Photo by Venti Views on Unsplash

Cross Platform Migration – Transportable Tablespaces to the Extreme

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Find Slides and Much More on Our Blogs

ORA-39405 with impdp when you have mixed time zone versions

MikeDietrichDE.com

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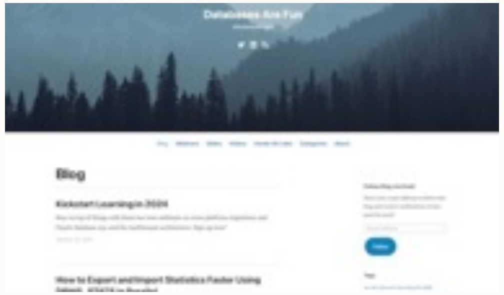


Databases Are Fun

Blog

Kickstart Learning in 2024

How to Export and Import Statistics Faster Using DBMS_STATS in Parallel

dohdatabase.com

Daniel.Overby.Hansen@oracle.com

What is new in Oracle Database 19.21 RU

How to check the code of the most important Oracle internal objects without having a database

DBArj.com.br

Rodrigo.R.Jorge@oracle.com

Alex Zaballa – Oracle Tips and Guides

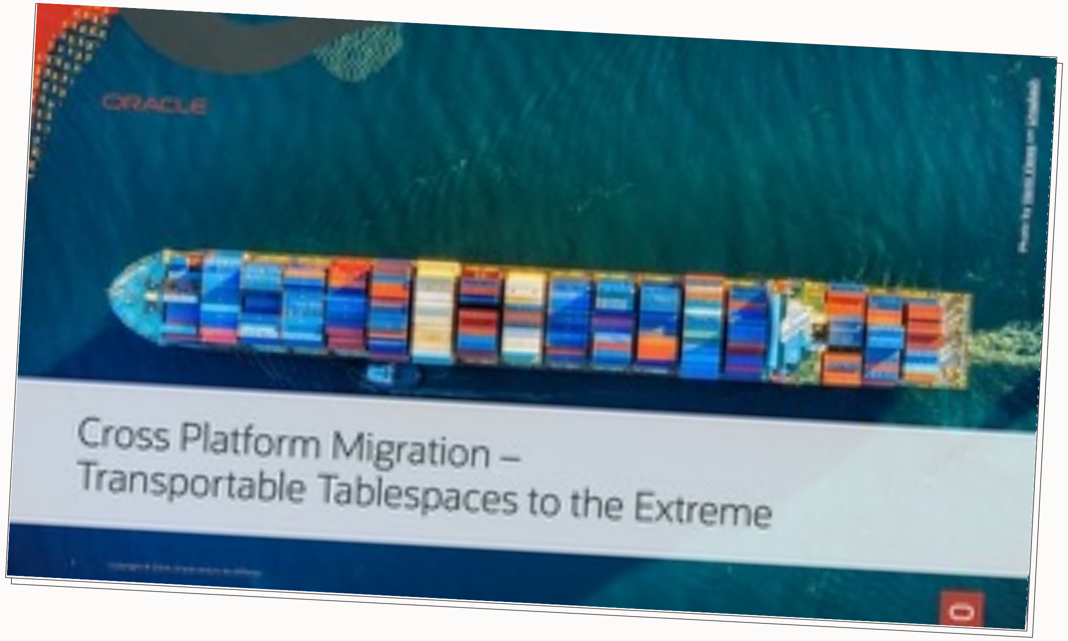
ORAdiff – Compare two Oracle Database releases and find the differences

AlexZaballa.com

Alex.Zaballa@oracle.com

Webinar | Get The Slides

https://MikeDietrichDE.com/slides



ORACLE

Cross Platform Migration –
Transportable Tablespaces to the Extreme

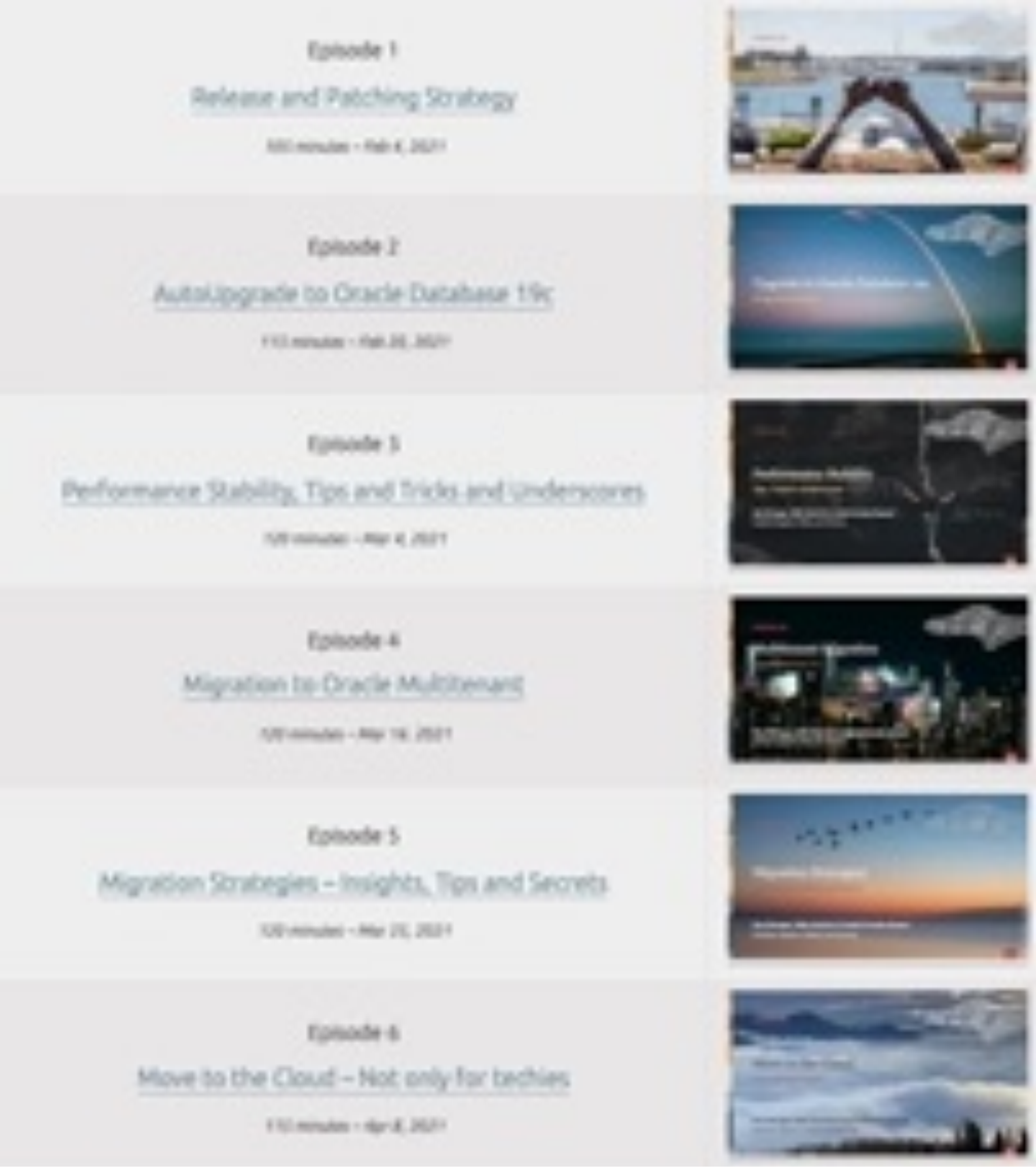
Webinar | Multitenant

Scan me to sign up

Move to Oracle Database 23c

– Everything you need to know about Oracle Multitenant

May 16, 14:00 CET
Sign up



Episode 1

Release and Patching Strategy

100 minutes - Feb 4, 2021

Episode 2

AutoUpgrade to Oracle Database 19c

113 minutes - Feb 20, 2021

Episode 3

Performance Stability, Tips and Tricks and Underscores

120 minutes - Mar 4, 2021

Episode 4

Migration to Oracle Multitenant

120 minutes - Mar 16, 2021

Episode 5

Migration Strategies – Insights, Tips and Secrets

120 minutes - Mar 25, 2021

Episode 6

Move to the Cloud – Not only for techies

110 minutes - Apr 8, 2021

Recorded Web Seminars

https://MikeDietrichDE.com/videos

More than 30 hours of technical content:

- All tech, no marketing
- On-demand
- Anytime
- Anywhere

Introduction

Transportable Tablespaces

Abbreviation

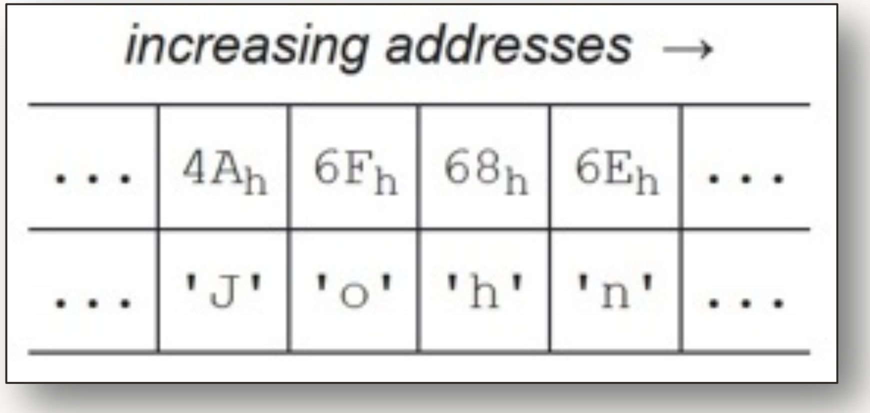
⇛

XTTS	Cross-platform transportable tablespaces
FTEX	Full Transportable Export/Import

Typically, you use XTTS for cross-endian migrations

Endianness | The Basics

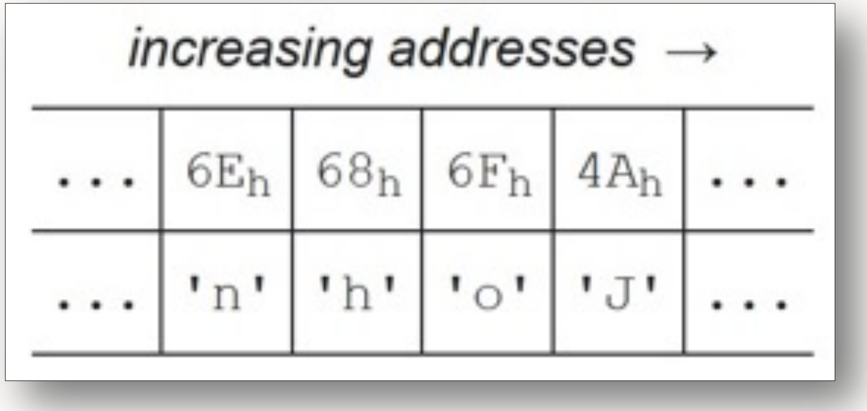
Big-endian



increasing addresses →

...	$4A_h$	$6F_h$	68_h	$6E_h$	...
...	'J'	'o'	'h'	'n'	...

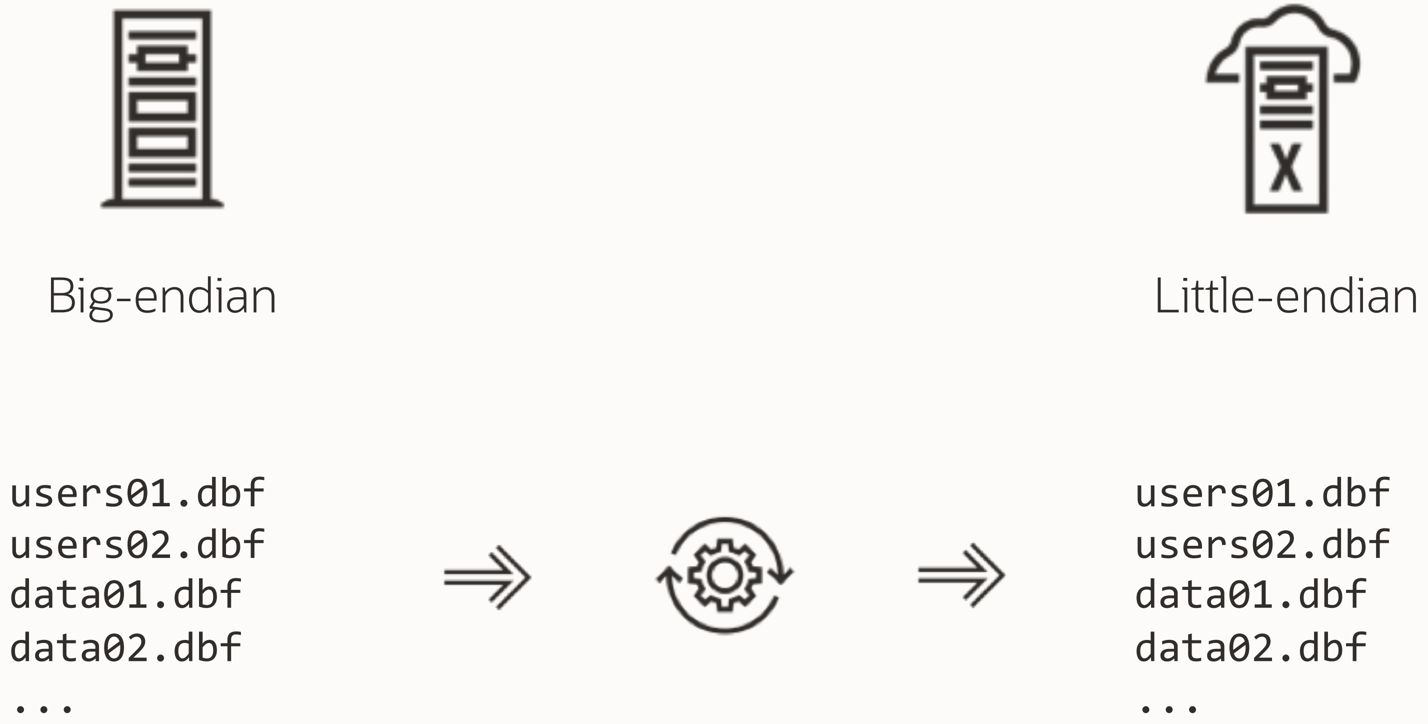
Little-endian



increasing addresses →

...	$6E_h$	68_h	$6F_h$	$4A_h$	...
...	'n'	'h'	'o'	'J'	...

Source: https://en.wikipedia.org/wiki/Endianness



Big-endian

Little-endian

```
users01.dbf
users02.dbf
data01.dbf
data02.dbf
...
```

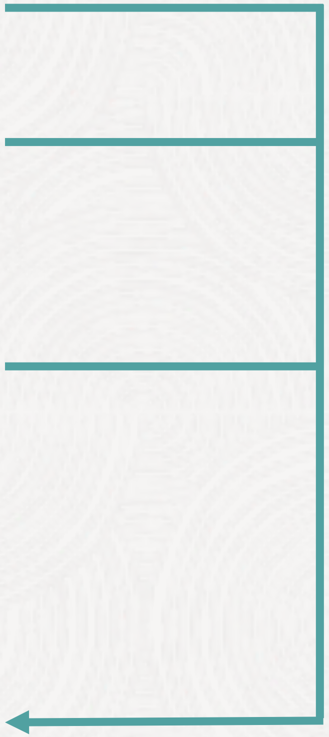
```
users01.dbf
users02.dbf
data01.dbf
data02.dbf
...
```

SuperCluster M8 systems run out of hardware maintenance in June 2024

- List of Oracle Supported Hardware with Last Ship Dates Announced (Doc ID 1450710.1)

```
SQL> select platform_name, endian_format from v$transportable_platform;

AIX-Based Systems (64-bit)           Big
Apple Mac OS                         Big
HP-UX (64-bit)                       Big
HP-UX IA (64-bit)                    Big
IBM Power Based Linux                Big
IBM zSeries Based Linux              Big
Linux OS (S64)                       Big
Solaris[tm] OE (32-bit)              Big
Solaris[tm] OE (64-bit)              Big
Apple Mac OS (x86-64)                Little
HP IA Open VMS                       Little
HP Open VMS                          Little
HP Tru64 UNIX                        Little
Linux IA (32-bit)                    Little
Linux IA (64-bit)                    Little
Linux OS (AARCH64)                   Little
Linux x86 64-bit                     Little
Microsoft Windows IA (32-bit)        Little
Microsoft Windows IA (64-bit)        Little
Microsoft Windows x86 64-bit         Little
Solaris Operating System (x86)       Little
Solaris Operating System (x86-64)    Little
```

```
SQL> select platform_name, endian_format from v$transportable_platform;

AIX-Based Systems (64-bit)           Big
Apple Mac OS                         Big
HP-UX (64-bit)                       Big
HP-UX IA (64-bit)                    Big
IBM Power Based Linux                Big
IBM zSeries Based Linux              Big
Linux OS (S64)                       Big
Solaris[tm] OE (32-bit)              Big
Solaris[tm] OE (64-bit)              Big
Apple Mac OS (x86-64)                Little
HP IA Open VMS                       Little
HP Open VMS                          Little
HP Tru64 UNIX                        Little
Linux IA (32-bit)                    Little
Linux IA (64-bit)                    Little
Linux OS (AARCH64)                   Little
Linux x86 64-bit                     Little
Microsoft Windows IA (32-bit)        Little
Microsoft Windows IA (64-bit)        Little
Microsoft Windows x86 64-bit         Little
Solaris Operating System (x86)       Little
Solaris Operating System (x86-64)    Little
```



Concept

Transportable Tablespace

Transportable Tablespaces | Concept

Your data ⇛

Rows

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

Metadata

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

Transportable Tablespaces | Concept

Rows

Stored in a user tablespace

⇛ Copy the data files

Metadata

Stored in *SYSTEM* tablespace

⇛ Recreate using Data Pump

ℹ

All data files must be consistent when you copy them

- Tablespaces must be *read only*

Transportable Tablespaces | Concept

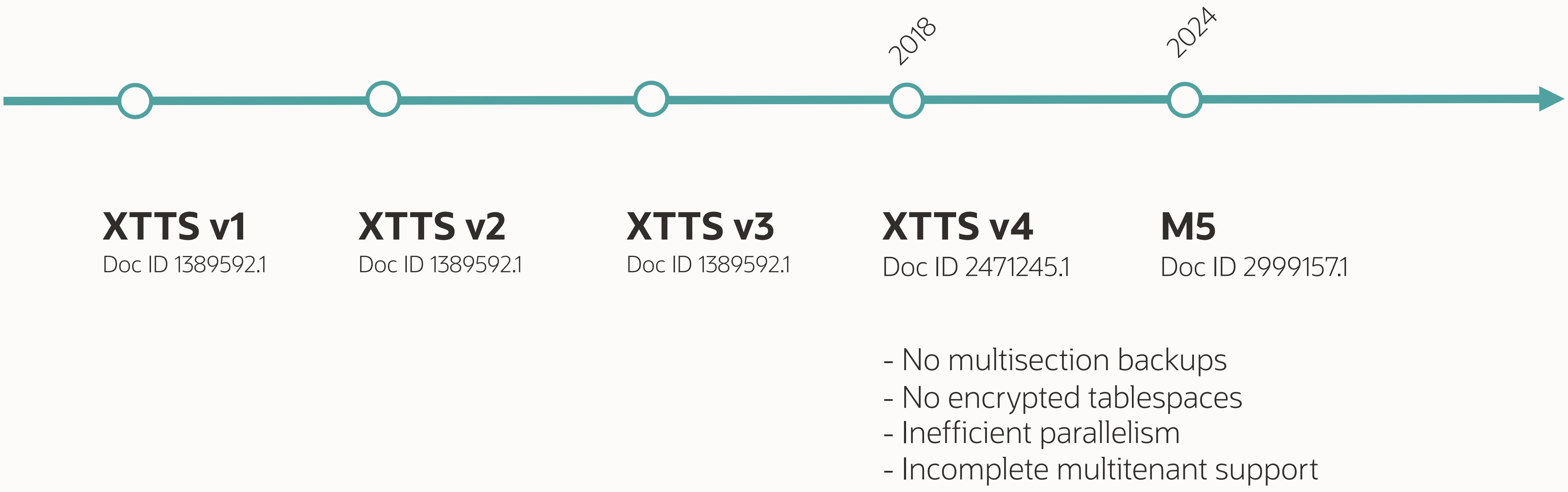
Copy the data files ⇛

1 File system copy

2 Backup / restore / recover

Transportable Tablespaces | Concept

2 Backup / restore / recover



2018

2024

XTTS v1
Doc ID 1389592.1

XTTS v2
Doc ID 1389592.1

XTTS v3
Doc ID 1389592.1

XTTS v4
Doc ID 2471245.1

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

M5
Doc ID 2999157.1

Transportable Tablespaces | Concept

Rows → Copy the data files

Stored in a user tablespace

Metadata → Recreate using Data Pump

Stored in *SYSTEM* tablespace

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 must be 11.2.0.3 or higher
- Target must be 12.1 or higher
- Strongly recommended

Full Transportable Export/Import

Designed to move an entire database, including:

- Profiles
- Public database links and synonyms
- Directories
- Database triggers except those owned by SYS
- SQL Management Base
  - SQL plan baselines, plan directives, profiles, patches
- And much more

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

- New RMAN functionality combined with Full Transportable Export/Import
- Doc ID 2999157.1

Further Reading | XTTS v4

Blog posts

YouTube playlist

Webinars (video and slide deck)

- Migration Strategies – Insights, Tips and Secrets
- Migrating Very Large Databases

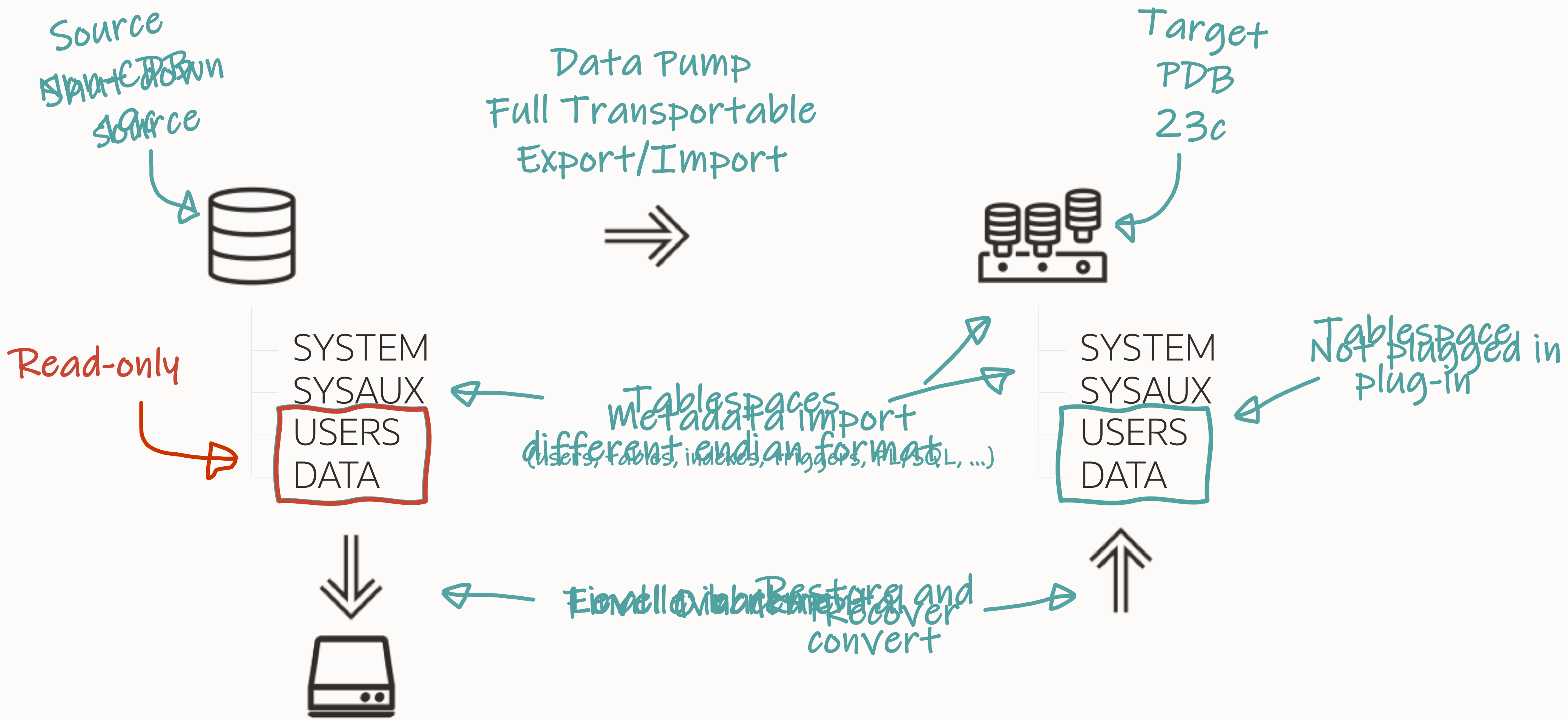
Reference cases

- Top healthcare provider: 230 TB in less than 24 hours
- Pushing the limits: ExaCC migration using a ZDLRA

Further Reading | Transportable

- Master Note for Transportable Tablespaces (TTS) -- Common Questions and Issues (Doc ID 1166564.1)
- Transportable Tablespace (TTS) Restrictions and Limitations: Details, Reference, and Version Where Applicable (Doc ID 1454872.1)
- V4 PERL Scripts to reduce Transportable Tablespace Downtime using Cross Platform Incremental Backup (Doc ID 2471245.1)
- Known Issues for Cross Platform Transportable Tablespaces XTTS (Doc ID 2311677.1)
- Cross Platform Database Migration using ZDLRA (Doc ID 2460552.1)
- 11G – Reduce Transportable Tablespace Downtime using Cross Platform Incremental Backup (Doc ID 1389592.1)
- 12C – Reduce Transportable Tablespace Downtime using Cross Platform Incremental Backup (Doc ID 2005729.1)
- Blog post: What Is a Self-contained Transportable Tablespace Set

Concept


Source
Non-CDB
Shutdown
19c
source
Data Pump
Full Transportable
Export/Import
Target
PDB
23c
Read-only
SYSTEM
SYSAUX
USERS
DATA
Tablespaces
Metadata import
different endian format
(users, tables, indexes, triggers, PL/SQL, ...)
Tablespace
Not plugged in
plug-in
SYSTEM
SYSAUX
USERS
DATA
Level 0 backup
Final incremental
Restore and
Recover
convert

Concept

Transportable Tablespaces enables

- Migration to a higher database release
- Migration between non-CDB and PDB
- Cross-endian and same-endian migration
- Cross-platform and same-platform migration

Requirements

Transportable Tablespace

The target database must have the same or higher `COMPATIBLE` setting

Target database must use the same character set

- A few exceptions exist
- Applies to national character set as well

```sql
--To check database character set.
--Optionally, convert source database to Unicode
--using Oracle Database Migration Assistant for Unicode (DMU)

select * from nls_database_parameters;
```

Character Set

PDBs may use a different character set than the CDB,
if the CDB character set is AL32UTF8.

1. Keep *production* CDB on AL32UTF8
2. Provision *temporary* CDB with the desired character set
3. Create a new empty PDB in the *temporary* CDB
4. Clone custom PDB to *production* CDB

We recommend using the same time zone file version in the target database

```
--To determine the active time zone file version

select * from v$timezone_file;
```

Target time zone file version must be equal to or higher than source

Timestamp with Time Zone

If you have `TIMESTAMP WITH TIME ZONE` (`TSTZ`) and time zone file version does not match:

- Full transportable export/import
  - Data Pump updates `TSTZ` columns during the import
  - Time-consuming

- Traditional transportable jobs:
  - Data Pump skips the entire table on import
  - Perform regular import after migration

```
-- By default, DBCA picks the newest available time zone file
-- To choose any time zone file during database creation
-- https://mikedietrichde.com/2016/12/08/create-a-database-with-non-default-time-zone/

export ORA_TZFILE=$ORACLE_HOME/oracore/zoneinfo/timezlrg_40.dat

./dbca
```

If you have `TIMESTAMP WITH LOCAL TIME ZONE`, you must use the same `DBTIMEZONE`

```
--To determine the database time zone

select dbtimezone from v$instance;
```

Timestamp with Local Time Zone

The database time zone (DBTIMEZONE) affects only:

- TIMESTAMP WITH LOCAL TIME ZONE (TSLTZ)
- CURRENT_DATE
- CURRENT_TIMESTAMP
- LOCALTIMESTAMP

SYSDATE and SYSTIMESTAMP do not rely on database time zone (DBTIMEZONE)

- Determined by operating system time zone and clock

```
--You can change the database time zone.
--A PDB can have a different time zone.
--You can only change the database time zone if you have no TSLTZ columns.

alter database cdb1 set time_zone = '+02:00';

alter pluggable database pdb1 set time_zone = '+04:00';
```

Timestamp with Local Time Zone

If you have `TIMESTAMP WITH LOCAL TIME ZONE` (`TSLTZ`) and `DBTIMEZONE` does not match:

- Data Pump skips the entire table on import
- Perform regular import after migration

M5 Migration Script

Interview

Watch on YouTube

```
# 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>;
}
```

```
# 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>'
};
```

Benefits

M5 procedure supports:

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

Requirements

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

- Target must use Oracle Managed Files (OMF)
  - Parameter DB_CREATE_FILE_DEST PARAMETER

Demo

Source

- Oracle Database 19c
- Non-CDB, called *UP19*

→

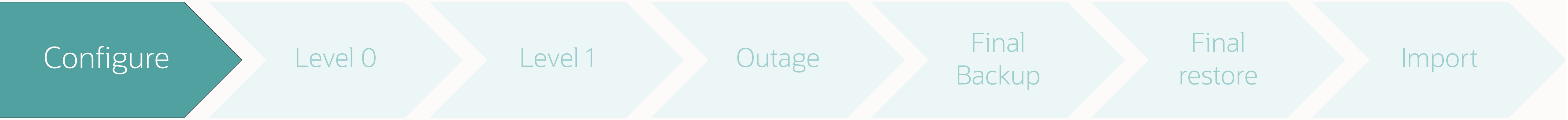
Target

- Oracle Database 19c
- CDB, called *CDB2*
- PDB, called *PDB1*

- M5 script on shared NFS mount point

Watch on [YouTube]

M5 Workflow



Configure

Level 0

Level 1

Outage

Final Backup

Final restore

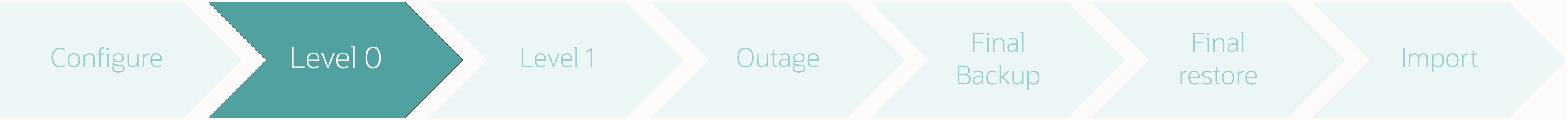
Import

- Download M5 script from Doc ID 2999157.1

- Configure shared NFS
- Edit **`dbmig_ts_list.txt`**
- Edit **`dbmig_driver.properties`**

- Create new, empty target database

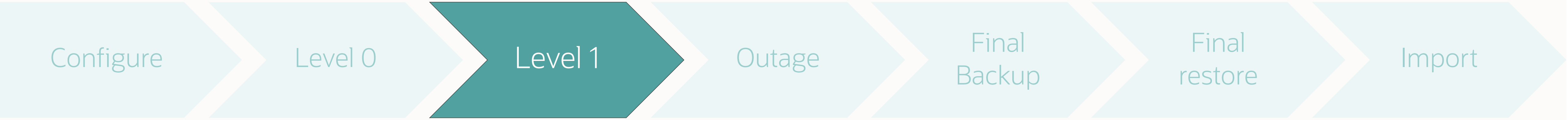
M5 Workflow



- Start initial level 0 backup
- Use driver script `dbmig_driver_m5.sh L0`

- Driver script creates a restore script
- Restore using `restore_L0_<source_sid>_<timestamp>.cmd`
- Check logs

M5 Workflow

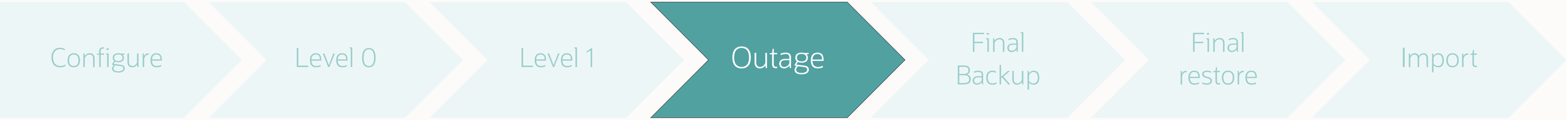


- Start level 1 incremental backup
- Use driver script `dbmig_driver_m5.sh L1`

- Driver script creates a restore script
- Restore using `restore_L1_<source_sid>_<timestamp>.cmd`
- Check logs

- Repeat as often as desired

M5 Workflow



Configure

Level 0

Level 1

Outage

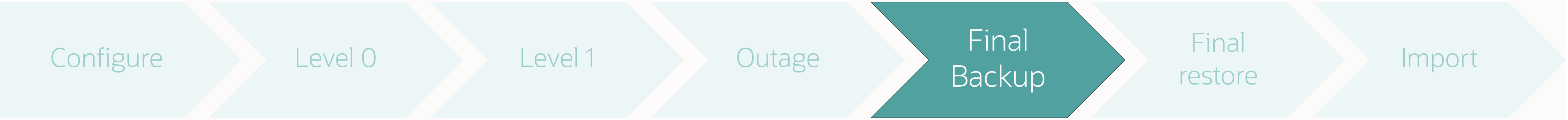
Final Backup

Final restore

Import

- Maintenance window begins
- Read-only sessions can still use the database

M5 Workflow



Configure

Level 0

Level 1

Outage

Final Backup

Final restore

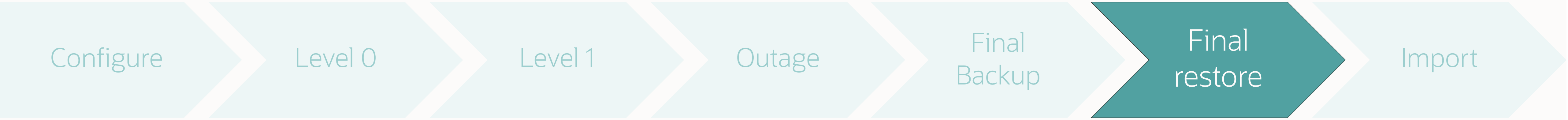
Import

- Start final level 1 incremental backup
- Use driver script `dbmig_driver_m5.sh L1F`

- Sets tablespaces read-only
- Performs level 1 incremental backup
- Start Data Pump full transportable export

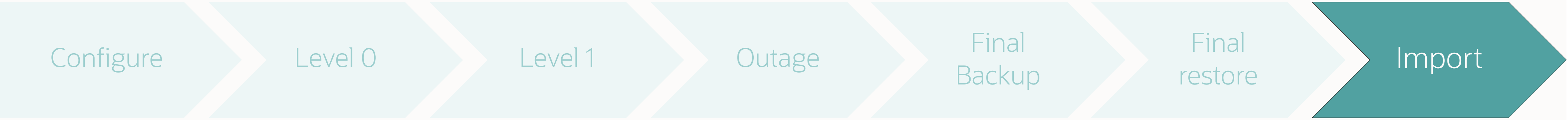
- Optionally, shut down source database

M5 Workflow



- Driver script created a restore script
- Restore using `restore_L1F_<source_sid>_<timestamp>.cmd`
- Check logs

M5 Workflow



- Copy Data Pump dump file to *DATA_PUMP_DIR*

- Use import driver script in test mode
- Start `impdp.sh <dump_file> <restore_log> test`
- Check generated parameter file
- Use `impdp.sh <dump_file> <restore_log> run`

- Check Data Pump log file

Recommendations

- Use a shared NFS mount point
  - Attach to source and target
  - Use for script, backups, logs, etc.

- If NFS is not possible
  - Manually copy files from source to target after each run
  - M5 can copy scripts using `DEST_SERVER` (for ZDLRA only)

⚠ Manually remove restore point in target database after migration

You must manually add new tablespaces to **`dbmig_ts_list.txt`**

- Failure to do so results in errors during Data Pump import

⚠

Keep backups on the source database. RMAN might need them for recovery

- Remove the backups using proper RMAN commands

Always use the latest version of M5 script

- Download from Doc ID 2999157.1

Best Practices

Before Migration

We strongly recommend using a recent Release Update

- Never migrate without the Data Pump Bundle Patch
- Applies to source and target database

Stay Current

1. Get the latest Release Update
   - Assistant: Download Reference for Oracle Database/GI Update, Revision, PSU, SPU(CPU), Bundle Patches, Patchsets and Base Releases (Doc ID 2118136.2)

2. Get important one-off patches
   - Oracle Database 19c Important Recommended One-off Patches (Doc ID 555.1)
   - Oracle Database Patches to Consider for 19c (Doc ID 2781612.2)

3. Get the Data Pump Bundle Patch
   - 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

Accurate dictionary and fixed objects stats are vital for Data Pump performance

Statistics | When to Gather

Gather dictionary statistics:

- Reasonable time before export
- Before import
- Immediately after import

Gather fixed objects statistics:

- Reasonable time before export
- After import when the system is *warmed up*
  - The database must be in *production* state

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

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

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

Clean up your database

- Less data, faster migration

Clean Up

Remove unneeded data and metadata

Everything matters - but metadata matters most

- Metadata affects Data Pump
- Data affects the level 0 backup

Our experience shows there is always data and metadata to remove

Execute a dictionary check

- Use `DBMS_DICTIONARY_CHECK`
- Formerly known as *health check*

```
SQL> set serveroutput on size unlimited
SQL> execute dbms_dictionary_check.full
```

```
dbms_dictionary_check on 07-MAR-2023 03:17:48
----------------------------------------------
Catalog Version 21.0.0.0.0 (2300000000)
db_name: ORCL
Is CDB?: NO
Trace File: /oracle/log/diag/rdbms/orcl/orcl/trace/orcl_ora_2574906_DICTCHECK.trc

                                   Catalog       Fixed
Procedure Name                     Version    Vs Release    Timestamp      Result
------------------------------ ... ---------- -- ---------- -------------- ------
.- OIDOnObjCol                 ... 2300000000 <=  *All Rel* 03/07 03:17:48 PASS
.- LobNotInObj                 ... 2300000000 <=  *All Rel* 03/07 03:17:48 PASS
.- SourceNotInObj              ... 2300000000 <=  *All Rel* 03/07 03:17:48 PASS
...
```

Dictionary Check

Dictionary check produces a report:

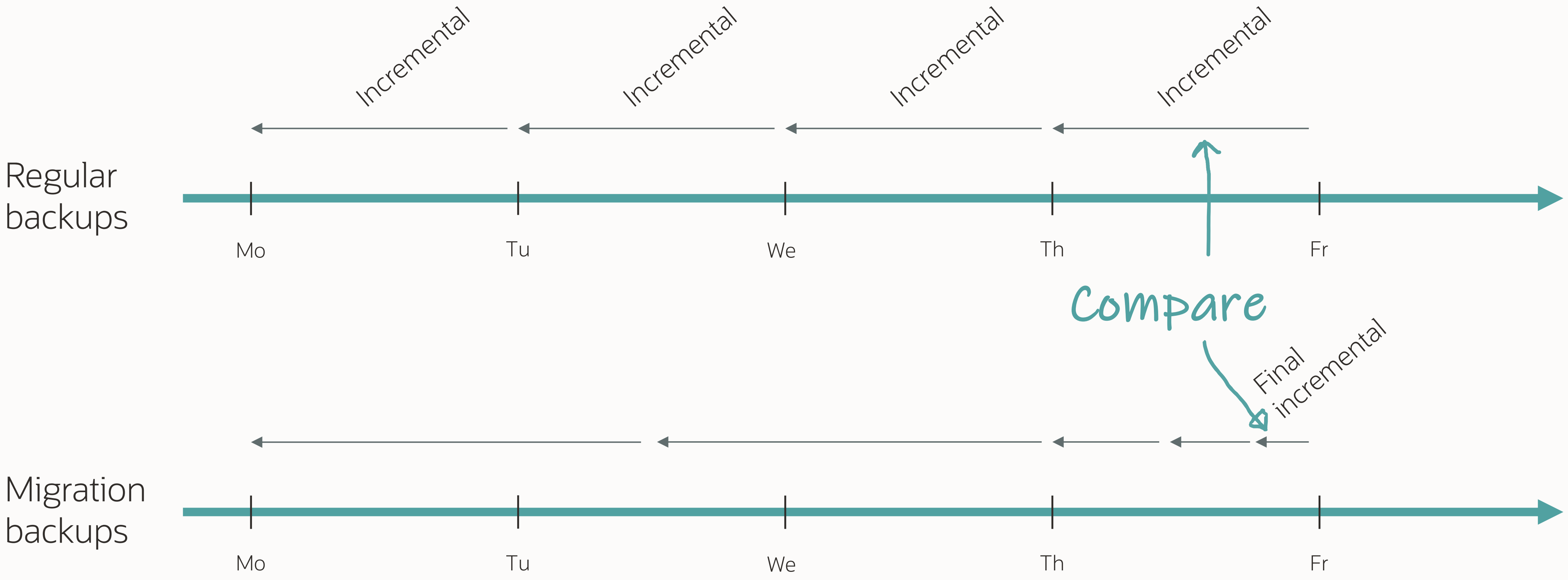
- Review findings
- Optionally, use the repair option

Also available through:

- Autonomous Health Framework
- EXAchk
- ORAchk
- MOS Doc ID 1366971 (older releases only)

How long will the final level 1 incremental backup take?

Estimate Final Incremental



Estimate Final Incremental

Compare `V$RMAN_BACKUP_SUBJOB_DETAILS`

- On the final day, you run several incrementals
- Final incremental may use more channels

Real-life example:

Daily incremental	2 TB
Final incremental	951 GB

Estimate Final Incremental

Don't use redo generation to estimate final level 1 backup

Real-life example:

Redo per day	15 TB
Daily incremental	2 TB
Final incremental	951 GB

Best Practices

During Migration

Use Block Change Tracking for faster incremental backups

- Check the License Guide for details

```
[oracle@hol m5]$ ./dbmig_driver_m5.sh L1

Properties file found, sourcing.
LOG and CMD directories found
2024-02-20 06:59:56 - 1708408796651: Requested L1 backup for pid 21485.  Using DISK destination,
4 channels and 64G section size.
2024-02-20 06:59:56 - 1708408796659: Performing L1 backup for pid 21485
RMAN> 2> 3> 4> RMAN> RMAN> 2> 3> 4> 5> 6> 7> 8> 9> 10> 11> 12> RMAN>
2024-02-20 07:00:55 - 1708408855044: No errors or warnings found in backup log file for ...
2024-02-20 07:00:55 - 1708408855059: Manually copy restore script to destination
2024-02-20 07:00:55 - 1708408855062:  => /u01/app/oracle/m5/cmd/restore_L1_UP19_240220065956.cmd
2024-02-20 07:00:55 - 1708408855076: Saving SCN for next backup for pid 21485

BACKUP_TYPE       INPUT_BYTES(MB)   OUTPUT_BYTES(MB)       STATUS
DATAFILE FULL                4458               1.32    COMPLETED
```

If BCT is in use,
this number decreases

Block Change Tracking

If `INPUT_BYTES` matches database size:

Option 1: Increase BCT bitmap size

- Increase parameter `_bct_bitmaps_per_file` (Doc ID 452455.1)

Option 2: Prevent standby database from updating primary bitmap

- Prevent with parameter `_disable_primary_bitmap_switch` (Doc ID 2144267.1)
- If changed, after switchover first incremental needs to fully scan

Converting to snapshot standby resets the change tracking bitmap

- The next incremental must fully scan the database

⚠

Block Change Tracking on standby database requires Active Data Guard

Further Reading

Block Change Tracking Inside Out (Doc ID 1528510.1)

Exclude statistics from Data Pump metadata export

- Use `exclude=statistics`
- Excluded by default in M5 script

`exclude=statistics` ⇛

1. Table statistics
2. Index statistics
3. Statistics preferences
4. Column usage information

```
exclude=statistics
```

⇒

1 Table statistics

2 Index statistics

3 Statistics preferences

4 Column usage information

Statistics

1 Regather

2 Transfer from source

Gather on database or schema using `DBMS_STATS`

Time-consuming

Resource-intensive

Go warp speed with `CONCURRENT` and `AUTO_DEGREE`

Mostly suitable when migrating from older release

Statistics

1 Regather

2 Transfer from source

Export and import using `DBMS_STATS`

Fast

Not resource-intensive

Run multiple imports simultaneously

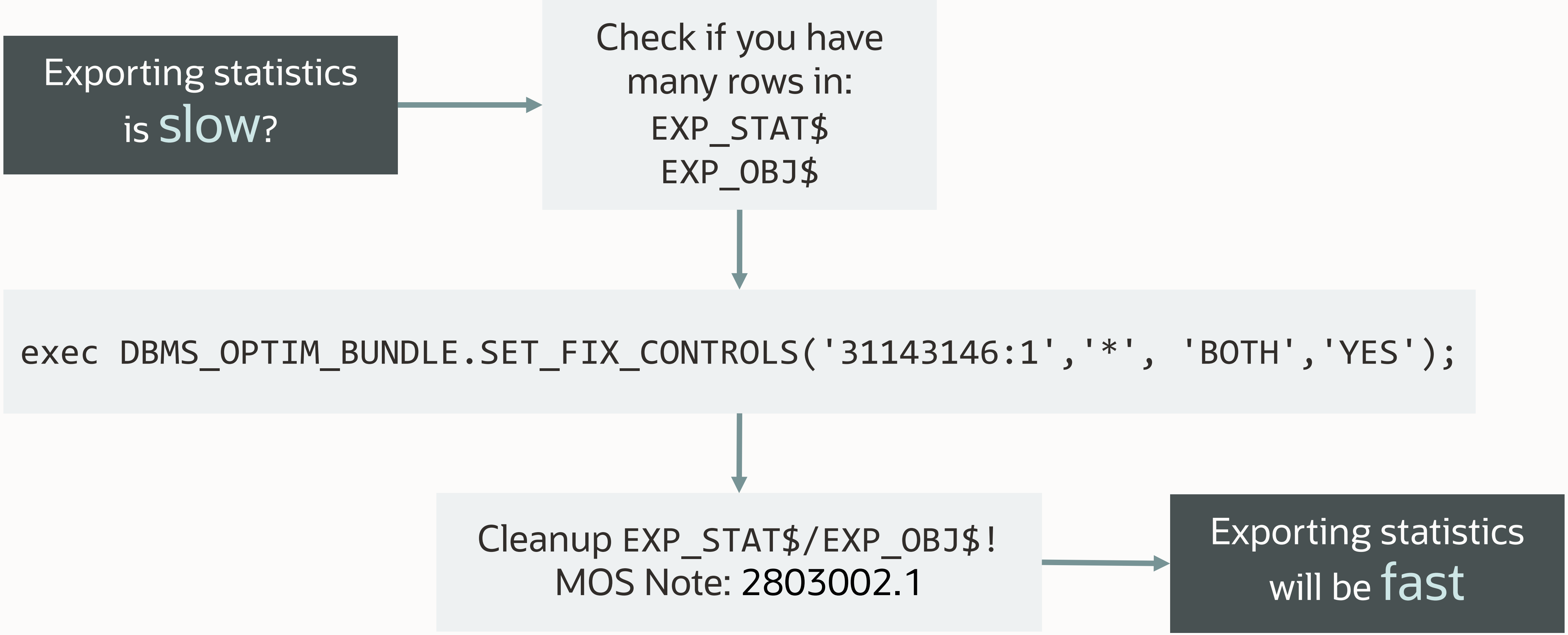
Check YouTube playlist and blog post

Our preferred option

Save downtime by exporting stats before the maintenance window

- Reduce tasks in the maintenance window
- Store stats staging table in a tablespace that you transport

Caution: Expression Statistics



Exporting statistics is slow?

Check if you have many rows in:
EXP_STAT$
EXP_OBJ$

```
exec DBMS_OPTIM_BUNDLE.SET_FIX_CONTROLS('31143146:1','*', 'BOTH','YES');
```

Cleanup EXP_STAT$/EXP_OBJ$!
MOS Note: 2803002.1

Exporting statistics will be fast

```
exclude=statistics
```

⇒

1 Table statistics

2 Index statistics

3 Statistics preferences

4 Column usage information

Statistics Preferences

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

Statistics Preferences

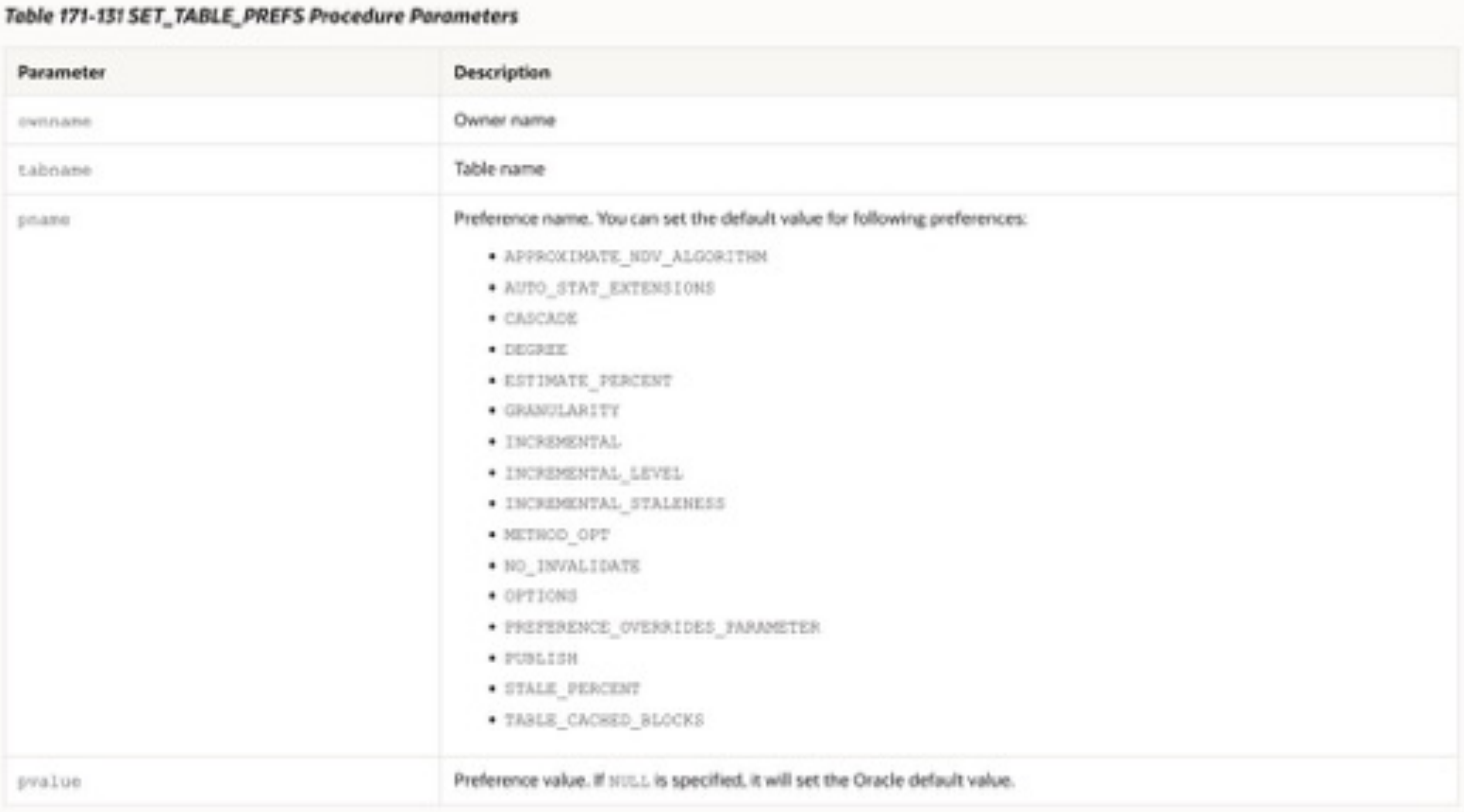


Table 171-131 SET_TABLE_PREFS Procedure Parameters

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

Statistics Preferences

- If you use global statistics preferences,
  you must redefine those in the target database
  - Use `DBMS_STATS.SET_GLOBAL_PREFS`

- If you use table-level statistics preferences,
  you can transport those from source database
  - Use `DBMS_STATS.EXPORT_TABLE_PREFS`

You often use statistics preferences to solve a particular problem

- Evaluate whether that problem exists in the target environment `exclude=statistics` ⇒

1 Table statistics

2 Index statistics

3 Statistics preferences

4 Column usage information

Column Usage Information

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

Take care when you gather statistics without column usage information

- Relevant only for workload that depends on histograms

EXCLUDE

`EXCLUDE=STATISTICS`

`COL_USAGE$` empty

REGATHER

First time only

```
METHOD_OPT =>
SIZE SKEWONLY
```

GO LIVE

Database updates column usage information

REGATHER

Use default

```
METHOD_OPT =>
SIZE AUTO
```

If you include statistics Data Pump includes everything, except global stats preferences

- Not recommended: **`include=statistics`**

Always add Data Pump diagnostic information to the log file

- M5 script adds `LOGTIME=ALL` and `METRICS=YES`

Use Data Pump parallel metadata export and import

- Available in Oracle Database 21c

```
-- Any transportable jobs can now run in parallel
-- Parallel unload/load of metadata provide a significant performance boost

expdp ... full=y transportable=always parallel=16
expdp ... tablespace=<list> parallel=16

impdp ... parallel=16
```

Parallel Transportable

Parallel degree in export and import is completely independent

Source

Oracle Database 19c

```
expdp ... parallel=1
```

⇛

Target

Oracle Database 23c

```
impdp ... parallel=32
```

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 16	1h 8m
Import parallel 16	1h 23m
Total	**2h 31m**

Parallel Transportable | Architecture

Parallel export:

- Each worker processes an object path serially
- Parallel happens by multiple workers working on multiple object paths

Parallel import:

- One worker plugs in tablespaces
- Control process orders the object paths
- All workers work on one object path in parallel
- Parallel happens by all workers working on the same object path
- One worker completes the import

Ensure adequate `streams_pool_size` during Data Pump export and import

- Avoid waits caused by SGA resize operations
- 512M should be sufficient

Disable the resource manager during the migration

```
alter system set resource_manager_plan='';
```

Disable all maintenance windows in the maintenance window group

- Disabling the group is not sufficient

```
--Find all the maintenance windows and disable them individually.
--Your database might have different windows enabled, so select from the database.
--You can also select from dba_scheduler_wingroup_members.

select window_name from dba_autotask_window_clients;

exec dbms_scheduler.disable(name  => 'SYS.MONDAY_WINDOW');
exec dbms_scheduler.disable(name  => 'SYS.TUESDAY_WINDOW');
...
exec dbms_scheduler.disable(name  => 'SYS.SUNDAY_WINDOW');
```

Do not use SYS AS SYSDBA for your Data Pump jobs

Use SYSTEM

Check DATAPUMP_EXP_FULL_DATABASE / DATAPUMP_IMP_FULL_DATABASE

Credentials

The control table goes into the default tablespace
of the user running the Data Pump job

Expect the control table to grow to several GB. At one customer it was 4 GB in size.

For import, create a dedicated user and set the default tablespace to one that you can scratch after the migration. This ensures you don't use unnecessary space in SYSTEM tablespace.

You can restart Data Pump transportable jobs

- Available in Oracle Database 21c

Best Practices

Practice, practice, practice

- Start on a small database
- Prove it works on a production-size database

To ensure consistency and avoid human error

- Automate
- Save all logs and output
- Data Pump, RMAN

Clean-up procedure

- In case of failure and rollback
- To repeat tests

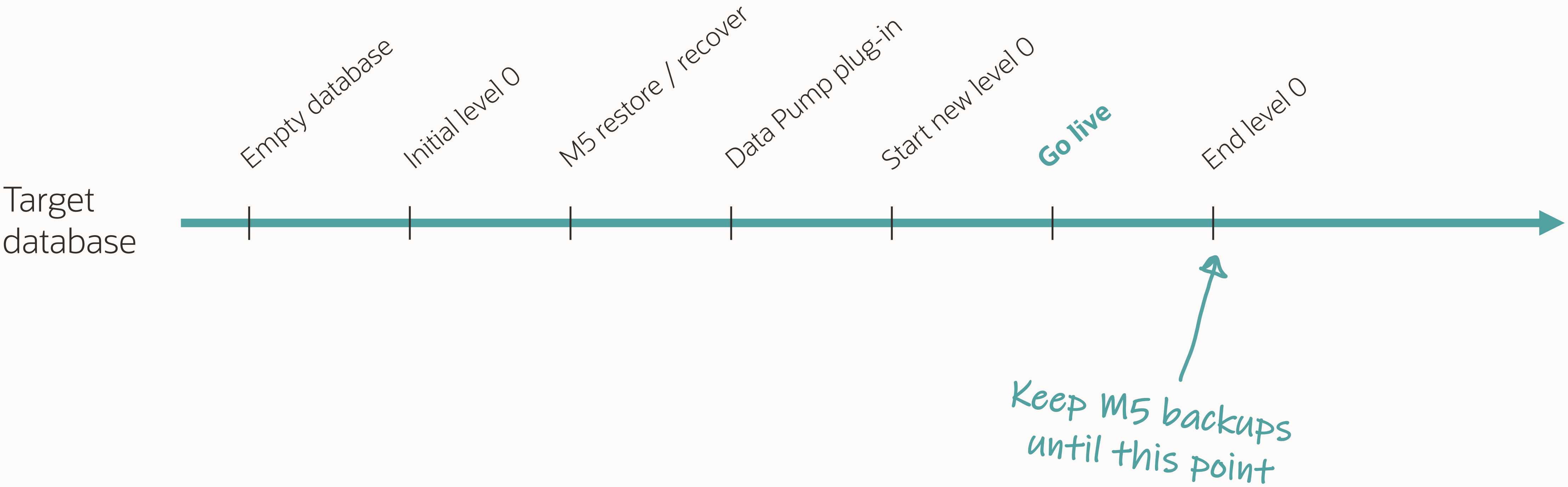
Best Practices

After Migration

Be sure to shut down the source database

Keep backups on the target database until a new level 0 backup completes

Target Backup



Target Backup

To remove M5 backups from target database use RMAN:

- `DELETE`
- `CHANGE ... UNCATALOG`

Advanced Scenarios

Using ZDLRA as a staging platform

- Instead of local storage or NFS

Use the latest `libra.so`

- On source, target and ZDLRA
- Doc ID 2219812.1

Consider to stall migration backups to prevent them from being virtualized

- Doc ID 2999157.1, appendix 4

ZDLRA throttles the number of channels based on appliance size

- Even if you specify more channels, ZDLRA might use fewer channels
- Normally, 64 channels

ZDLRA | Additional Information

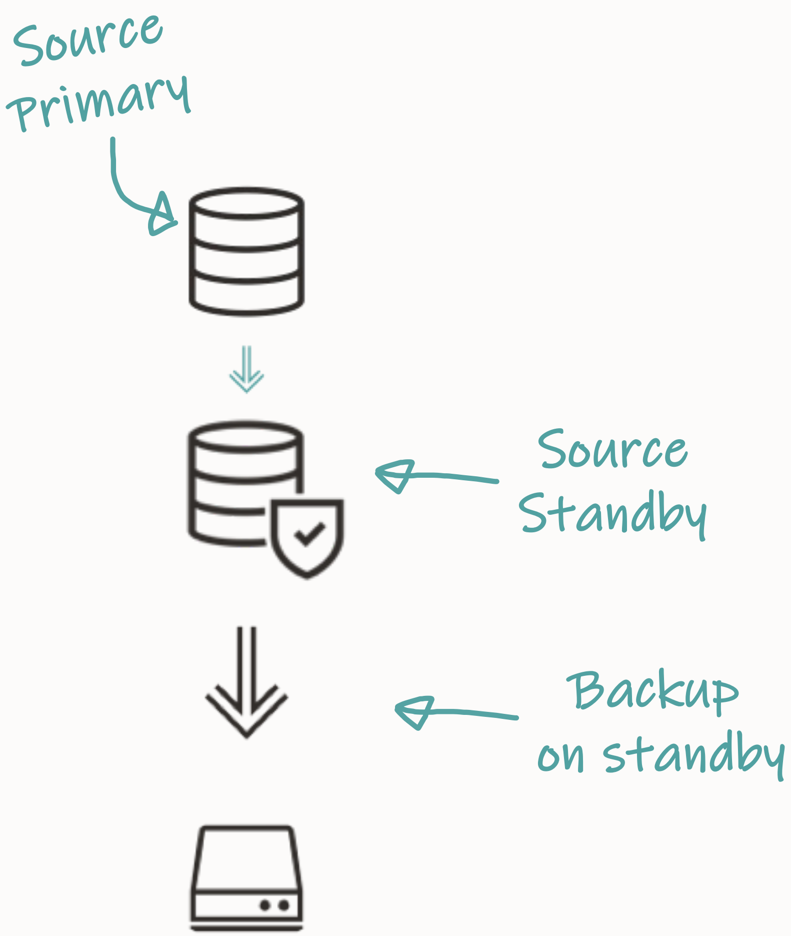
Known issue: VPC user password may not contain dollar-sign ($)
Workaround: use a secure external password store

XTTS v4 note for ZDLRA:
Cross Platform Database Migration using ZDLRA (Doc ID 2460552.1)

Taking backups on standby database

- Offload primary database

Backup on Standby



Backup on Standby

Backup for test

- Start M5 driver script on standby host
- Connect to standby database
- Set `BKP_FROM_STDBY=1` in M5 properties file

Backup for migration

- For level 0 (`L0`) and level 1 (`L1`):
  - Start M5 driver script on standby host
  - Connect to standby database
- For final level 1 (`L1F`):
  - Start M5 driver script on primary host
  - Connect to primary database

Backup from Standby

Effect of setting `BKP_FROM_STDBY=1` in M5 properties file

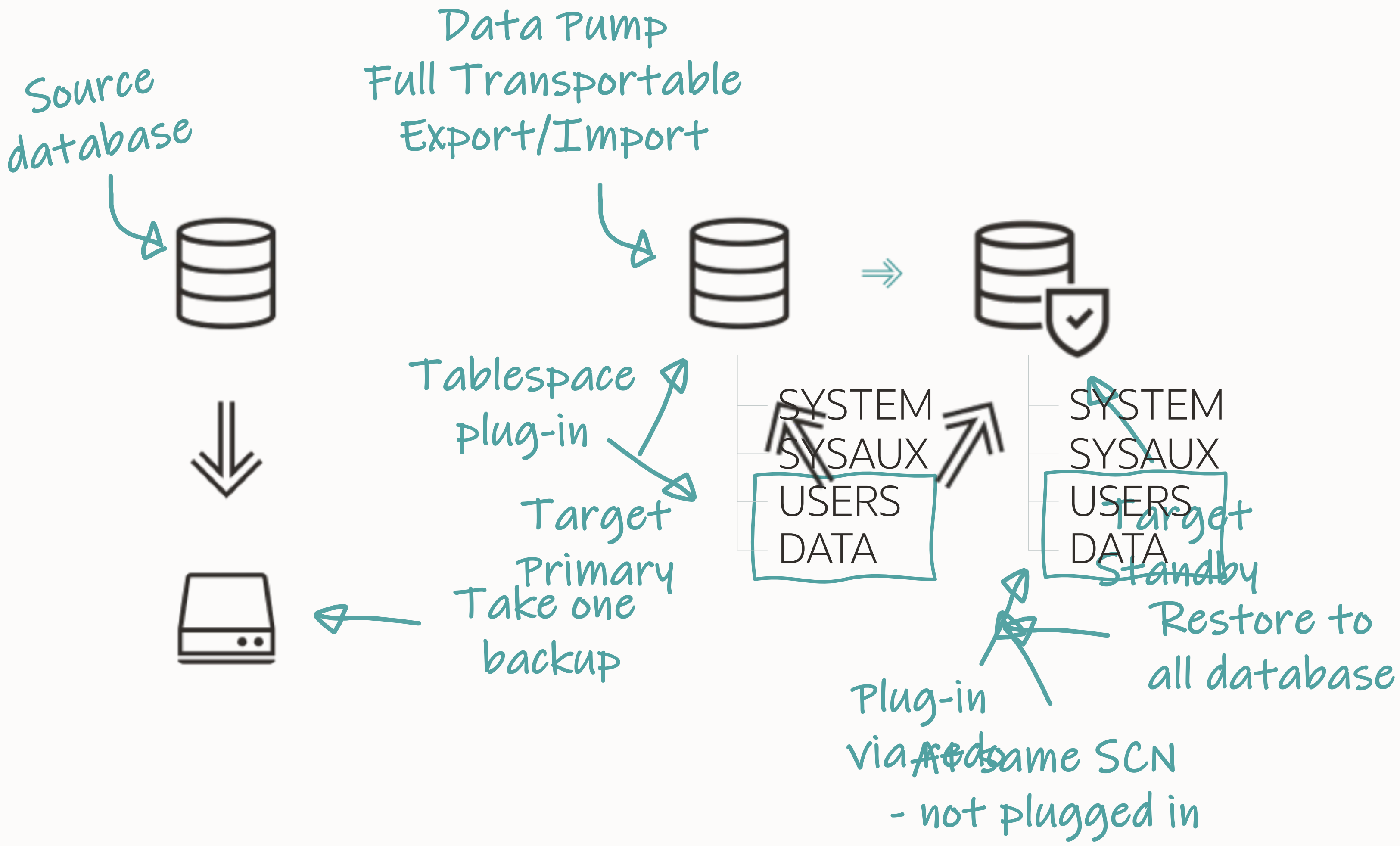
Affects only final level 1 (`L1F`):

- Convert to snapshot standby
- Snapshot standby resets BCT bitmap
  requiring final incremental to fully scan the database
- Recommended for testing only

Build target standby database as part of the migration

- Protect the target database immediately

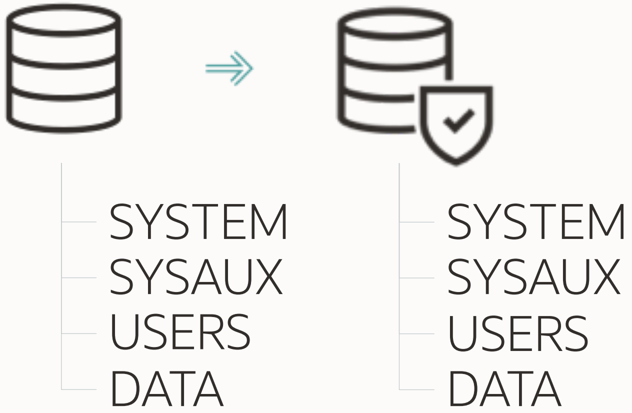
Target Standby Database



SYSTEM
SYSAUX
USERS
DATA

SYSTEM
SYSAUX
USERS
DATA

Target Standby Database



- SYSTEM
- SYSAUX
- USERS
- DATA

- SYSTEM
- SYSAUX
- USERS
- DATA

`+DATA/DB_BOSTON/.../data.273.1103046827`

`+DATA/DB_CHICAGO/.../data.269.1103050009`

Same data file,
but different path

Tablespace plug-in propagates to standby database via redo

- Expects data files with identical path / name on standby

Target Standby Database

Redo contains data file path from primary,
but it's different on standby

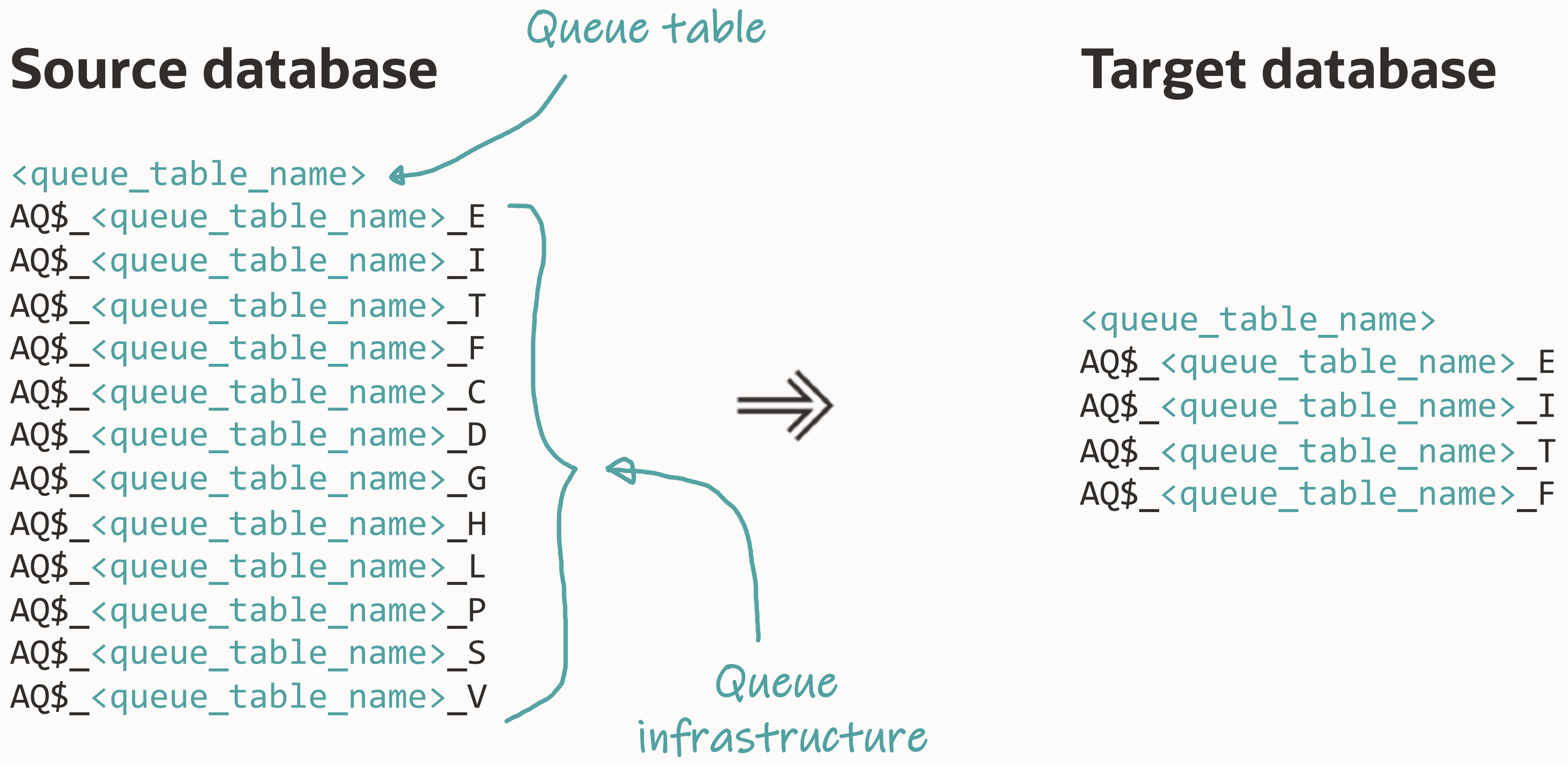
1 Use ASM aliases

2 Rename standby data files after plug-in failure

Using Advanced Queueing

- AQ creates some queue structures on demand only
- Blog post

Advanced Queueing



Source database

Queue table

```
<queue_table_name>
AQ$_<queue_table_name>_E
AQ$_<queue_table_name>_I
AQ$_<queue_table_name>_T
AQ$_<queue_table_name>_F
AQ$_<queue_table_name>_C
AQ$_<queue_table_name>_D
AQ$_<queue_table_name>_G
AQ$_<queue_table_name>_H
AQ$_<queue_table_name>_L
AQ$_<queue_table_name>_P
AQ$_<queue_table_name>_S
AQ$_<queue_table_name>_V
```

Queue infrastructure

Target database

```
<queue_table_name>
AQ$_<queue_table_name>_E
AQ$_<queue_table_name>_I
AQ$_<queue_table_name>_T
AQ$_<queue_table_name>_F
```

Take into account in comparing source and target database object count

- Understanding How Advanced Queueing (AQ) Objects Are Exported And Imported. (Doc ID 2291530.1)

Data Pump does not start queues

- Manually start queues after migration
- Use `DBMS_AQADM.START_QUEUE`

Further Reading

Understanding How Advanced Queueing (AQ) Objects Are Exported And Imported. (Doc ID 2291530.1)

What Objects Are Created When Creating a Queue Table ? (Doc ID 224027.1)

Things to Consider When Importing Advanced Queues using Oracle Data Pump

Data Pump moves audit policies and records

- During Full Transportable Export/Import
- Traditional and unified auditing

Archive audit records in advance using `DBMS_AUDIT_MGMT`

- Optionally, export audit records to target database

Configure a separate audit tablespace in target database

- Migrate audit records directly into dedicated tablespace
- Don't use *SYSAUX* for audit records

Audit Trail

Target database already has auditing infrastructure

- Schema, table, potentially also dedicated tablespace
- Not possible to move audit tablespace via transportable tablespace

Data Pump always unloads the audit records into the dump file

If you have a huge audit trail, empty it! Or ...

- You get a huge dump file
- You extend the maintenance window

Data Pump does not move AWR data

AWR

Consider whether it makes sense to move AWR data

- New and more powerful hardware
- New platform and architecture
- Potentially also newer version and into multitenant

To export AWR data

- How to Export and Import the AWR Repository From One Database to Another (Doc ID 785730.1)
- Do it outside of the maintenance window

But we are on Windows

Windows

M5 script is written for Bash shell

- Use Windows Terminal
- Or another Bash shell for Windows

Untested

Run commands manually

- Data Pump
- RMAN

```
BACKUP TABLESPACE
RESTORE ALL FOREIGN DATAFILES
```

In the unlikely event of …

- Rollback and fallback options

Rollback and Fallback

- To roll back (before go-live):
  Source environment is preserved

- To fall back (after go-live):
  Reverse process back to source

- If you also migrated to a PDB:
  Reverse process back to source

- If you also upgraded:
  Data Pump and GoldenGate

Edge Cases

Using binary XML

```
--Create a new table using XMLTYPE
CREATE TABLE CARS (CARDATA XMLTYPE);

--XMLTYPE columns consists of two columns
SELECT COLUMN_NAME, DATA_TYPE, HIDDEN_COLUMN, VIRTUAL_COLUMN FROM USER_TAB_COLS;

COLUMN_NAME     DATA_TYPE     HIDDEN_COLUMN    VIRTUAL_COLUMN
_______________ ____________ ________________ _________________
CARDATA         XMLTYPE       NO               YES
SYS_NC00002$    BLOB          YES              NO
```

Encoded/compressed
XML data

XMLTYPE
is a virtual column

```
--Detecting Binary XML in your Oracle Database

select *
from   dba_xml_tab_cols
where  storage_type= 'BINARY'
       and owner != 'SYS';
```

Binary XML

```
<CARS>
  <CAR>
    <MODEL>
      Volvo V90
    </MODEL>
  </CAR>
</CARS>
```

XML document

```
INSERT INTO CARS ...
```

⇓

Compress and encode XML to binary format

1. Generate tokens from namespace and tags
2. Insert into central token table
3. Insert encoded XML into CARS

```
INSERT INTO CARS VALUES('<CARS><CAR><MODEL>Volvo V90</MODEL></CAR></CARS>');
```

```
SELECT CARDATA, SYS_NC00002$ FROM CARS;

                     CARDATA                                                SYS_NC00002$
____________________________ __________________________________________________________
<CARS>                       9F01639E000000C850B4C81F1FC0085D90566F6C766F20563930D9D9A0
  <CAR>
    <MODEL>Volvo V90</MODEL>
  </CAR>
</CARS>
```

```
                                                  SYS_NC00002$
------------------------------------------------------------------
9F01639E000000C850B4C81F1FC0085D90566F6C766F20563930D9D9A0
```

Token repository

```
select * from XDB.X$QN6LVUTKVD49541E0L8000000001;

NMSPCID    LOCALNAME          FLAGS    ID
---------- ------------------ -------- -------
...        ...                ...      ...
07         CARS               00       50B4
07         CAR                00       1F1F
07         MODEL              00       5D90
```

```
<CARS>
  <CAR>
    <MODEL>
      Volvo V90
    </MODEL>
  </CAR>
</CARS>
```

Binary XML

- The table contains the encoded binary XML
- The dictionary contains the token repository
- Both are required to read and understand the data

👍 Data Pump moves tokens during Full Transportable Export/Import

```
--If a token is already in use in the target database
--Data Pump skips the table to avoid data corruption

impdp ... transport_datafiles=<list-of-files>


ORA-39945: Token conflicting with existing tokens
```

Binary XML

Possible solutions

1 Conventional Data Pump export

- When Data Pump inserts the binary XML, the target database generates a new token

2 Prune the target database tokens

- Re-use all source database tokens in the target database
- Works on brand new, empty target databases only
- Be aware of bug 34425044
- Strongly recommended patching the source and target database using the latest available Release Update and Data Pump Bundle Patch
- How to Migrate Large Amount of Binary XML Data between Databases (Doc ID 2309649.1)

Binary XML

Binary XML uses tokens to compress/encode XML Data. The token ids and their value (Tag name) are stored in a central token table. During TTS import of data the tokens need to be reused, that means tokens on the exporting side and importing side cannot conflict with each other. In case of a conflict not XL data can be imported and an error message is raised during TTS import.

The Export and Import utilities can be used to move Binary XML storage data between environments. This option works well on smaller datasets, however, since it involves several internal insert commands, it will be very resource intensive on larger data migrations. For customers with a limited timescale planned migration window, this is not a feasible option.

How to move XMLType tables/columns with Binary XML Storage between schemas/databases (Doc ID 1405457.1)

Binary XML

How to find XML token table:

```
select TOKSUF from xdb.xdb$ttset;
```

Add as suffix:

--Tags

```
select * from XDB.X$QN<toksuf>;
```

--Namespaces

```
select * from XDB.X$NM<toksuf>;
```

Staging tables during FTEX:

```
xdb.xdb$tsetmap
xdb.xdb$ttset
```

Using evolved types in table definitions

```
--Create a new type. The type is now version 1
--Use the type in a table
CREATE TYPE CAR_INFO_TYPE IS OBJECT (model VARCHAR2(40));
CREATE TABLE CARS (id number, car_info car_info_type);
INSERT INTO CARS VALUES (1, car_info_type('Volvo V90'));

--Make a change to the type. The type is now version 2
ALTER TYPE CAR_INFO_TYPE ADD ATTRIBUTE horsepower NUMBER CASCADE NOT INCLUDING TABLE DATA;
INSERT INTO CARS VALUES (2, car_info_type('BMW 530i', 250));

--Make another change to the type. The type is now version 3
ALTER TYPE CAR_INFO_TYPE ADD ATTRIBUTE color VARCHAR2(20) CASCADE NOT INCLUDING TABLE DATA;
INSERT INTO CARS VALUES (3, car_info_type('Hyundai Sonata', 160, 'Black'));
```

The type is now evolving

Existing data is not updated

Evolved Types

```
SELECT * FROM CARS
```

CARS	
1	car_info_type v1: Volvo V90
2	car_info_type v2: BMW 530i, 250
3	car_info_type v3: Hyundai Sonata, 160, Black

DICTIONARY	
car_info_type v1	model
car_info_type v2	model, horsepower
car_info_type v3	model, horsepower, color

👍 Data Pump recreates types during Full Transportable Export/Import

Evolved Types

- To avoid data corruption,
  Data Pump must recreate the exact same type evolution in target database

- Due to implementation restrictions,
  it is not always possible to recreate the exact same type evolution

- In such situations, to avoid corruption,
  Data Pump reports `ORA-39218` or `ORA-39216` on import

```
--Identifying tables with evolved types
--These tables potentially pose a problem during transportable import

select owner, table_name, column_name, data_type_owner, data_type
from   dba_tab_cols
where  (data_type_owner, data_type) IN (
          select distinct u.username, o.name
          from   obj$ o, dba_users u, type$ t
          where  o.owner# = u.user_id
                 and oracle_maintained='N'
                 and o.oid$ = t.toid
                 and t.version# > 1
          group by u.username, o.name);
```

Find tables using these types

Find types with more than one version

Evolved Types | Possible Solutions

1 Conventional Data Pump export

2 Manually recreate type in target database with matching evolution

3 Recreate type without evolution before export

Blog post with details

Migrating databases with Oracle E-Business Suite

M5 script has not yet been certified by E-Business Suite

- XTTS v4 remains the certified approach

Customer Case

Customer

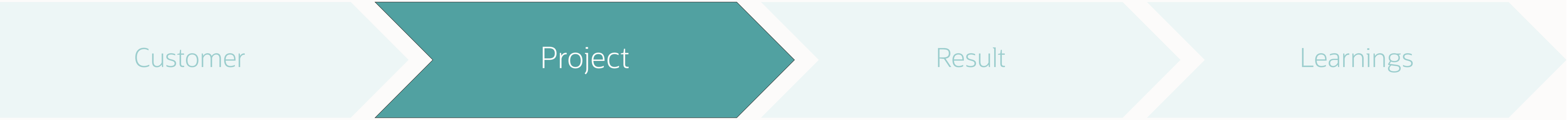
Project

Result

Learnings

- **Advania** - Icelandic tech company
- Operating across Sweden, Norway, UK, Iceland, Finland and Denmark.
- Offering Managed services, Hardware and Software, and Professional Services to clients in both private and public sectors

Customer Case



Oracle SPARC SuperCluster M7

Oracle E-Business Suite 12.2.11

Database size: 13 TB
19.18.0 + Data Pump Bundle Patch

Oracle Exadata Cloud@Customer

19.20.0 + Data Pump Bundle Patch

Customer Case

Customer

Project

Result

Learnings

- Planned 48-hours maintenance window
  - Includes encryption of tablespaces

- Database migration ~16 hours
  - Export: 4h 35m
  - Import: 11h 19m

Customer Case

Customer | Project | Result | Learnings

1 Test, test, and test

2 Create your own runbook

3 Use AWR to identify bottlenecks

4 Clone target database before import for easy testing and re-runs

Further Reading | E-Business Suite

MOS notes:

- Using Transportable Tablespaces to Migrate Oracle E-Business Suite Release 12.2 Using Oracle Database 19c Enterprise Edition On a Multitenant Environment (Doc ID 2674405.1)
- Oracle E-Business Suite 12.2 Platform Migration from On-Premises to Oracle Cloud Using Transportable Tablespaces with Oracle Database 19c (Doc ID 2725558.1)

Blog posts:

- Collection of EBS upgrade information for Oracle Database 19c

Testing the Migration

FTEX Testing Options

Test the transportable export

- How long will the export take?
- expdp parameter `TTS_CLOSURE_CHECK=TEST_MODE`

Repeat your tests without the need to restore again

- Tablespaces will be taken online by default since Oracle 12c
- `impdp` parameter option `TRANSPORTABLE=KEEP_READ_ONLY` prevents this

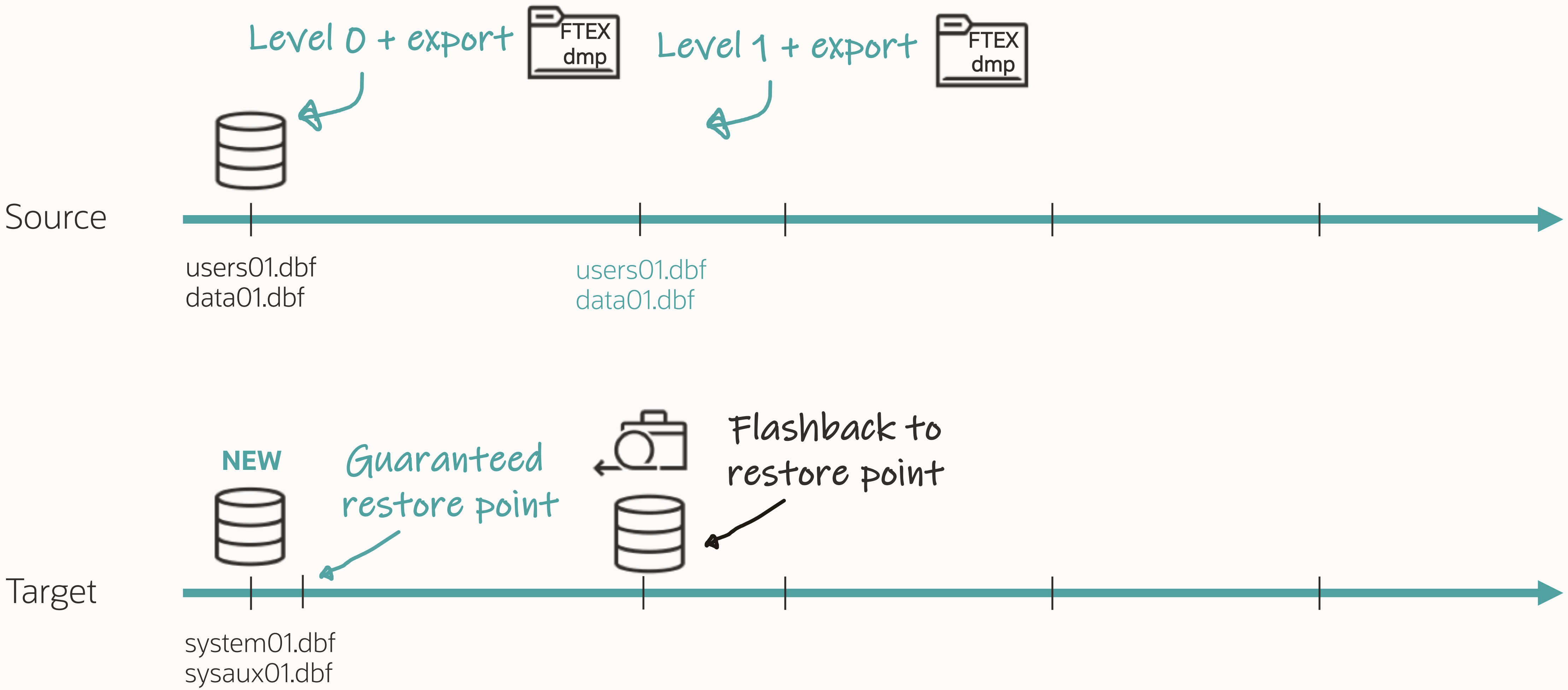
You can test the Data Pump export without setting tablespaces in read-only mode

```
--Performs a metadata export for a full transportable export/import
--Dump file is unusable for import.
--Parameter is available since Oracle Database 19c
--Logfile says: Dump file set is unusable. TEST_MODE requested.

expdp ... full=y transportable=always tts_closure_check=test_mode
```

Repeat import tests by keeping tablespaces in read-only mode

```
--Performs a real FTEX but keeps the tablespace read-write
--This ensures the data files may be re-used for a different import
--Parameter is available since Oracle Database 19c

impdp ... transportable=keep_read_only
```

impdp ... transportable=keep_read_only



Level 0 + export

FTEX dmp

Level 1 + export

FTEX dmp

Source

users01.dbf
data01.dbf

users01.dbf
data01.dbf

NEW

Guaranteed restore point

Flashback to restore point

Target

system01.dbf
sysaux01.dbf

Using a Snapshot Standby

For FTEX, tablespaces must be switched to read-only

- This isn't usually an option on PROD

Use a physical standby database for FTEX testing

- Take L0 backup from the standby
- Take L1 backup from the standby
- Convert it into a snapshot standby
- Switch tablespaces read-only
- Run the Full Transportable Export
- Take the "final" L1 backup
- Convert it back to a physical standby

Repeat!

Testing Without Data

1. Perform a regular Data Pump metadata export
   - Use `content=metadata_only`

2. Import into a test database
   - All metadata is there, but no data

3. Test M5 migration procedure
   - Learn and test the procedure
   - Easier due to very small database

Migrating the Beast

Customer Case

Entain is one of the world's largest sports betting and gaming groups. Leveraging the power of the Entain Platform, they bring moments of excitement into their customers lives through more than 30 iconic brands such as bwin, Coral, Ladbrokes and many more.

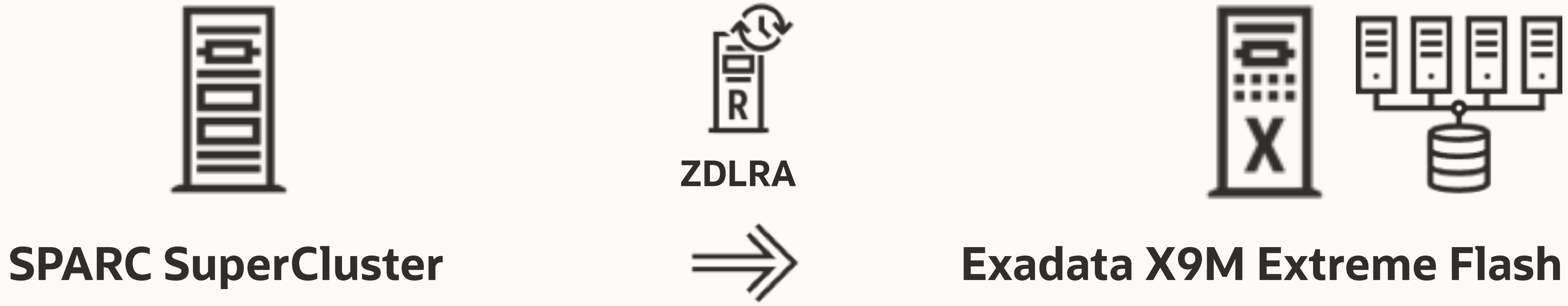
Entain operates on over 140 licenses across 40+ territories and employs over 29,000 talented workforce. Entain is listed on the London Stock Exchange and is a constituent of the FTSE 100 Index.

Entain

Challenges and Constraints

What is special, what makes it so complex?

Migration Challenges

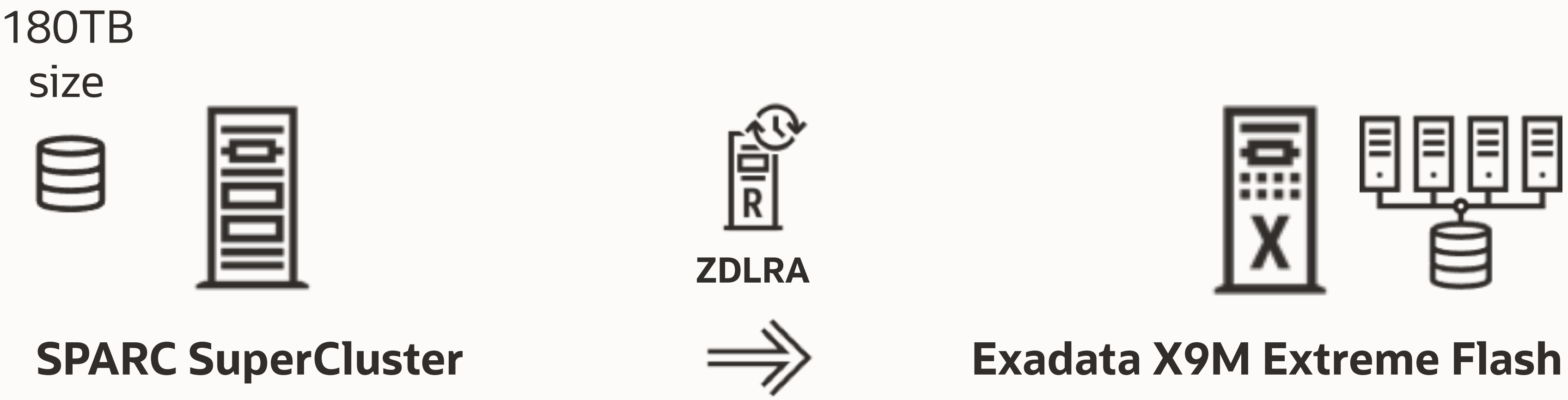


SPARC SuperCluster

ZDLRA

Exadata X9M Extreme Flash

Migration Challenges



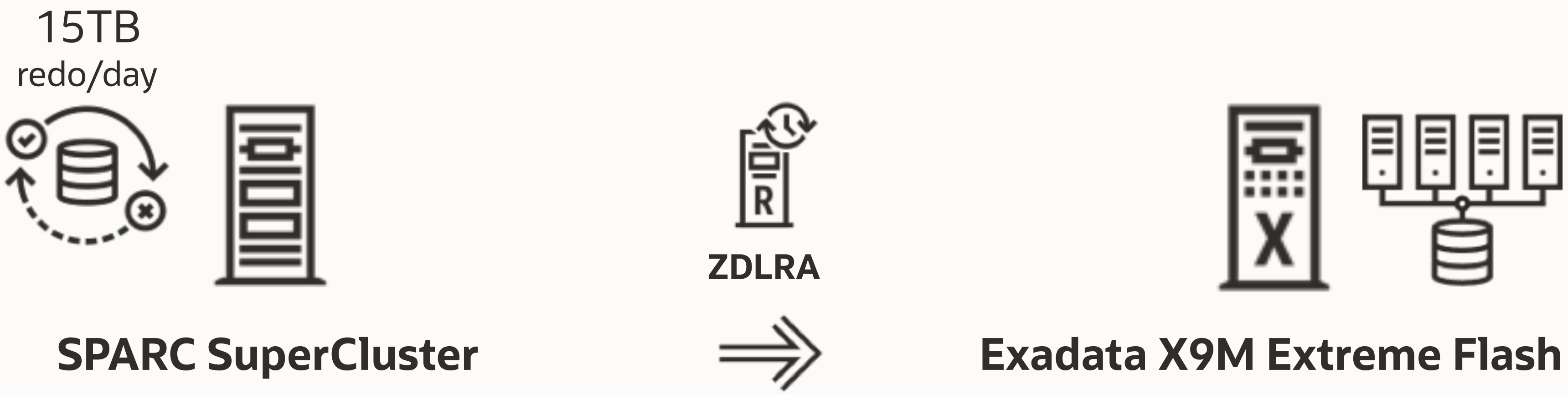
180TB size

SPARC SuperCluster

ZDLRA

Exadata X9M Extreme Flash

Migration Challenges



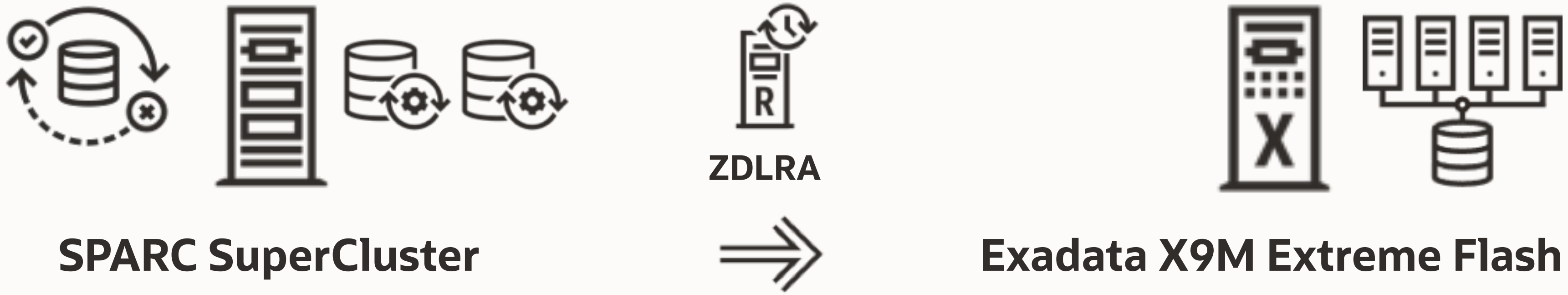
15TB
redo/day

ZDLRA

SPARC SuperCluster

Exadata X9M Extreme Flash

Migration Challenges



SPARC SuperCluster

ZDLRA

Exadata X9M Extreme Flash

5 Physical Standby DBs

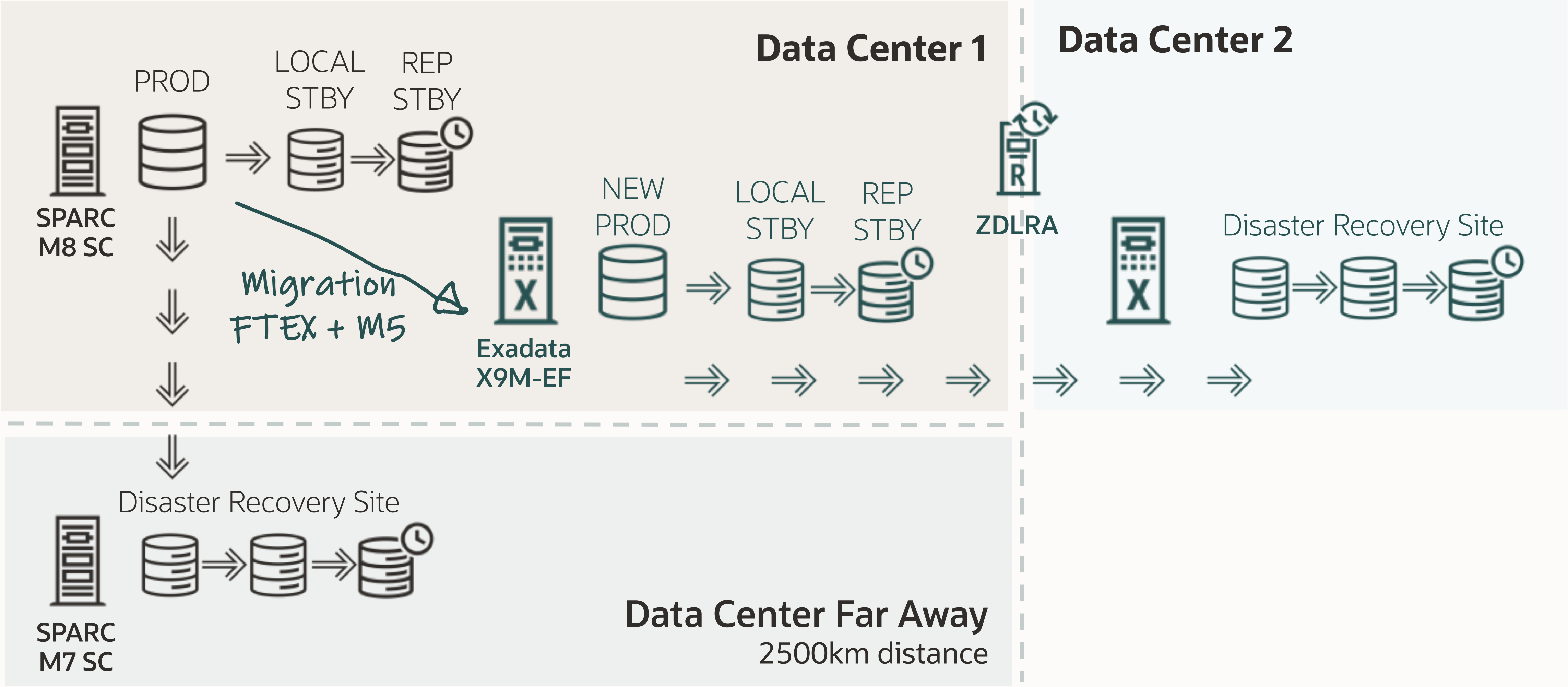
Local, and in different region, 2500km away

Migration

Full Transportable Export/Import is the only possible option to migrate

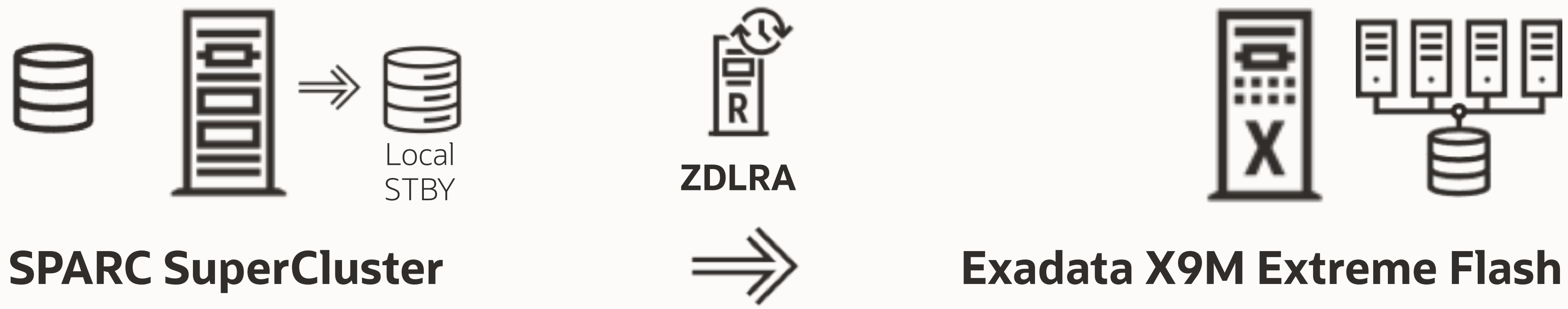
- Oracle GoldenGate unlikely to synch 15TB redo/day
- Data Pump would have taken too long

Migration Plan



Migration Workflow

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



Local STBY

ZDLRA

SPARC SuperCluster

Exadata X9M Extreme Flash

Migration Workflow

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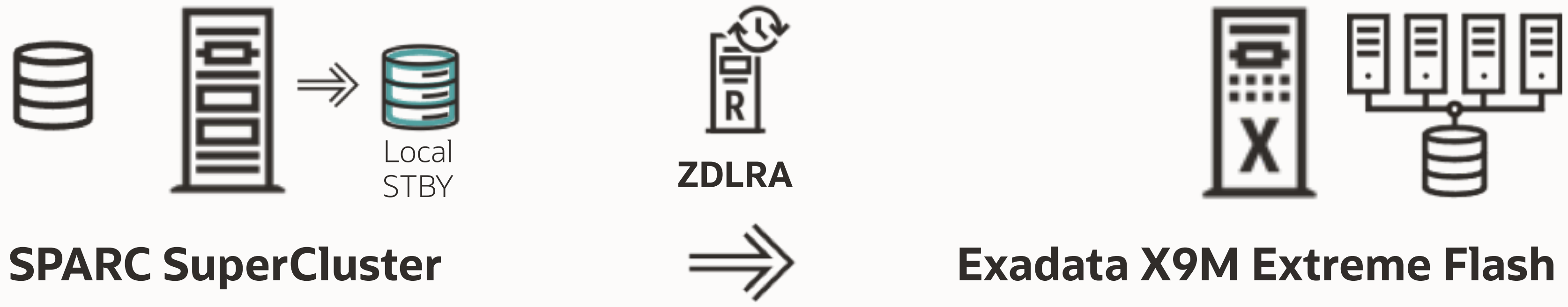

Local STBY

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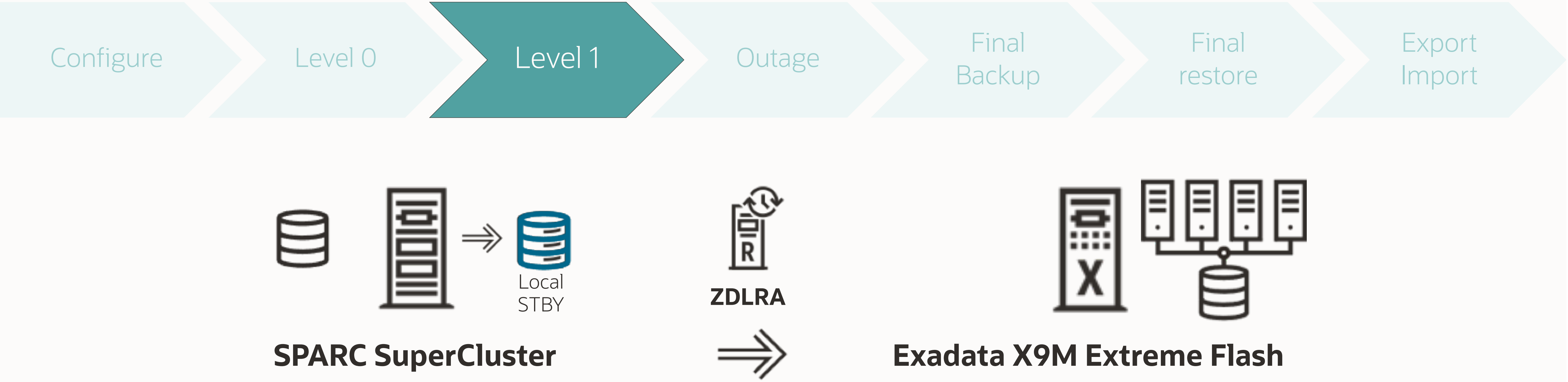
Migration Workflow



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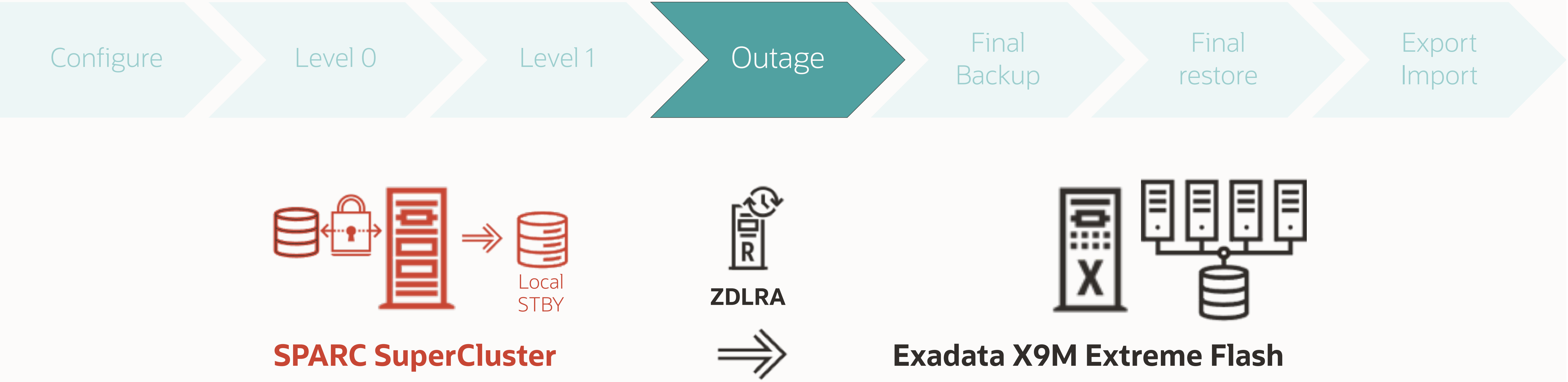
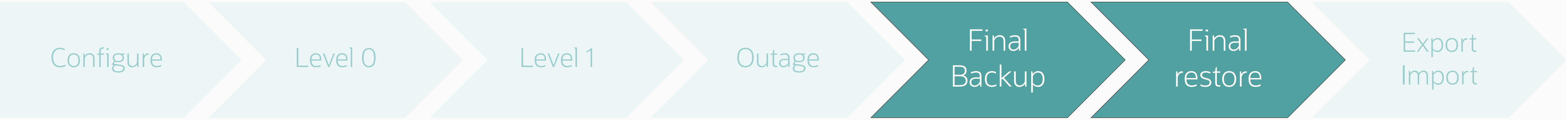
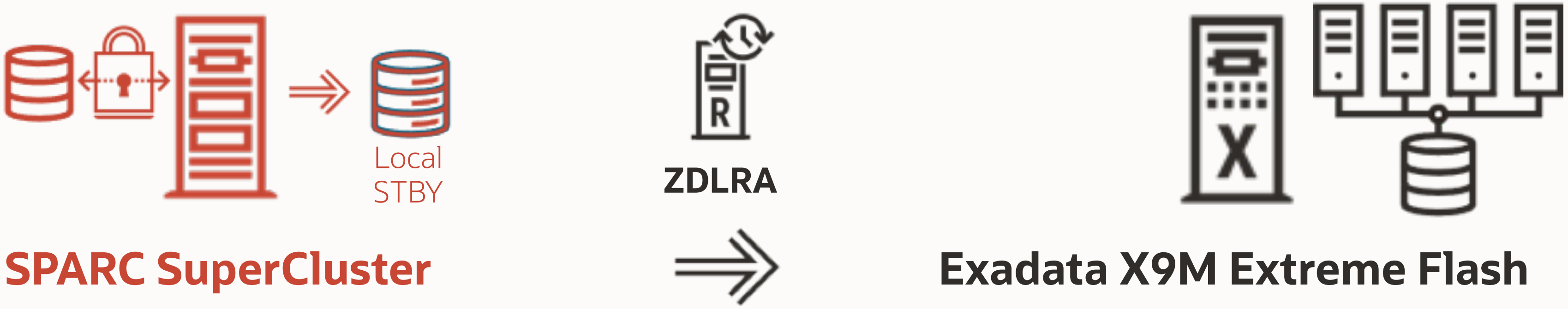
Migration Workflow

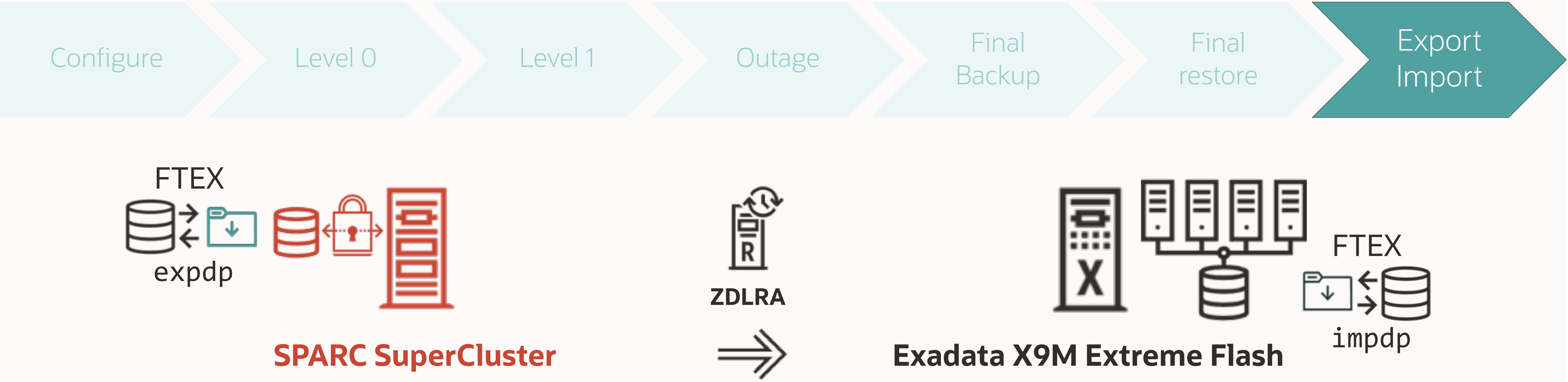


Migration Workflow





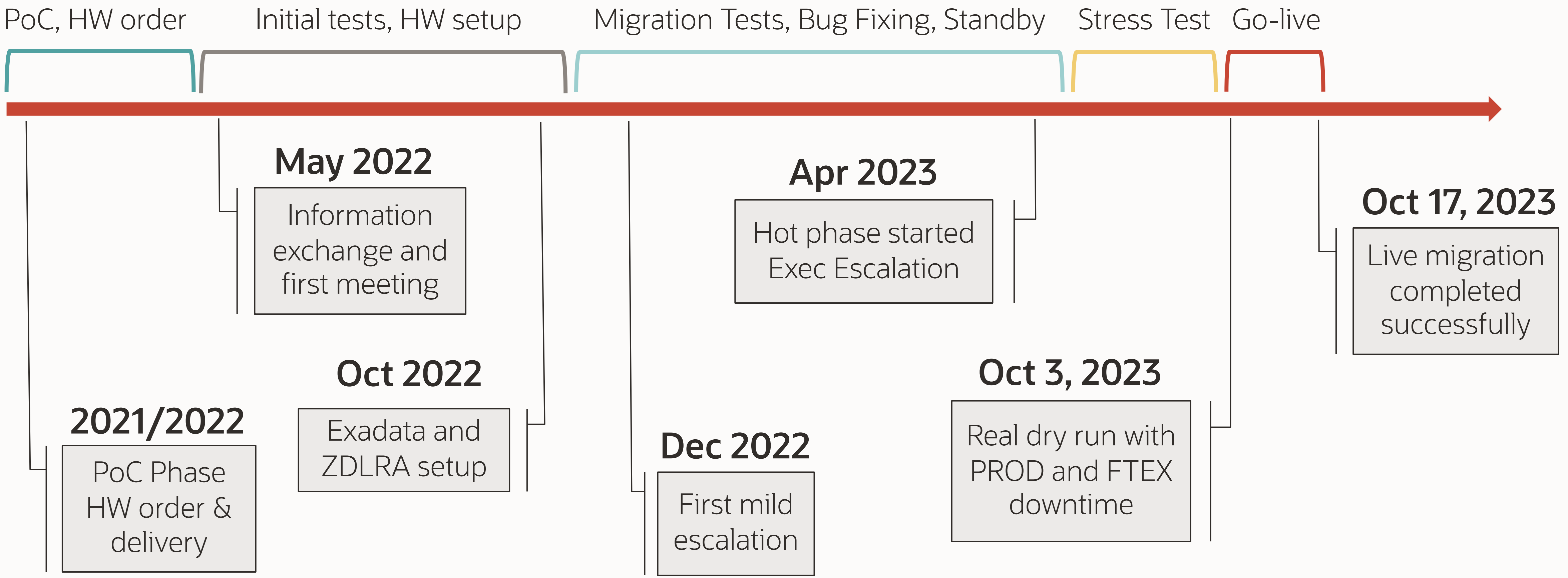
Migration Workflow



Success Factors

Timelines and the Run Book

Overall Project Timeline



PoC, HW order

Initial tests, HW setup

Migration Tests, Bug Fixing, Standby

Stress Test

Go-live

2021/2022
PoC Phase HW order & delivery

May 2022
Information exchange and first meeting

Oct 2022
Exadata and ZDLRA setup

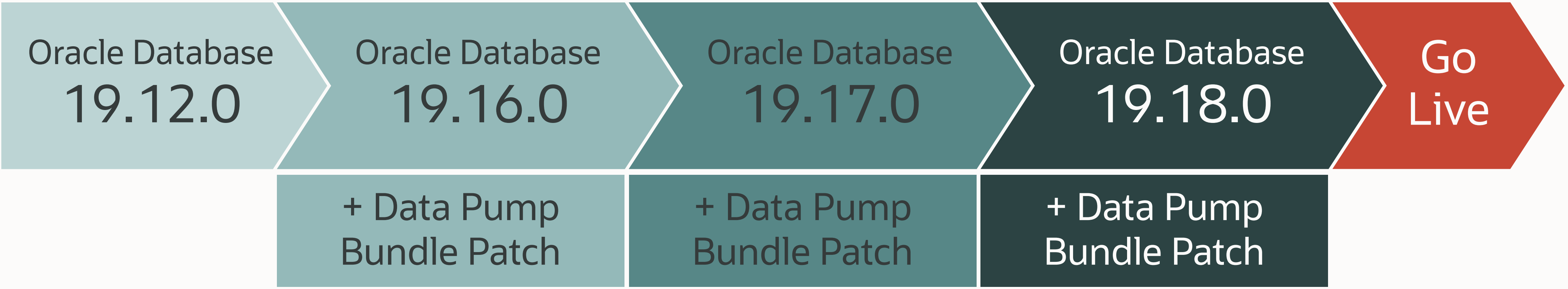
Dec 2022
First mild escalation

Apr 2023
Hot phase started Exec Escalation

Oct 3, 2023
Real dry run with PROD and FTEX downtime

Oct 17, 2023
Live migration completed successfully

Oracle Database Release Migration Evolution



Oracle Database 19.12.0

Oracle Database 19.16.0

+ Data Pump Bundle Patch

Oracle Database 19.17.0

+ Data Pump Bundle Patch

Oracle Database 19.18.0

+ Data Pump Bundle Patch

Go Live

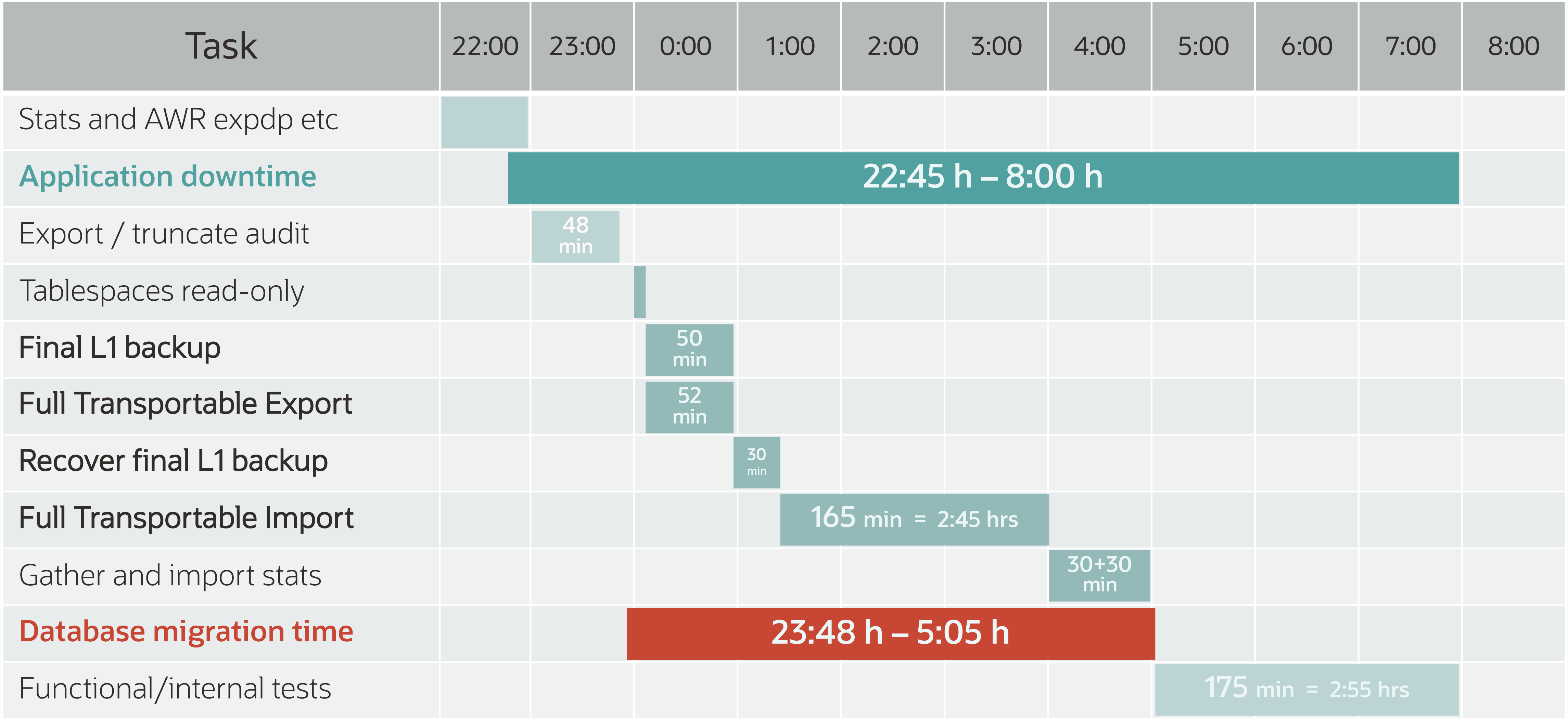
Key to Success: Runbook

Complex projects absolutely require a detailed runbook

ID	Task	Status	Responsible Primary Person	Responsible Secondary Person	Predecessor	Start Time (CEST)	Duration (hh:mm)	End Time (CEST)	Start Time (IST)	End Time (IST)	Actual Start Time (CEST)	Actual Duration	Actual End Time (CEST)	Comments - Blocker

- This run book covered over 200 individual tasks

Timeline Live Migration



Task	22:00	23:00	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00
Stats and AWR expdp etc	■										
Application downtime	22:45 h – 8:00 h										
Export / truncate audit		48 min									
Tablespaces read-only			■								
Final L1 backup			50 min								
Full Transportable Export			52 min								
Recover final L1 backup				30 min							
Full Transportable Import				165 min = 2:45 hrs							
Gather and import stats							30+30 min				
Database migration time		23:48 h – 5:05 h									
Functional/internal tests								175 min = 2:55 hrs			

Monitoring and Troubleshooting

Attach to a running job and use the interactive command mode

```
$ expdp user/password@alias ...

Export: Release 23.0.0.0.0 - Production on Tue Oct 31 14:56:06 2023
Version 23.3.0.23.09

Copyright (c) 1982, 2023, Oracle and/or its affiliates.  All rights reserved.
Connected to: Oracle Database 23c EE High Perf Release 23.0.0.0.0 - Production
31-OCT-23 14:56:13.420: Starting "SYSTEM"."SYS_EXPORT_FULL_01"
31-OCT-23 14:56:13.799: W-1 Startup on instance 1 took 0 seconds
31-OCT-23 14:56:30.550: W-2 Startup on instance 1 took 0 seconds
31-OCT-23 14:56:38.519: W-3 Startup on instance 1 took 0 seconds
31-OCT-23 14:56:38.529: W-4 Startup on instance 1 took 0 seconds
```

```
$ expdp user/password@alias attach=SYSTEM.SYS_EXPORT_FULL_01

Export> status

...

Worker 1 Status:
  Instance ID: 1
  Instance name: CDB23
  Host name: dbs23
  Object start time: Tuesday, 14 November, 2023 9:22:30
  Object status at: Tuesday, 14 November, 2023 9:30:35
  Process Name: DW00
  State: EXECUTING
  Object Schema: APPS
  Object Name: AP_INVOICE_DISTRIBUTIONS_PKG
  Object Type: DATABASE_EXPORT/SCHEMA/PACKAGE_BODIES/PACKAGE/PACKAGE_BODY
  Completed Objects: 1,938
  Worker Parallelism: 1
```

Monitoring | Other Sources

- Tail alert log
- Use `V$SESSION_LONGOPS`
- Use SQL Monitoring
  - Enterprise Manager SQL Monitoring
  - SQL Developer Real Time SQL Monitoring
  - Check license requirements

M5 scripts adds RMAN trace automatically

To enable Data Pump trace use **DP_TRACE** in M5 properties files

- Trace level 3FF0300 suitable for transportable jobs
- MOS Doc ID 286496.1

```
-- Change AWR snap interval to 15 minutes and create snapshot
exec dbms_workload_repository.modify_snapshot_settings(null, 15);
exec dbms_workload_repository.create_snapshot;

-- Optionally, enable SQL trace for Data Pump processes or specific SQL ID
alter system set events 'sql_trace {process: pname = dw | process: pname = dm} level=8';
alter system set events 'sql_trace[SQL: 03g1bnw08m4ds ]';

-- Run Data Pump job with trace (Doc ID 286496.1)
-- Trace value 3FF0300 is suitable for transportable jobs
-- LOGTIME and METRICS is added by default by M5 script
expdp ... metrics=yes logtime=all trace=3FF0300
impdp ... metrics=yes logtime=all trace=3FF0300

-- Create AWR snapshot and produce AWR report
exec dbms_workload_repository.modify_snapshot_settings(null, <original-value>);
exec dbms_workload_repository.create_snapshot;
@?/rdbms/admin/awrrpt
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```

Data Pump Trace

Collect:

- Data Pump log file
- AWR report
- Data Pump trace files
  - Stored in the database trace directory
  - Control process file name: `*dm*`
  - Worker process file names: `*dw*`

Migration

A migration is not a pet project

- Plan
- Train
- Focus
- Work together

A migration is not successful unless the database performs acceptably after going live

Use our Performance Stability Prescription

Performance Stability Webinar

- Watch the recording
- Get the slides

Performance Stability Prescription

1. Collect

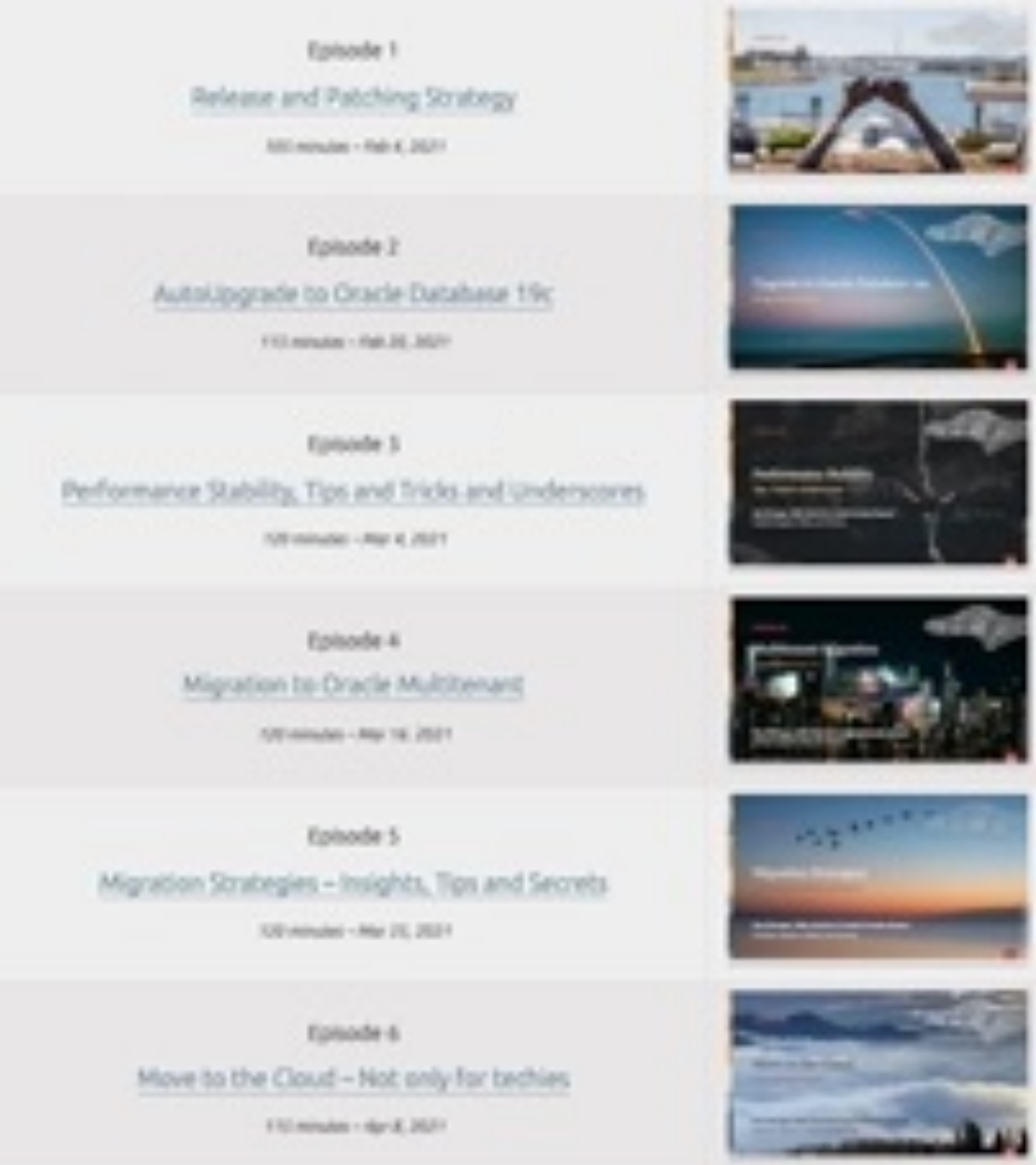
2. Compare

3. Analyze

4. Tune

5. Manage

6. Test



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300 minutes - Feb 4, 2021

Episode 2

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115 minutes - Feb 25, 2021

Episode 3

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120 minutes - Mar 4, 2021

Episode 4

Migration to Oracle Multitenant

120 minutes - Mar 16, 2021

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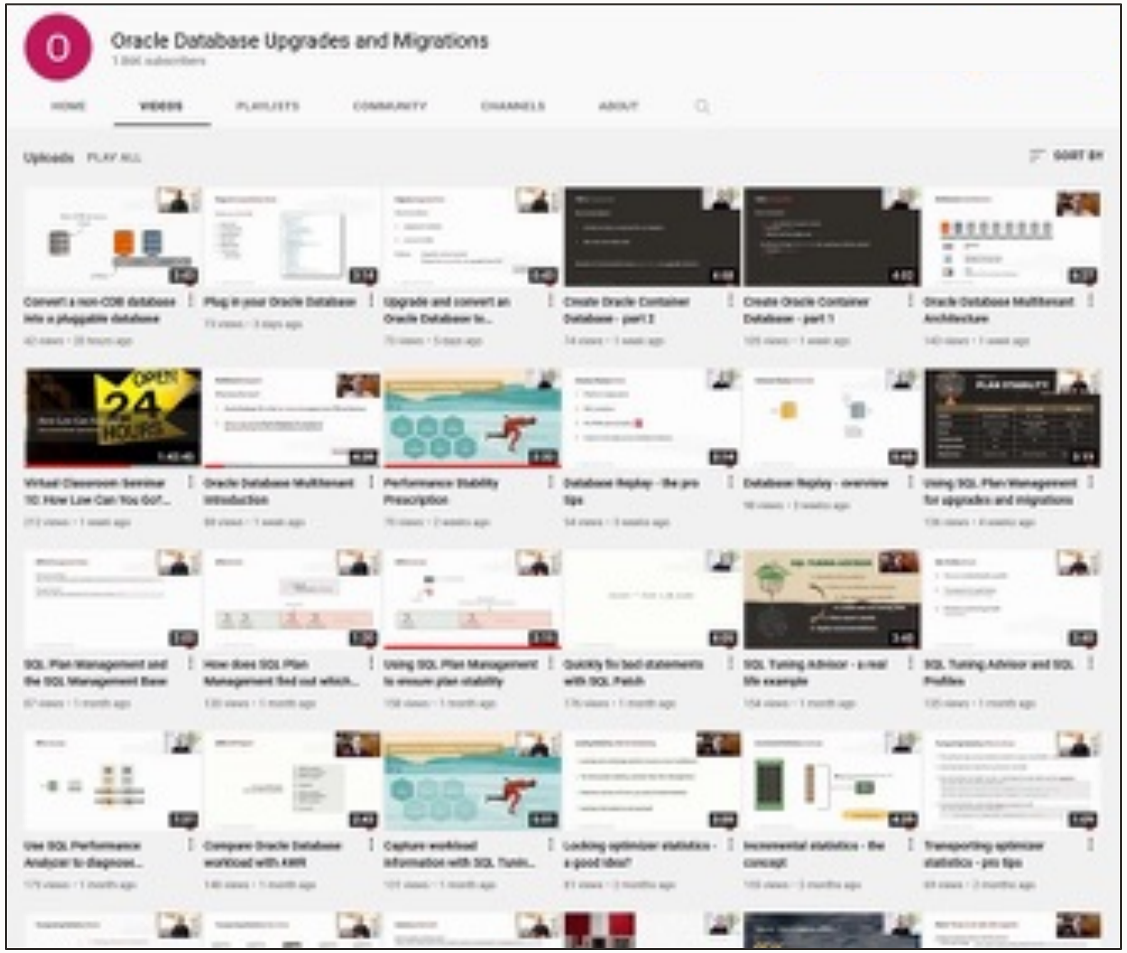

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