



dbi services
by Sequotech

**Database migration to
an Exadata Cloud at
Customer platform:**
Automized and with
(nearly) Zero Downtime.

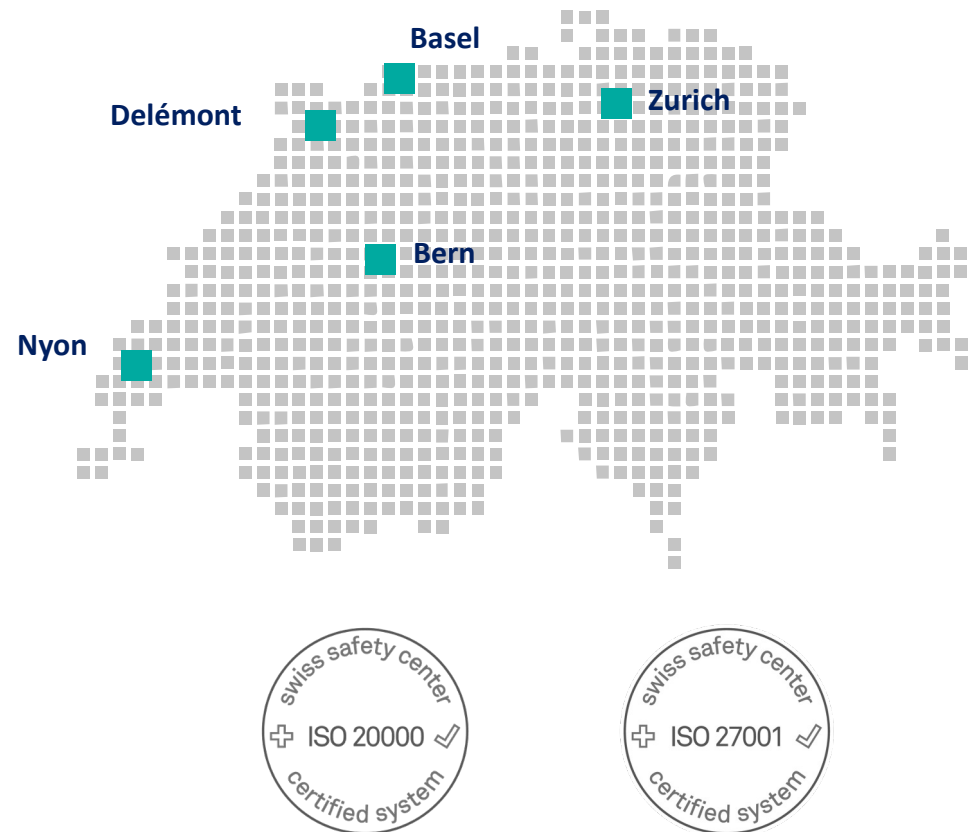
WHO WE ARE

The company

- Founded in 2010
- 80 employees
- Specialized in data infrastructure and platforms
- Customers in Switzerland and all over Europe

Our offer

- Consulting
- Service Level Agreements
- Trainings
- License Management
- Products



ABOUT ME

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Agenda

1. DBaaS Ist/Soll-Zustand
2. Lift & Shift: The 'how and why'
3. Hiccups
4. Core Message

DBaaS Ist/Soll-Zustand



- Source environment
- Target architecture
- Constraint:
“Thin clon” technology shift
- Constraint: The clock

DBaaS Ist/Soll-Zustand

Source environment

+100 Oracle single instance databases

- Mostly 19c (outdated Release Updates 19.10-16)
- Oracle EE / SE2

NonCDB database architecture

NetApp ONTAP integration

- SnapMirror cross data center replication
- [Thin clon @ NetApp SnapManager for Oracle](#)

Active/Passive (but active) Oracle InfoScale Veritas clusters

- Failover cluster configuration

DBaaS Ist/Soll-Zustand

Target architecture

Oracle Exadata Cloud-At-Customer

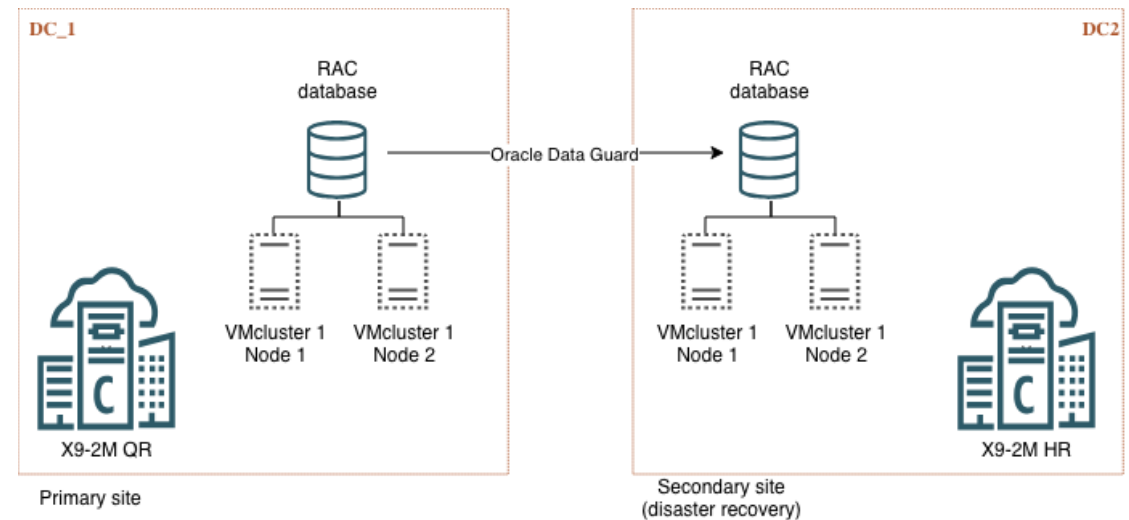
- Real Application Cluster
- Data Guard
- Data-in-transit encryption
- Data-at-rest encryption

Oracle CDB architecture adoption

- Recent Oracle Release update
(Oracle Cloud N-4 version principle)

Exadata sparse clone adoption

- NetApp SnapManager for Oracle thin clone replacement



DBaaS Ist/Soll-Zustand

Constraint: “Thin clon” technology shift

How to replace NetApp “Thin clones” ?

nonCDB Exadata sparse clones

- ✓ Thin clone
- ✗ Test Master Read-Only (Oracle 19c)
- ✗ Complex provisioning
- ✗ High automation effort for already known Oracle nonCDB architecture depreciation (Oracle 19c EOL initially set to 2024)

Exadata PDB sparse clone

- ✓ Thin clone
- ✗ Test Master Read-Only (Oracle 19c)
- ✓ one-liner PDB provisioning (create PDB as snapshot copy)
- ✓ High automation effort for long-term Oracle CDB architecture support
- ✓ Oracle Exascale readiness (Oracle 26ai)

DBaaS Ist/Soll-Zustand & constraints

Constraint: The clock



Lift & Shift: The 'how and why'



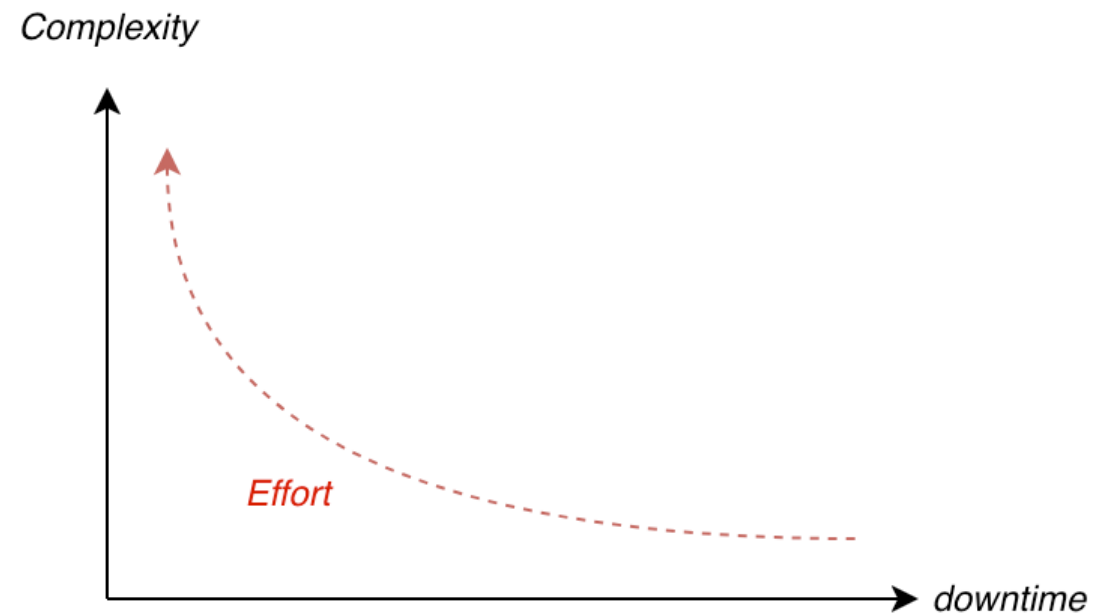
- Migration factory
- Oracle Zero Downtime Migration tool
- ZDM architecture
- ZDM command-line interface
- ZDM verbosity
- Logical offline migration process
- Physical online migration process

Lift & Shift: The ‘how and why’

Migration factory – 1

How to migrate 100+ nonCDB databases (+25 applications) ?

- Handle Oracle EE / SE2
- Control downtime
- Handle “The shift” to Oracle CDB
- Ensure “exceptions” remain “exceptions”



Lift & Shift: The 'how and why'

Migration factory – 2

Assessment: Downtime vs. effort vs. complexity

(near) "Zero downtime" →

	SE2 Small DBs	SE2 Large DBs	EE Small DBs	EE Large DBs
Logical Online (Data Pump + OGG)	Possible	Preferred	Possible	Preferred
Physical Online (Data Guard)	✗	✗	Preferred	Mandatory
Physical Offline (RMAN backup)	Possible	Possible	Possible	Possible
Logical Offline (Data Pump)	Mandatory	Possible	Possible	Possible
Manuel Physical Online (RMAN duplicate4standby)	Preferred	Mandatory	✗	✗

← "Complexity" vs "time" vs Application compatibility

↘ "downtime" = backup + restore
expdp + impdp
impdp @ DB-Links

The "exceptions" #DBA skills →

Lift & Shift: The ‘how and why’

Oracle Zero Downtime Migration tool

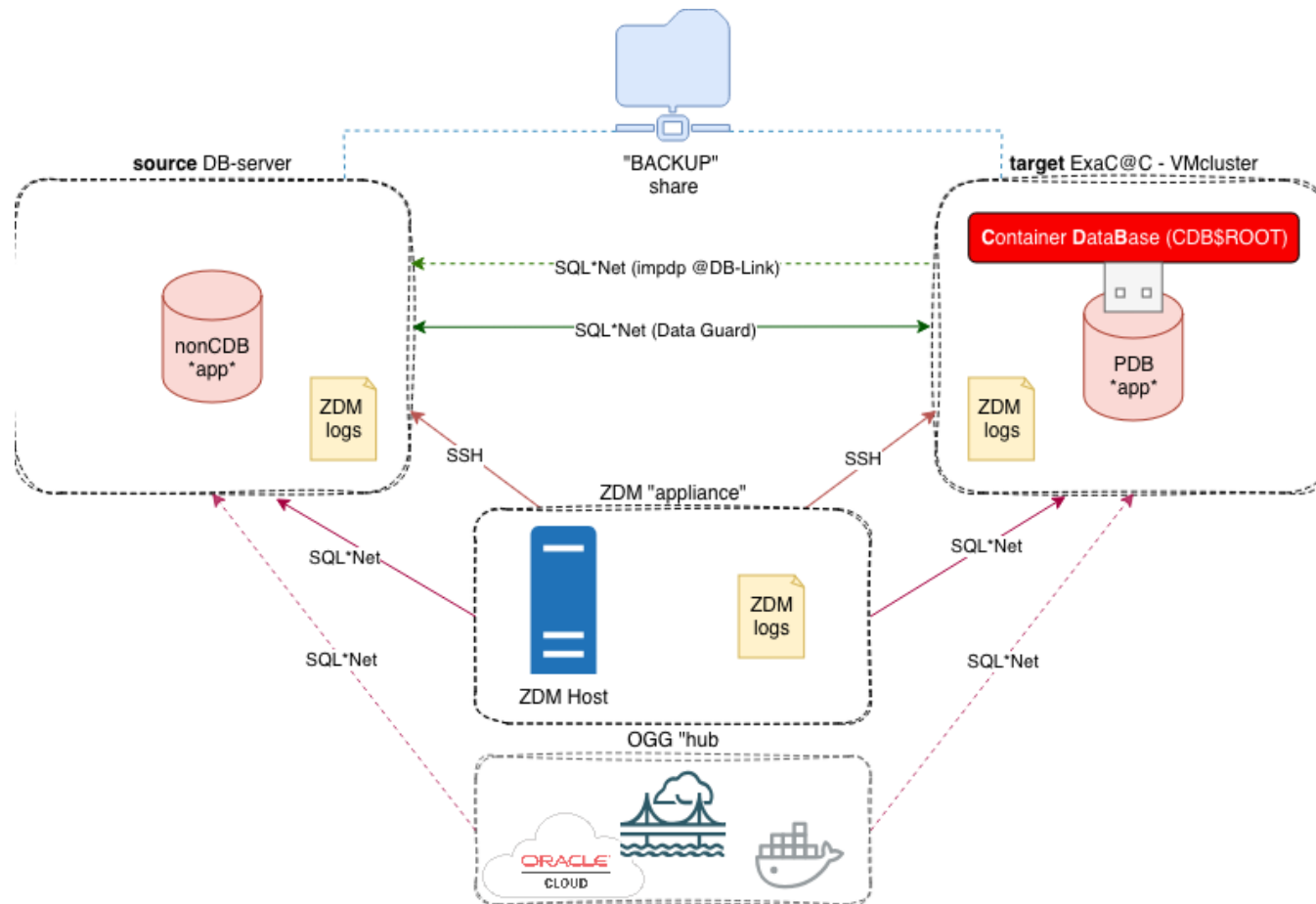
Supported migration workflows and targets

	Exadata On-Premises	Base Database Service	Oracle Exadata Database Service on Dedicated Infrastructure*	Oracle Exadata Database Service on Cloud@Customer	Oracle Autonomous Database Serverless*	Oracle Autonomous Database on Dedicated Exadata Infrastructure
Physical Online Migration	✓	✓	✓	✓	✗	✗
Physical Offline Migration	✓	✓	✓	✓	✗	✗
Logical Online Migration	✓	✓	✓	✓	✓	✓
Logical Offline Migration	✓	✓	✓	✓	✓	✓
Hybrid Offline Migration	✓	✓	✓	✓	✗	✗

*OCI and Oracle Database@Hyperscaler

Lift & Shift: The 'how and why'

ZDM Architecture



Lift & Shift: The ‘how and why’

ZDM Command Line Interface

```
# /u01/app/zdmhome/bin/zdmcli -h
```

Performs Zero Downtime Migration operations for the cloud.

Usage:

zdmcli abort	Perform abort operation for a migration job.
zdmcli add	Adds an image type or user actions.
zdmcli audit	Perform audit operation for a migration job.
zdmcli delete	Deletes a job, an image type or an user action.
zdmcli migrate	Performs migration operation for the cloud.
zdmcli modify	Modifies user actions.
zdmcli query	Gets information of a job, image type, user actions and audit.
zdmcli resume	Perform resume operation for a migration job.
zdmcli suspend	Suspend the migration job.

For detailed help on each command use:

```
zdmcli <command> <object> -help
```

Lift & Shift: The ‘how and why’

ZDM verbosity (logfiles)

“Migrations” qualified uniquely by a Job ID

Overall logfile on ZDM host

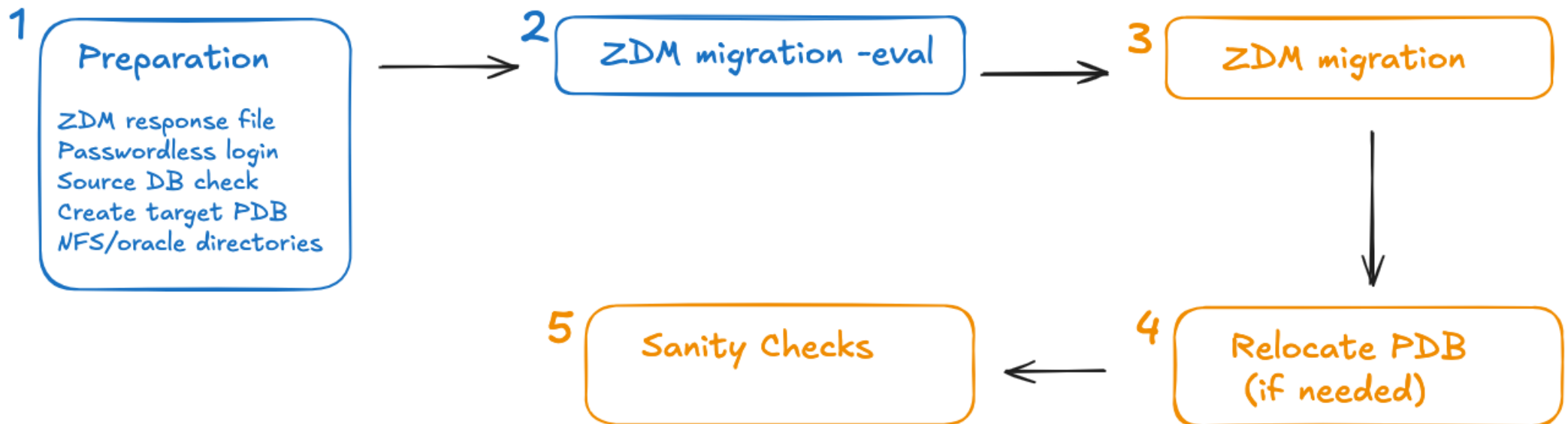
- Task/Job scheduling & global operations
- `$ZDM_BASE/chkbase/scheduled`

Logfiles on source & target systems

- `$ORACLE_BASE/zdm/zdm_<db_unique_name>_<job_num>/zdm/log`

Lift & Shift: The 'how and why'

Logical offline migration process – Overview



Lift & Shift: The 'how and why'

Logical offline migration process – Example (1)

```
# /u01/app/oracle/product/zdm/bin/zdmcli migrate database -sourcesid EASYT \  
-rsp /home/exauser/migration/zdm_EASYT_logical_offline.rsp \  
-sourcenode ora1EASYT -srcauth dbuser -srcarg1 user:oracle \  
-srcarg2 identity_file:/home/exauser/.ssh/id_rsa \  
-targetnode <TargetExaCC-VMcluster> -tgtauth zdmauth -tgtarg1 user:opc \  
-tgtarg2 identity_file:/home/exauser/.ssh/id_rsa \  
-tgtarg3 sudo_location:/usr/bin/sudo
```

zdmhost.jewlab.ch: Audit ID: 5979

Enter source database administrative user "system" password:

Enter target database administrative user "system" password:

Operation "zdmcli migrate database" scheduled with the job ID "485".

Lift & Shift: The ‘how and why’

Logical offline migration process – Example (2)

ZDM responseFile “snippet”

```
MIGRATION_METHOD=OFFLINE_LOGICAL
DATA_TRANSFER_MEDIUM=DBLINK
TARGETDATABASE_ADMINUSERNAME=system
SOURCEDATABASE_ADMINUSERNAME=system
SOURCEDATABASE_CONNECTIONDETAILS_HOST=ora1EASYT
SOURCEDATABASE_CONNECTIONDETAILS_PORT=1521
SOURCEDATABASE_CONNECTIONDETAILS_SERVICENAME=EASYT.jewlab.ch
TARGETDATABASE_CONNECTIONDETAILS_HOST= <TargetExaCC-VMcluster>.jewlab.ch
TARGETDATABASE_CONNECTIONDETAILS_PORT=1521
TARGETDATABASE_CONNECTIONDETAILS_SERVICENAME=EASYT_PDB_PRI.jewlab.ch
TARGETDATABASE_DBTYPE=EXADATA
```

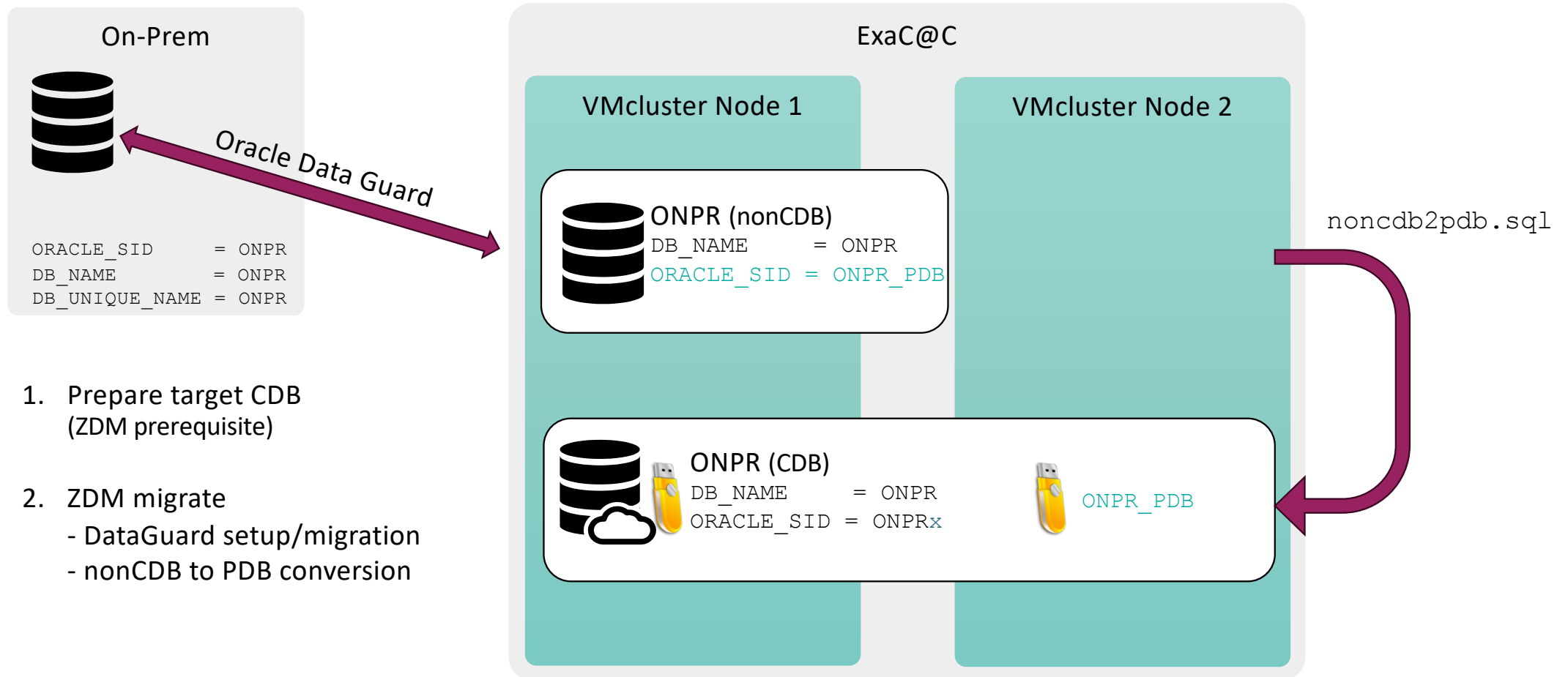
Lift & Shift: The 'how and why'

Logical offline migration process – Example (3)

```
# zdmcli query job -jobid 485
...
Job ID: 485
Job Type: "MIGRATE"
...
Current status: SUCCEEDED
Result file path: "/u01/app/oracle/chkbase/scheduled/job-485-2026-01-16-16:05:57.log"
...
Job execution elapsed time: 3 minutes 47 seconds
ZDM_VALIDATE_TGT ..... COMPLETED
ZDM_VALIDATE_SRC ..... COMPLETED
ZDM_SETUP_SRC ..... COMPLETED
ZDM_PRE_MIGRATION_ADVISOR ..... COMPLETED
ZDM_VALIDATE_DATAPUMP_SETTINGS_SRC .... COMPLETED
ZDM_VALIDATE_DATAPUMP_SETTINGS_TGT .... COMPLETED
ZDM_PREPARE_DATAPUMP_SRC ..... COMPLETED
ZDM_PREPARE_DATAPUMP_TGT ..... COMPLETED
ZDM_PARALLEL_IMPORT_TGT ..... COMPLETED
ZDM_POST_DATAPUMP_SRC ..... COMPLETED
ZDM_POST_DATAPUMP_TGT ..... COMPLETED
ZDM_POST_ACTIONS ..... COMPLETED
ZDM_CLEANUP_SRC ..... COMPLETED
```

Lift & Shift: The 'how and why'

Physical online migration process - The "theory"



Hiccups



- Oracle Transparent Data Encryption
- One RAC-to-go please!
- One PDB-to go please!
- Bugs

Hiccups

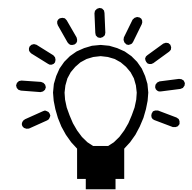
Oracle Transparent Data Encryption – intro.

Source database prerequisite

- TDE pre-configured with Wallet
 - Ensure/Set database INIT parameter `WALLET_ROOT` (TDE Wallet path)
 - Ensure TDE master key is present within wallet
 - `V$ENCRYPTION_KEY.MASTERKEYID`
 - `mkstore -wrl <WalletRootPath> -list`

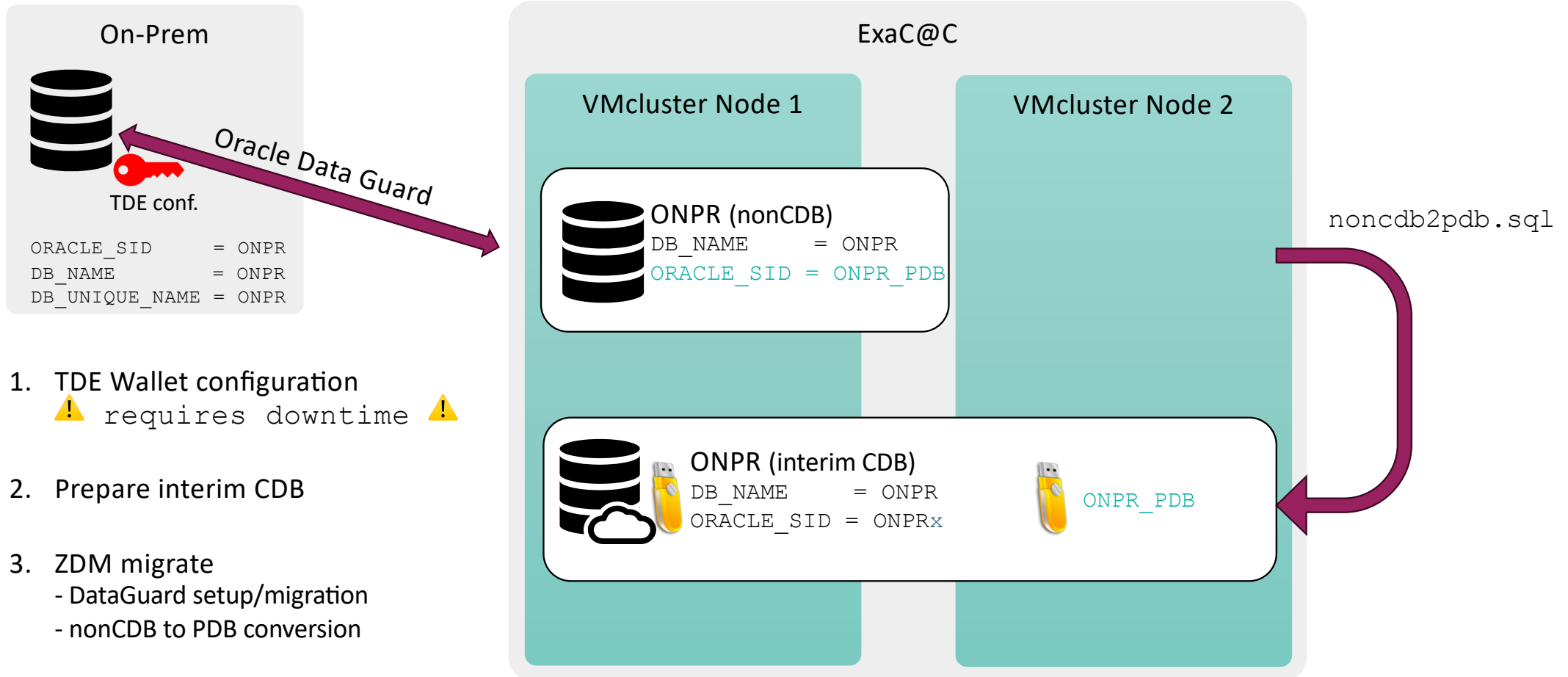
Best Practice

- Set `TABLESPACE_ENCRYPTION = DECRYPT_ONLY (≥ 19.16)`
- Protects against “possible”
 - Human errors
 - Oracle licensing violations



Hiccups

Oracle Transparent Data Encryption – Physical online migration



1. TDE Wallet configuration
⚠ requires downtime ⚠
2. Prepare interim CDB
3. ZDM migrate
 - DataGuard setup/migration
 - nonCDB to PDB conversion

Hiccups

One RAC-to-go please!

Beware ZDM will prepare the source database to be “RAC compliant”

```
# cd /u00/app/oracle/zdm/zdm_PCRE_38/zdm/log/
# tail -f zdm_configure_dg_src_12973.log

Connected to:
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0 - Production
Version 19.10.0.0.0

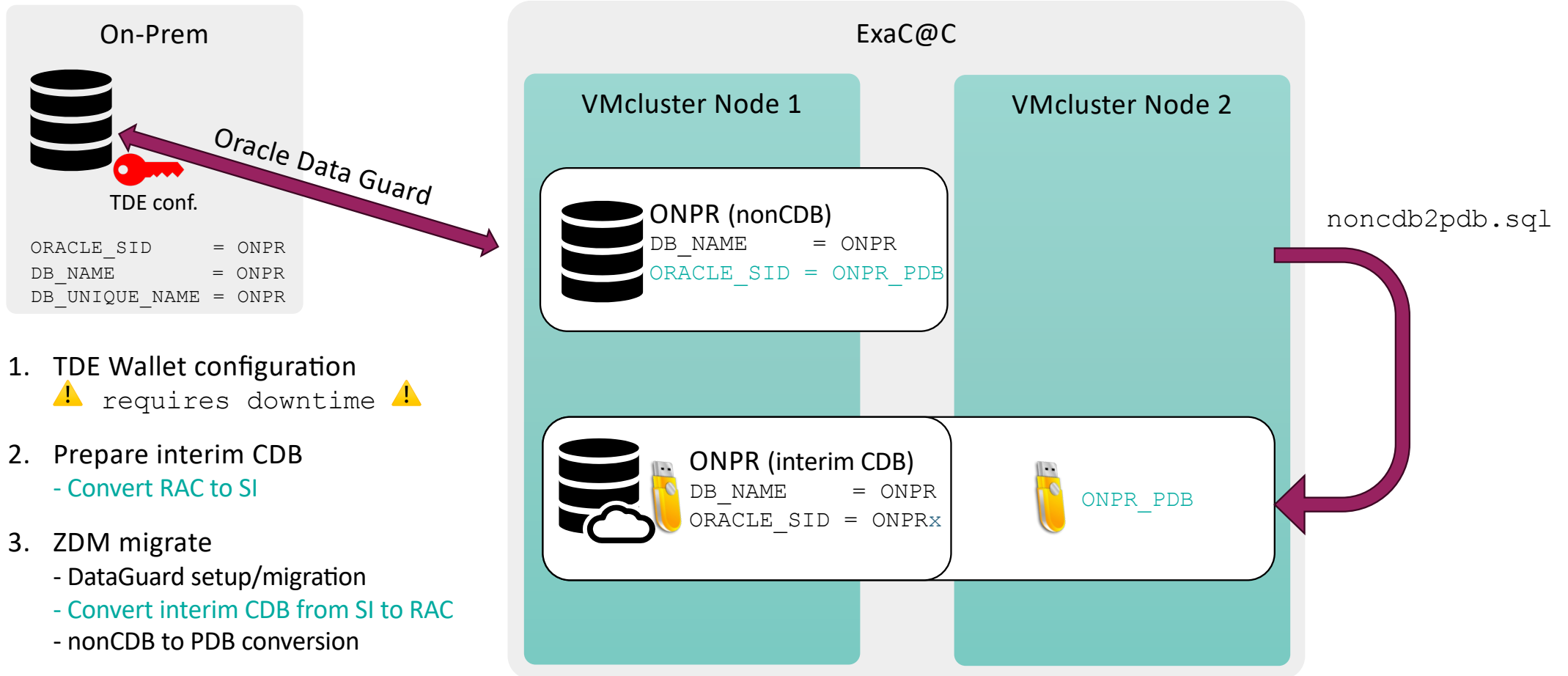
CREATE UNDO TABLESPACE UNDOTBS2 DATAFILE '/PCRE/u01/oradata/undotbs2.dbf' SIZE 5120M
*
ERROR at line 1:
ORA-28374: typed master key not found in wallet
```

- Workaround: Use intermediate CDB converted temporarily to single-instance
 - Set database parameter `CLUSTER_DATABASE=FALSE`
 - Stop database, remove instance, restart database using `SRVCTL`



Hiccups

One RAC-to-go please!



1. TDE Wallet configuration
⚠ requires downtime ⚠
2. Prepare interim CDB
- Convert RAC to SI
3. ZDM migrate
- DataGuard setup/migration
- Convert interim CDB from SI to RAC
- nonCDB to PDB conversion

Hiccups

One PDB-to-go please!

Source	A must?	Why?
Already multitenant	Not needed	ZDM works at CDB level (cutover for all PDBs)
Non-CDB	Yes	ZDM works with NOCOPY option which implies Datafiles are not moved (wrong place)

NonCDB to PDB conversion

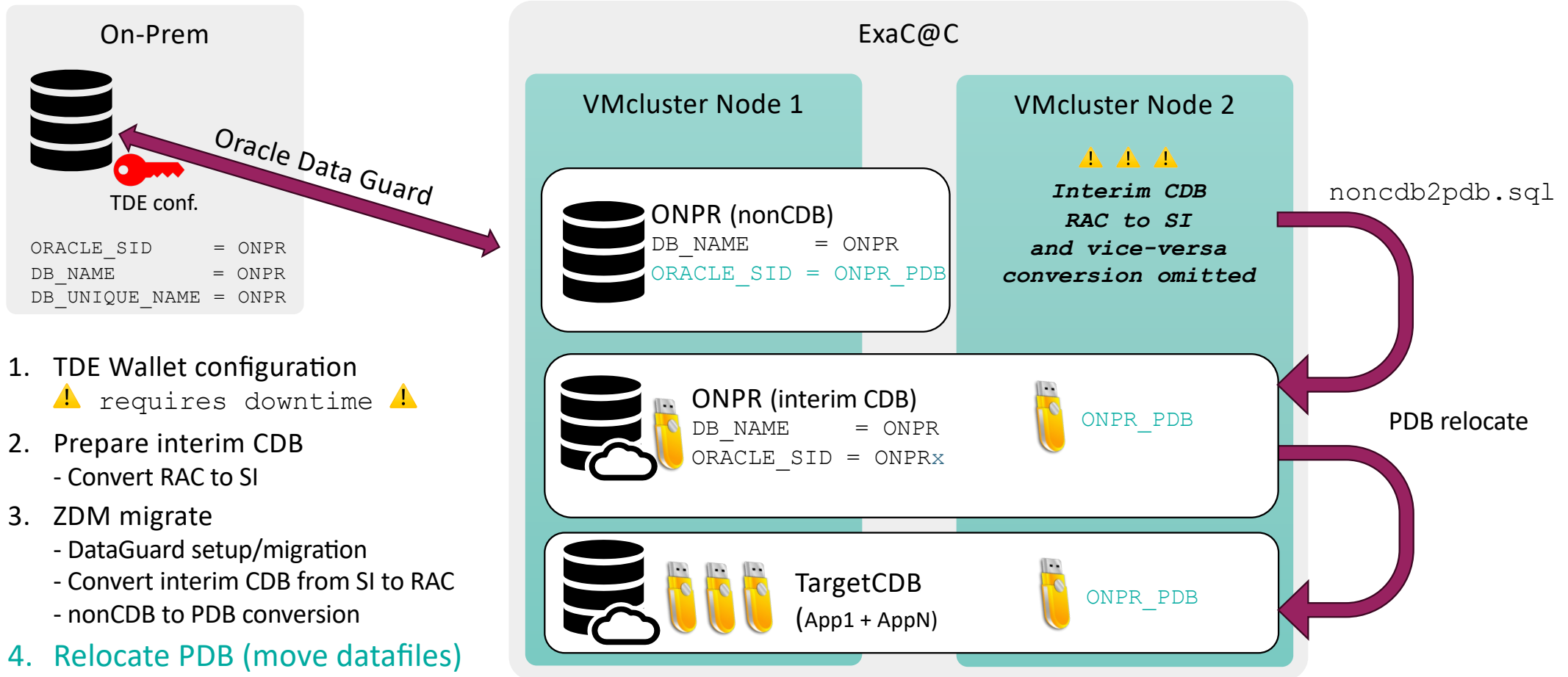
```
# cd /u02/app/oracle/zdm/zdm_ONPR_SITE2_280/zdm/log/  
# grep -i "CREATE PLUGGABLE DATABASE" zdm_noncdbtopdb_conversion_211779.log  
CREATE PLUGGABLE DATABASE ONPRZ_PDB AS CLONE USING '/tmp/ONPR_PDB.xml' NOCOPY TEMPFILE REUSE
```

- <https://www.dbi-services.com/blog/why-relocating-the-pdb-after-zdm-physical-online-migration-with-noncdb-to-cdb-conversion-is-a-must/>



Hiccups

One PDB-to-go please!



Hiccups

Bugs

Oracle RDBMS 19c

- Bug 31500699 - ORA-28374: typed master key not found in wallet after tablespace TDE Enabled (KI29045) – Affects Release Update 19.10 / 19.11 (versions below 21.3)
- Bug 31268326 - PDB Wallet might hit ORA-28374 in isolated mode using root wallet context (KI28651) – Release Update 19.17 / 19.18 / 19.19 (versions below 21.3)

ZDM - physical online migration (any version)

- Missing static _DGMGRL_ Listener entry on source listener leads to switchover step failure

ZDM

- 21.3: TDE master key copy error (physical online), Parameter AUDIT_TRAIL='DB', 'EXTENDED' not supported
- 21.3 + 21.4 : SYSAUX, SYSTEM. UNDO and TEMP tablespace remained unencrypted
- 21.5: Temp tablespace encryption failed due to ORA-60100 (drop blocked due to sort segments)

Core Message

4

- Constraints?
- To ZDM or not?
- Blogs & Trainings

Core Message

Constraints?

Any Oracle licensing considerations? “Restricted Use Licenses” ?

Table 1-17 Restricted Use Licenses

Feature / Option	Licensing Information
AQ Sharded Queues	Restricted use of Oracle Partitioning is allowed on all offerings, free of charge, for the sole purpose of supporting AQ Sharded Queues. All other uses of Oracle Partitioning require a license for the Oracle Partitioning option, where available.
Oracle Advanced Compression Oracle Advanced Security	Restricted use licenses for Oracle Advanced Compression and Oracle Advanced Security are granted when performing either of the following migrations: • Oracle Zero Downtime Migration • Oracle Cloud Infrastructure Database Migration (DMS)

Source: Oracle 19c Database Licensing Information User Manual

Core Message

Constraints?

What about Oracle Data Guard and GoldenGate?

- OCI GoldenGate (fully managed service) = PAYG
- Oracle Database Migration to OCI
 - <https://www.oracle.com/database/cloud-migration/pricing/>

Zero Downtime Migration

- Free, included in database license and subscriptions. Zero downtime migration includes embedded licenses for Oracle GoldenGate and Oracle Data Guard.

OCI Database Migration service

- Free for six months. OCI Database Migration includes an embedded license for Oracle GoldenGate.

Cloud Premigration Advisor Tool

- Free, with access to Oracle Support.

Core Message

Constraints?

No real “fallback” procedure foreseen

- nonCDB to PDB conversion is a “one way” process
- Any fallback plans needs to be covered by “manual procedures”

Any further constraints?

- No 😊

ZDM host @ Oracle Linux

- No support for RHEL
- Most of the software prerequisites comes from [Oracle Linux 7/8 devel repository](#)

Core Message

To ZDM or not?



- ✓ Various migration methodologies
- ✓ Rich command-line options
- ✓ Rich automation “sets”
(i.e.: TZ file upgrade)
- ✓ Verbosity (IT compliance)
- ✓ Resumable / re-run(s)
- ✓ Custom tasks
(available since latest ZDM 21.5)



- ✗ Source database prerequisites
(single-instance vs. RAC)
- ✗ TDE Wallet & SYS password
must all be the same
(general OCI & Data Guard restriction)
- ✗ *Hyperscaler “exit” unsupported
(on-prem to Cloud only = one way)*
- ✗ ZDM Bugs / Reverse engineering
(perl DBA)

Core Message

Blogs from my colleague Marc Wagner

- <https://www.dbi-services.com/blog/zero-downtime-migration-zdm-to-oracle-cloud-infrastructure-oci/>
- <https://www.dbi-services.com/blog/oracle-zero-downtime-migration-offline-logical-database-migration-from-on-premises-to-autonomous-db/>
- <https://www.dbi-services.com/blog/oracle-zdm-migration-java-security-invalidkeyexception-invalid-key-format/>
- <https://www.dbi-services.com/blog/logical-offline-migration-to-exacc-with-oracle-zero-downtime-migration-zdm/>
- <https://www.dbi-services.com/blog/physical-online-migration-to-exacc-with-oracle-zero-downtime-migration-zdm/>
- https://www.dbi-services.com/blog/zdm-physical-online-migration-failing-during-zdm_switchover_src-phase/
- <https://www.dbi-services.com/blog/zdm-physical-online-migration-a-success-story/>
- <https://www.dbi-services.com/blog/dry-run-with-zdm-physical-online-with-no-downtime-for-the-source/>
- <https://www.dbi-services.com/blog/why-relocating-the-pdb-after-zdm-physical-online-migration-with-noncdb-to-cdb-conversion-is-a-must/>
- <https://www.dbi-services.com/blog/automatisation-for-oracle-zdm-installation-and-update/>
- <https://www.dbi-services.com/blog/oracle-zdm-21-5-new-features/>
- <https://www.dbi-services.com/blog/zdm-21-5-physical-online-migration-failing-during-temp-tablespace-encryption/>

Core Message

From trainee to trainer

🏠 > SCHULUNGEN > ORACLE ZERO DOWNTIME MIGRATION (ZDM)

Oracle Zero Downtime Migration (ZDM)

Möchten Sie lernen, wie Sie Ihre Datenbanken mit dem Oracle ZDM-Tool mit minimaler bis gar keiner Ausfallzeit auf Exadata oder Oracle Cloud Infrastructure (OCI) migrieren können? Im Workshop Zero Downtime Migration stellen wir Ihnen die Oracle ZDM-Tools vor, erläutern die Methodik, lernen, wie das ZDM-Tool verwendet wird und wie das Tool mit den Quell- und Zielen Datenbanken arbeitet und interagiert. Während dieses Workshops werden Sie auch üben, eine so genannte On-Premise-Datenbank mit der ZDM Physical Online- und der ZDM Logical Offline-Methode auf OCI zu migrieren.

Ziele ▾

Methode ▾

Zielgruppen ▾

Voraussetzungen ▾



Marc Wagner
Principal Consultant



THANK YOU!

ANY QUESTIONS? PLEASE, DO ASK

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