ORACLE

Oracle Database Migration to Oracle Cloud Infrastructure

October 2021

Sinan Petrus Toma

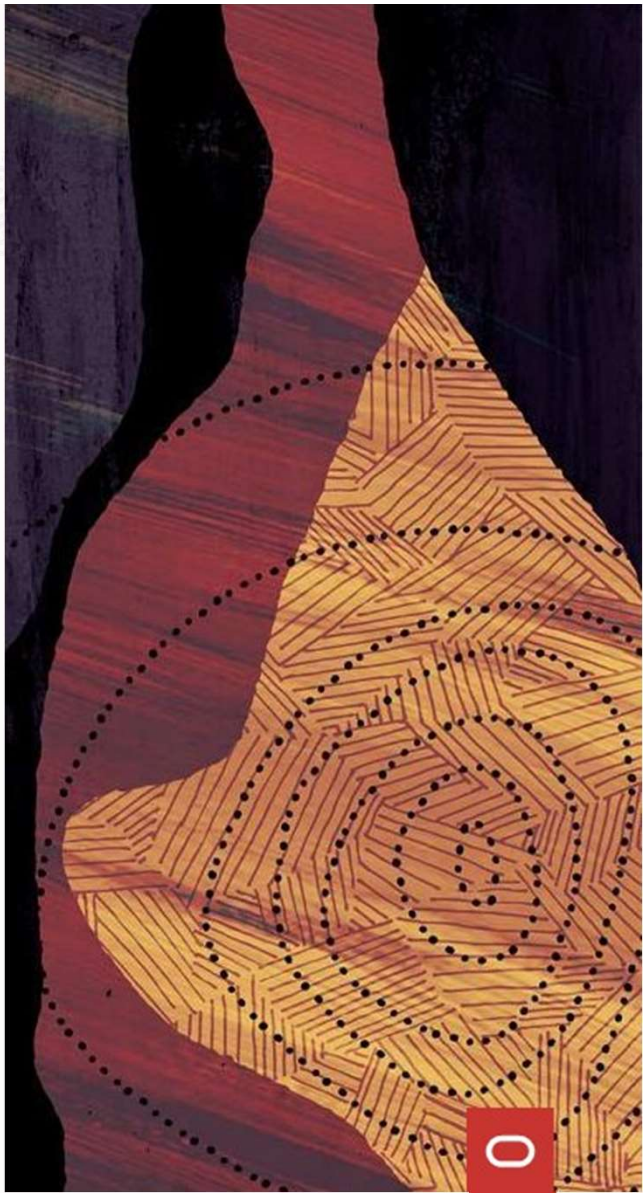
Principal Cloud Specialist

Oracle Database Cloud Services

database-heartbeat.com

@sinanpetrus

sinanpetrustoma



Safe harbor statement

The following is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions. 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.

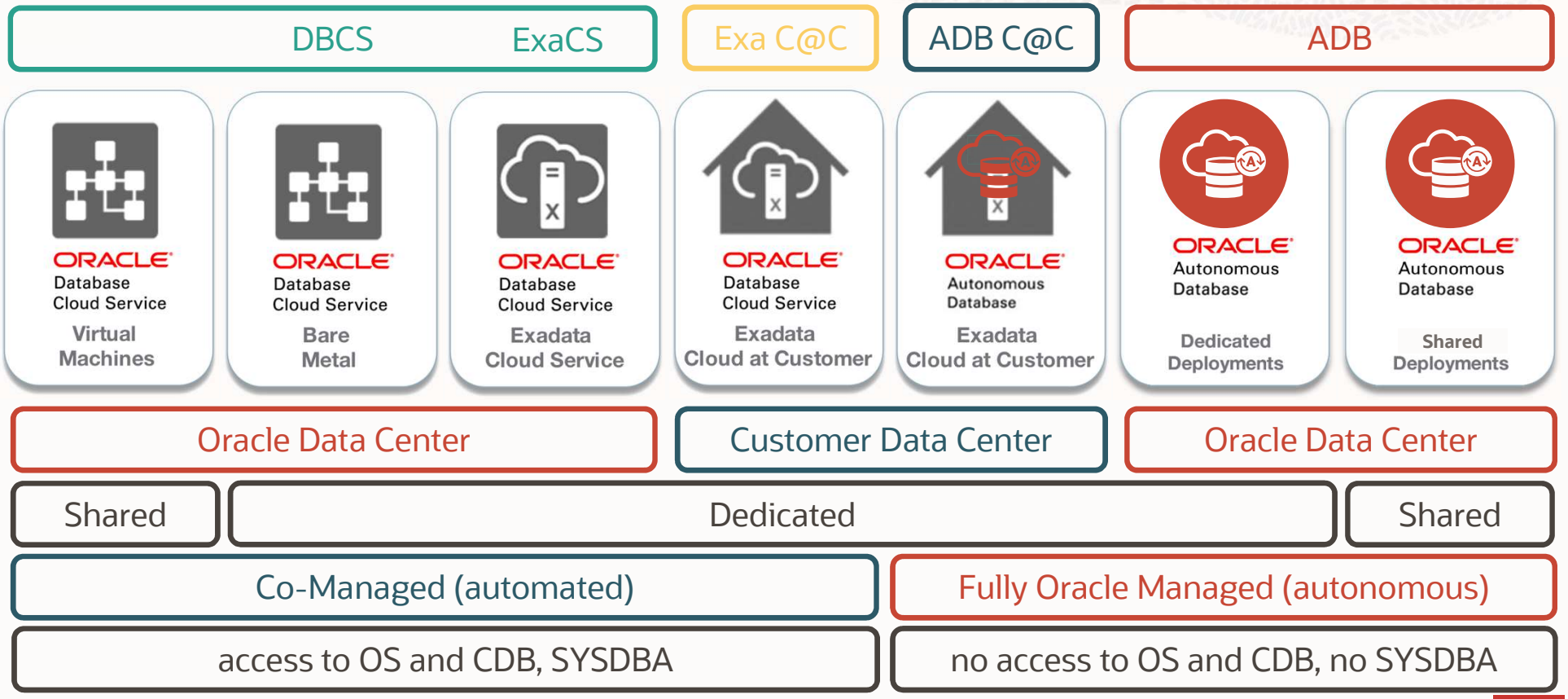
Agenda

1. Oracle Database in Oracle Cloud
2. Considerations for Cloud Migration
3. Automation Tools
4. Migration Methods
5. Decision Tree for Migration Methods

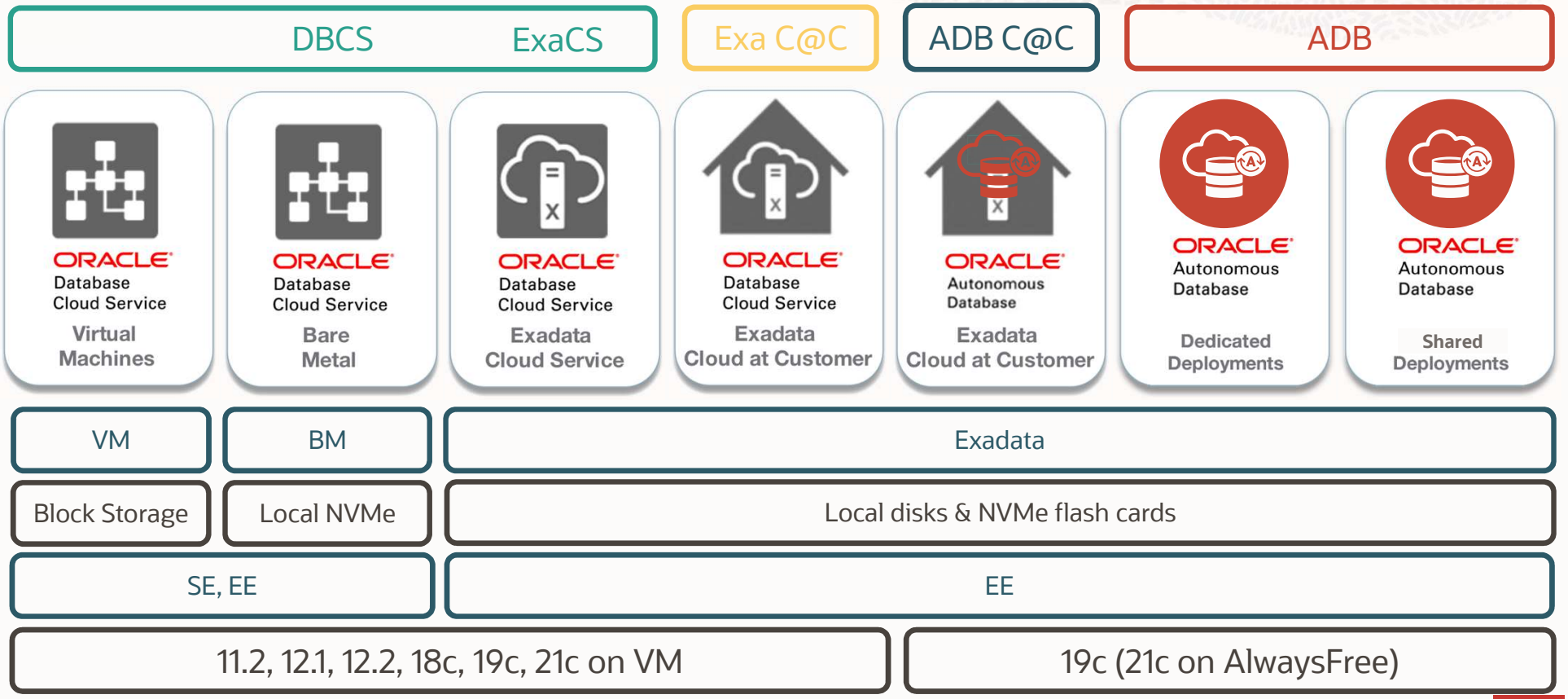
Agenda

1. Oracle Database in Oracle Cloud
2. Considerations for Cloud Migration
3. Automation Tools
4. Migration Methods
5. Decision Tree for Migration Methods

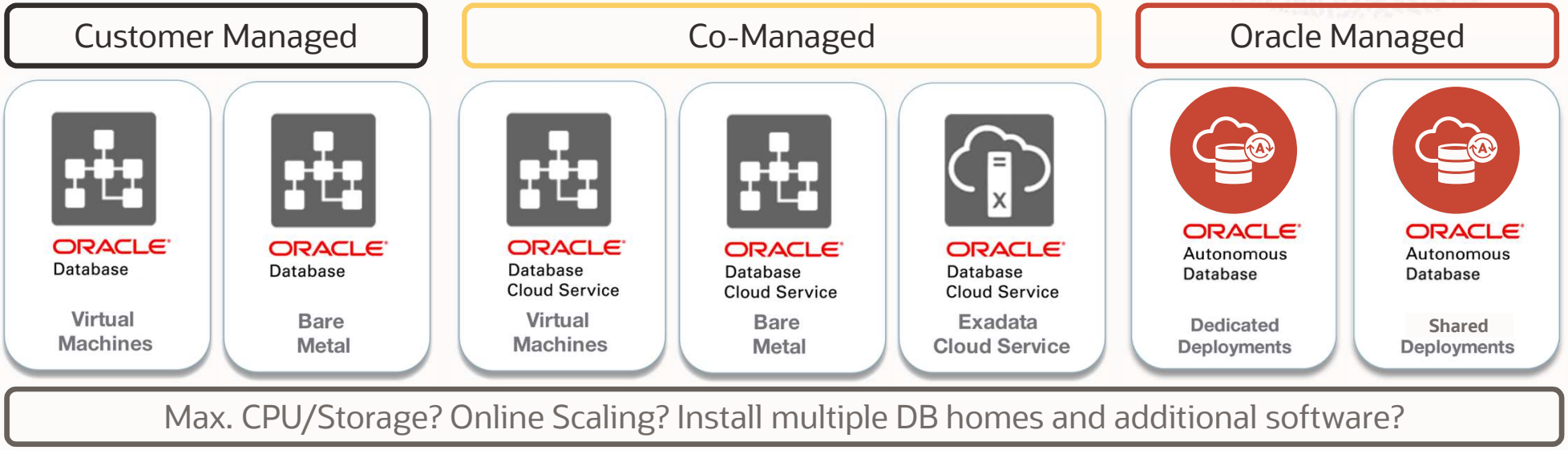
Oracle Database Cloud Offering

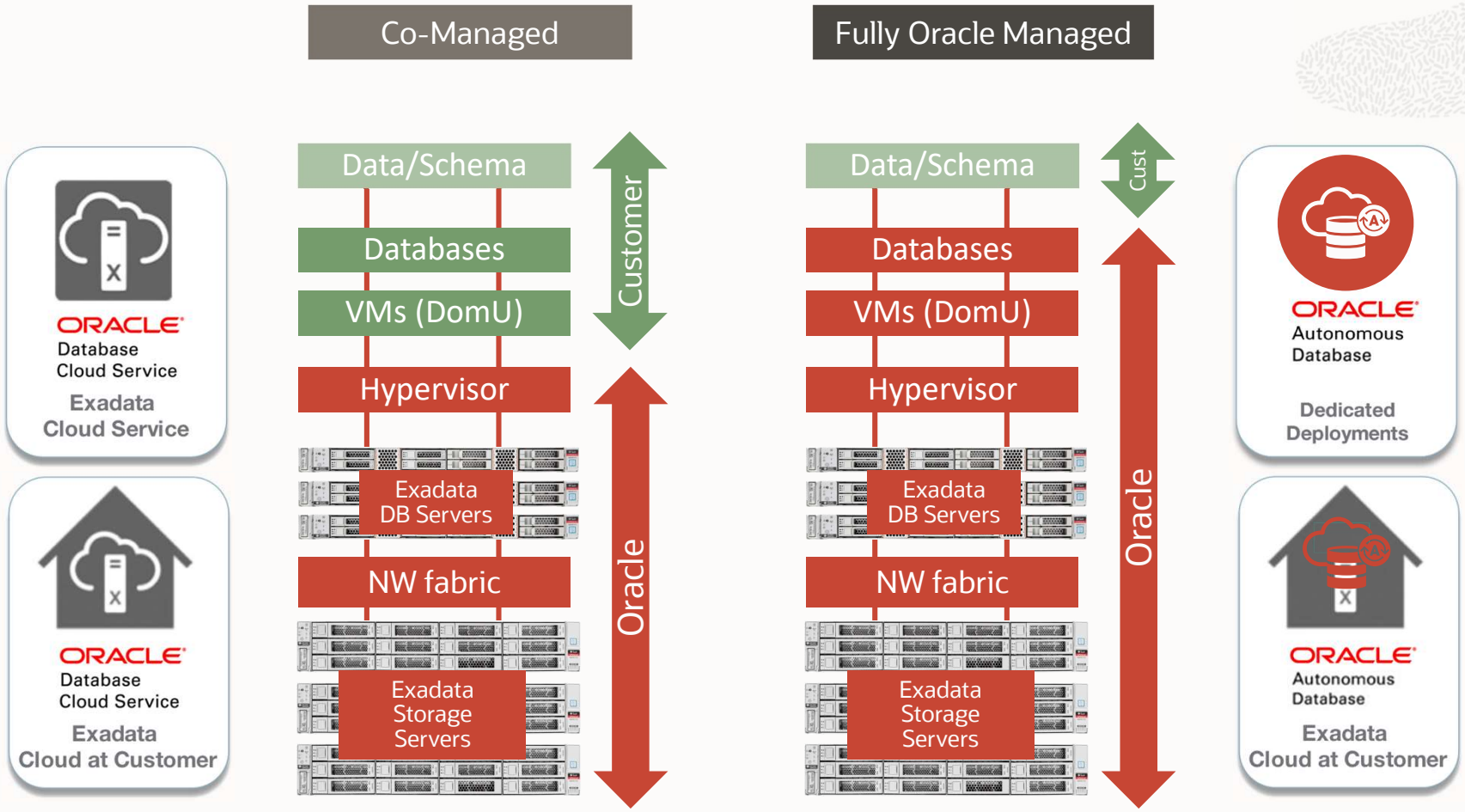


Oracle Database Cloud Offering



Deployment Options





What is Migration?

Patching

- Apply fixes within the same Release version
- Quarterly Release Updates (RUs)
- 18.11 → 18.12
- 19.9 → 19.10

Upgrade

- Change from one Major Release to another
- 11.2.0.4 → 19.9
- 18.11 → 19.10

Migration

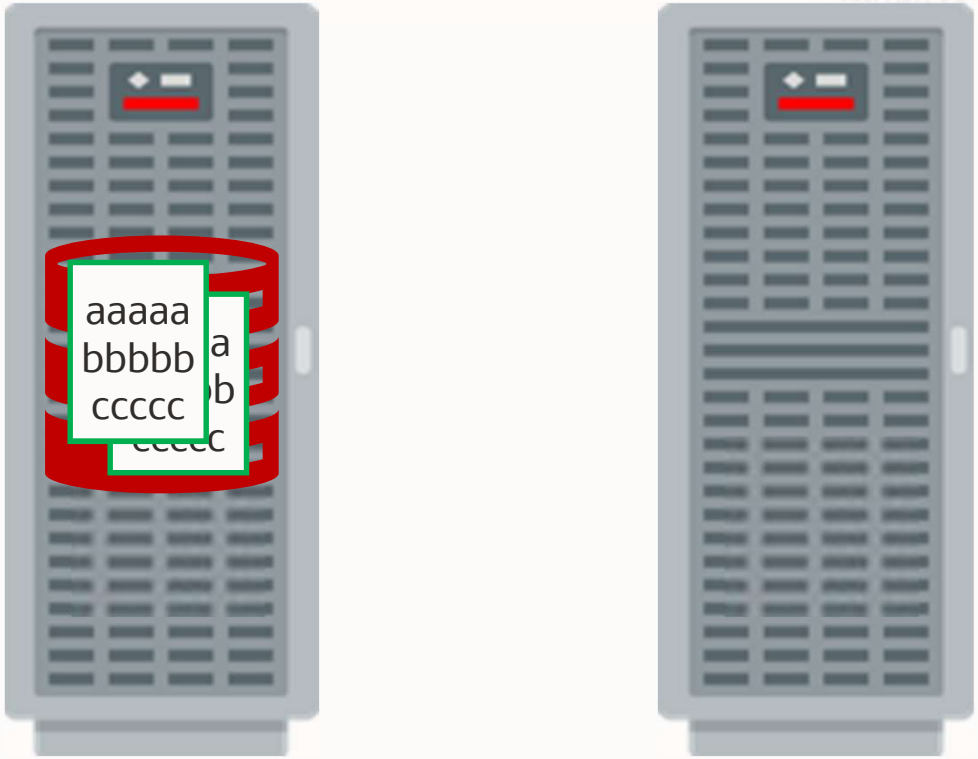
- Move the Database
- Old HW → New HW
- AIX → Linux
- On-premises → Cloud
- non-CDB to Multitenant

Data Center Relocation

- Move entire HW from one place to another

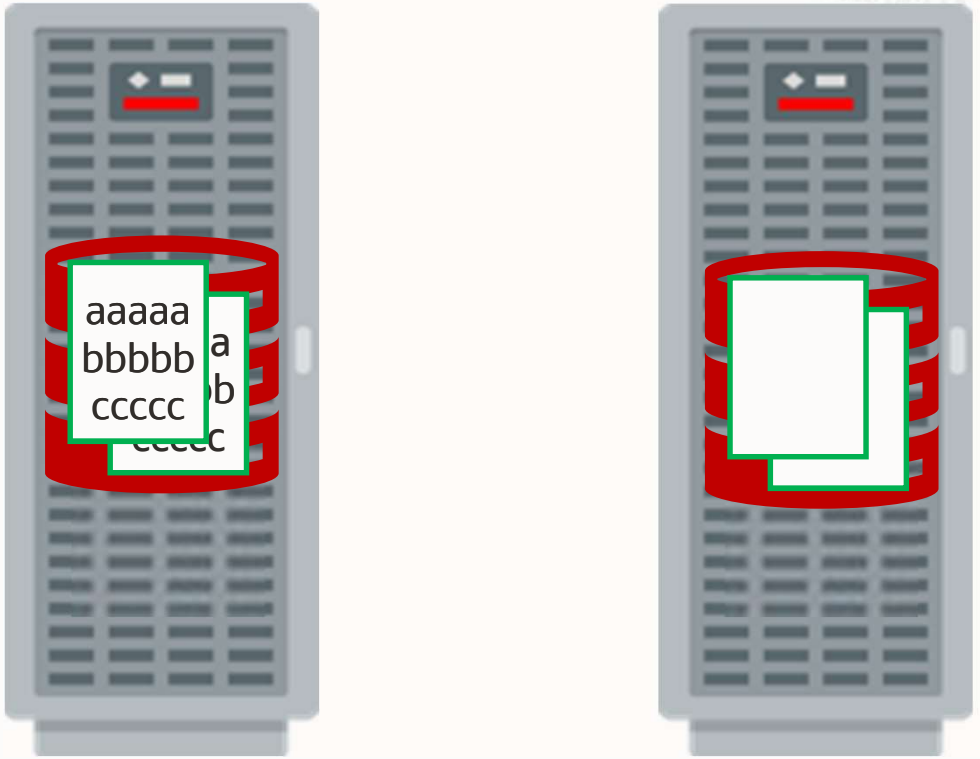
Physical Migration

Move the **datafiles**
from source
to target **server**

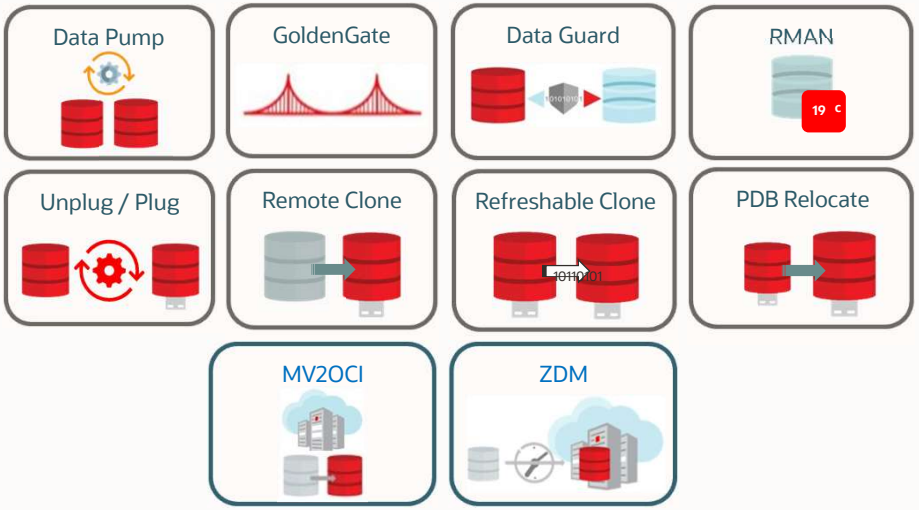


Logical Migration

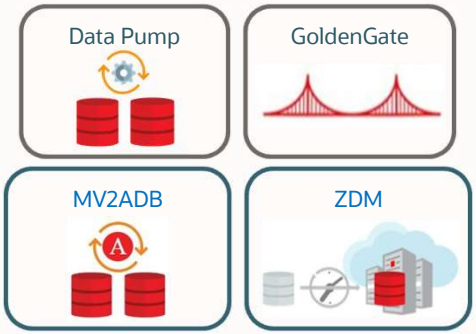
Move the **data**
from source
to target **database**



Logical & Physical (access to OS and CDB)

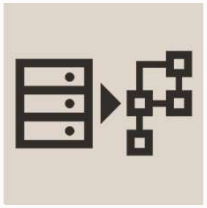


Logical (no access to OS and CDB)



Oracle Solutions to migrate databases to Oracle Cloud

OCI Database Migration (DMS)



- Fully managed
- Graphical guidance
- Online and offline migrations
- *Autonomous Database target only in first release*

Based on Zero Downtime Migration

Zero Downtime Migration (ZDM)

- User Managed Expert Tool
- Fleet Migrations
- Logical and Physical Migrations
- Migrations to ExaCC

SQL Developer

- Developer Experience
- Fine-grained transformations

Enterprise Manager

ORACLE Enterprise Manager

- Integrated with EM ecosystem
- Use as part of EM Automation and Monitoring

Database Tools

- Manual use of DB Tools (Data Pump, Multitenant, RMAN, Data Guard, GoldenGate)
- Full expert control
- Special use cases (bi-directional replication, etc.)

Cloud Benefits

Automation
- Infrastructure
- Provisioning
- Backups

Simplified Management
- Patching
- Restore
- Cloning

Higher Availability & Performance
- RAC
- Data Guard
- Exadata

Higher Security
- Self-patching
- Encryption
- IAM

Cost Effectiveness
- Scalability
- Elasticity
- Pay-per-use

Take Automation to Next Level

Agenda

1. Oracle Database in Oracle Cloud
2. Considerations for Cloud Migration
3. Automation Tools
4. Migration Methods
5. Decision Tree for Migration Methods

Characteristics & Factors

Database version
- 11g, 12c, 18c, 19c

Database edition
- Standard, Enterprise

Database options
- Adv. Security (TDE), RAC, ..

Database architecture
- Non-CDB, Multitenant

Character set
- UTF8, ISO8859P1, ...

Database platform
- Endian format (little, big)

Data transfer
- Physical, Logical

Source database availability
- Online, Offline

DB block size
- 2K, 4K, 8K, 16K, 32K

Performance
- VM, BM, Exadata

Isolation
- Shared or dedicated environment

Data types
- LONG, Mulitmedia, ...

Characteristics & Factors

Database size
- Small, medium, large

Network bandwidth
- Internet, VPN, FastConnect
- Storage Gateway
- Data Transfer Appliance

Options
- Parallelism
- Compression

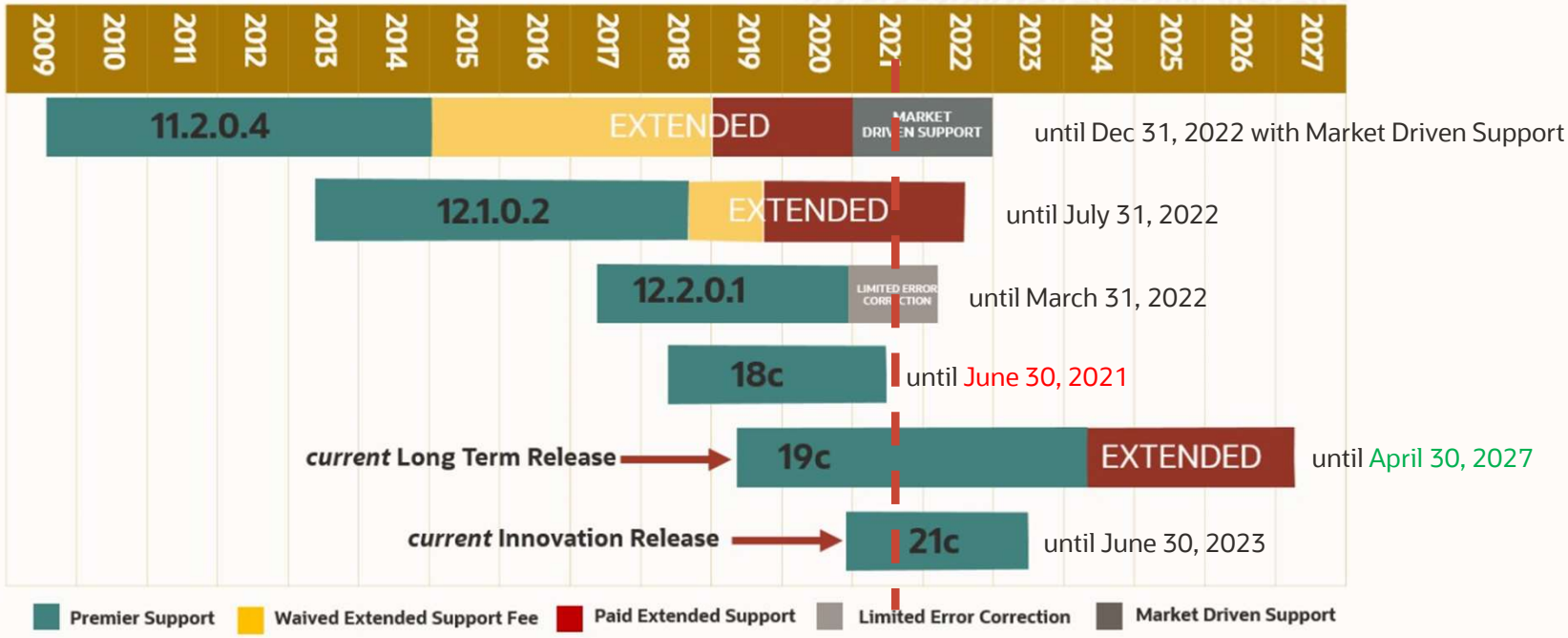
Downtime

- Long: Time needed for Data Pump conventional export and import for full backup & restore
- Short: Time needed to copy the data files over the network or create and apply last incremental backup
- Zero: Time needed for switchover or 1min for refreshable clones

Single Source of Truth ☺ Doc ID 742060.1

Database Releases and Support Timelines

AutoUpgrade Tool
Doc ID 2485457.1



Agenda

1 Oracle Database in Oracle Cloud

2 Considerations for Cloud Migration

3 Automation Tools

4 Migration Methods

5 Decision Tree for Migration Methods

Automation Tools

MV2ADB

Move to ADB
Migration to Autonomous by using Data Pump
Doc ID 2463574.1

MV2OCI

Move to OCI
Migration to DBCS by using Data Pump
Doc ID 2514026.1

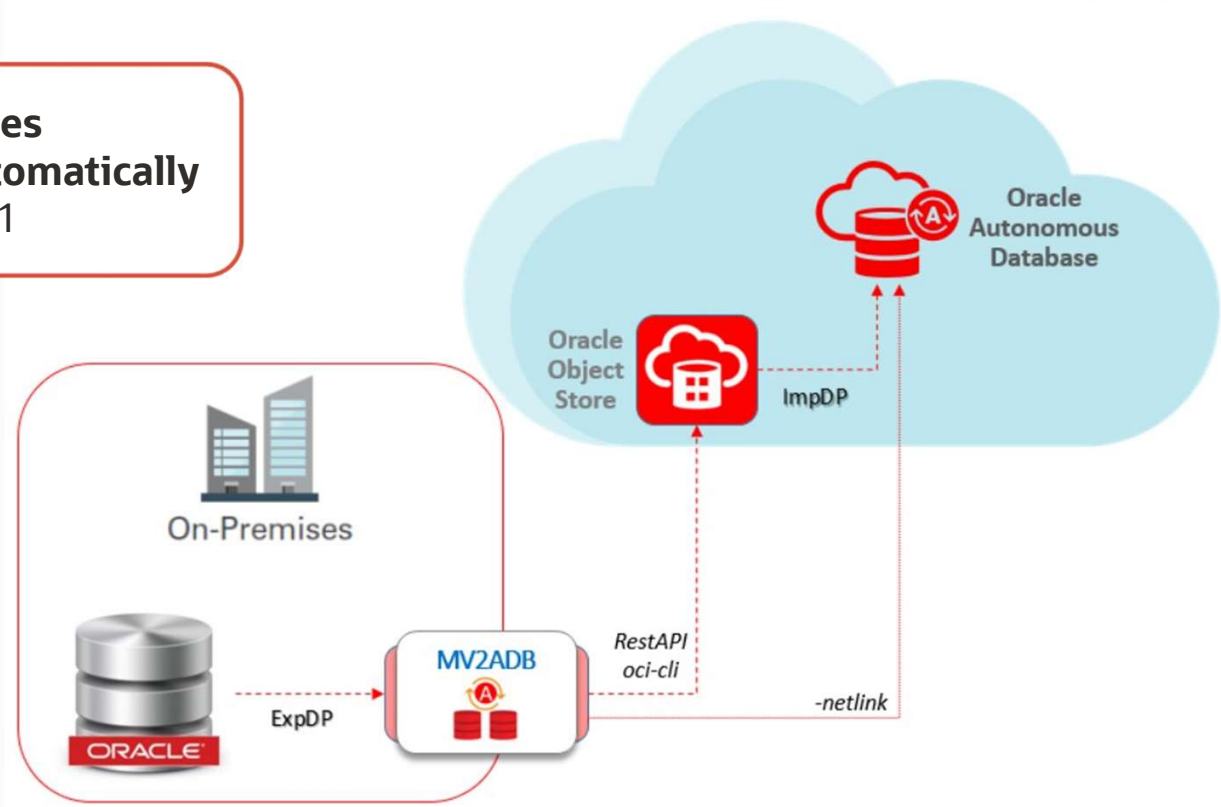
ZDM

Zero Downtime Migration
Migration to DBCS by using Standby Database
oracle.com/database/technologies/rac/zdm.html

All for Free

MV2ADB | move data to Autonomous Database in "one-click"

Installs & executes
ADB Schema Advisor automatically
Doc ID 2462677.1

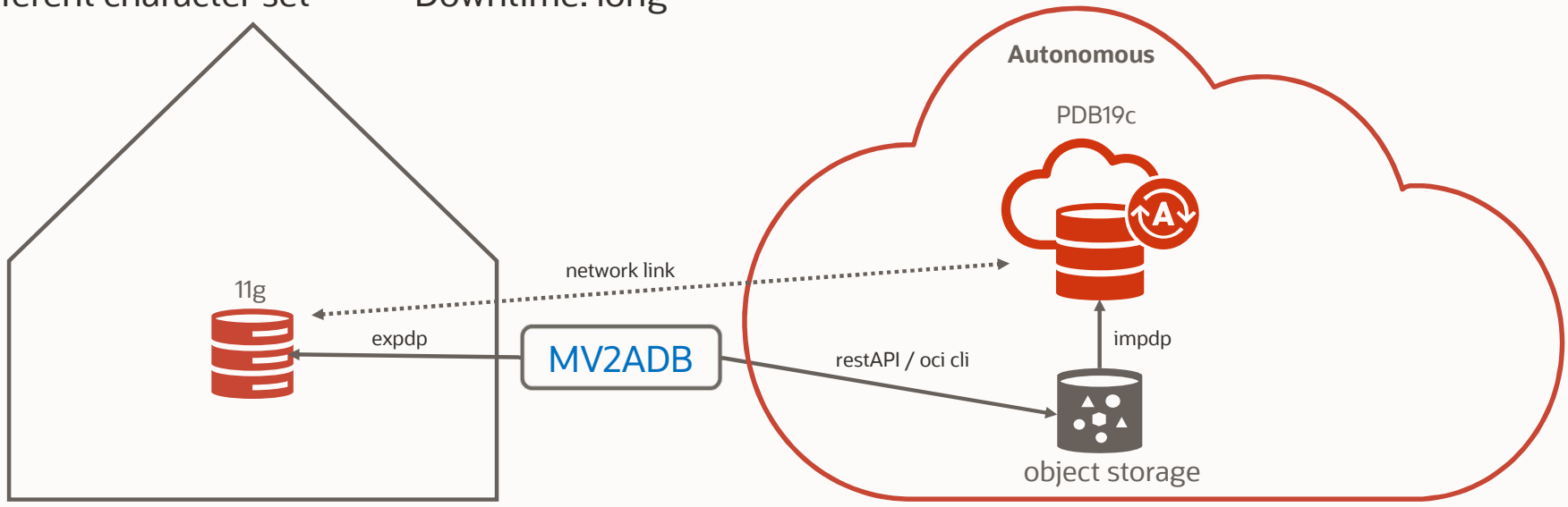


MV2ADB | move data to Autonomous Database in "one-click"

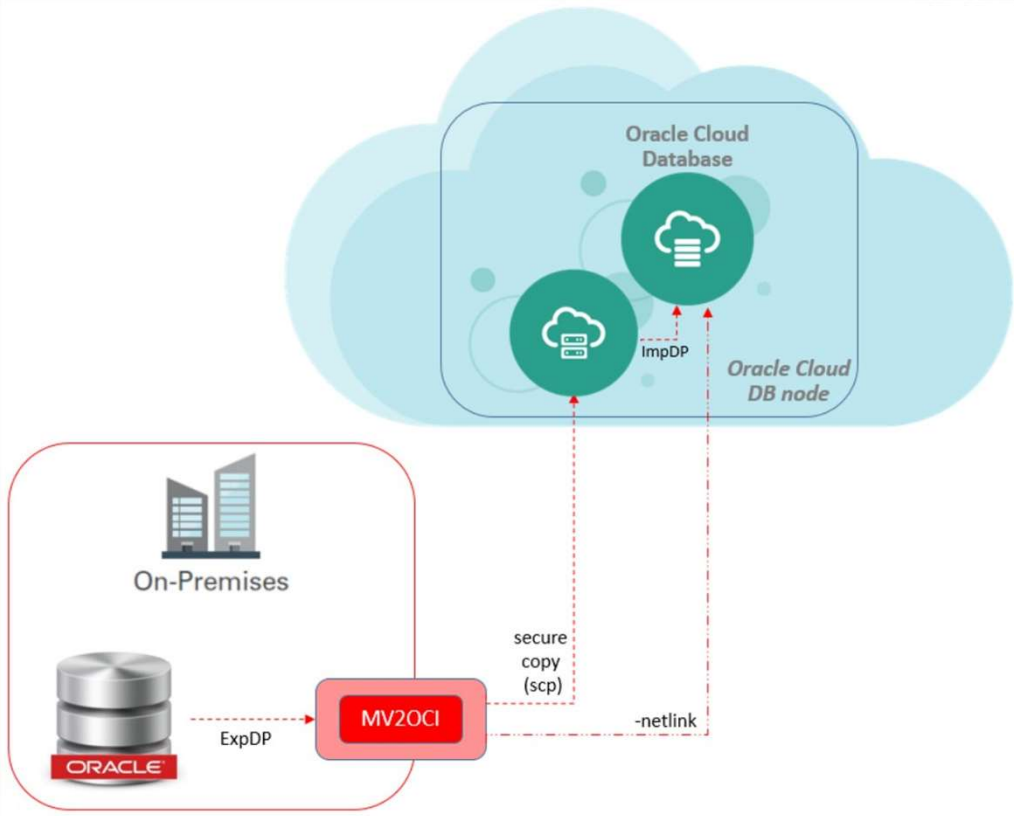
MV2ADB

- ✓ Different version
- ✓ Different architecture
- ✓ Different endian format
- ✓ Different character set
- ✓ Logical
- ✓ Online
- ✓ SE, EE
- ▪ Downtime: long

Installs & executes ADB Schema Advisor automatically Doc ID 2462677.1

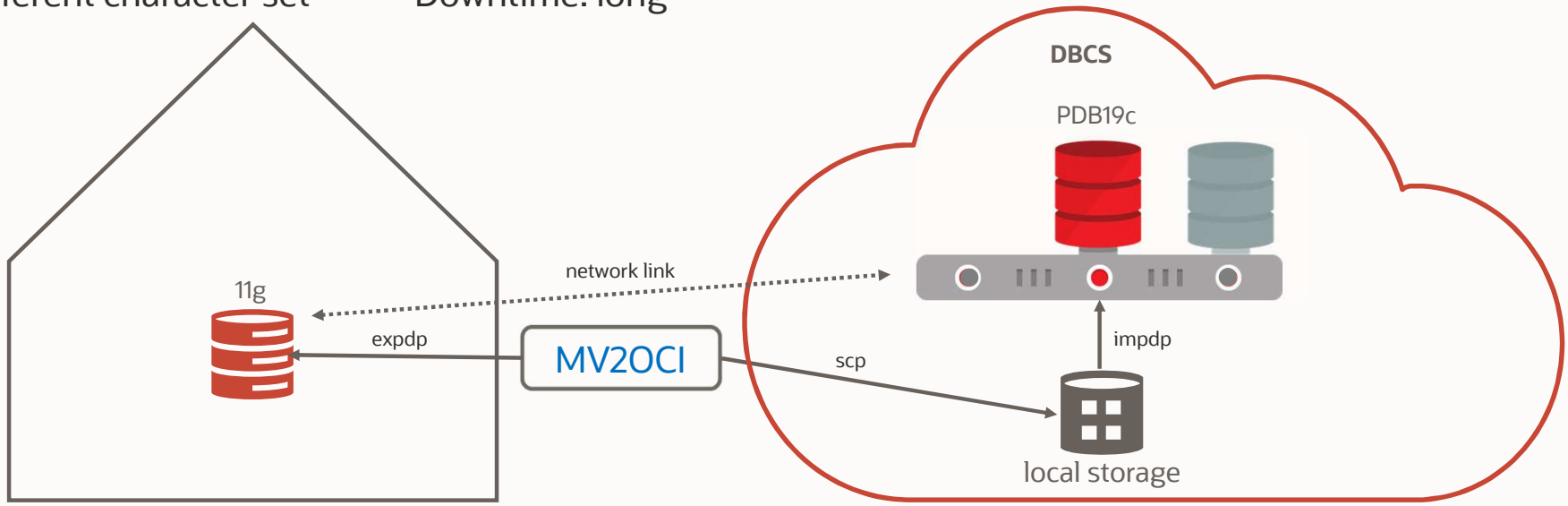


MV2OCI | move data to Oracle Cloud Database in "one-click"

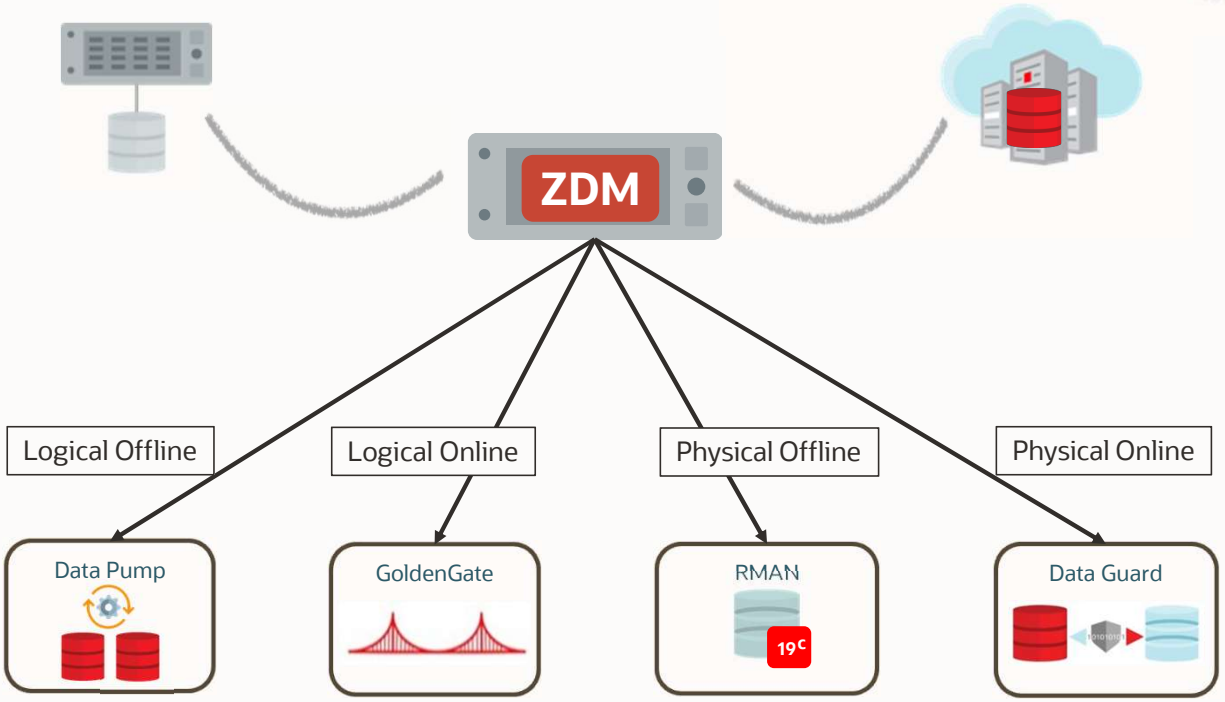


MV2OCI | move data to Oracle Cloud Database in "one-click"

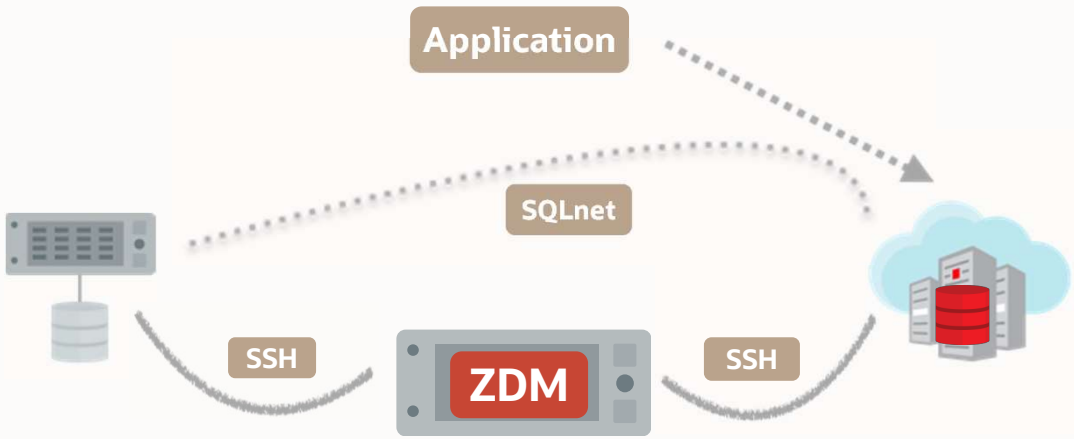
- ✓ Different version
- ✓ Different architecture
- ✓ Different endian format
- ✓ Different character set
- ✓ Logical
- ✓ Online
- ✓ SE, EE
- ▪ Downtime: long



ZDM | Zero Downtime Migration



ZDM | Physical Online – Data Guard

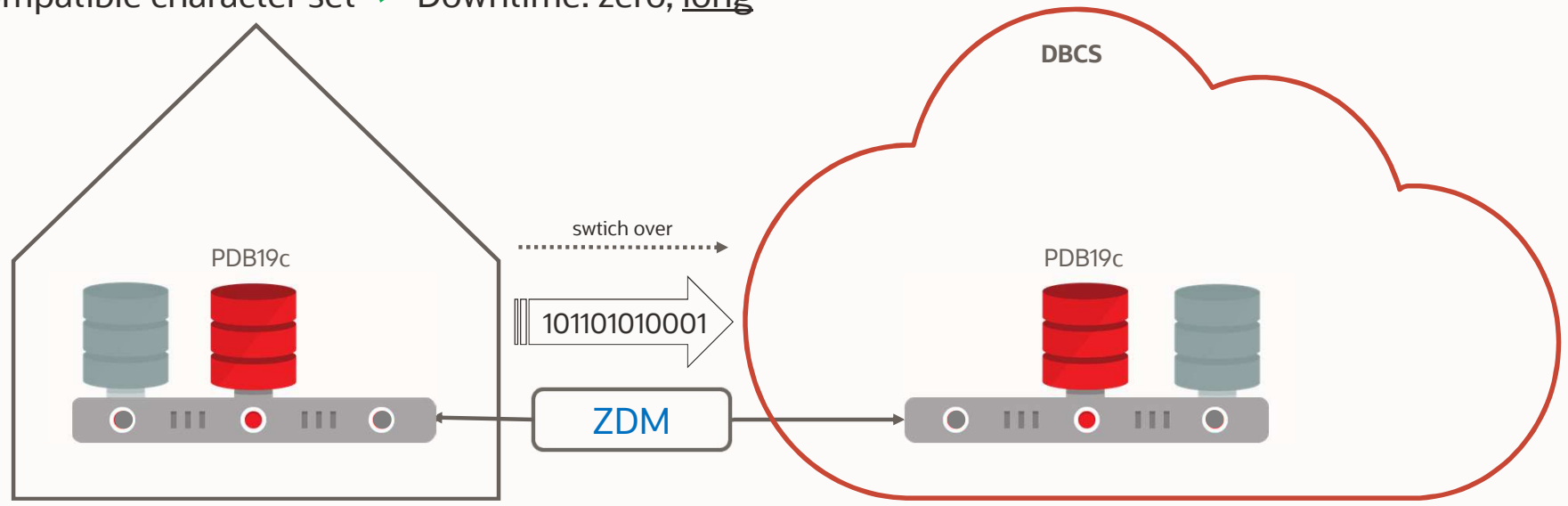


1. Download ZDM
2. Connects to Source & Target
3. Connects to Object Store
4. Transfers DB Files
5. Instantiates Standby
6. Syncs Primary & Standby
7. Switches Over & Role Swaps
8. User Finalizes at Will

ZDM | Zero Downtime Migration

- Same version
- Same architecture
- Same endian format
- Compatible character set

✓ Physical
✓ Online, Offline
✓ EE, SE
✓ Downtime: zero, long



ZDM: https://dohdatabase.com/2020/07/06/zdm/

Sources	Targets
On-premise, OCI Classic, OCI	DBCS VM, DBCS BM, ExaCS, ExaC@C
Linux operating system	Oracle Linux 7 or newer
DB release 11.2.0.4 or newer	Same release as on-premise
Patch level	Same, higher (run datapatch)
Enterprise Edition	Enterprise Edition (zero downtime)
Standard Edition	Standard Edition (offline)
CDB	CDB
12c non-CDB	12c non-CDB (ExaCS, ExaC@C)
Single Instance	Single Instance, RAC
RAC one node, RAC	RAC
Encrypted, not encrypted	Encrypted (no fallback if no ASO on-prem)

Cloud Migration | Best Practice

For Autonomous Database use MV2ADB

For all other use cases use ZDM when applicable

If not applicable, use manual methods according on your requirements

Agenda

1 Oracle Database in Oracle Cloud

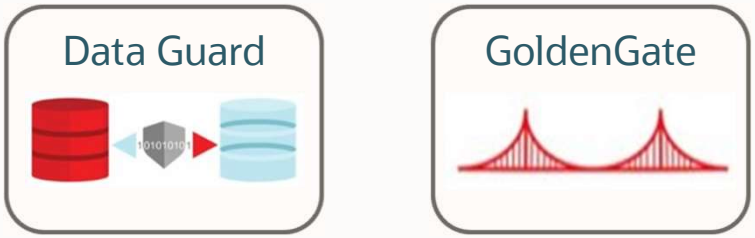
2 Considerations for Cloud Migration

3 Automation Tools

4 Migration Methods

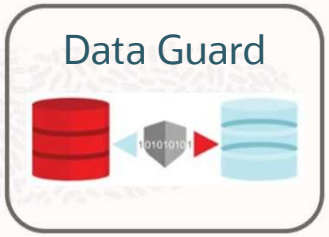
5 Decision Tree for Migration Methods

Maximum Availability Architecture (MAA)



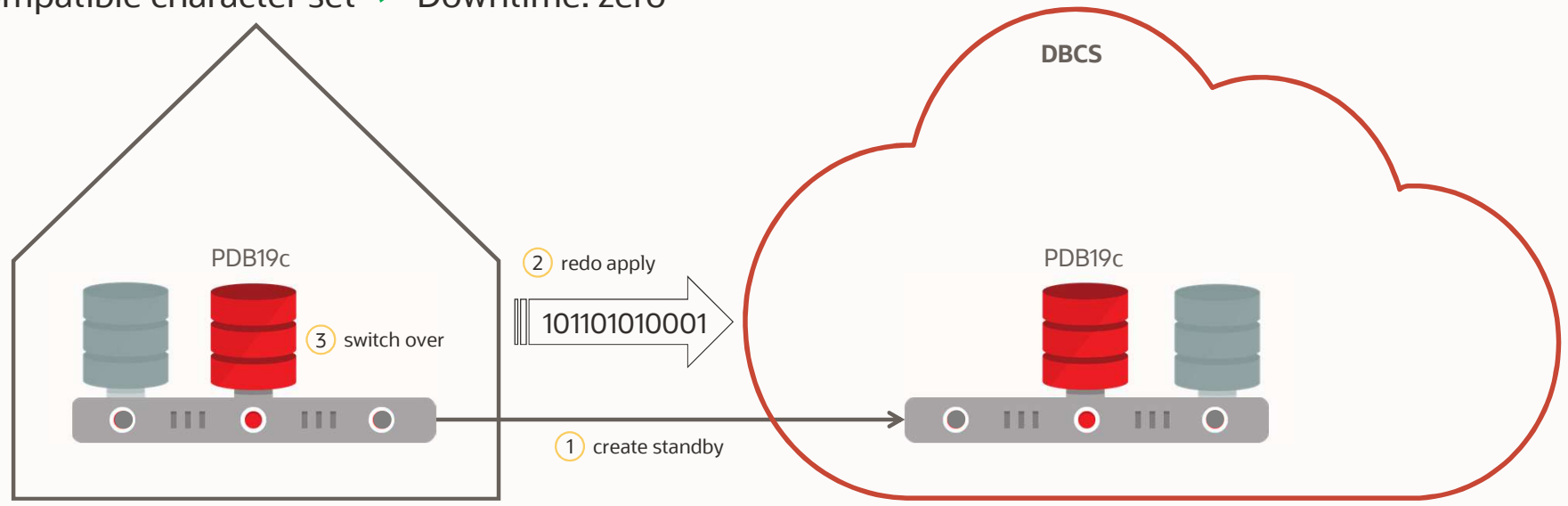
1. Data Gaurd
2. GoldenGate

1. Data Guard



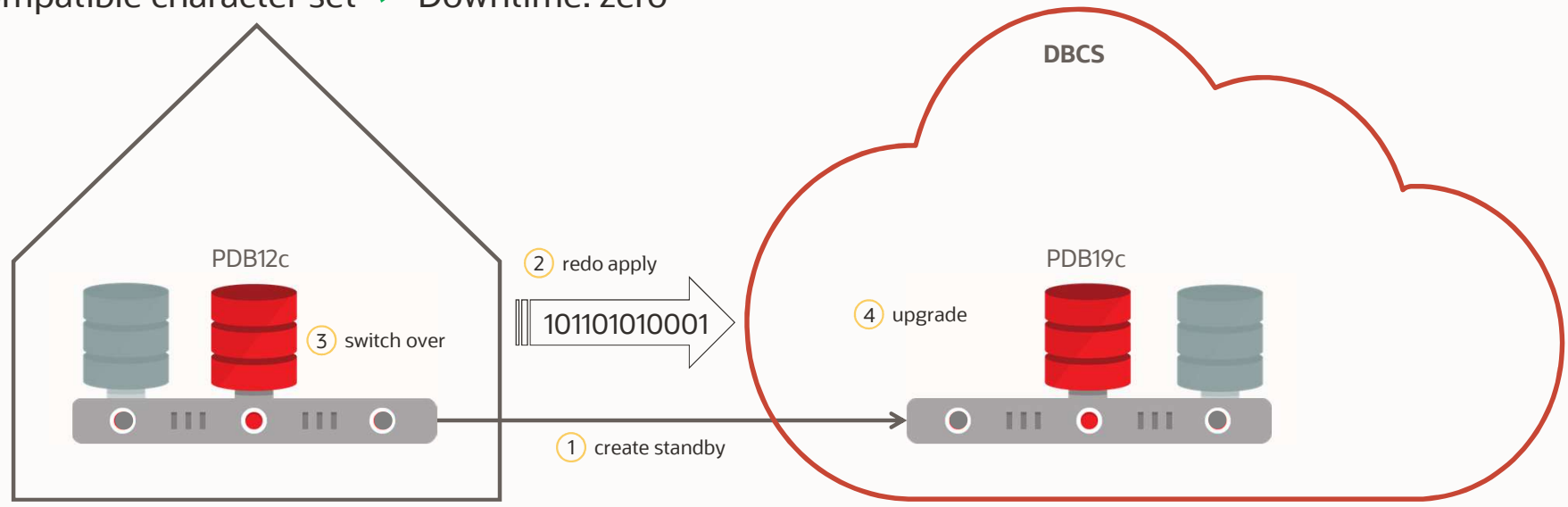
- Same version
- Same architecture
- Same endian format
- Compatible character set

✓ Physical
✓ Online
✓ EE
✓ Downtime: zero



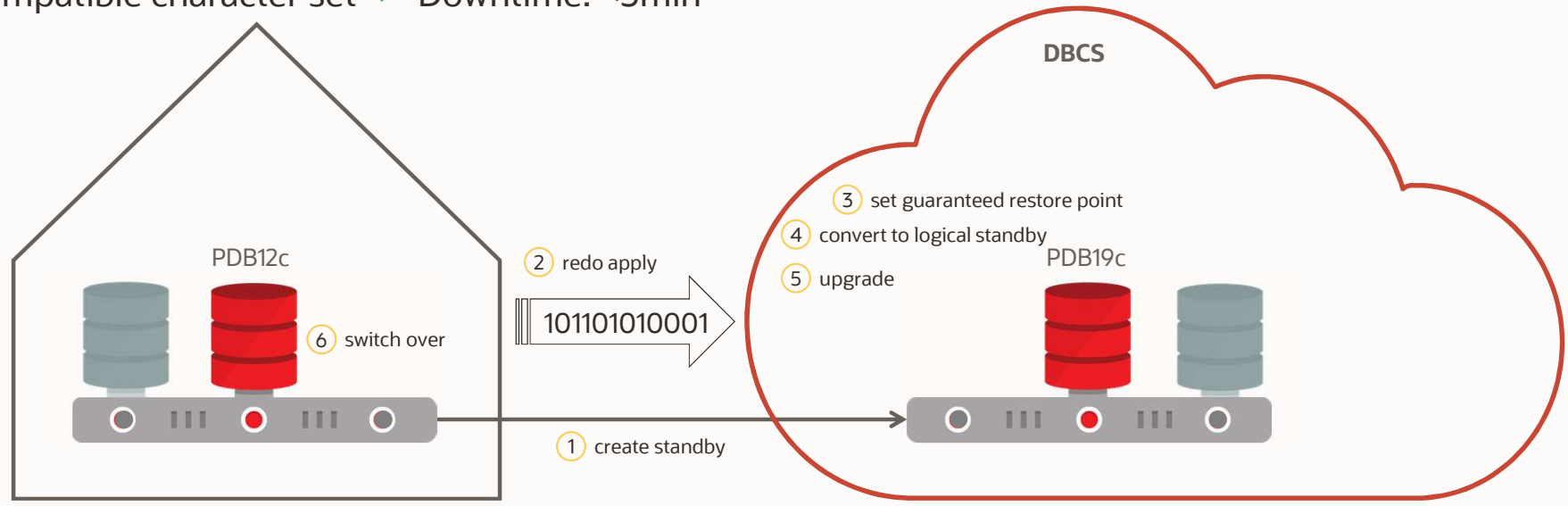
Data Guard | Switchover and Upgrade

- ✓ Different version
- ▪ Same architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ✓ Online
- ✓ EE
- ✓ Downtime: zero



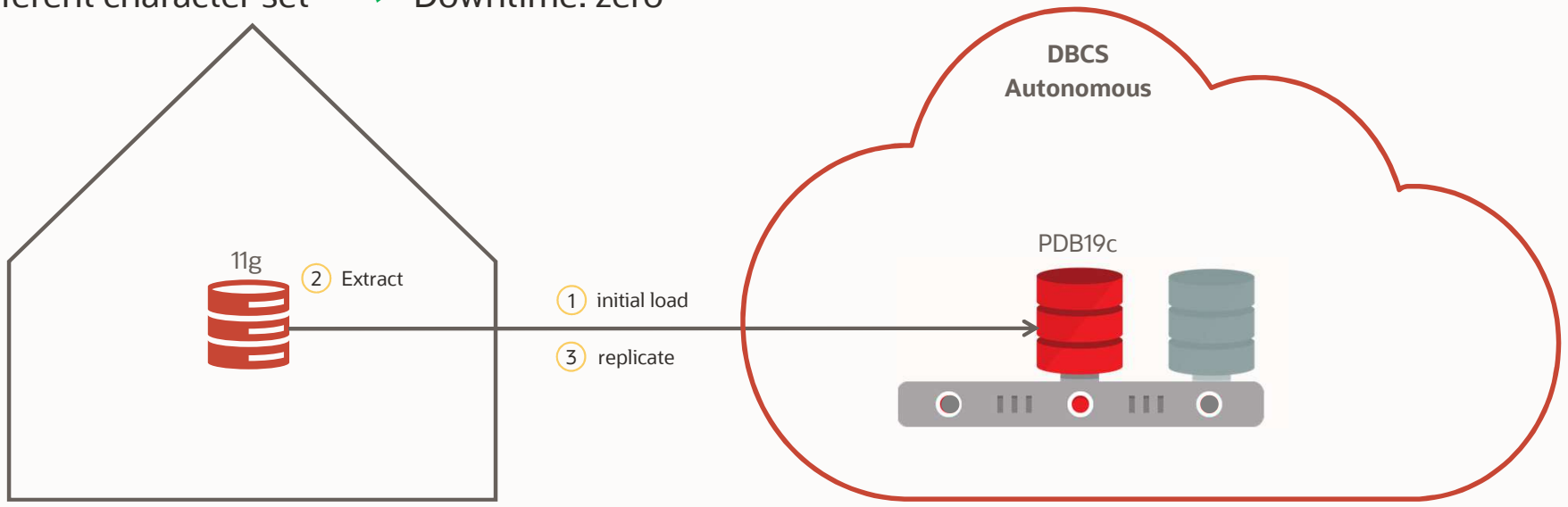
Data Guard | Transient Logical Standby

- ✓ Different version
- ▪ Same architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Logical
- ✓ Online
- ✓ EE
- ✓ Downtime: <5min

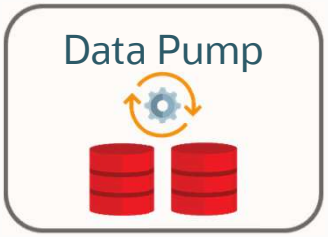


2. GoldenGate

- ✓ Different version
- ✓ Different architecture
- ✓ Different endian format
- ✓ Different character set
- ✓ Logical
- ✓ Online
- ✓ SE, EE
- ✓ Downtime: zero

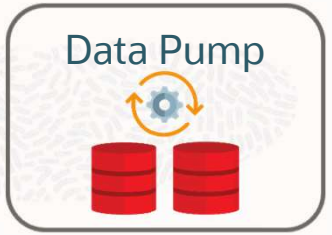


Data Pump

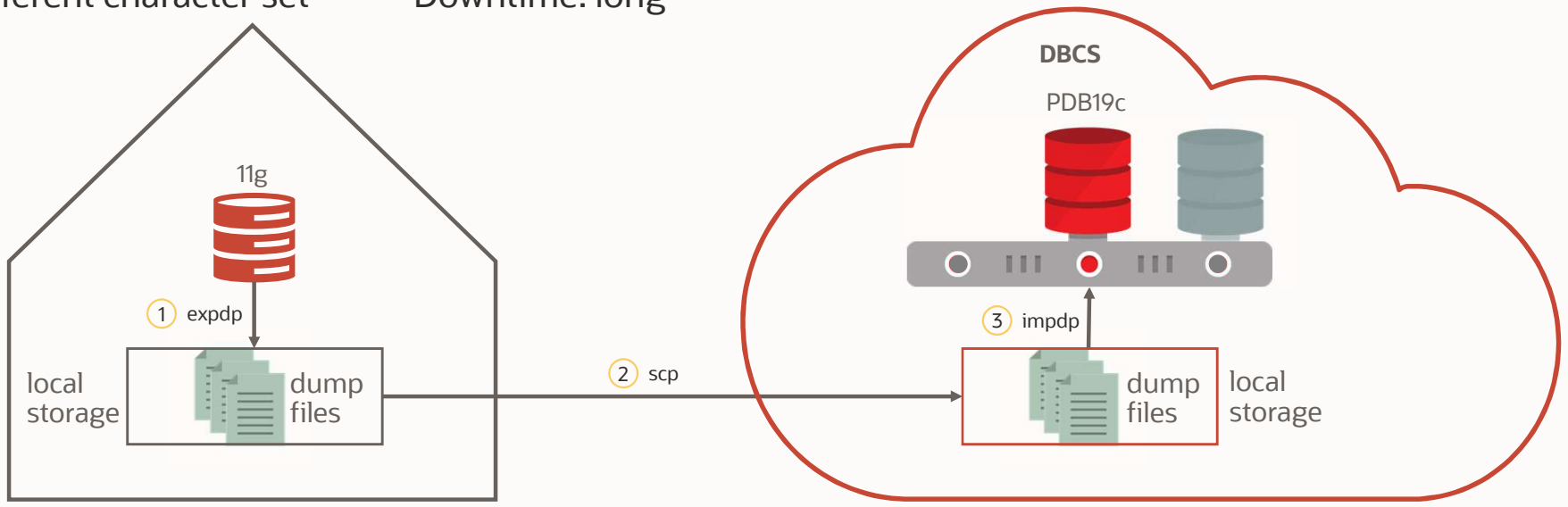


3. Conventional Export/Import
4. Full Transportable
5. Transportable Tablespace
6. Convert Full Transportable

3. Data Pump | Conventional Export/Import - DBCS

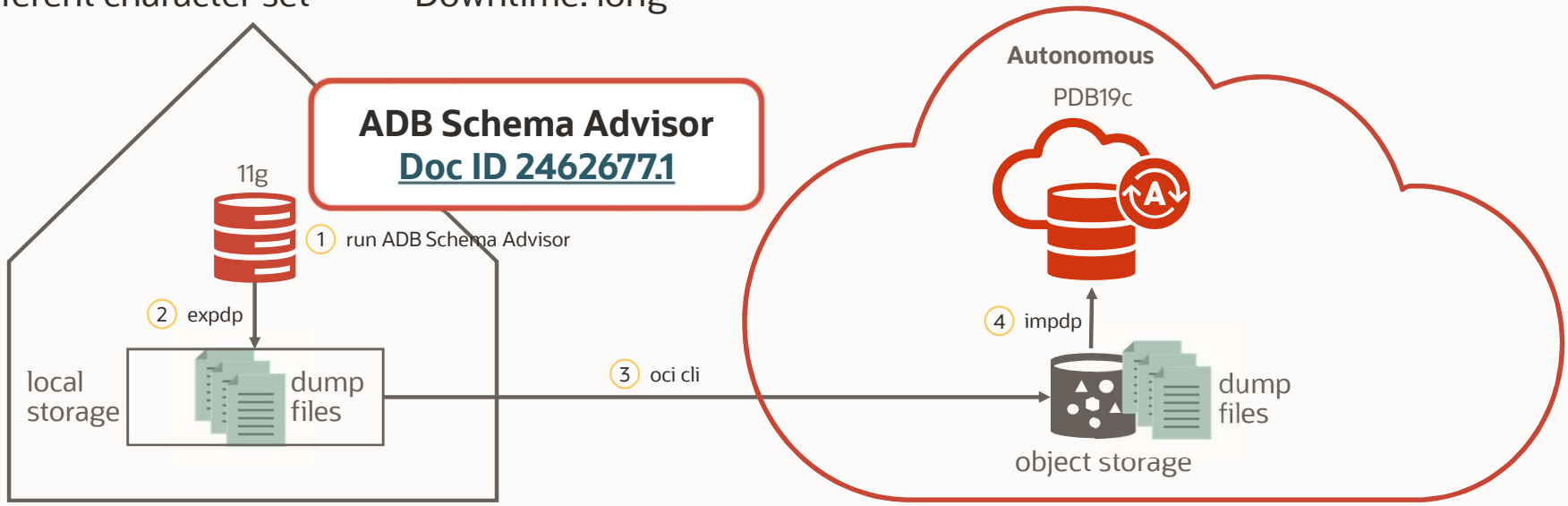


- ✓ Different version
- ✓ Different architecture
- ✓ Different endian format
- ✓ Different character set
- ✓ Logical
- ✓ Online
- ✓ SE, EE
- ▪ Downtime: long



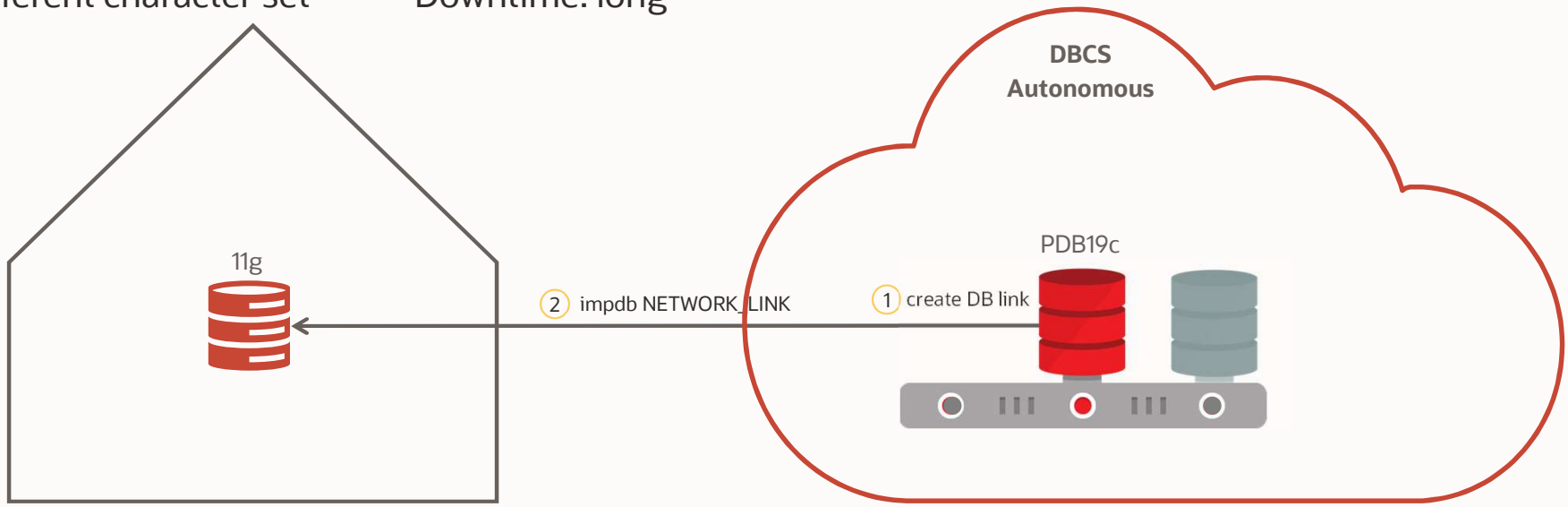
Data Pump | Conventional Export/Import - ADB

- ✓ Different version
- ✓ Different architecture
- ✓ Different endian format
- ✓ Different character set
- ✓ Logical
- ✓ Online
- ✓ SE, EE
- ▪ Downtime: long



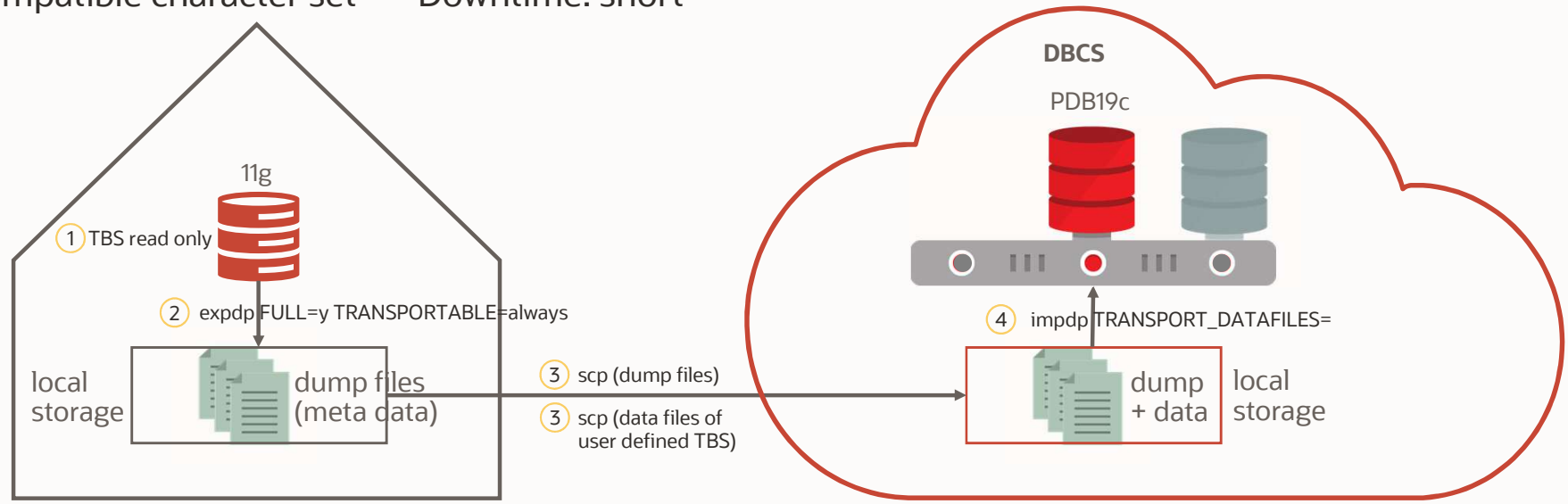
Data Pump | Network Link

- ✓ Different version
- ✓ Different architecture
- ✓ Different endian format
- ✓ Different character set
- ✓ Logical
- ✓ Online
- ✓ SE, EE
- ▪ Downtime: long



4. Data Pump | Full Transportable Export Import (FTEX)

- ✓ Different version
- ✓ Different architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: short



4. Data Pump | Full Transportable Export Import (FTEX) + Inc. Backups

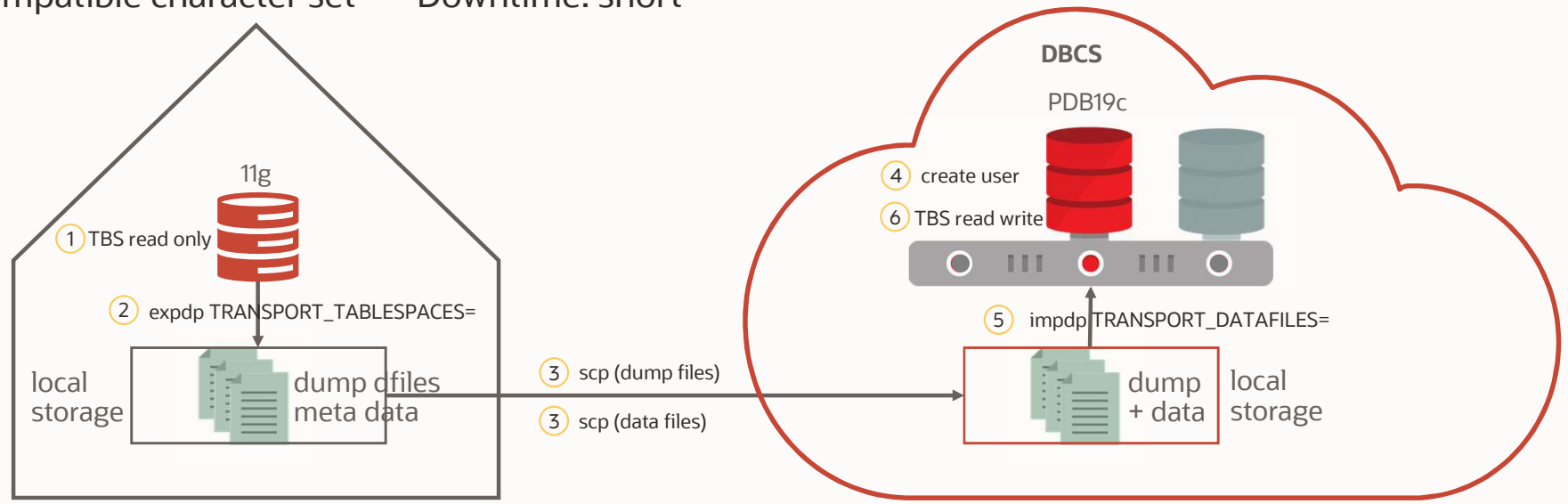
- ✓ Different version
- ✓ Different architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: **very short**

https://www.youtube.com/watch?v=dyDefQxSesI

https://www.youtube.com/watch?v=IEwfhA_GuF8

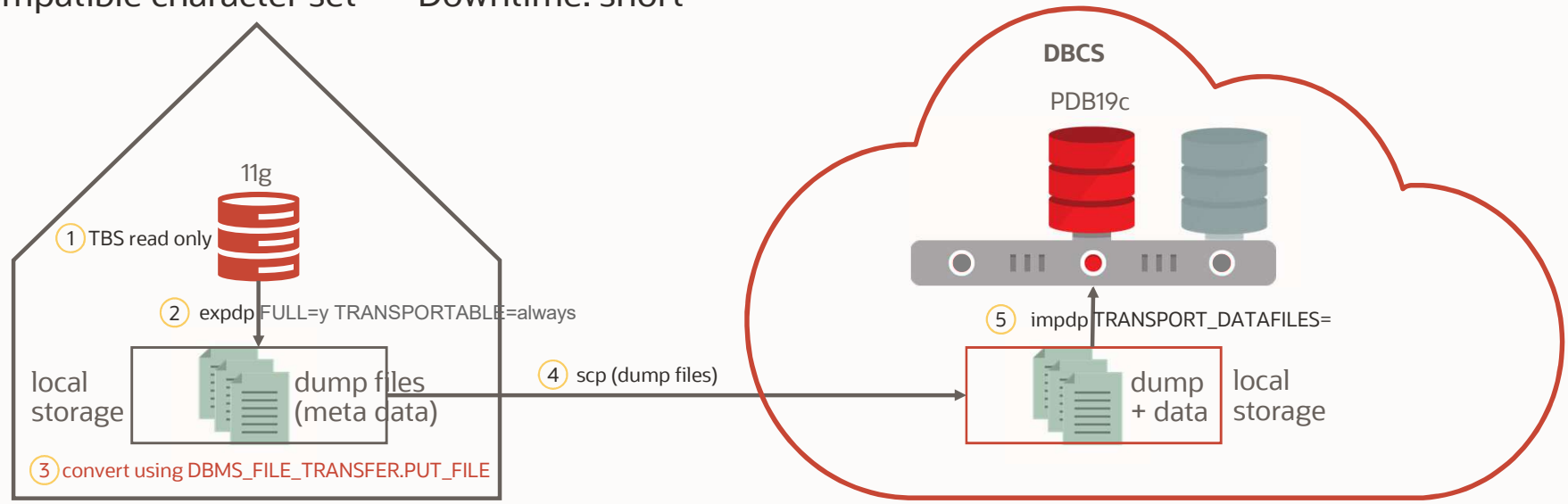
5. Data Pump | Transportable Tablespace

- ✓ Different version
- ✓ Different architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: short

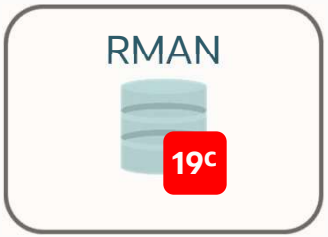


6. Data Pump | Convert Full Transportable

- ✓ Different version
- ✓ Different architecture
- ✓ Different endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: short

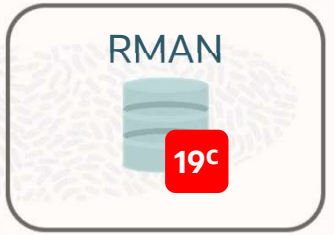


Recovery Manager (RMAN)

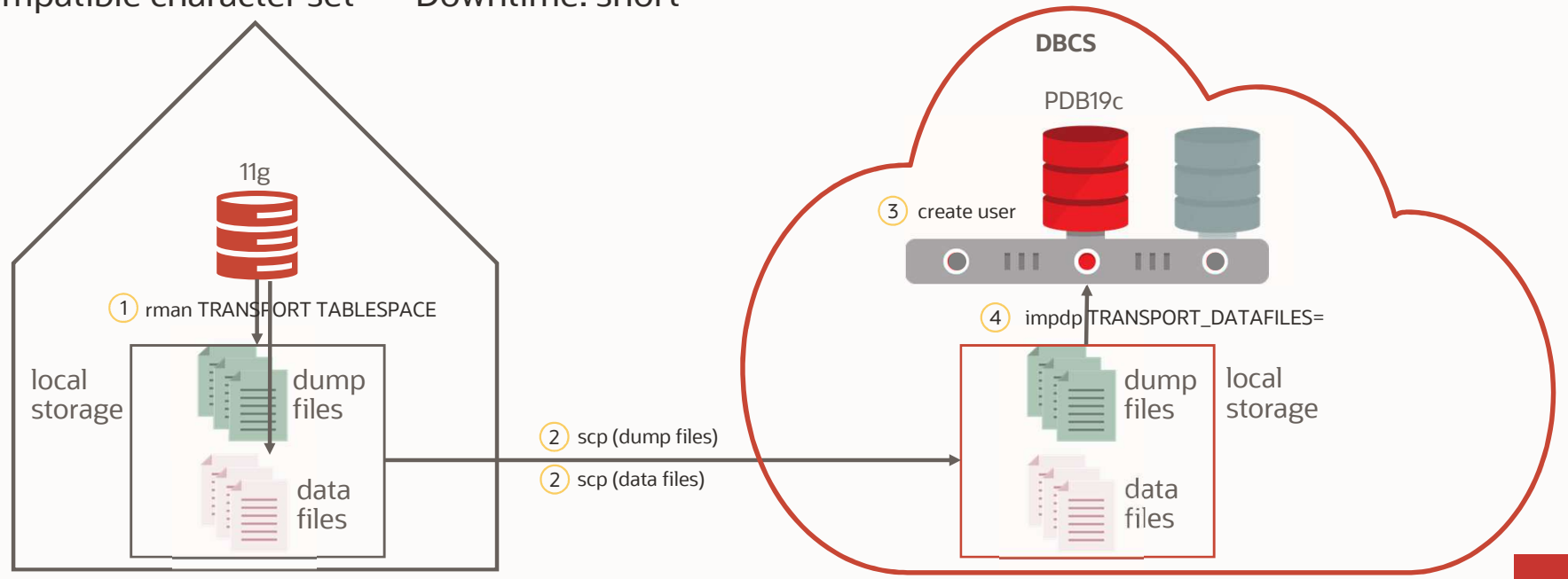


7. Transportable Tablespace
8. Convert Transportable Tablespace
9. Cross-Platform Transportable Tablespace Backup Sets
10. Cross-Platform Transportable PDB
11. Cross-Platform Transportable PDB Inconsistent Backups
12. Duplicate from an Active Database
13. Backup & Restore

7. RMAN | Transportable Tablespace with Data Pump

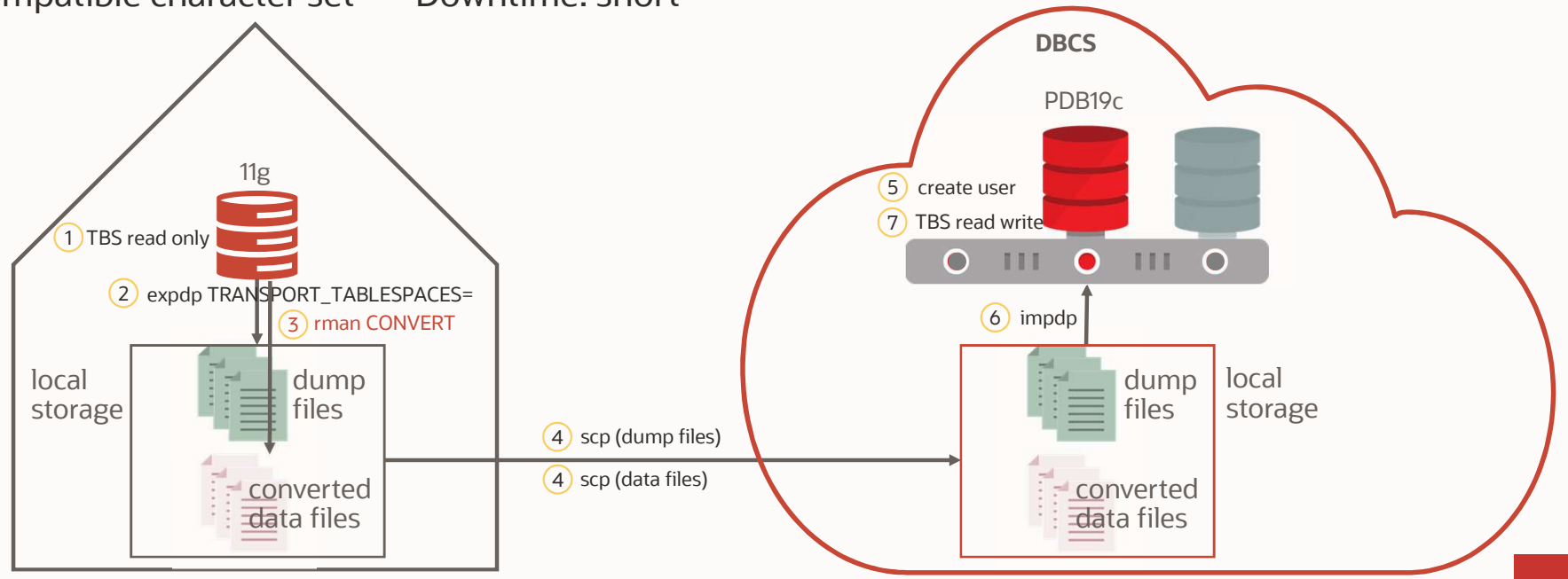


- ✓ Different version
- ✓ Different architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ✓ Online
- ✓ SE, EE
- ▪ Downtime: short



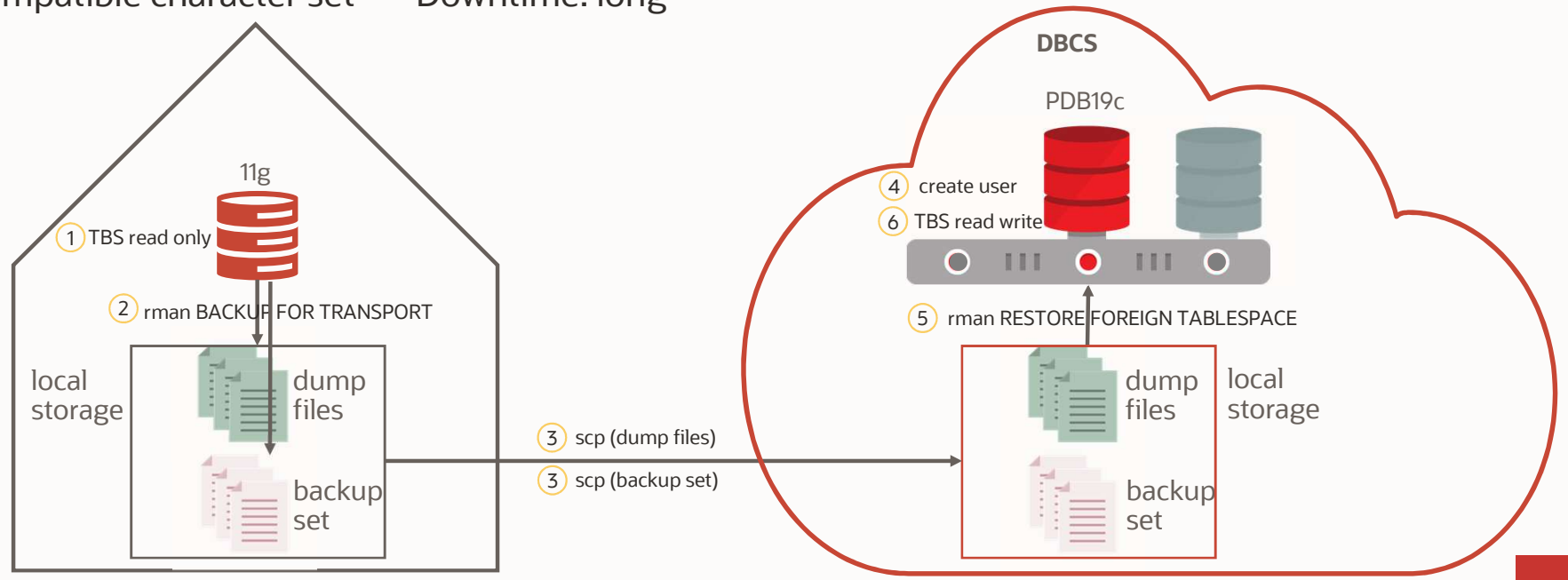
8. RMAN | Convert Transportable Tablespace with Data Pump

- ✓ Different version
- ✓ Different architecture
- ✓ Different endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: short



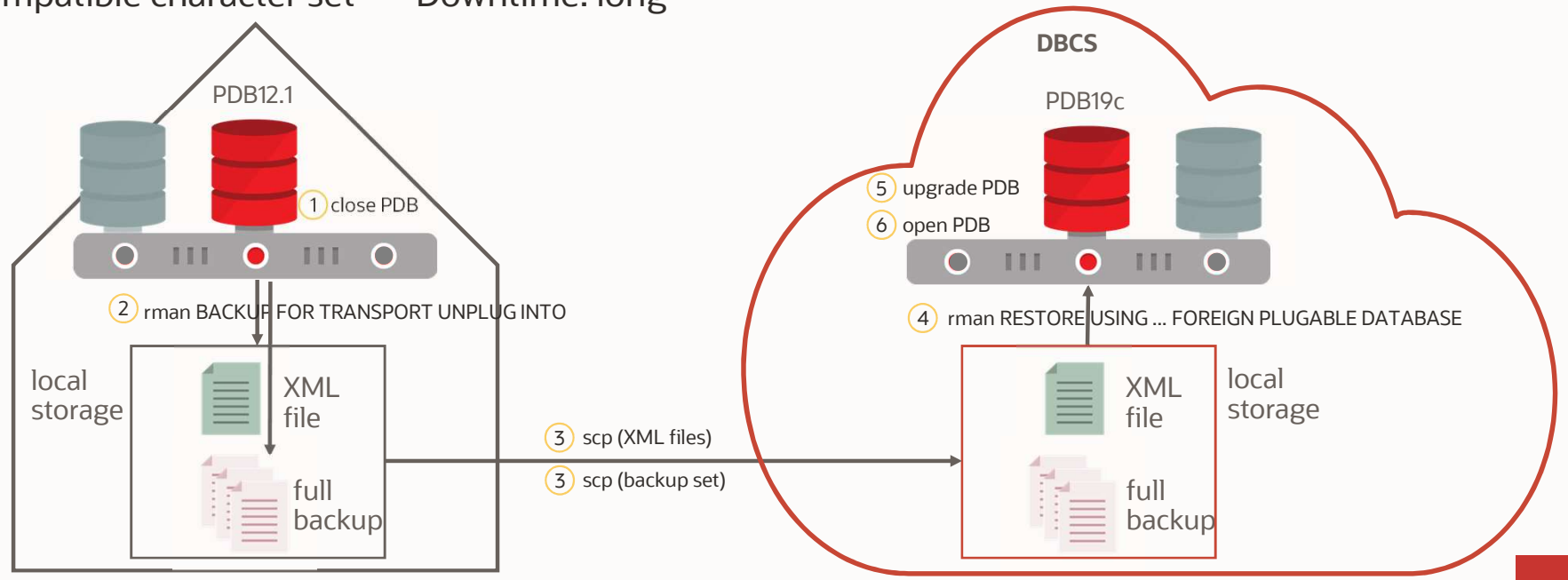
9. RMAN | Cross-Platform Transportable Tablespace Backup Sets

- ✓ Different version
- ✓ Different architecture
- ✓ Different endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: long



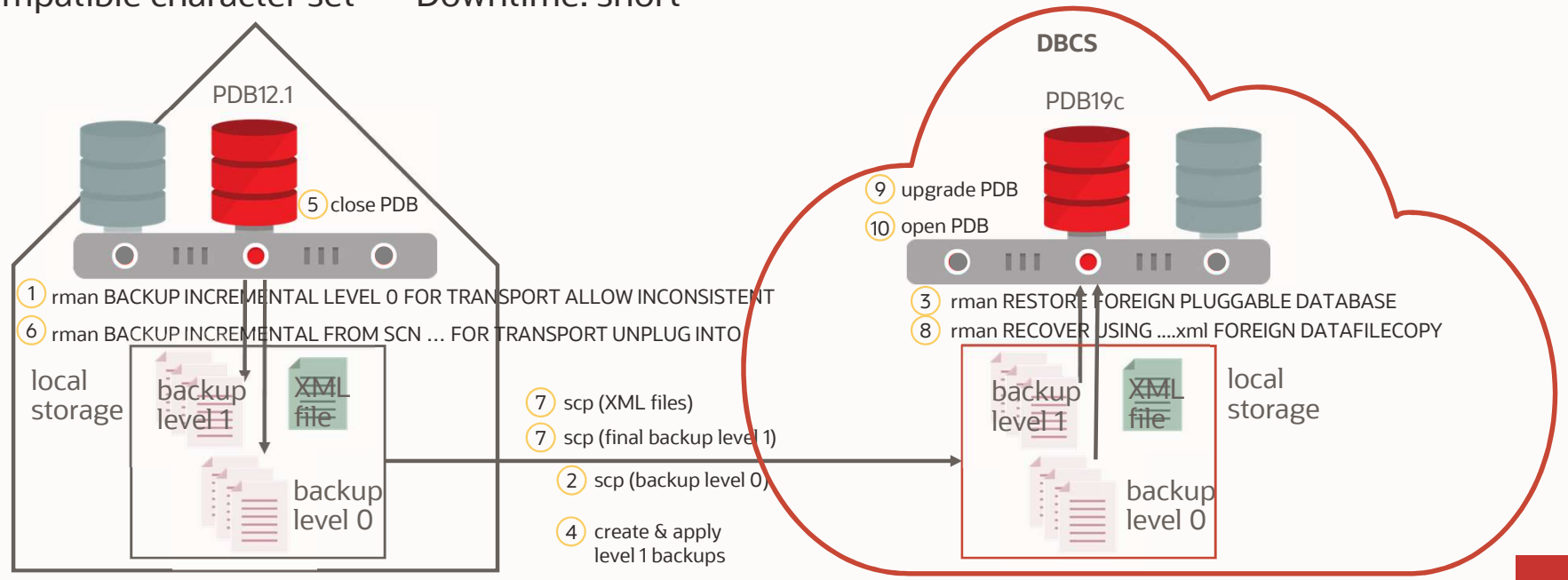
10. RMAN | Cross-Platform Transportable PDB

- ✓ Different version >= 12.1
- ▪ Same architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: long



11. RMAN | Cross-Platform Transportable PDB Inconsistent Backups

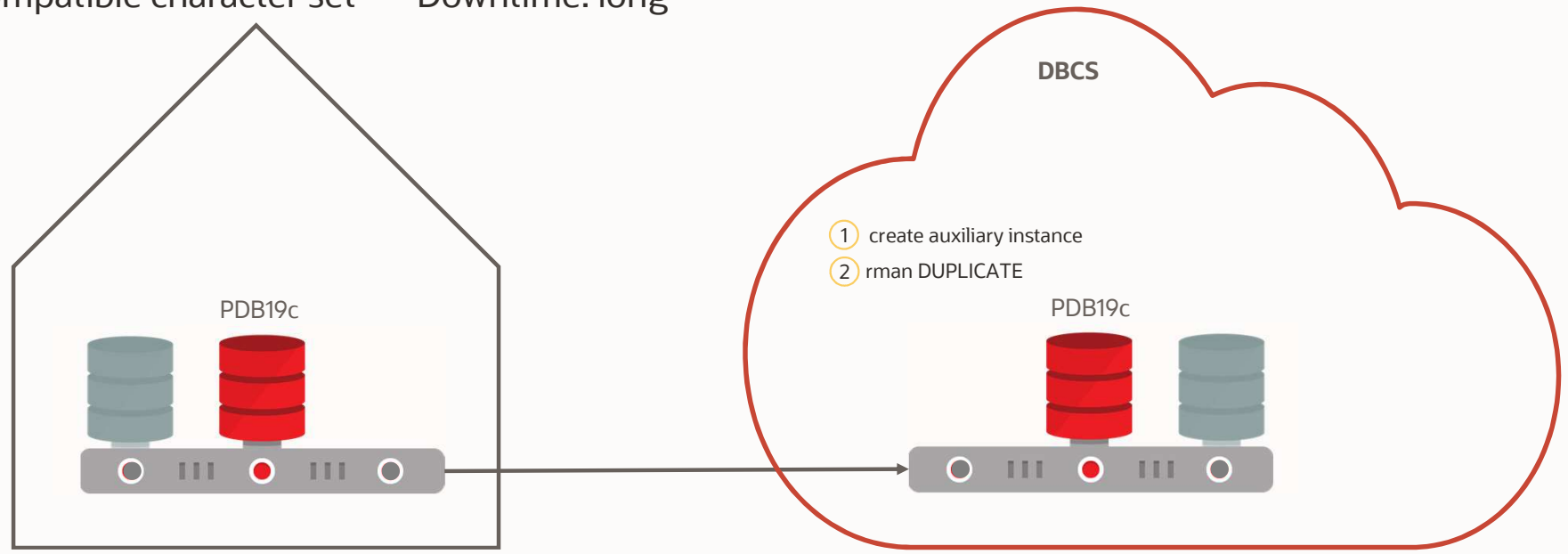
- ✓ Different version >= 12.2
- ▪ Same architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: short



12. RMAN | Duplicate from an Active Database

- Same version
- Same architecture
- Same endian format
- Compatible character set

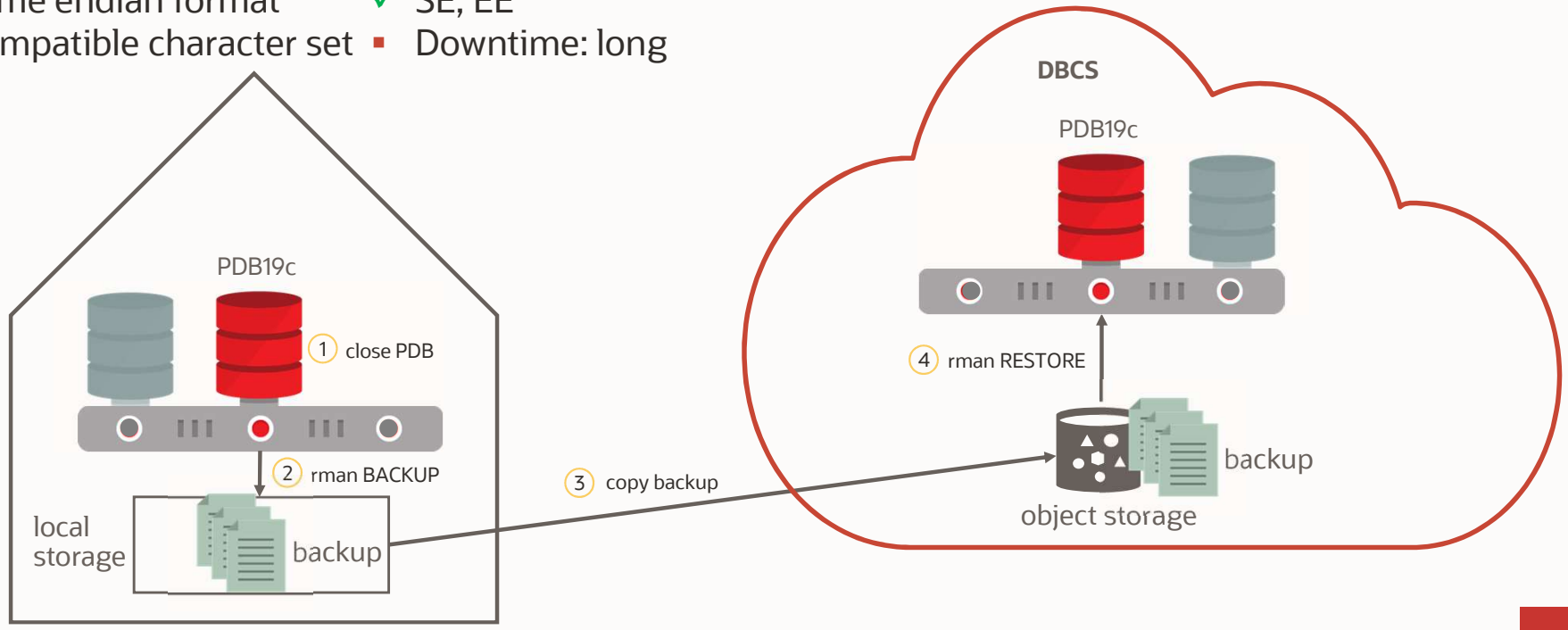
- ✓ Physical
- ✓ Online
- ✓ SE, EE
- Downtime: long



13. RMAN | Backup & Restore

- Same version
- Same architecture
- Same endian format
- Compatible character set

- ✓ Physical
- Offline
- ✓ SE, EE
- Downtime: long

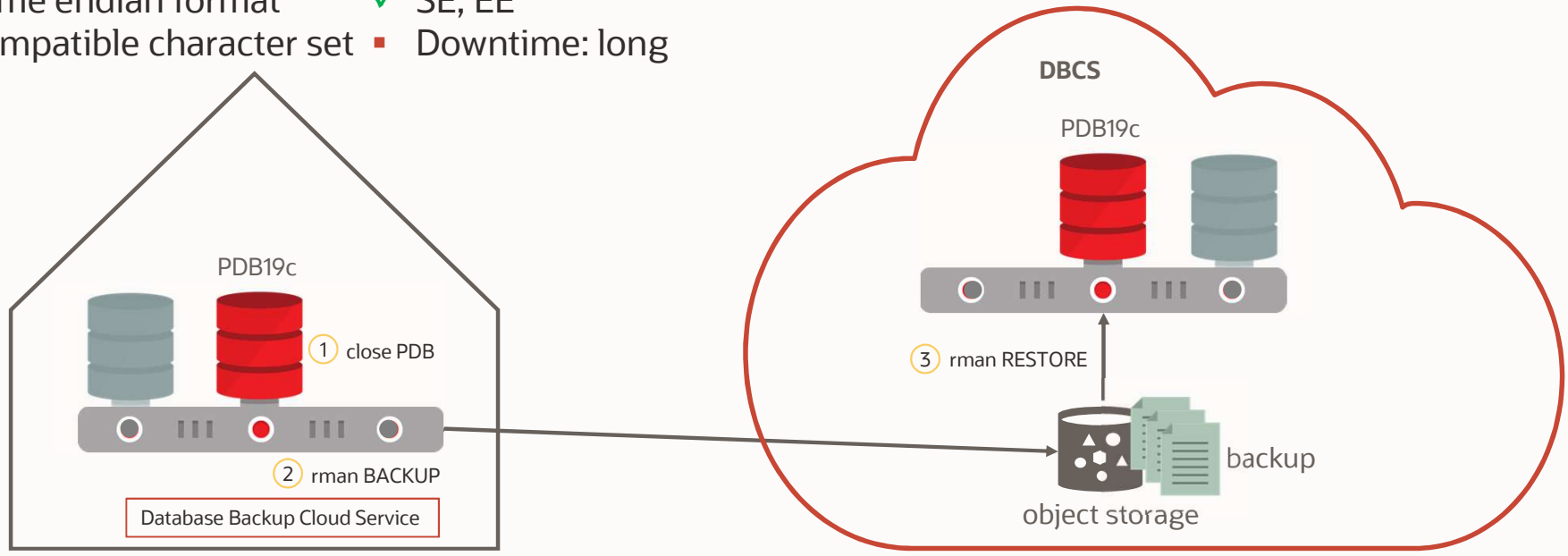


RMAN | Backup & Restore

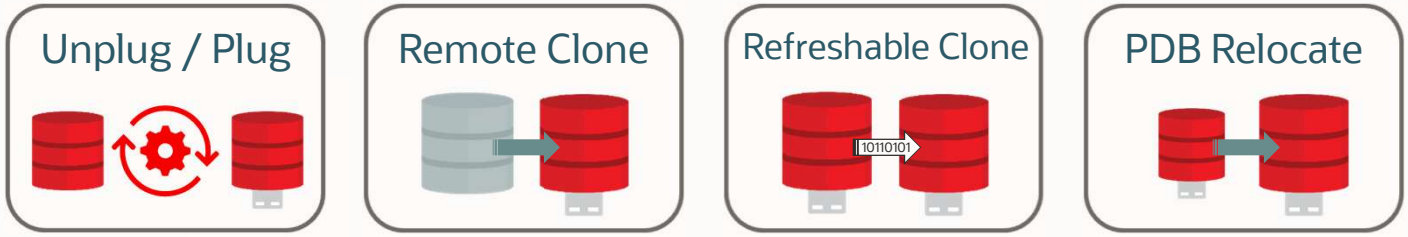
- Same version
- Same architecture
- Same endian format
- Compatible character set

✓ Physical
- Offline

✓ SE, EE
- Downtime: long

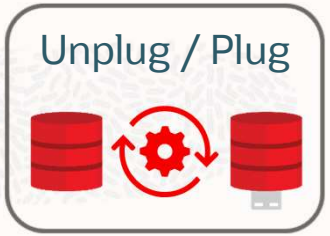


Mulitetenant Architecture

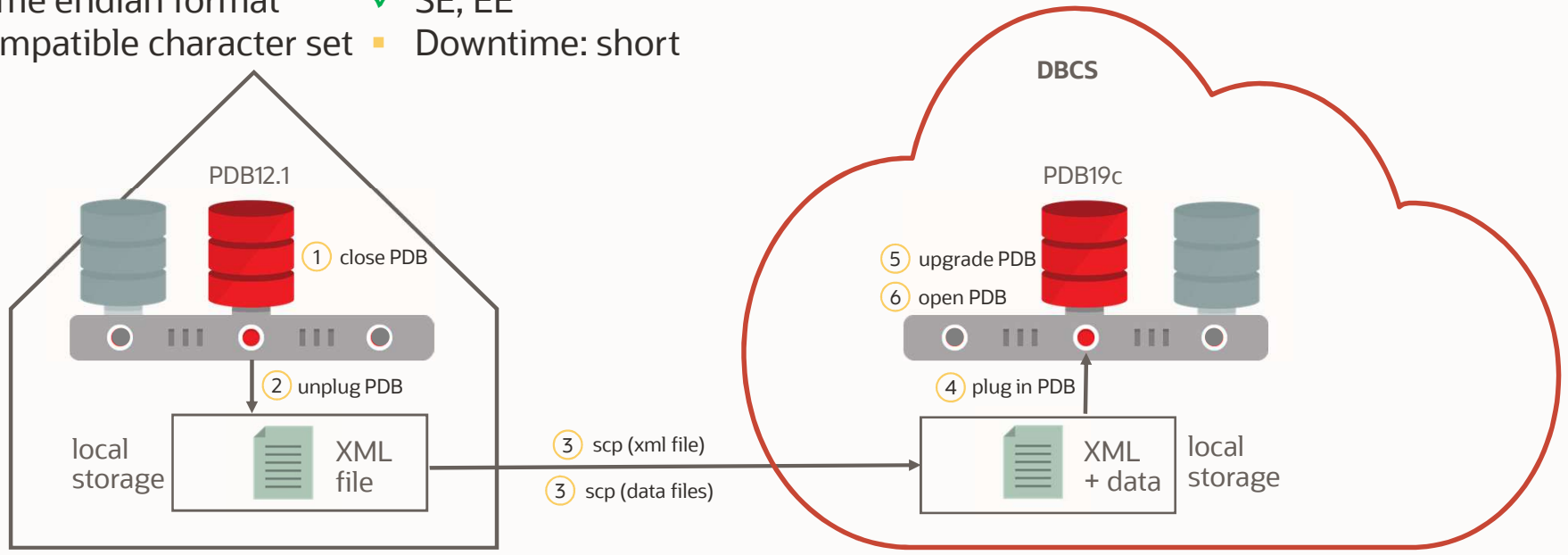


14. Unplug & Plug
15. Remote Cloning
16. Remote Hot Cloning
17. PDB Refreshable Clone
18. PDB Relocate

14. Unplug & Plug | PDB

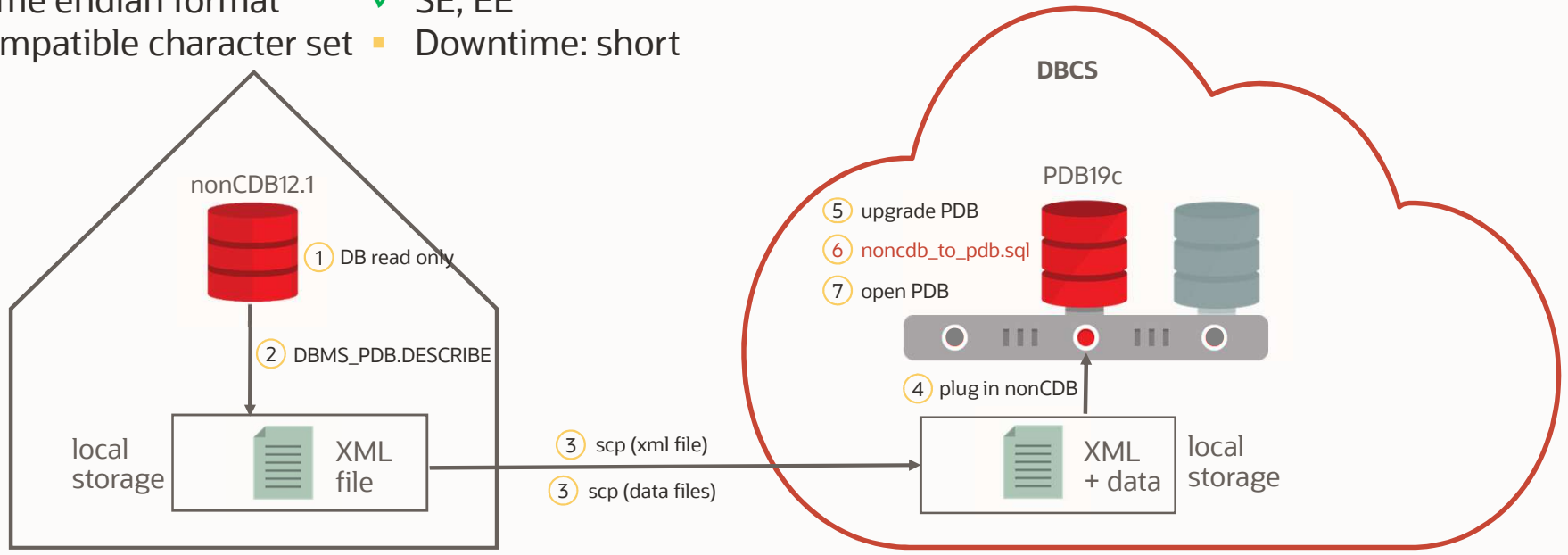


- ✓ Different version >= 12.1
- ▪ Same architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: short

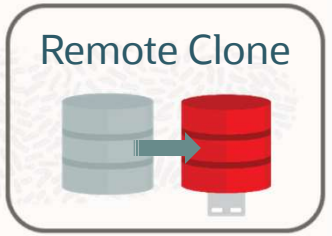


Unplug & Plug | non-CDB

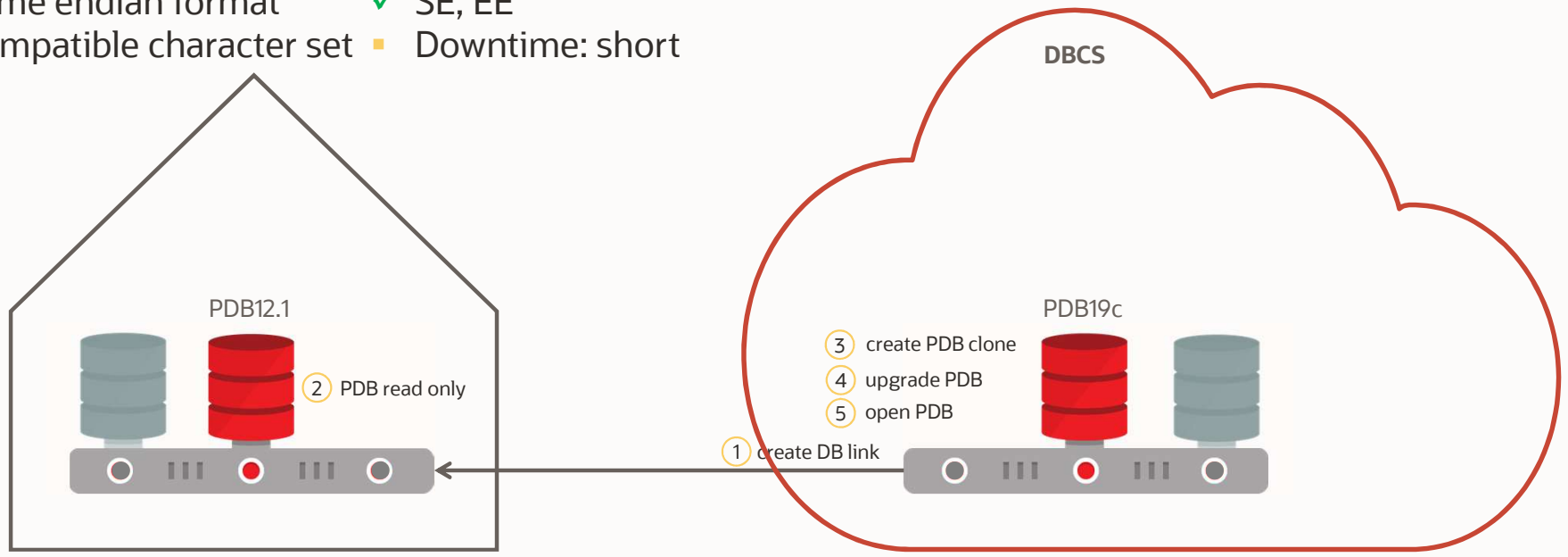
- ✓ Different version >= 12.1
- ✓ Different architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: short



15. Remote Cloning | PDB

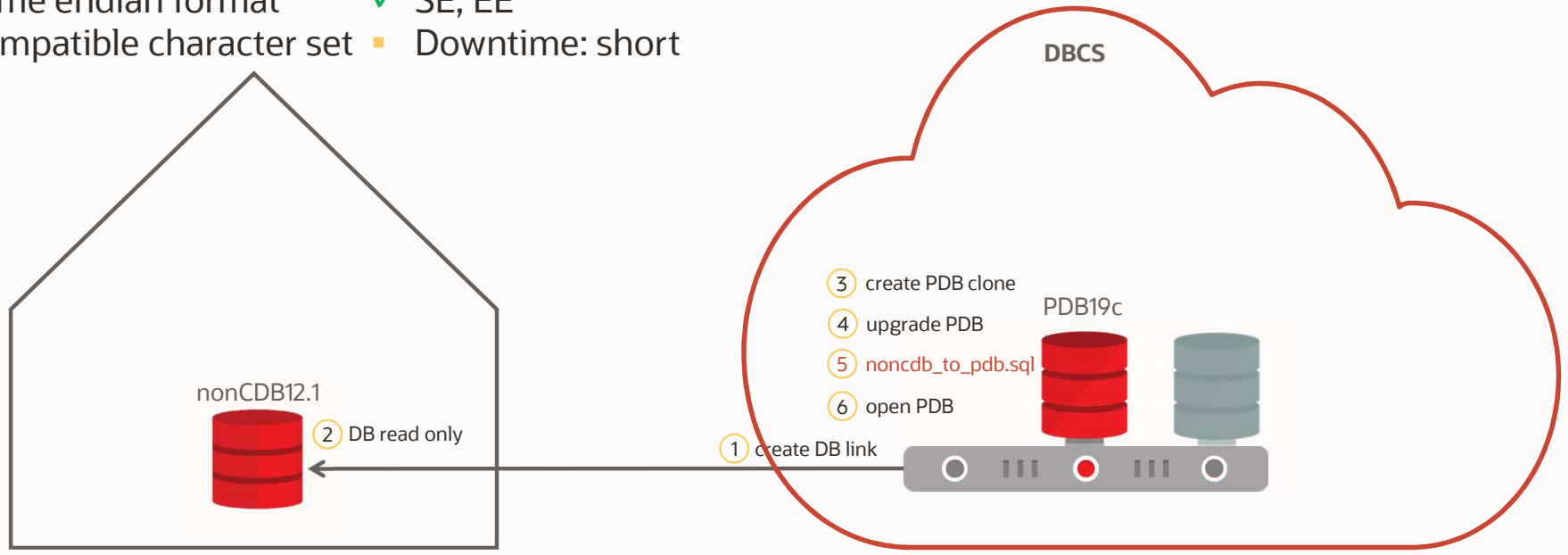


- ✓ Different version >= 12.1
- Same architecture
- Same endian format
- Compatible character set
- ✓ Physical
- Offline
- ✓ SE, EE
- Downtime: short

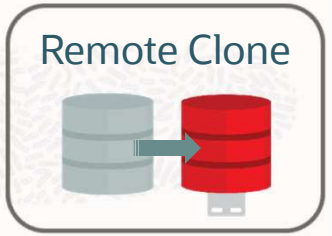


Remote Cloning | non-CDB

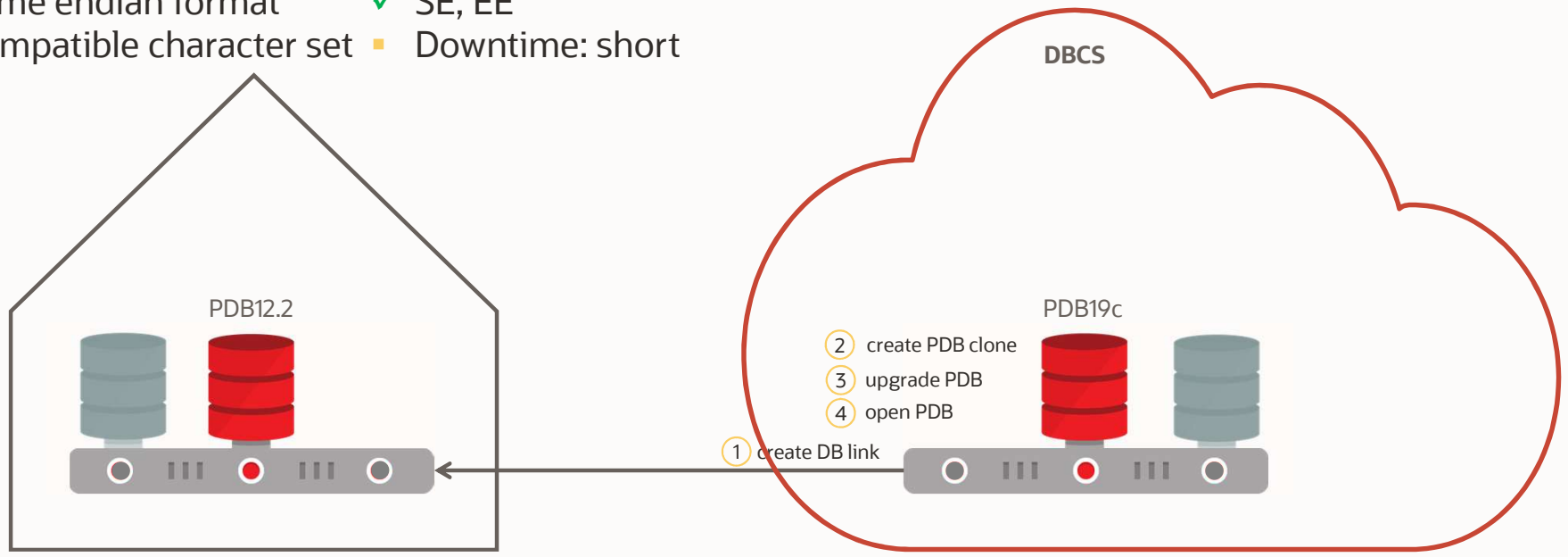
- ✓ Different version >= 12.1
- ✓ Different architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ▪ Offline
- ✓ SE, EE
- ▪ Downtime: short



16. Remote Hot Cloning | PDB

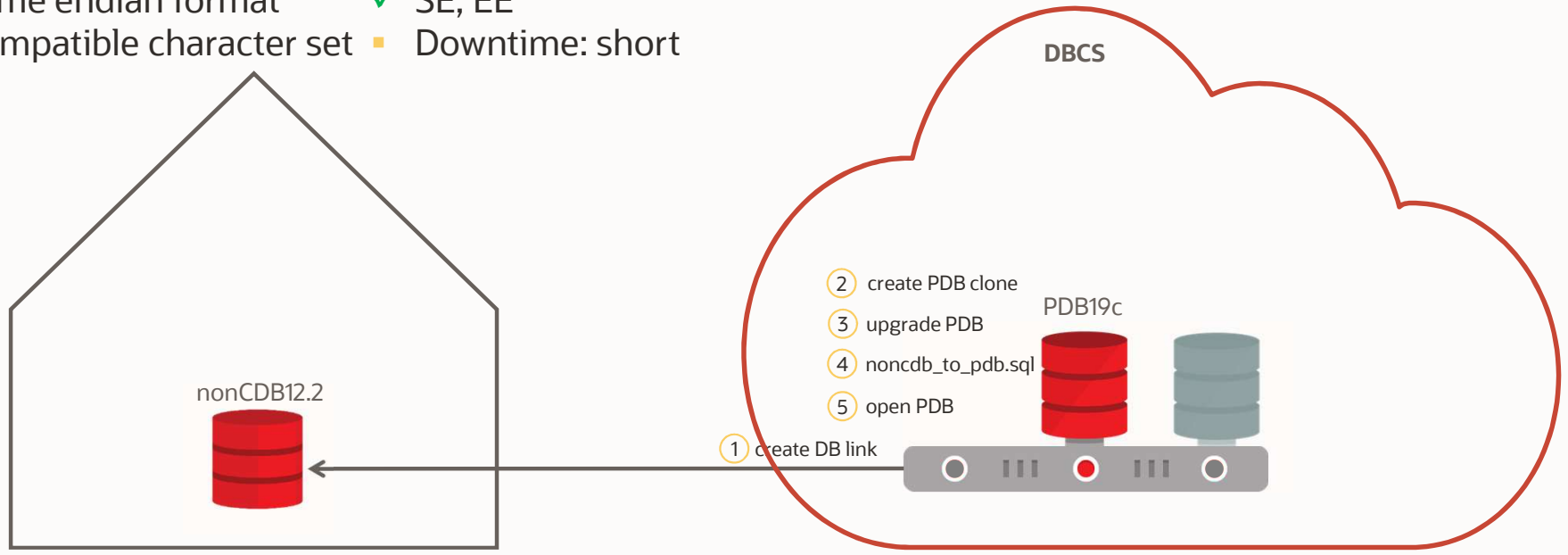


- ✓ Different version >= 12.2
- ▪ Same architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ✓ Online
- ✓ SE, EE
- ▪ Downtime: short



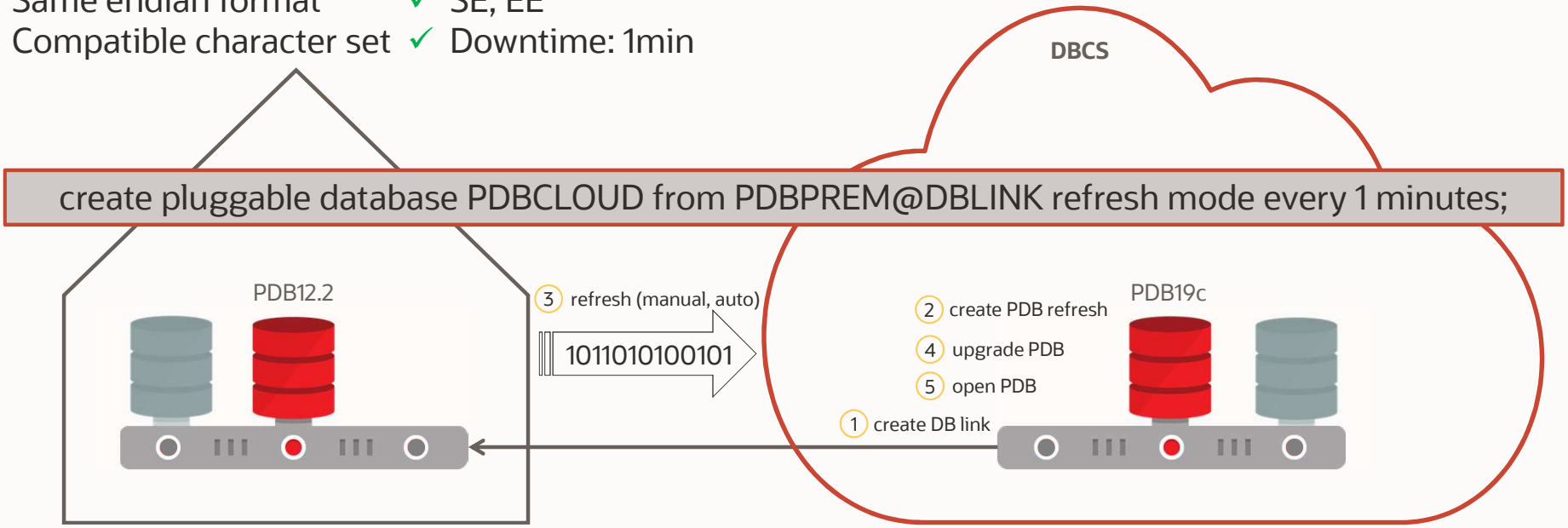
Remote Hot Cloning | non-CDB

- ✓ Different version >= 12.2
- ✓ Different architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ✓ Online
- ✓ SE, EE
- ▪ Downtime: short

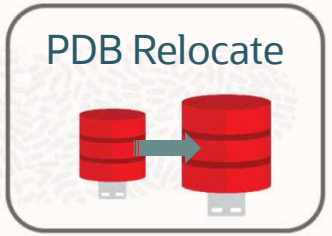


17. PDB Refreshable Clone

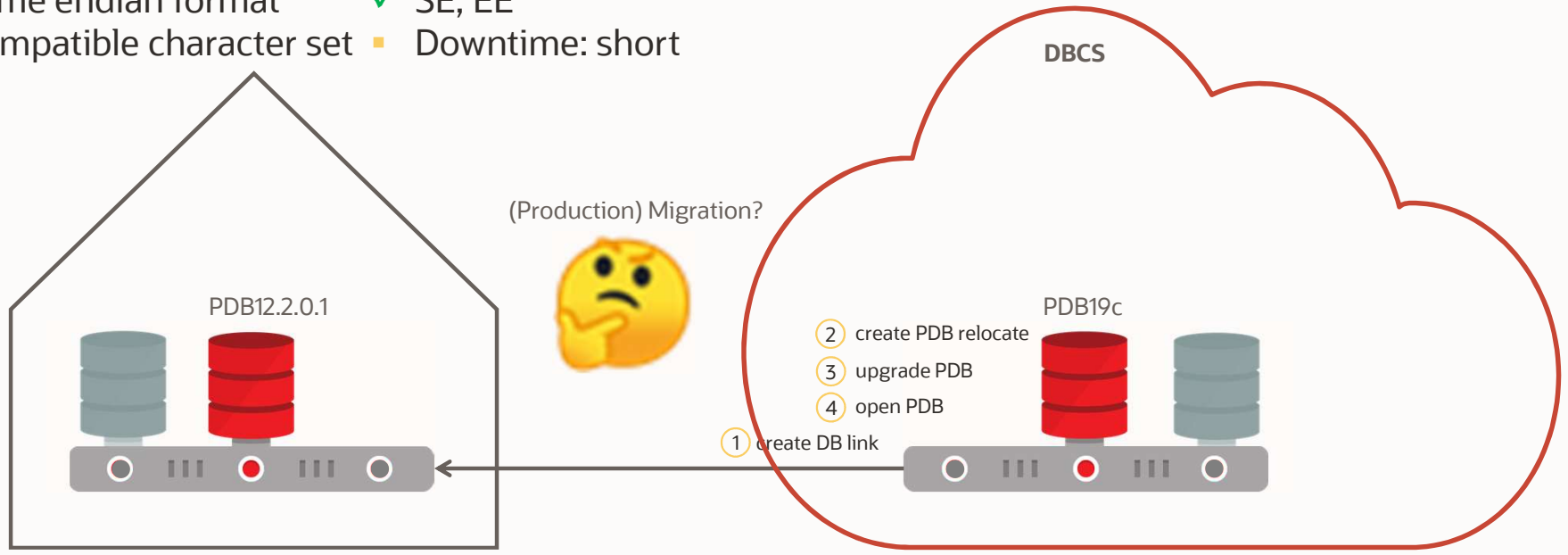
- ✓ Different version >= 12.2
- ▪ Same architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ✓ Online
- ✓ SE, EE
- ✓ Downtime: 1min



18. PDB Relocate



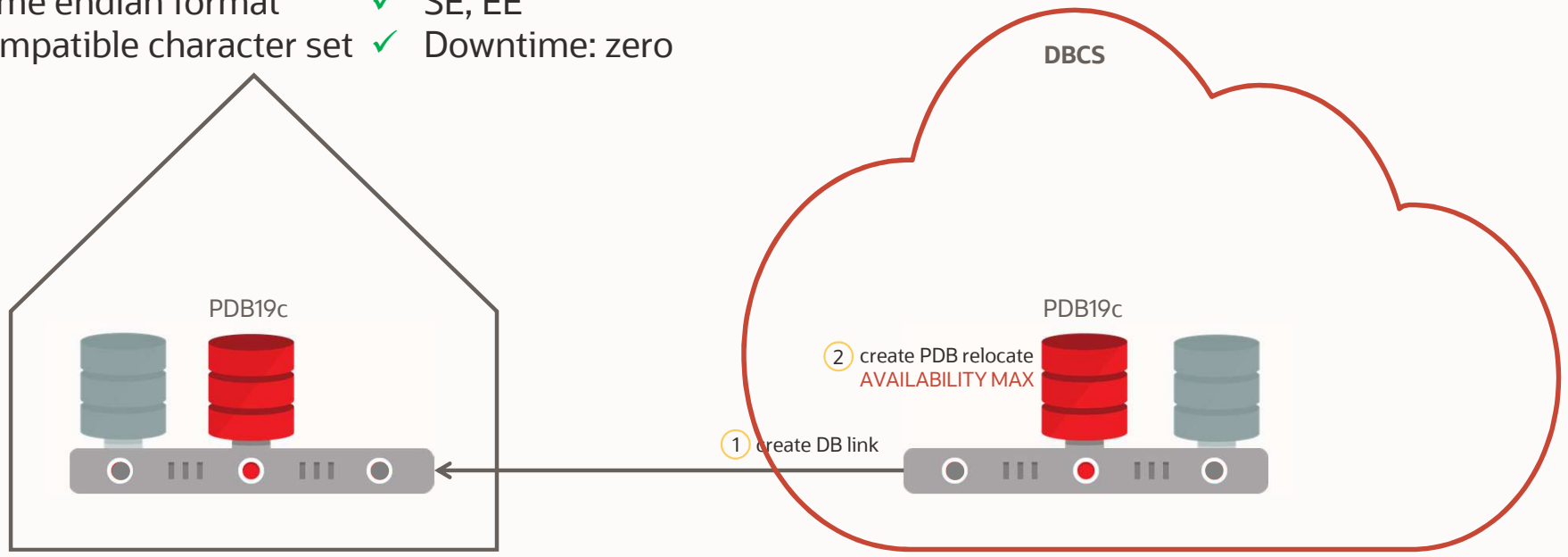
- ✓ Different version >= 12.2
- ▪ Same architecture
- ▪ Same endian format
- ▪ Compatible character set
- ✓ Physical
- ✓ Online
- ✓ SE, EE
- ▪ Downtime: short



PDB Relocate | AVAILABILITY MAX

- Same version >= 12.2
- Same architecture
- Same endian format
- Compatible character set

✓ Physical
✓ Online
✓ SE, EE
✓ Downtime: zero



Further Methods

Further Methods

- ✓ Different version
- ✓ Different architecture
- ✓ Different endian format
- ✓ Different character set
- ✓ Logical
- ✓ Online
- ✓ SE, EE
- ✓ Downtime: min/hrs
- ✓ Small amount of data
- ✓ Limited number of objects
- ✓ Flat files

19. SQL Developer Database Copy Utility

20. SQL Developer Cart Utility

21. SQL Developer Drag and Drop Option

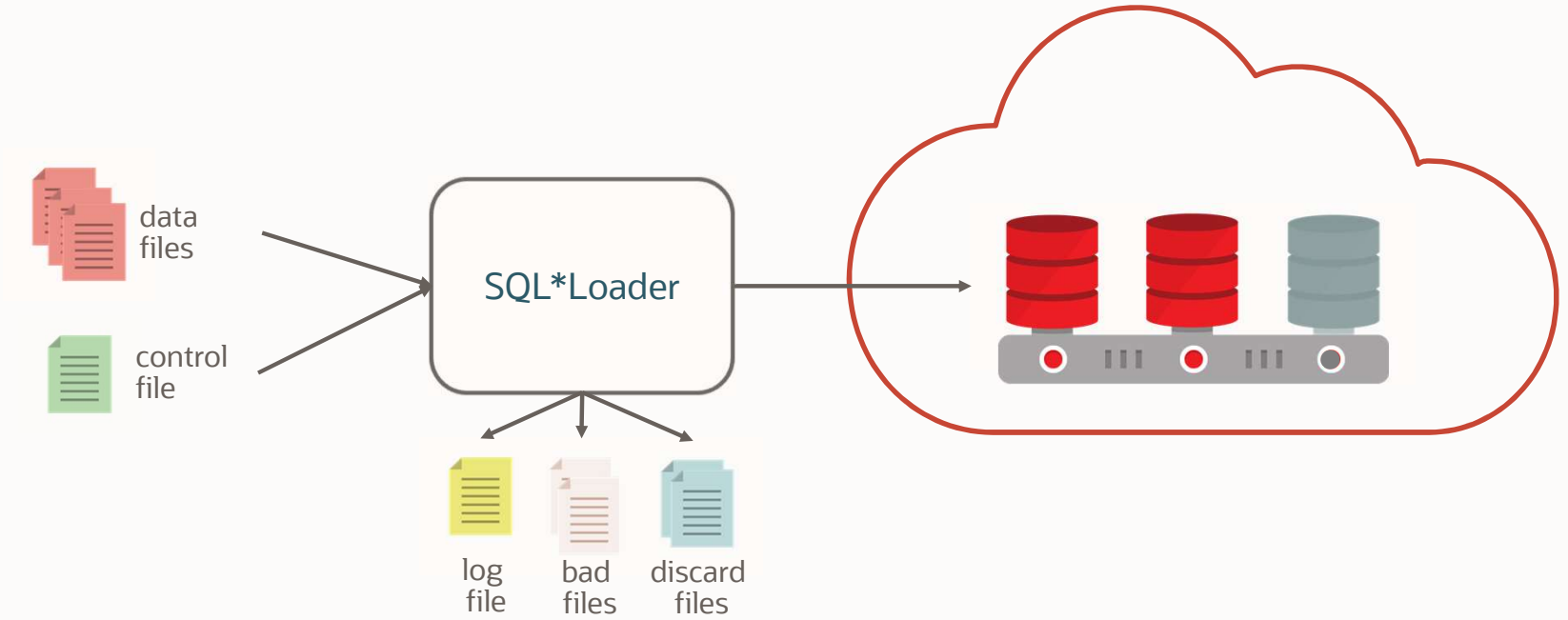
22. SQL Developer Export and Import Wizard

23. SQL*Loader

24. DBMS_CLOUD COPY_DATA & CREATE_EXTERNAL_TABLE - Autonomous

25. DB Link & Create Table As Statement (CTAS)

SQL*Loader



Agenda

1 Oracle Database in Oracle Cloud

2 Considerations for Cloud Migration

3 Automation Tools

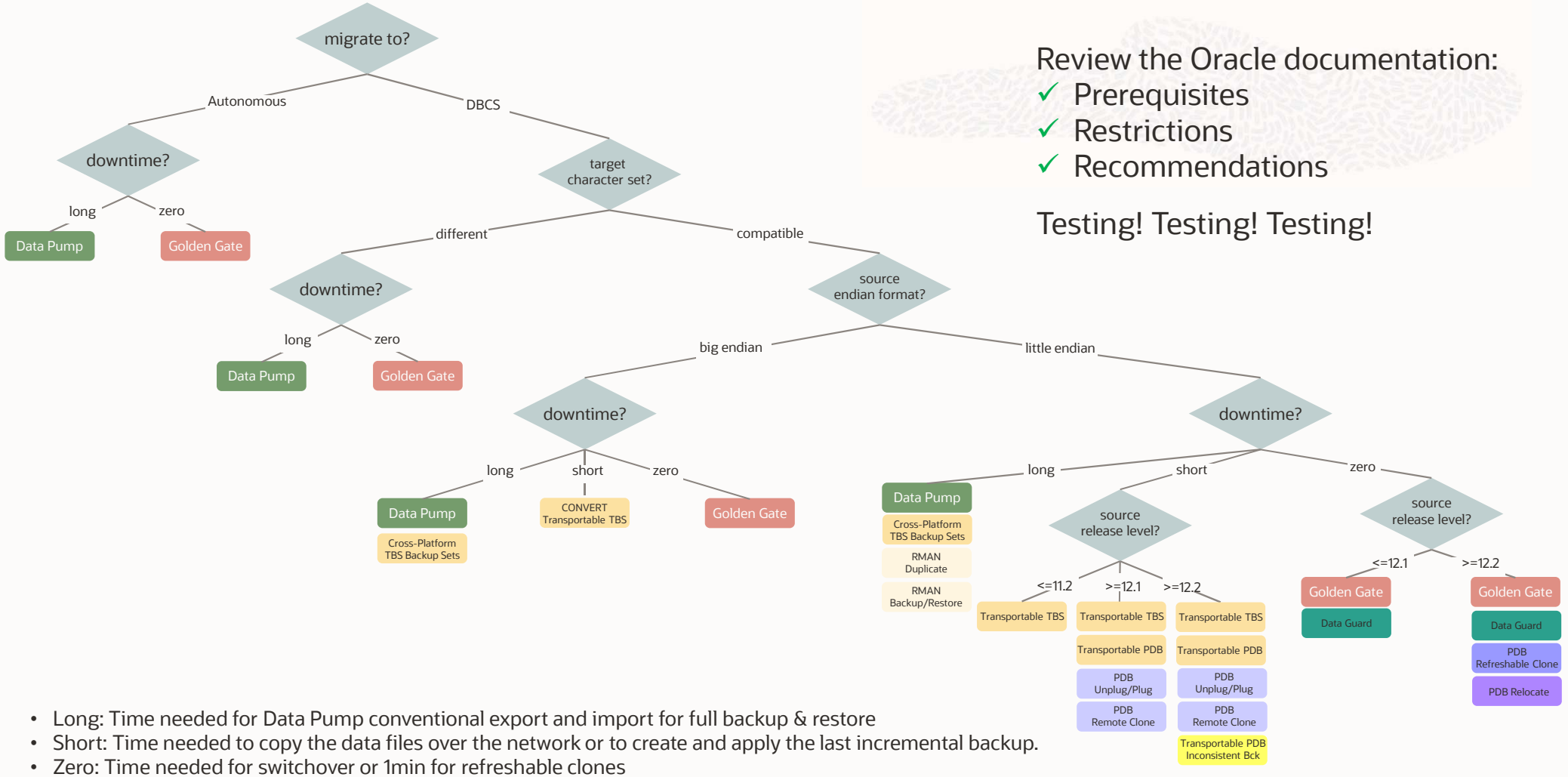
4 Migration Methods

5 Decision Tree for Migration Methods

Summary

category	migration_method	version	architecture	endian_format	character_set	data_transfer	source_availability	edition	downtime	min_version
MAA	Data Guard	same	same	same	compatible	physical	online	EE	zero	9i
MAA	GoldenGate	different	different	different	different	logical	online	SE,EE	zero	8i
DataPump	Data Pump - Conventional Export/Import	different	different	different	different	logical	online	SE,EE	long	10.2
DataPump	Data Pump - Transportable Tablespace	different	different	same	compatible	physical	offline	SE,EE	short	10.2
DataPump	Data Pump - Full Transportable	different	different	same	compatible	physical	offline	SE,EE	short	10.2
DataPump	Data Pump - Convert Full Transportable	different	different	different	compatible	physical	offline	SE,EE	short	10.2
RMAN	RMAN - Transportable Tablespace with Data Pump	different	different	same	compatible	physical	online	SE,EE	short	10.2
RMAN	RMAN - Convert Transportable Tablespace with Data Pump	different	different	different	compatible	physical	offline	SE,EE	short	10.2
RMAN	RMAN - Cross-Platform Transportable Tablespace Backup Sets	different	different	different	compatible	physical	offline	SE,EE	long	10.2
RMAN	RMAN - Cross-Platform Transportable PDB	different	same	same	compatible	physical	offline	SE,EE	long	12.1
RMAN	RMAN - Cross-Platform Transportable PDB Inconsistent Backups	different	same	same	compatible	physical	offline	SE,EE	(very) short*	12.2
RMAN	RMAN - Duplicate from an Active Database	same	same	same	compatible	physical	online	SE,EE	long	10.2
RMAN	RMAN - Backup & Restore	same	same	same	compatible	physical	online	SE,EE	long	8i
Multitenant	PDB Unplug & Plug	different	same	same	compatible	physical	offline	SE,EE	short	12.1
Multitenant	PDB Remote Cloning	different	same	same	compatible	physical	offline	SE,EE	short	12.1
Multitenant	PDB Remote Hot Cloning	different	same	same	compatible	physical	online	SE,EE	short	12.2
Multitenant	PDB Refreshable Clone	different	same	same	compatible	physical	online	SE,EE	1min	12.2
Multitenant	PDB Relocate	different	same	same	compatible	physical	online	SE,EE	short	12.2
Multitenant	PDB Relocate - AVAILABILITY MAX	same	same	same	compatible	physical	online	SE,EE	zero	12.2

*faster than Unplug/Plug or Remote Cloning for larg databases



Review the Oracle documentation:

- ✓ Prerequisites
- ✓ Restrictions
- ✓ Recommendations

Testing! Testing! Testing!

- Long: Time needed for Data Pump conventional export and import for full backup & restore
- Short: Time needed to copy the data files over the network or to create and apply the last incremental backup.
- Zero: Time needed for switchover or 1min for refreshable clones

10 Series Blog

https://database-heartbeat.com/category/database-migration/

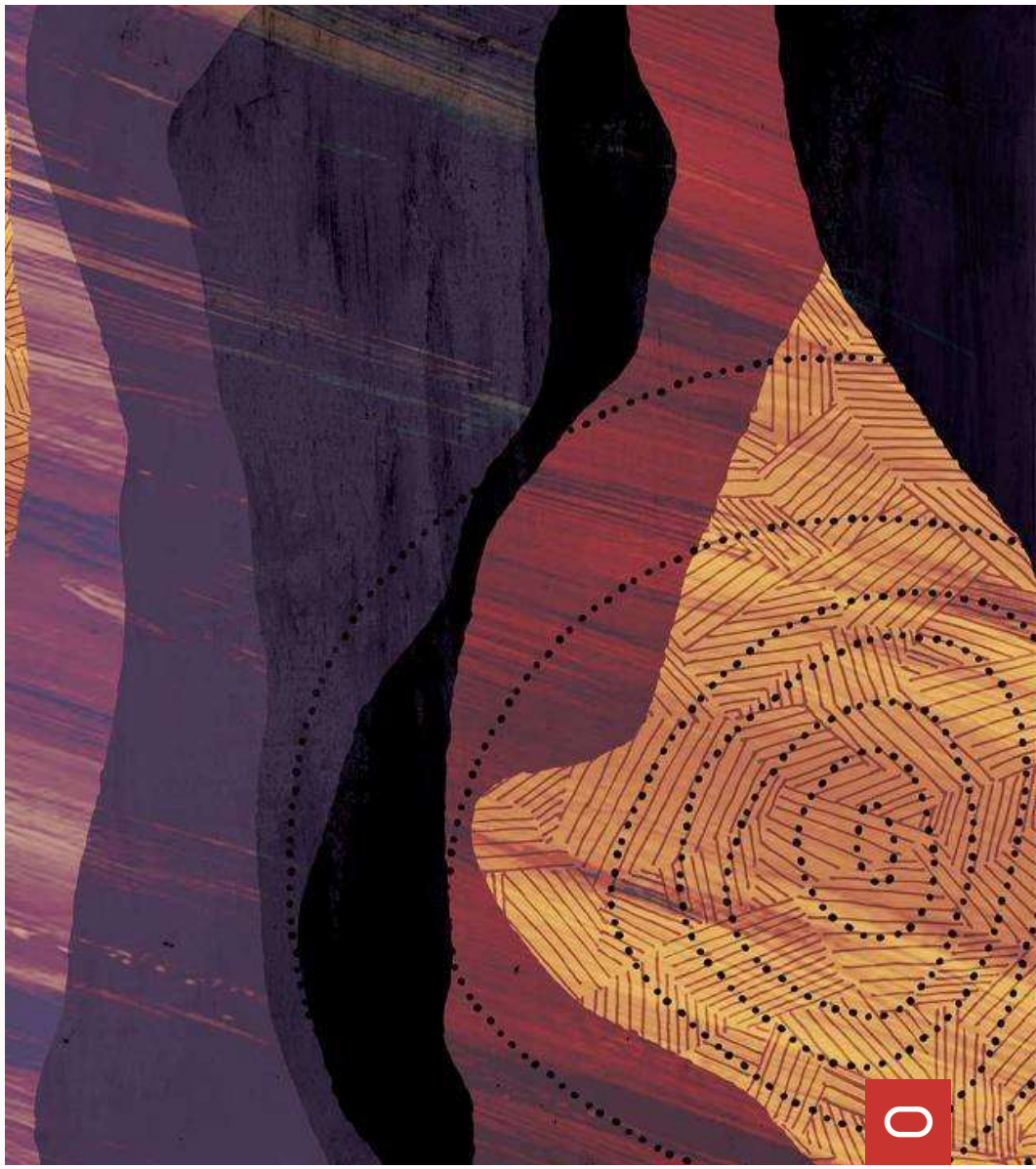
Part 1/10: Why to Migrate your Oracle Database to Oracle Cloud?
Part 2/10: Introduction to Oracle Database Cloud Services
Part 3/10: Oracle Database Migration Considerations
Part 4/10: Automation Tools and Maximum Availability Architecture Migration Methods
Part 5/10: Migration Methods using Data Pump
Part 6/10: Migration Methods using RMAN
Part 7/10: Migration Methods using Multitenant Architecture
Part 8/10: Migration Tools and Methods for Small Amount of Data
Part 9/10: Migrating Oracle Databases from AWS to Oracle Cloud
Part 10/10: Summary and a Migration Decision Tree

Further Reading

- Move to the Oracle Cloud
  - oracle.com/goto/move
- Cloud Migration Advisor
  - https://www.oracle.com/webfolder/s/assets/webtool/cloud-migration-advisor/index.html
- Oracle Architecture Center
  - https://docs.oracle.com/en/solutions/
- Oracle Database Cloud Migration Methods
  - https://www.oracle.com/database/technologies/cloud-migration.html#migration-methods
- Migrating Databases to the Cloud
  - https://docs.cloud.oracle.com/en-us/iaas/Content/Database/Tasks/migrating.htm
- Oracle Zero Downtime Migration
  - https://www.oracle.com/database/technologies/rac/zdm.html
  - https://dohdatabase.com/2020/07/06/zdm/

Thank you

Sinan Petrus Toma




ORACLE

Our mission is to help people see data in new ways, discover insights, unlock endless possibilities.