SPA | Continuous Improvement



Performance Stability Prescription

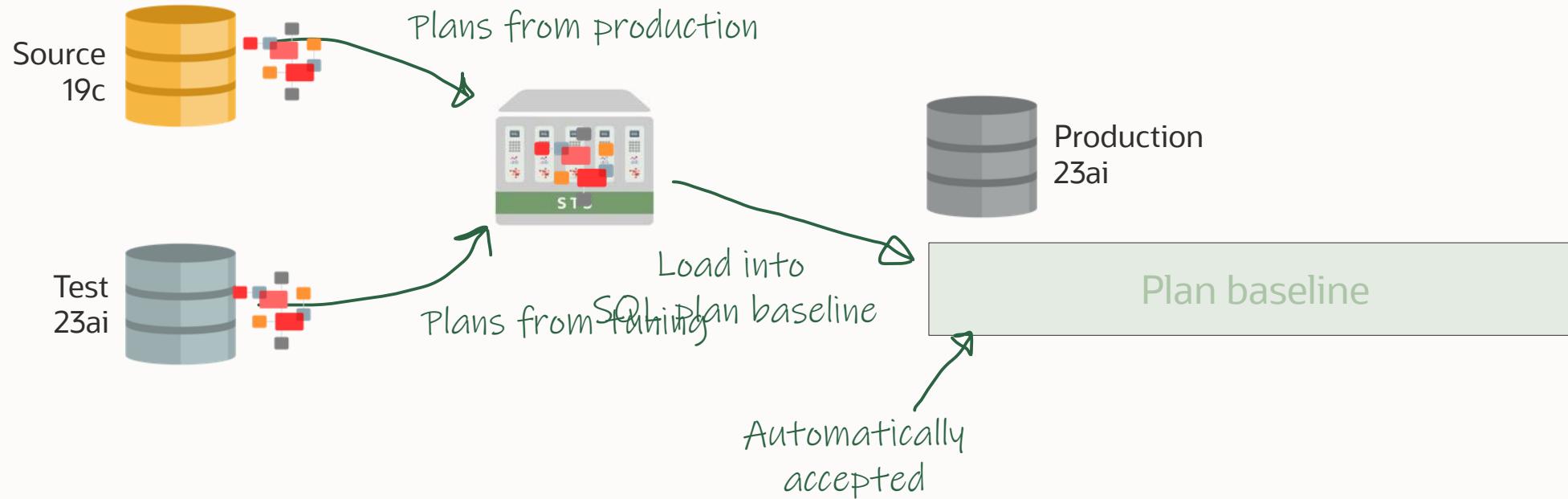


Tune SQLs with regressed plans

Create SQL Plan Baselines

Transport to production database

SPM | Use Case



SPM | What If ... Literals

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

- Many distinct statements
- CURSOR_SHARING = FORCE? No!

Optimal solution: Change your application to use bind variables





Use SQL Profiles for statements with literals

- Part of Tuning Pack

SQL Profiles | Facts

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

There is only one tool to ensure plan stability:

SQL Plan Management

Don't use

- OPTIMIZER_FEATURES_ENABLE
- COMPATIBLE

COMPATIBLE vs. OPTIMIZER_FEATURES_ENABLE

COMPATIBLE

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

OPTIMIZER_FEATURES_ENABLE

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



try it out for free

IT'S EASY



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

- Relevant options and packs included in most cloud offerings

Use OCI for Performance Testing



Performance Tips & Tricks



Use as few initialization parameters
as possible

- Stick to the defaults
- Stick to vendor recommendations



Only use underscores and events to solve specific situations

- Only under guidance of Oracle Support



Patches For Optimal Performance

- 1** Install the latest Release Update
- 2** Install the latest Monthly Recommended Patches
- 3** Check for important recommended one-off patches (Doc ID [555.1](#))
- 4** Check for other SQL performance bug fixes (Doc ID [2773715.1](#))

Enable Optimizer Fixes

5 Selectively enable optimizer fixes using DBMS_OPTIM_BUNDLE

```
begin
    dbms_optim_bundle.enable_optim_fixes(
        action              => 'ON',
        scope               => 'BOTH',
        current_setting_precedence => 'YES');
end;
/
```

Find available bug fixes in ORAdiff or dbms_optim_bundle.GetBugsForBundle

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

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

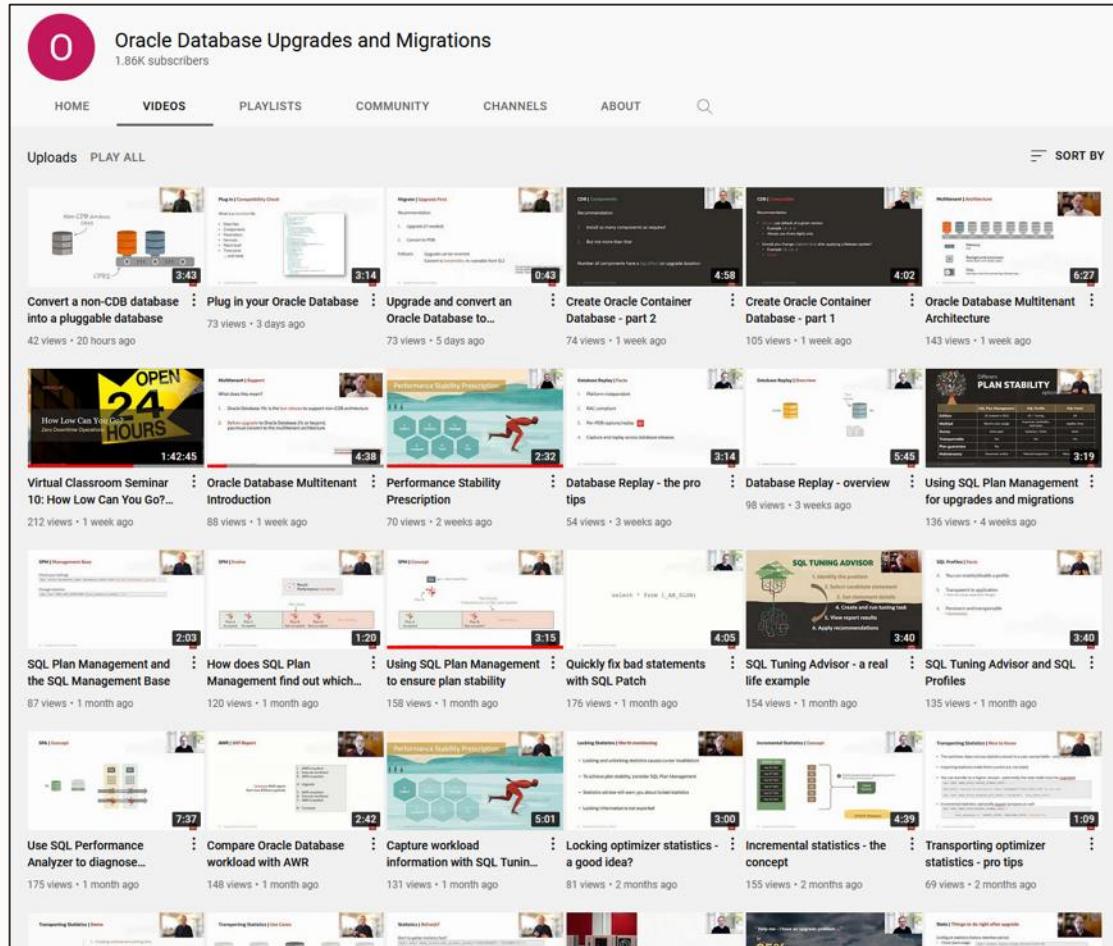


--Database collects SQL Plan Directives even when adaptive
--statistics are off.
--If you do not use Adaptive Statistics (optimizer_adaptive_statistics)
--then turn it completely off as described in MOS 2209560.1

```
alter system set "_sql_plan_directive_mgmt_control"=0;
```



YouTube | Oracle Database Upgrades and Migrations



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

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



Oracle
DBAs
run the world



Thank You

