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DBA Brasil 2023

Database Patching Internals

Let's read the code

Diamante

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- (…)


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NEW Episode 1

Release and Patching Strategy

105 minutes – Feb 4, 2021

NEW Episode 2

AutoUpgrade to Oracle Database 19c

115 minutes – Feb 20, 2021

NEW Episode 3

Performance Stability, Tips and Tricks and Underscores

120 minutes – Mar 4, 2021

NEW Episode 4

Migration to Oracle Multitenant

120 minutes – Mar 16, 2021

NEW Seminar 5

Migration Strategies – Insights, Tips and Secrets

120 minutes – Mar 25, 2021

NEW Seminar 6

Move to the Cloud – Not only for techies

115 minutes – Apr 8, 2021

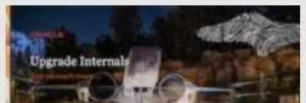
NEW Episode 7

Cool Features – Not only for DBAs

110 minutes – Jan 14, 2021

NEW Episode 8

Database Upgrade Internals – and so much more



Recorded Web Seminars

https://MikeDietrichDE.com/videos/

https://dohdatabase.com/webinars/

https://dbarj.com.br/webinars/

Warm-Up
Overview

Photo by SOCIAL.CUT on Unsplash

Basic Facts | Patch versus Upgrade

- PATCH


```
opatch
datapatch
```

- UPGRADE


```
autoupgrade.jar
```

Overview

Patch Set Updates, Bundle Patches, Release Updates, Release Update Revisions

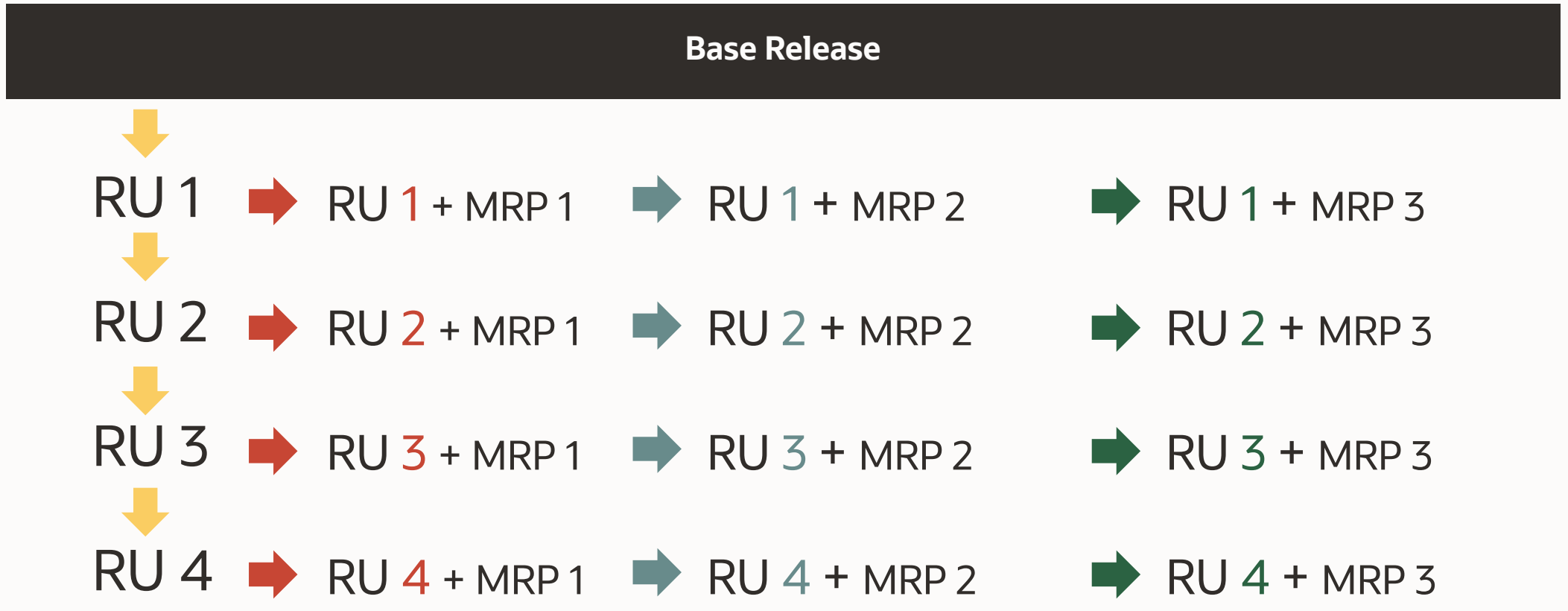
Patching | Before Oracle Database 12.2

Patching | Since Oracle Database 12.2

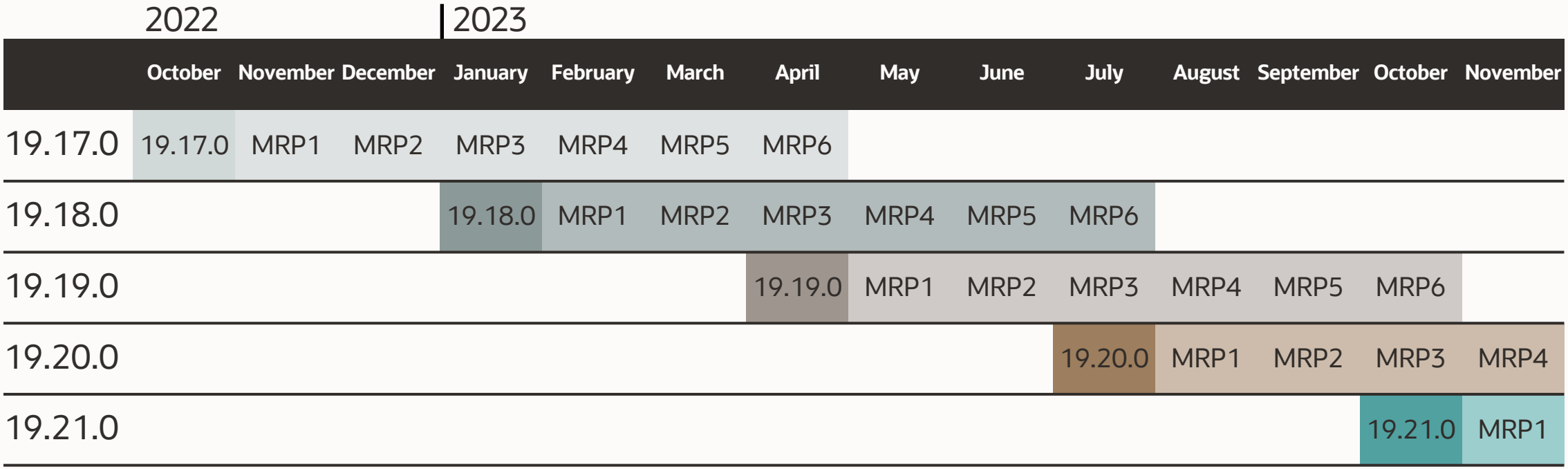
Base Release

RU 1	RUR 1 for RU 1	RUR 2 for RU 1
RU 2	RUR 1 for RU 2	RUR 2 for RU 2
RU 3	RUR 1 for RU 3	RUR 2 for RU 3
RU 4	RUR 1 for RU 4	RUR 2 for RU 4

Patching | From Oracle Database 19.17.0 (Oct 2022)



Monthly Recommended Patches | Timeline



Timeline | Release Updates

	2020				2021				2022				2023		
	January	April	July	October	January	April	July	October	January	April	July	October	January	April	July
19c	19.6.0	19.9.0	19.8.0	19.9.0	19.10.0	19.11.0	19.12.0	19.13.0	19.14.0	19.15.0	19.16.0	19.17.0	19.18.0	19.19.0	19.20.0
21c						21.3.0	21.4.0	21.5.0	21.6.0	21.7.0	21.8.0	21.9.0	21.10.0	21.11.0	21.12.0

Patching Strategies

—

Patching Basics

Patching Internals

Basic Facts | What Is In A Patch

FILES

New or changed executables, libs or files

```
bin/oracle
bin/srvctl
oracore/zoneinfo/timezone_34.dat
```

Apply and rollback scripts

```
sqlpatch/.../nnn_apply.sql
sqlpatch/.../nnn_rollback.sql
```

SQL
PL/SQL

New or changed objects

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


Basic Facts | How To Apply A Patch

$ORACLE_HOME/OPatch

```
[oracle@hol ~]$ cd $ORACLE_HOME/OPatch
[oracle@hol OPatch]$ ls -l
total 164
drwxr-x---. 6 oracle dba    68 Apr 22  2020 auto
drwxr-x---. 2 oracle dba    31 Apr 22  2020 config
-rwxr-x---. 1 oracle dba   589 Apr 22  2020 datapatch
-rwxr-x---. 1 oracle dba   627 Apr 22  2020 datapatch.bat
drwxr-x---. 2 oracle dba    90 Apr 22  2020 docs
-rwxr-x---. 1 oracle dba 23550 Apr 22  2020 emdpatch.pl
drwxr-x---. 2 oracle dba  4096 Apr 22  2020 jlib
drwxr-x---. 5 oracle dba  4096 Mar 26  2020 jre
drwxr-x---. 9 oracle dba  4096 Apr 22  2020 modules
drwxr-x---. 5 oracle dba    58 Apr 22  2020 ocm
-rwxr-x---. 1 oracle dba 49462 Apr 22  2020 opatch
-rwxr-x---. 1 oracle dba  1442 Apr 22  2020 opatchauto
-rwxr-x---. 1 oracle dba   393 Apr 22  2020 opatchauto.cmd
-rwxr-x---. 1 oracle dba 16412 Apr 22  2020 opatch.bat
-rwxr-x---. 1 oracle dba  4290 Apr 22  2020 opatch_env.sh
-rw-r-----. 1 oracle dba  2551 Apr 22  2020 opatch.pl
drwxr-x---. 4 oracle dba    62 Apr 22  2020 opatchprereqs
-rwxr-x---. 1 oracle dba  3159 Apr 22  2020 operr
-rwxr-x---. 1 oracle dba  4218 Apr 22  2020 operr.bat
-rw-r-----. 1 oracle dba  3177 Apr 22  2020 operr_readme.txt
drwxr-x---. 2 oracle dba    19 Apr 22  2020 oplan
drwxr-x---. 3 oracle dba    21 Apr 22  2020 oracle_common
drwxr-x---. 3 oracle dba    24 Apr 22  2020 plugins
-rw-r-----. 1 oracle dba  2980 Apr 22  2020 README.txt
drwxr-x---. 2 oracle dba  4096 Apr 22  2020 scripts
-rw-r-----. 1 oracle dba    27 Apr 22  2020 version.txt
```

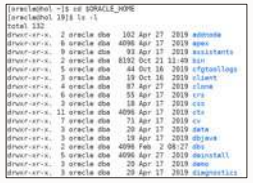
Basic Facts | How To Apply A Patch

`opatch`	Applies binaries to an Oracle Home	All instances are down
`datapatch`	Applies SQL and PL/SQL changes to a database	Database is up (normal, not upgrade)

Pro tip: Use `opatchauto` on RAC environments

Patching | In-Place

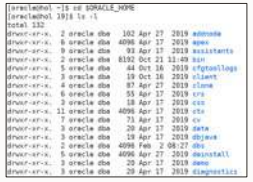
Oracle Home, 19.17.0



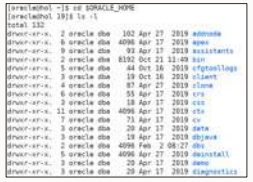
```
$ datapatch -verbose
```

Patching | Out-of-Place

Oracle Home, 19.16.0



```
SQL> SHUTDOWN IMMEDIATE
```

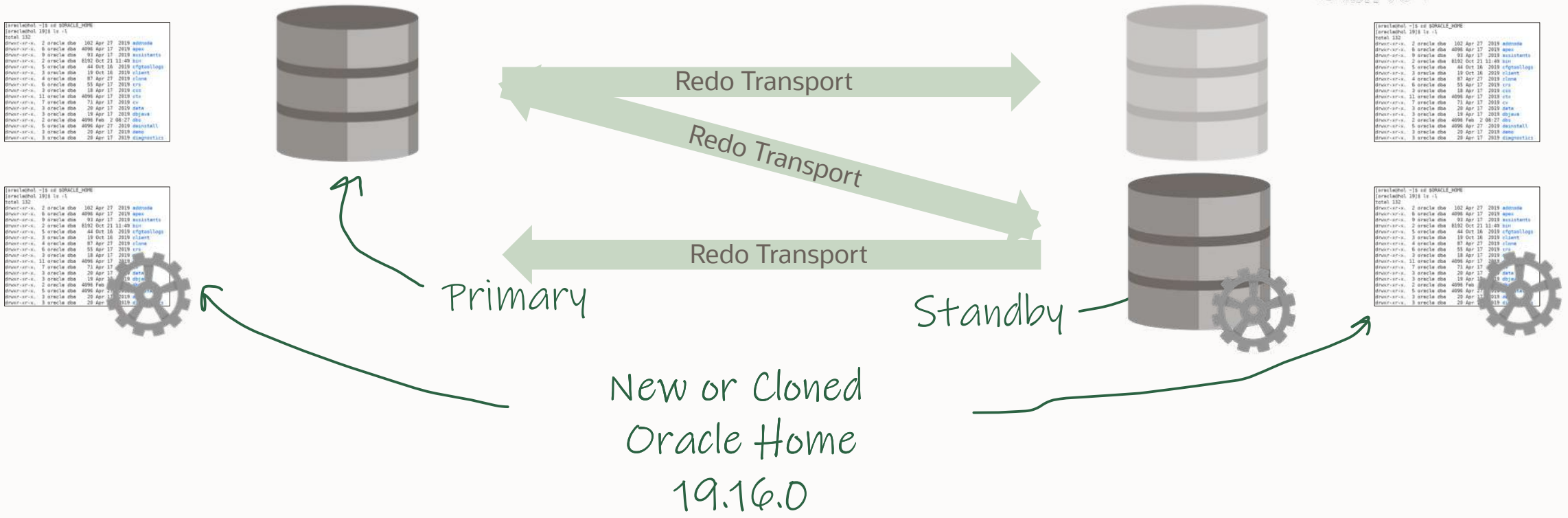


New Oracle Home, 19.17.0

```
$ datapatch -verbose
```

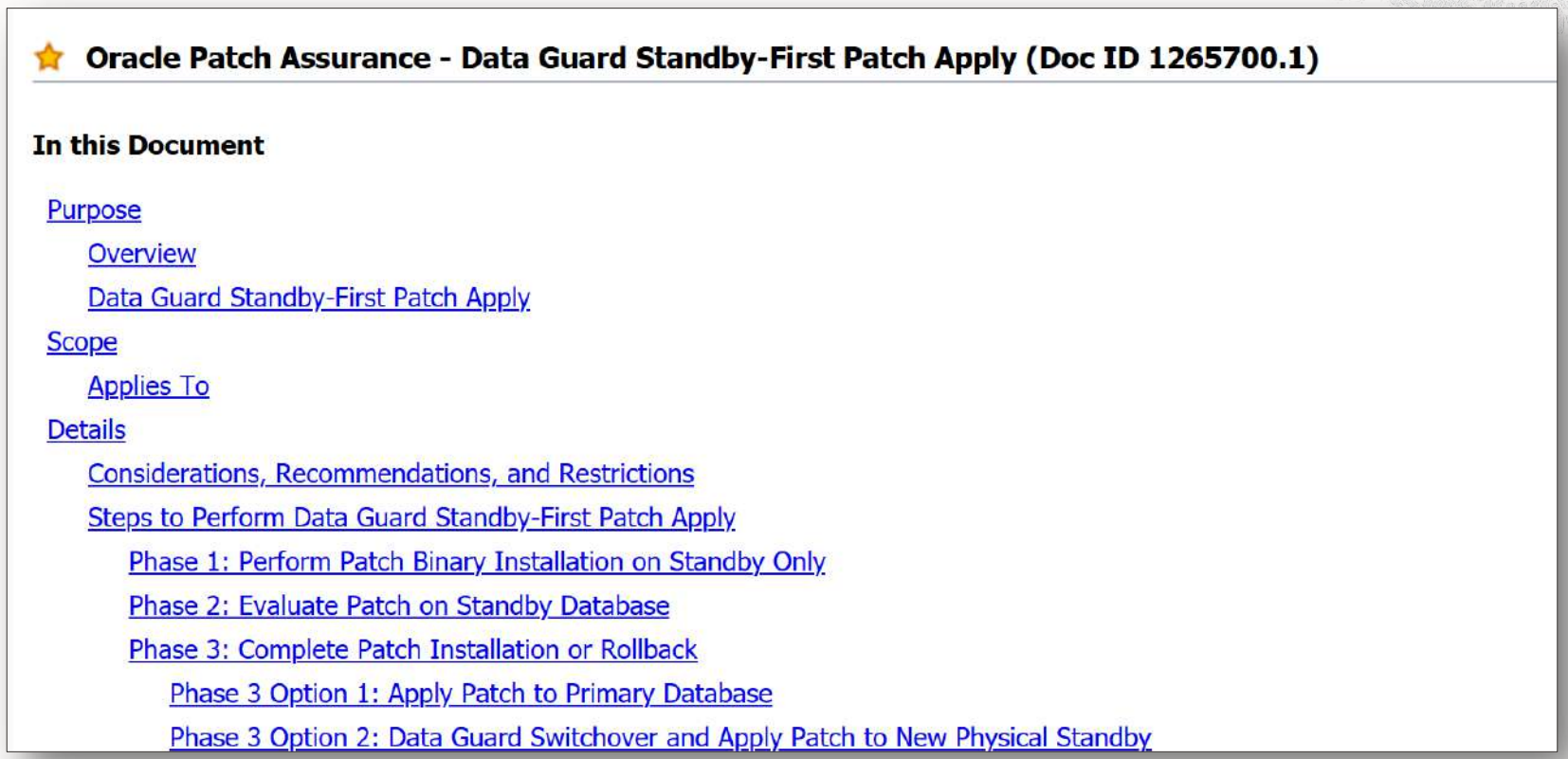
Always patch out-of-place

Recommendation | Standby-First Patch Apply




```
D [oracle]$ $ORACLE_HOME/OPatch/datapatch -verbose
```

Recommendation | Standby-First Patch Apply



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

In this Document

Purpose
- Overview
- Data Guard Standby-First Patch Apply

Scope
- Applies To

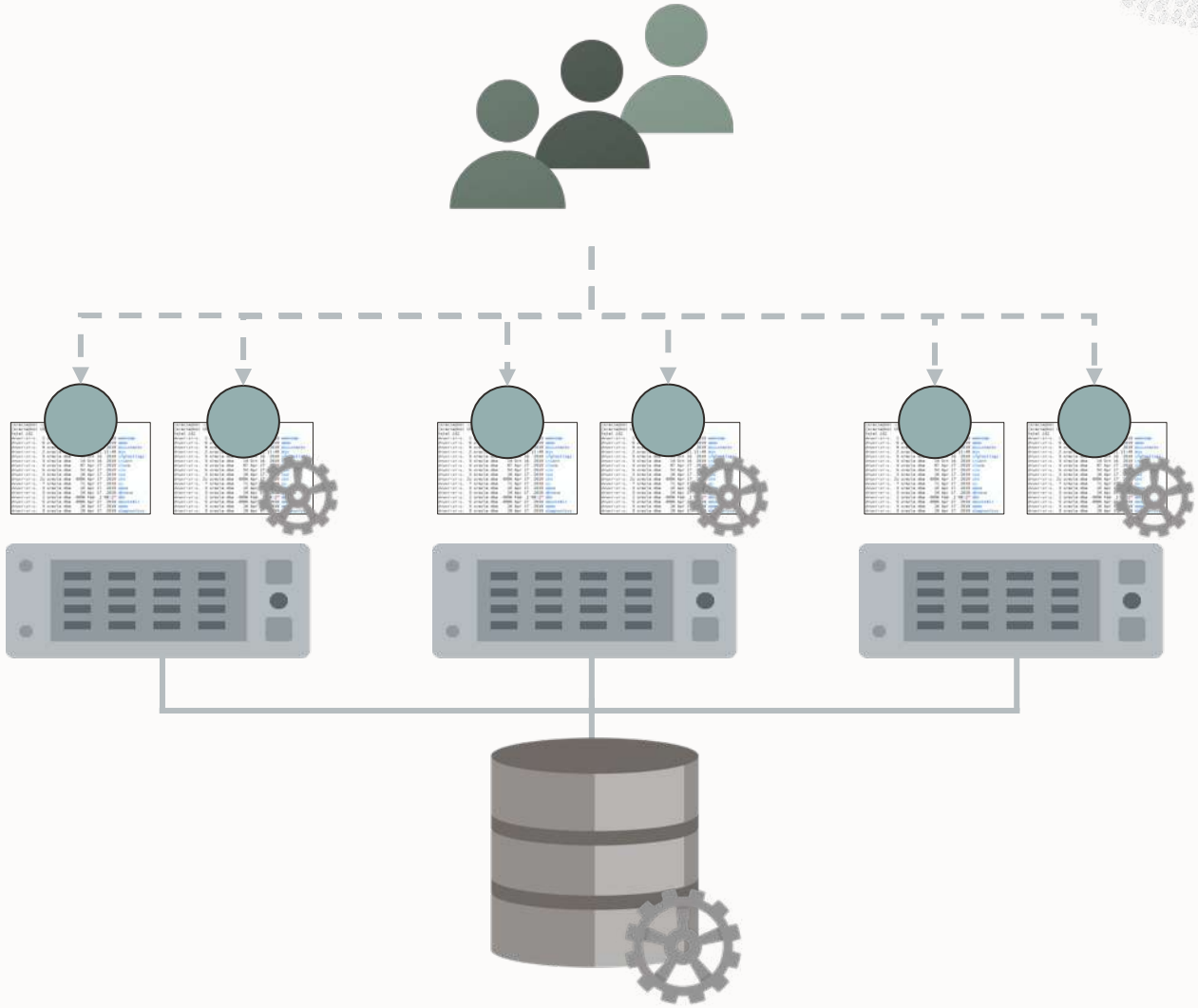
Details
- Considerations, Recommendations, and Restrictions
- Steps to Perform Data Guard Standby-First Patch Apply
  - Phase 1: Perform Patch Binary Installation on Standby Only
  - Phase 2: Evaluate Patch on Standby Database
  - Phase 3: Complete Patch Installation or Rollback
    - Phase 3 Option 1: Apply Patch to Primary Database
    - Phase 3 Option 2: Data Guard Switchover and Apply Patch to New Physical Standby

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

PRO-TIP – HOW TO SPEED UP PATCHING

Avoid downtime with RAC Rolling Patching

Recommendation | RAC Rolling Patching



```
$ $ORACLE_HOME/OPatch/datapatch -verbose
```

Release updates are **always**:

Standby-First installable

RAC Rolling installable

Patching Strategies

—

Patching Basics

Patching Internals

Types of Patches

Binary	SQL
Contain changes to C files (.c, .h)	Contain changes to SQL files (.sql, .pls, .pkh, etc.)
Are installed into an oracle home with opatch	Are installed into a database using datapatch
The patch .zip contains .o and/or .a files and executables are relinked with the changed objects	The patch .zip contains SQL files which need to be loaded into the database after binary patching is complete

A given patch can contain binary content, SQL content, or both

Binary Patch | Installation

- Patch .zip is downloaded from MOS
- Installation is done using opatch
  - Instances(s) must be shut down first
  - Executables are relinked
- Located at $ORACLE_HOME/OPatch/opatch

SQL Patch | Installation

- SQL files are laid down into the ORACLE_HOME by opatch first
- Installation is done using datapatch
  - Database must be up before invoking datapatch
  - Each invocation of datapatch will process one database in the ORACLE_HOME
  - All open PDBs, the root, and PDB$SEED will be patched
- Located at $ORACLE_HOME/OPatch/datapatch

Datapatch | Overview

- Introduced with Oracle 12.1

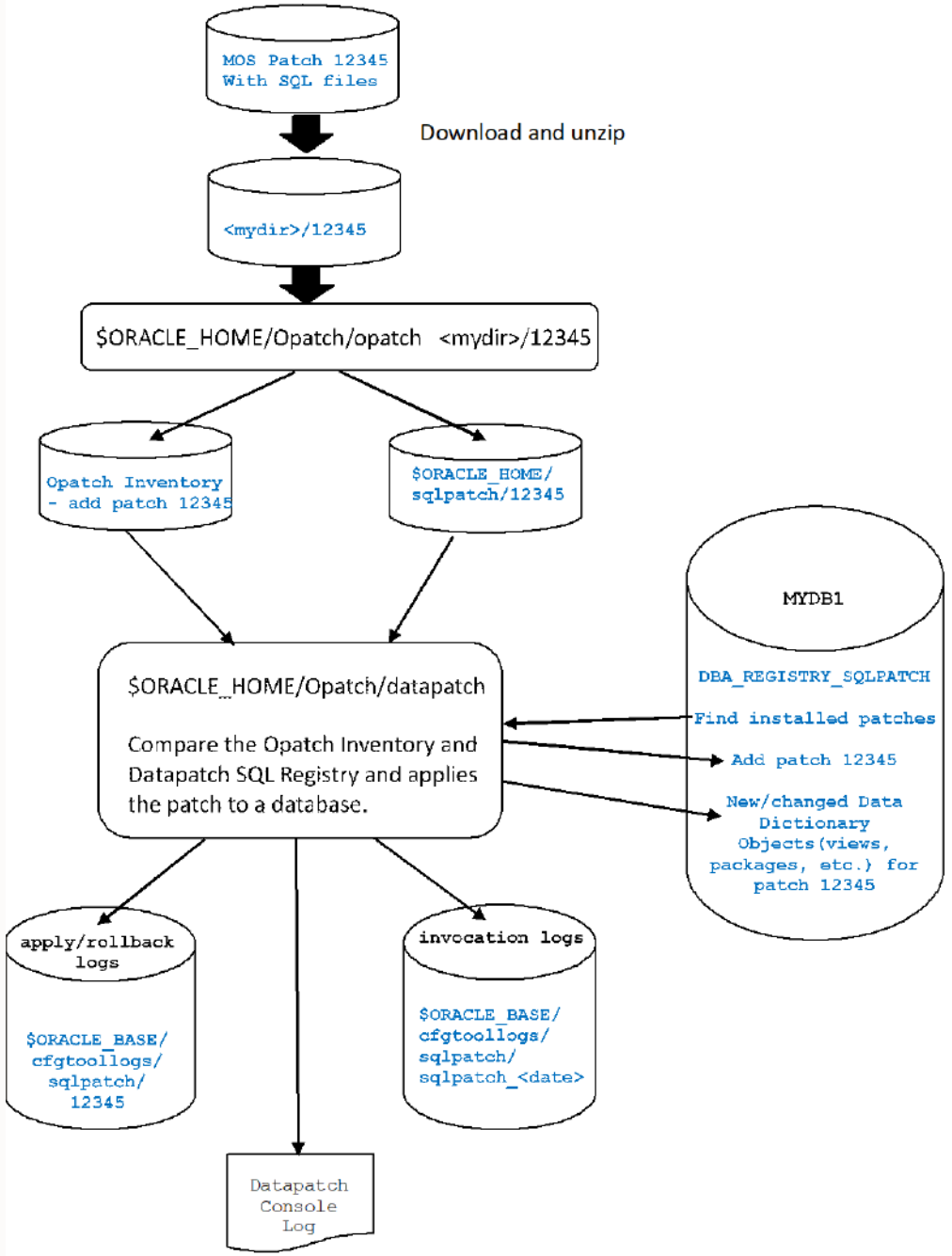
- Consists of:
  - Perl scripts and libraries (outside the Database)
  - SQL scripts and PL/SQL packages (inside the Database)

ORACLE

Datapatch Public Documentation

Datapatch | Public Documentation

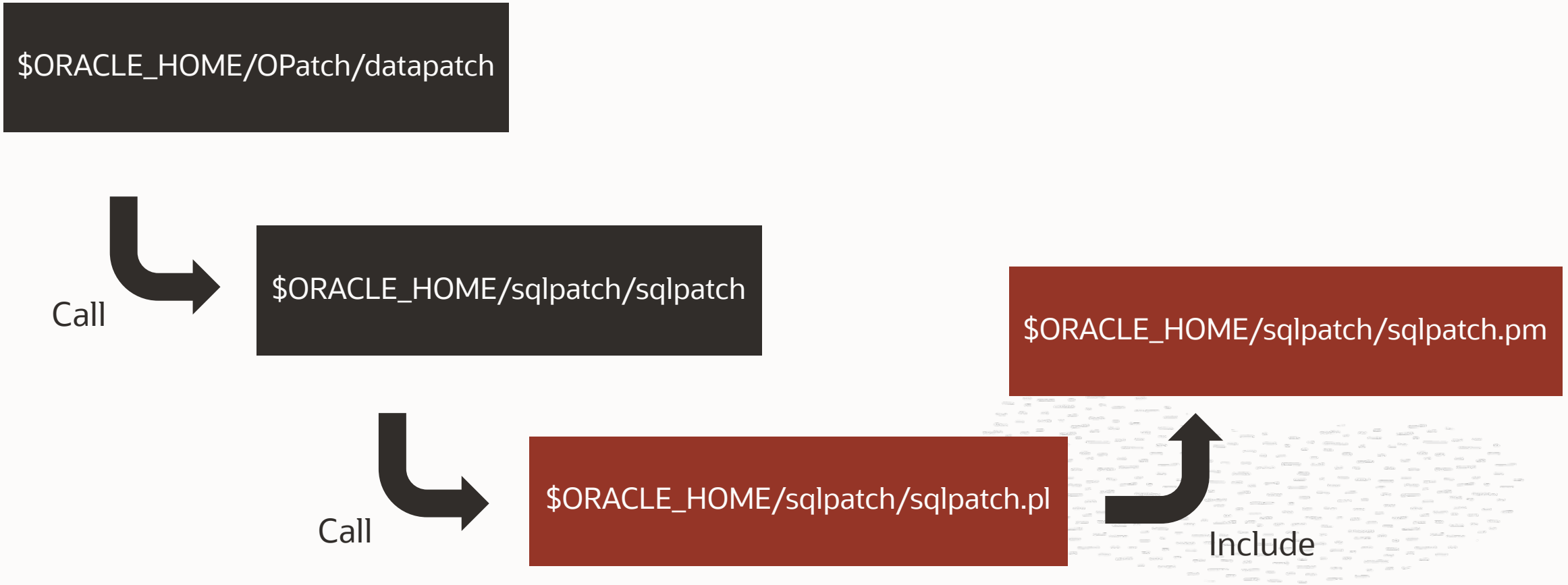
Datapatch User Guide (Doc ID 2680521.1)



ORACLE

Datapatch Internal Documentation

Datapatch | Call Flow



Datapatch | Sequence

1. sqlpatch::initialize
2. sqlpatch::patch
3. sqlpatch::finalize

Datapatch | Directories

$ORACLE_HOME/sqlpatch/28655784/<unique ID>/

28655784_apply.sql
28655784_rollback.sql
28655784.xml
28655784.zip
rollback_files (a directory with subdirectories for original .sql files)

Datapatch | Registry

Binary Registry	SQL Registry
Maintained by opatch	Maintained by datapatch

Datapatch | Registry

Binary Registry	SQL Registry
Maintained by opatch	Maintained by datapatch
Binary data structure in the ORACLE_HOME	Database table `registry$sqlpatch` and view `dba_registry_sqlpatch`

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Datapatch | Registry

Binary Registry	SQL Registry
Maintained by opatch	Maintained by datapatch
Binary data structure in the ORACLE_HOME	Database table `registry$sqlpatch` and view `dba_registry_sqlpatch`
If a patch is installed in the ORACLE_HOME then it exists in the registry; if a patch is rolled back it is removed from the registry	Each row in the registry represents a patch apply or rollback
opatch lsinventory returns the contents of the binary registry	Querying the table returns the contents of the SQL registry

Datapatch | Registry

Binary Registry	SQL Registry
Maintained by opatch	Maintained by datapatch
Binary data structure in the ORACLE_HOME	Database table `registry$sqlpatch` and view `dba_registry_sqlpatch`
If a patch is installed in the ORACLE_HOME then it exists in the registry; if a patch is rolled back it is removed from the registry	Each row in the registry represents a patch apply or rollback
opatch lsinventory returns the contents of the binary registry	Querying the table returns the contents of the SQL registry
Single registry for an ORACLE_HOME, and thus all databases in that ORACLE_HOME are at the same binary state	Each PDB contains its own SQL registry

Datapatch | Registry Comparison

Patch Present in Binary Registry	Patch Present in SQL Registry	Datapatch Action
YES	NO	Patch needs to be applied
NO	YES	Patch needs to be rolled back
YES	YES	No action needed for this patch

A patch must be consistent in binary across all nodes of a RAC installation

Datapatch | Registry Comparison

```
$ORACLE_HOME/OPatch/datapatch -verbose
SQL Patching tool version 12.2.0.1.0 Production on Fri Jun  2 14:23:38 2017
Copyright (c) 2012, 2017, Oracle.  All rights reserved.

Log file for this invocation:
<cfgtoollogs>/sqlpatch/sqlpatch_70035_2017_06_02_14_23_38/sqlpatch_invocation.log

Connecting to database...OK
Bootstrapping registry and package to current versions...done
Determining current state...done

Current state of SQL patches:
Patch 14128996 (SQL PATCHING TEST BUG 1):
  Installed in the binary registry only
Patch 14129004 (SQL PATCHING TEST BUG 2):
  Installed in the binary registry only
```

Datapatch | Queryable Inventory

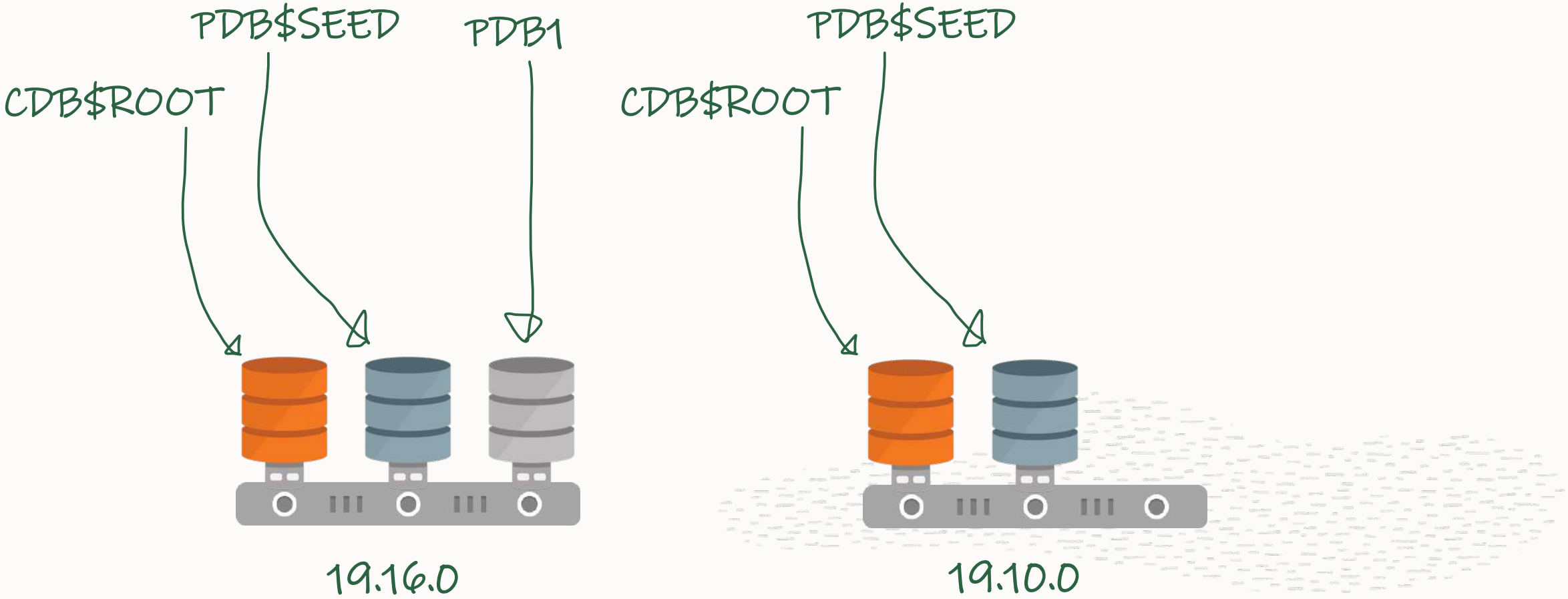
```
SQL> set long 1000
SQL> SELECT XMLSerialize(CONTENT dbms_sqlpatch.opatch_registry_state INDENT) FROM dual;

XMLSERIALIZE(CONTENTDBMS_SQLPATCH.OPATCH_REGISTRY_STATEINDENT)
--------------------------------------------------------------------------------
<activityRoot>
  <p33192793>
    <patchUId>24462514</patchUId>
  </p33192793>
</activityRoot>
```

Datapatch | Queryable Inventory

```
$ $ORACLE_HOME/OPatch/opatch lspatches
33192793;Database Release Update : 19.13.0.0.211019 (33192793)
29585399;OCW RELEASE UPDATE 19.3.0.0.0 (29585399)

OPatch succeeded.
```

*Why patch **29585399** is not showing on QI ?*

Datapatch | Move another ORACLE_HOME

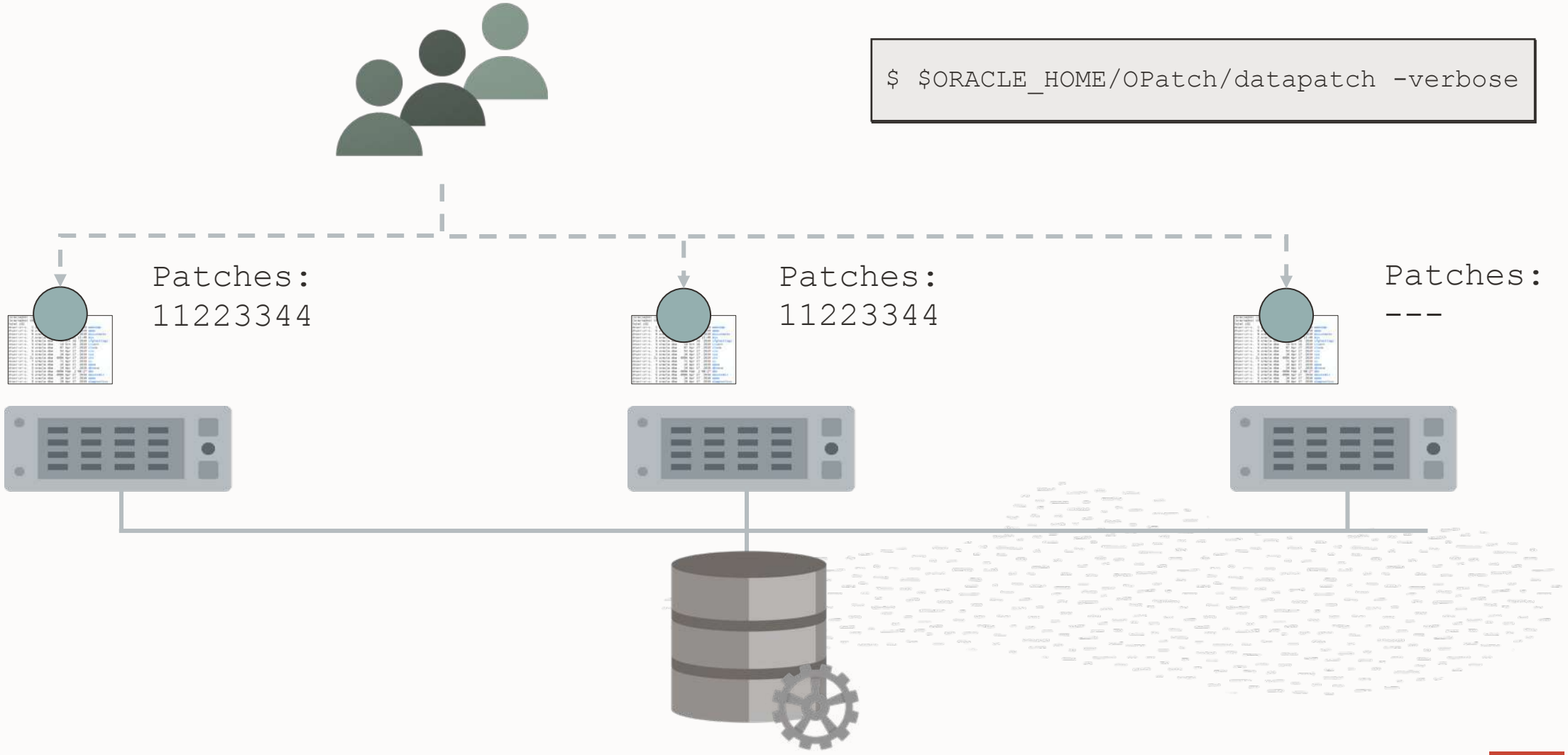


Datapatch | Move another ORACLE_HOME

- 19.10.0 Oracle Home does not contain scripts for 19.16.0 rollback.
- Before 12.2, you had to move sqlpatch folders manually.
- After 12.2, this is automatically handled by datapatch.
  - REGISTRY$SQLPATCH.PATCH_DIRECTORY (BLOB)

Datapatch | Partial Installed Patches

```
$ $ORACLE_HOME/OPatch/datapatch -verbose
```



Performance Improvement

Old behavior

- `opatchauto` invokes `opatch` on every node
- `opatchauto` then invokes `datapatch` on every node

Result:

Many useless `datapatch` calls since it needs to be executed only once the last node has been patched

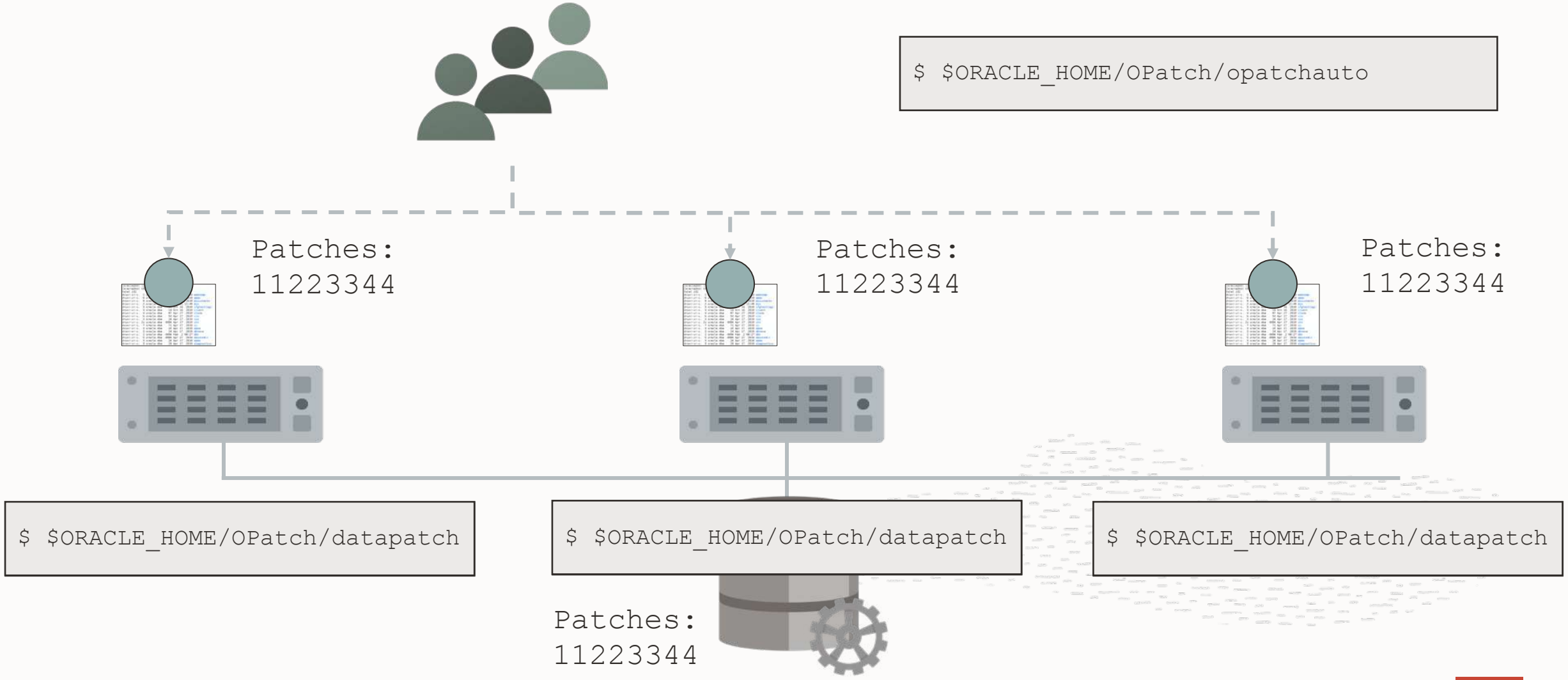
New behavior

- `opatchauto` invokes `opatch` on every node
- `opatchauto` invokes `datapatch` on last node

Result:

Useless `datapatch` calls avoided, faster patch runs. Fix is included in the current `opatch`

Datapatch | RAC

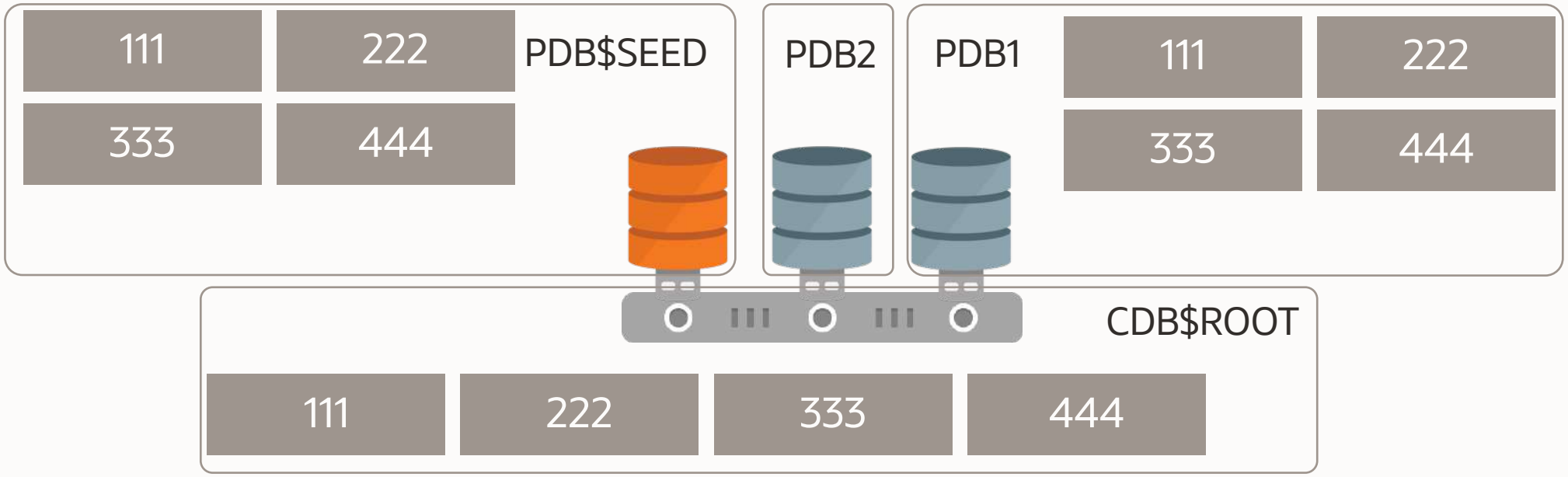


Datapatch | Multitenant

- Each PDB has it's own registry.
  - REGISTRY$ tables.

- Catcon.pl will consolidate the apply.sql calls.

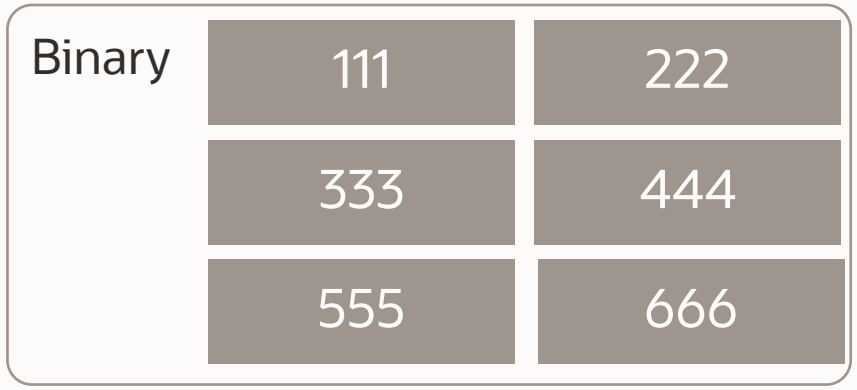
Datapatch | Multitenant



To Do:

```
$ $ORACLE_HOME/OPatch/datapatch
```

- Apply 555 and 666 on CDB$ROOT
- Apply 555 and 666 on PDB$SEED
- Apply 555 and 666 on PDB1
- Apply All on PDB2



Datapatch | Multitenant

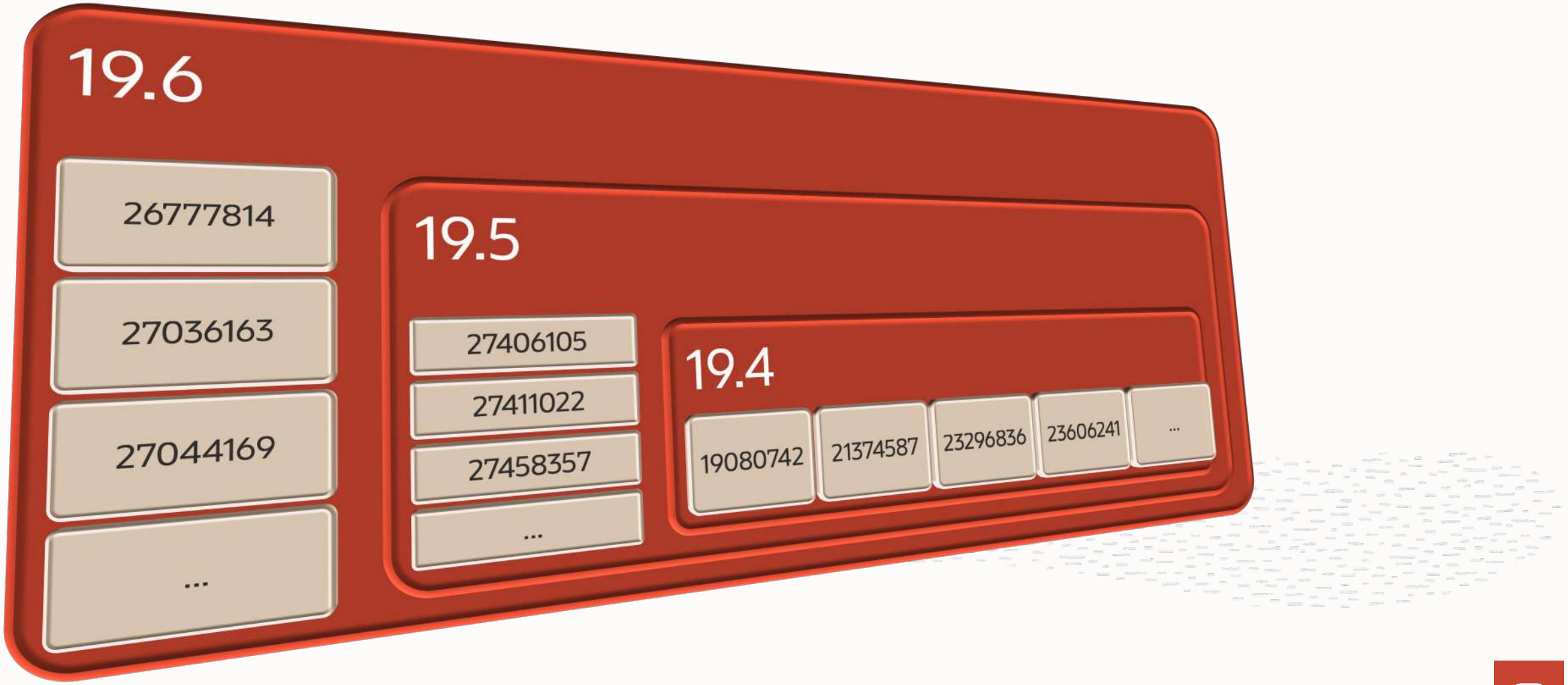
To Do:

- Apply 555 and 666 on CDB$ROOT
- Apply 555 and 666 on PDB$SEED
- Apply 555 and 666 on PDB1
- Apply All on PDB2

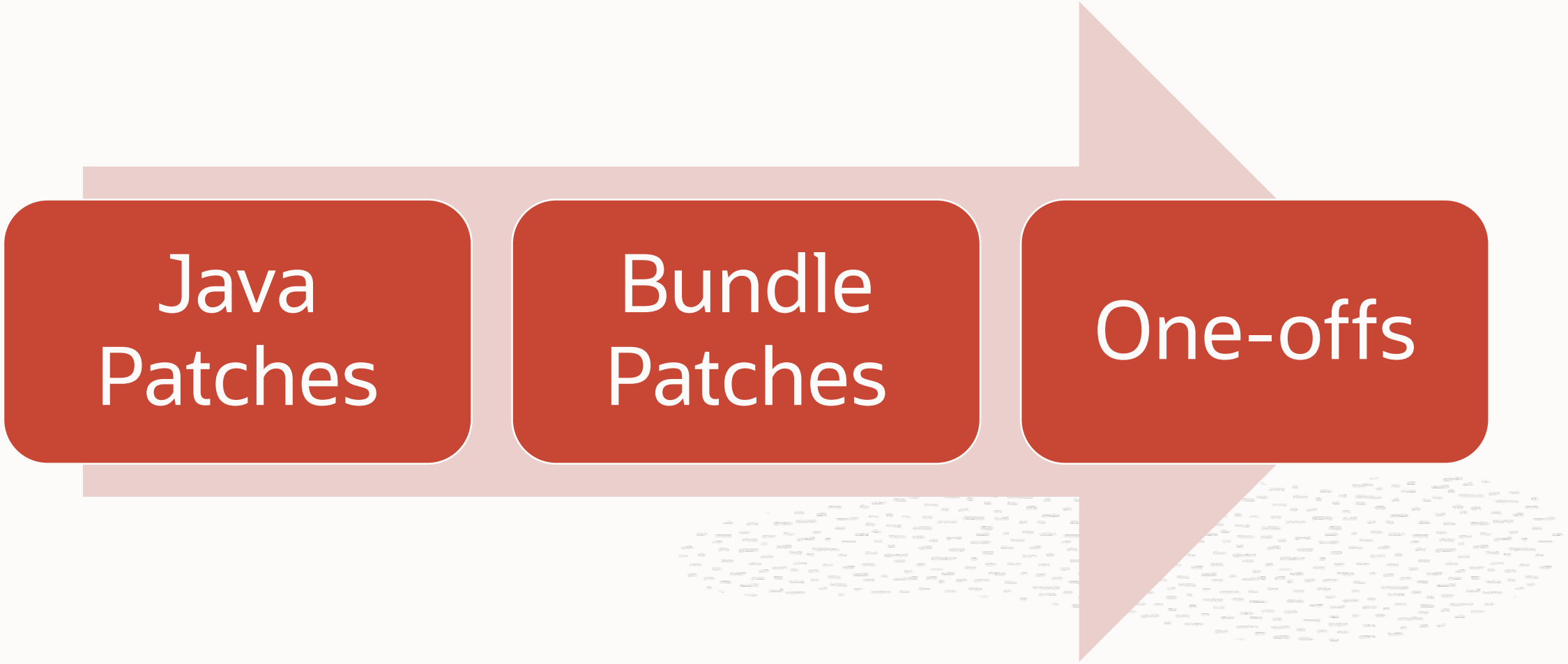
```
$ORACLE_HOME/perl/bin/perl catcon.pl … \
sqlplatch/555/555_apply.sql \
sqlplatch/666/666_apply.sql

$ORACLE_HOME/perl/bin/perl catcon.pl -c 'PDB2' … \
sqlplatch/111/111_apply.sql \
sqlplatch/222/222_apply.sql \
sqlplatch/333/333_apply.sql \
sqlplatch/444/444_apply.sql
```

MOS Note: 1932340.1 - How to execute sql scripts in Multitenant environment (catcon.pl)

Datapatch | Bundle Patches Delta



Datapatch | Patch Queue



Datapatch | Patch Rollback and Apply Queue

Oracle Home after `opatch`:

- Patch 444 – Java Patch
- Patch 555 – Bundle Patch
- Patch 666 – One-off Patch

Database registry before `datapatch`:

- Patch 111 – Java Patch
- Patch 222 – Bundle Patch
- Patch 333 – One-off Patch

```
$ ./datapatch
```

datapatch queue

Rollback:

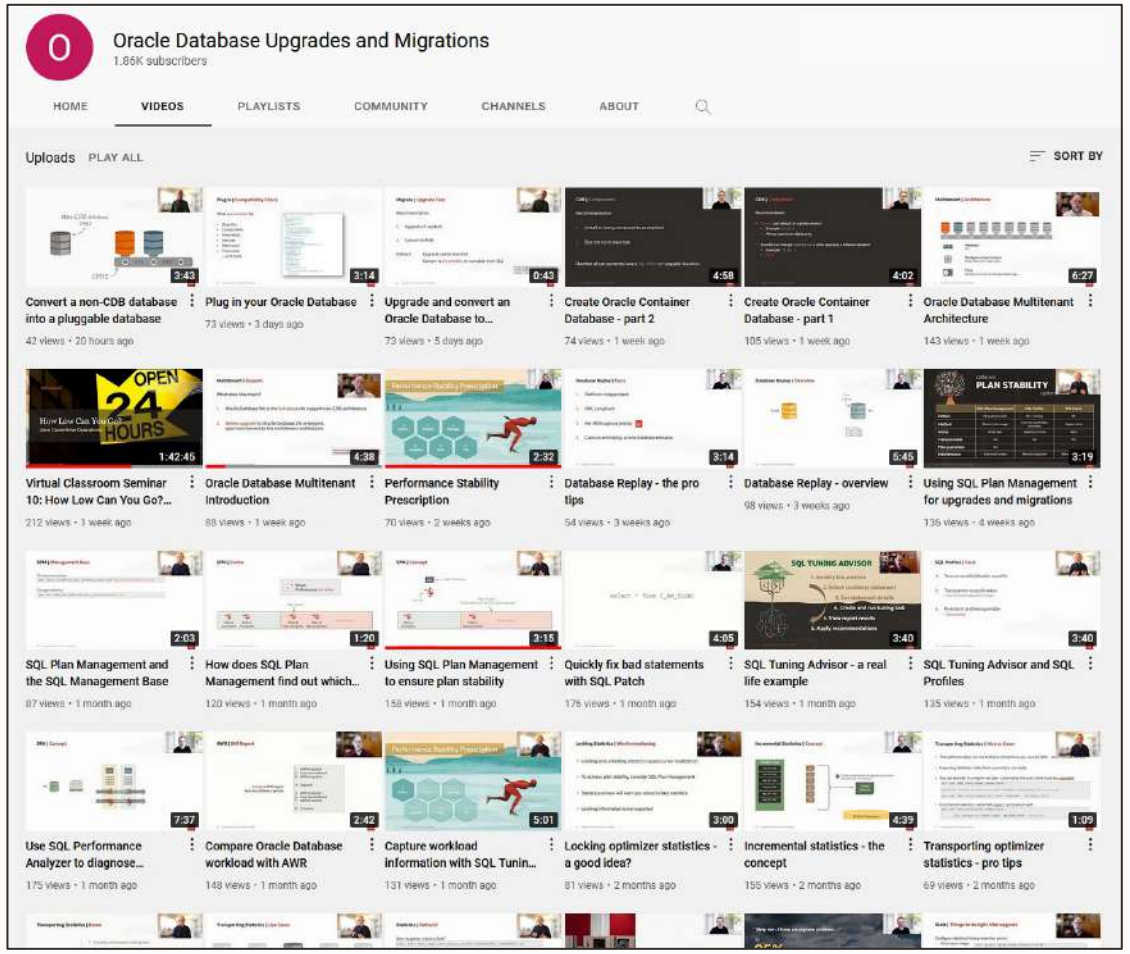
Apply:

Rollback:

Cumulative: Patch 222 to 555 – Bundle Patch

Apply:

YouTube | Oracle Database Upgrades and Migrations



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

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