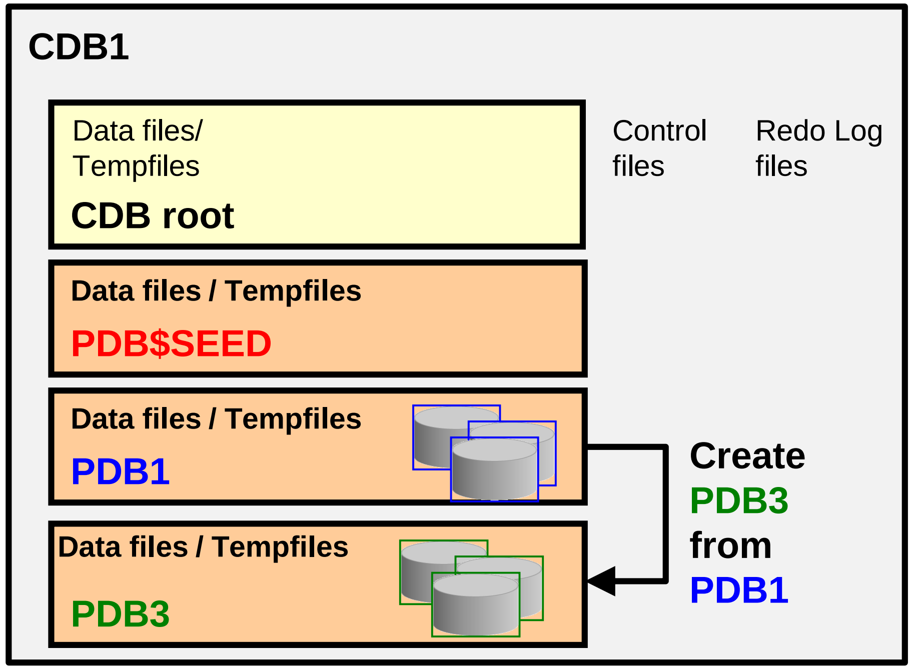
PDB Creation

Objectives

- After completing this lesson, you should be able to:
  - Clone a regular PDB
  - Clone an application container
  - Unplug and plug or clone a non-CDB
  - Unplug and plug a regular PDB
  - Unplug and plug an application container
  - Convert regular PDBs to application PDBs
  - Configure and use the local UNDO mode
  - Perform hot cloning
  - Perform near-zero downtime PDB relocation
  - Create and use a proxy PDB
  - Drop PDBs

Cloning Regular PDBs



1. Define how Oracle will find the location of the data files:
   - In init.ora, set `DB_CREATE_FILE_DEST= 'PDB3dir'`
   - In init.ora, set `PDB_FILE_NAME_CONVERT='PDB1dir', 'PDB3dir'`
   - Using the `CREATE_FILE_DEST= 'PDB3dir'` clause
2. Connect to the CDB root to close **`PDB1`**.
3. Clone **`PDB3`** from **`PDB1`**.

```
SQL> CREATE PLUGGABLE DATABASE pdb3 FROM pdb1
          CREATE_FILE_DEST = 'PDB3dir';
```

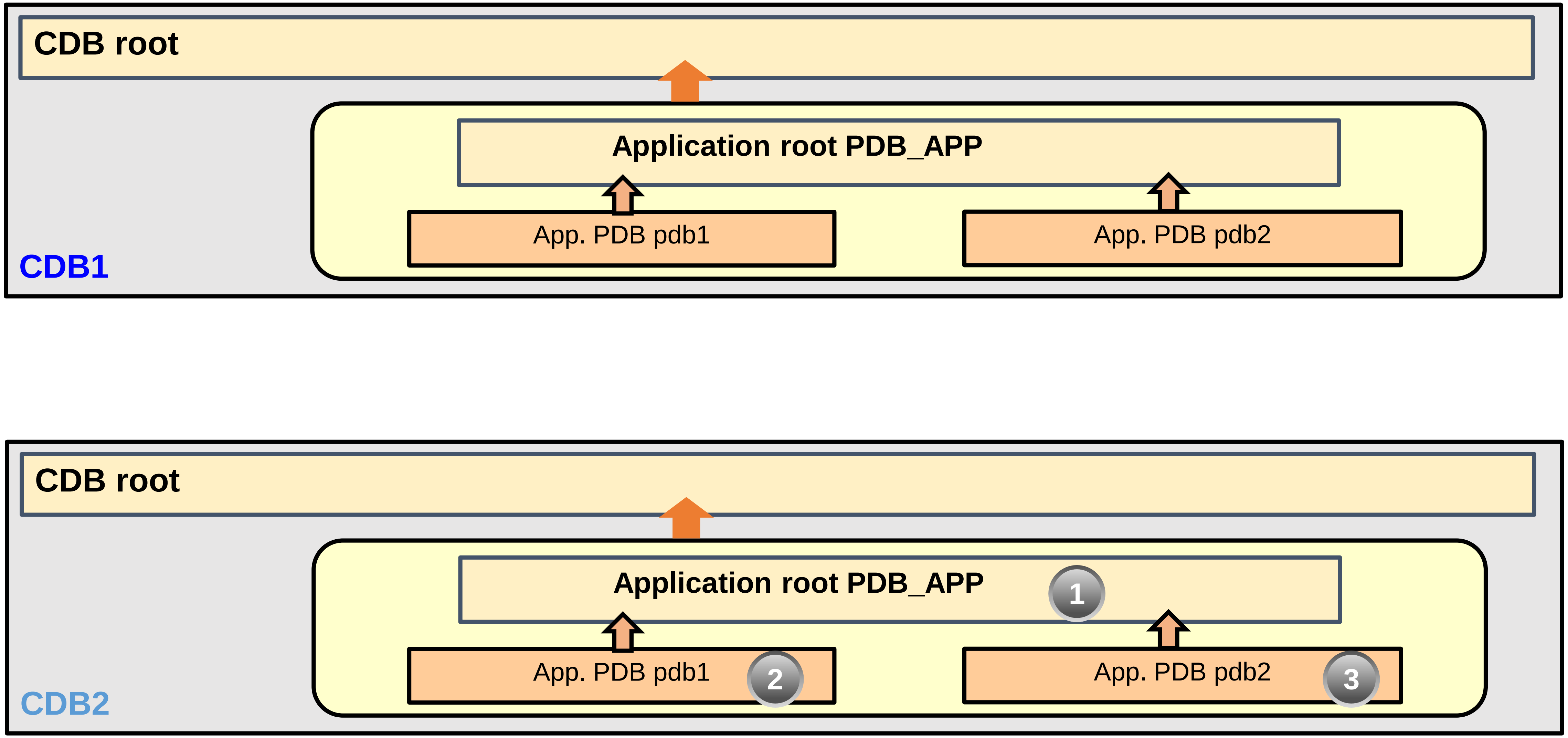
4. Open PDB3 in read write mode.

```
SQL> ALTER PLUGGABLE DATABASE pdb3 OPEN;
```

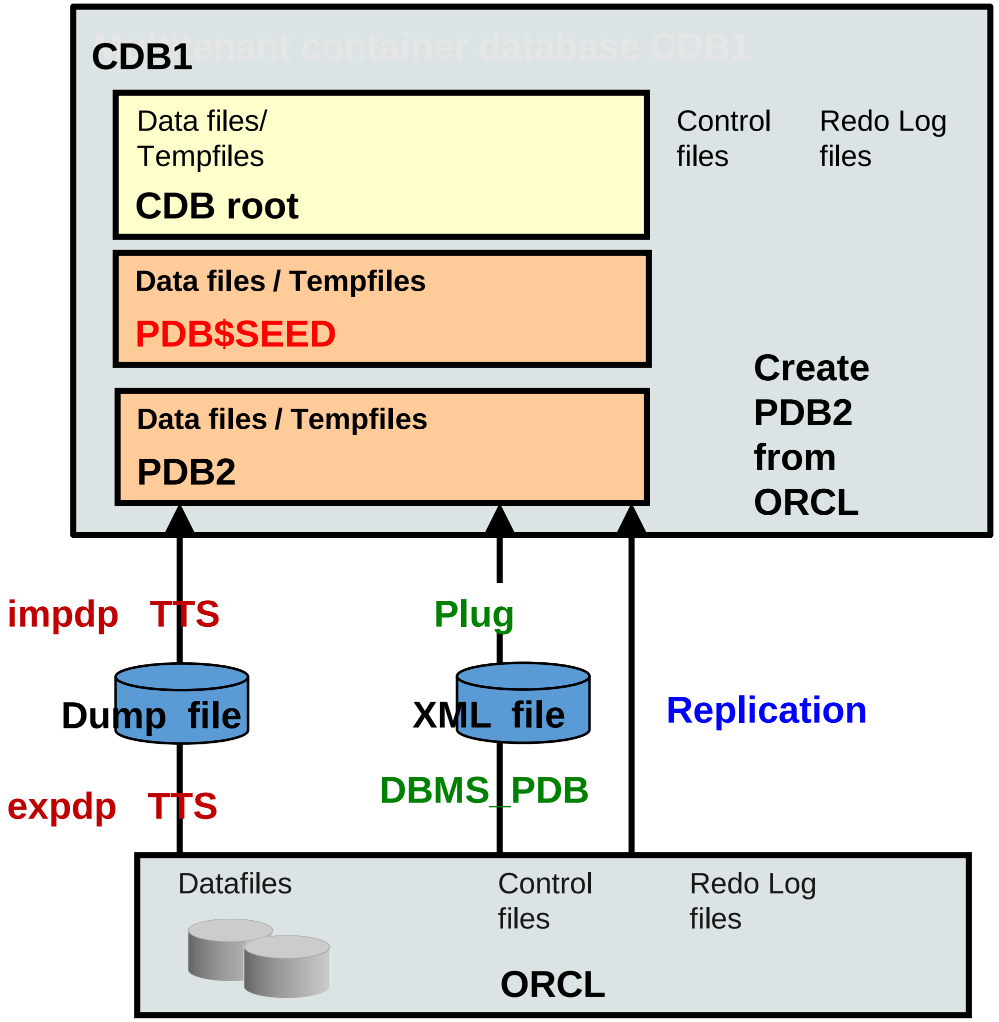
Note: Cloning metadata only with `NO DATA`

`PDB3` owns:
- `SYSTEM`, `SYSAUX`, `UNDO` tablespaces
- Full catalog
- `SYS`, `SYSTEM` common users
- Same local administrator name
- New service name

Cloning Application Containers



Plugging a Non-CDB into CDB



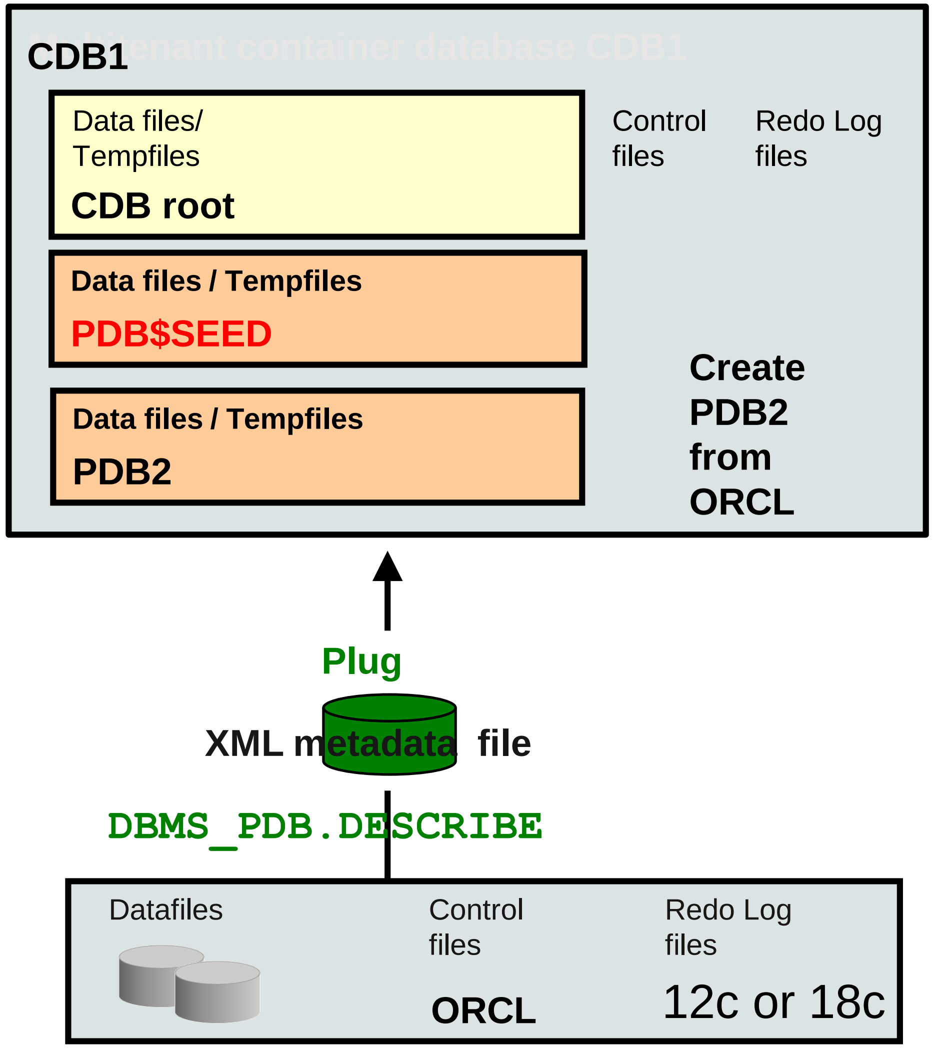
Possible methods:

- Data Pump (TTS or TDB or full export/import)
- Plugging (XML file definition with `DBMS_PDB`)
- Cloning
- Replication

Entities are created in the new PDB:

- Tablespaces: `SYSTEM`, `SYSAUX`, `UNDO`
- A full catalog
- Common users: `SYS`, `SYSTEM`
- A local administrator (PDBA)
- A new default service

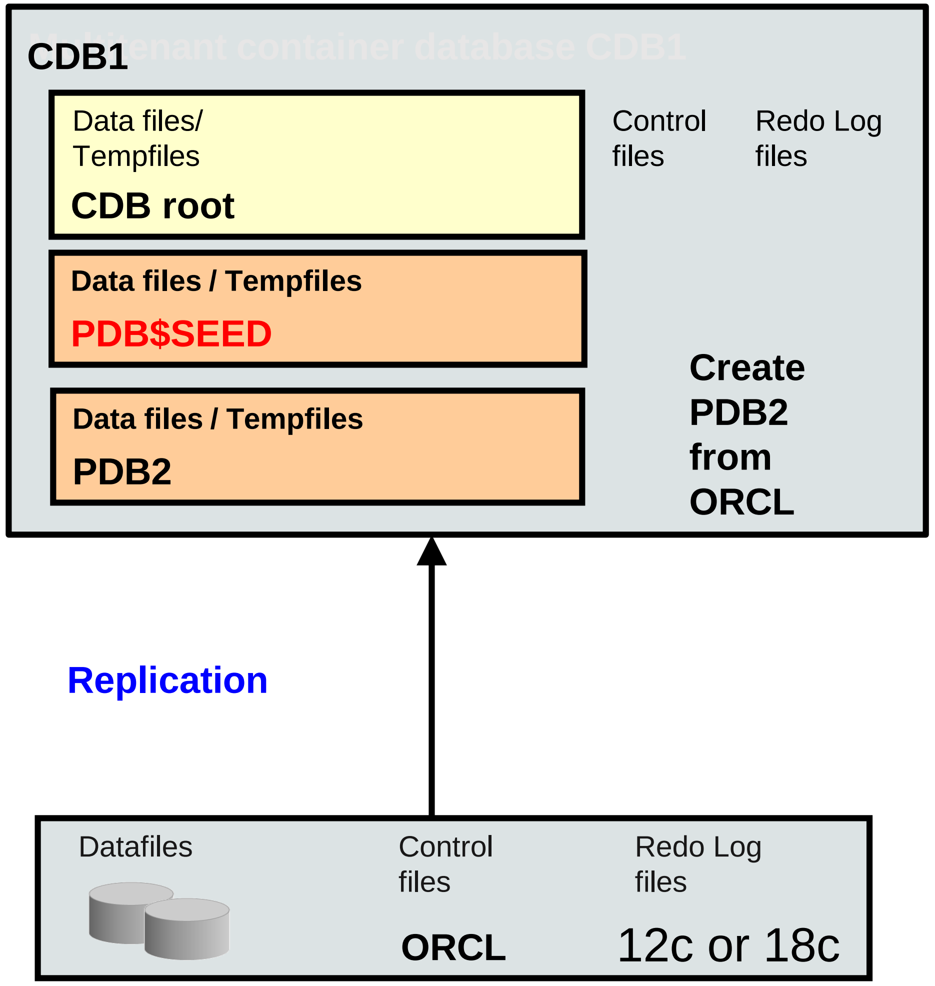
Plugging a Non-CDB into CDB Using DBMS_PDB



1. Open **ORCL** in READ ONLY mode.
2.
```
SQL> EXEC DBMS_PDB.DESCRIBE ('/tmp/ORCL.xml')
```
3. Connect to the target CDB root as a common user with `CREATE PLUGGABLE DATABASE` privilege.
4. Plug in the unplugged **ORCL** as **PDB2**.
```
SQL> CREATE PLUGGABLE DATABASE PDB2
          USING '/tmp/ORCL.xml';
```
5. Run the `noncdb_to_pdb.sql` script in **PDB2**.
```
SQL> CONNECT sys@PDB2 AS SYSDBA
SQL> @$ORACLE_HOME/rdbms/admin/noncdb_to_pdb
```
6. Open `PDB2`.

Note: The `STATUS` of the PDB is `CONVERTING`.

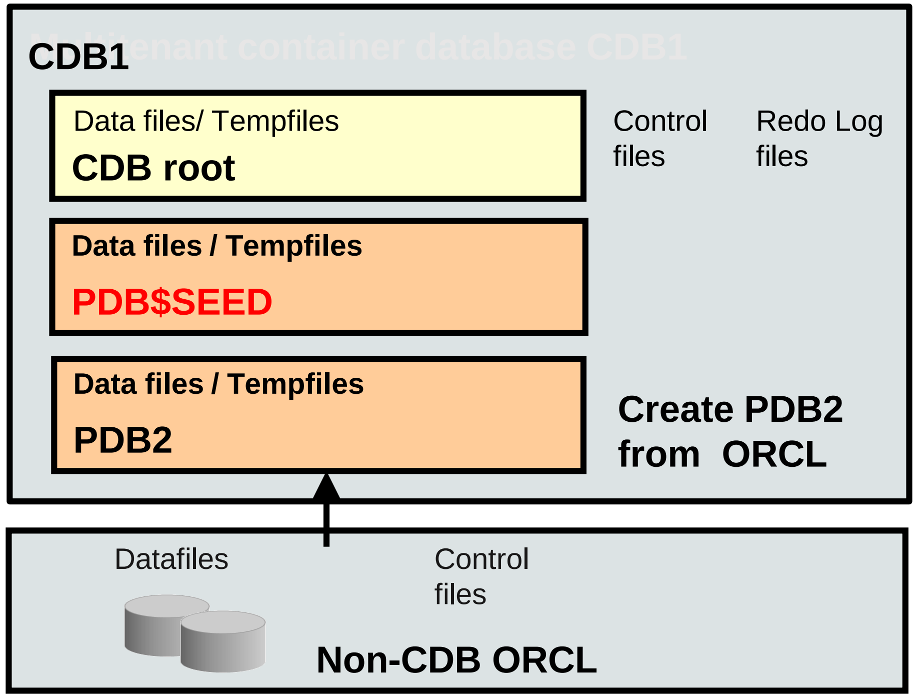
Replicating Non-CDB into CDB



1. Connect to the CDB root as a common user with `CREATE PLUGGABLE DATABASE` privilege.
2. Create new **`PDB2`** (from `PDB$SEED`).
3. Open **`PDB2`** in read write mode.
4. Configure unidirectional replication environment from **`ORCL`** to **`PDB2`**.
5. Check application data.

```
SQL> CONNECT sys@PDB2
SQL> SELECT * FROM dba_tables;
SQL> SELECT * FROM HR.EMP;
```

Cloning a Non-CDB or Remote PDB



PDB_ORCL owns:

- `SYSTEM`, `SYSAUX`, `UNDO` tablespaces
- Full catalog
- A temporary tablespace
- `SYS`, `SYSTEM` common users
- New service name

1. Set **ORCL** in READ ONLY mode.
2. Connect to the CDB to create the database link:

```
SQL> CREATE DATABASE LINK link_orcl
            CONNECT TO system IDENTIFIED BY ***
            USING 'orcl';
```

3. Clone the non-CDB:

```
SQL> CREATE PLUGGABLE DATABASE pdb_orcl
            FROM NON$CDB@link_orcl
            CREATE_FILE_DEST = '…/PDB_orcl';
```

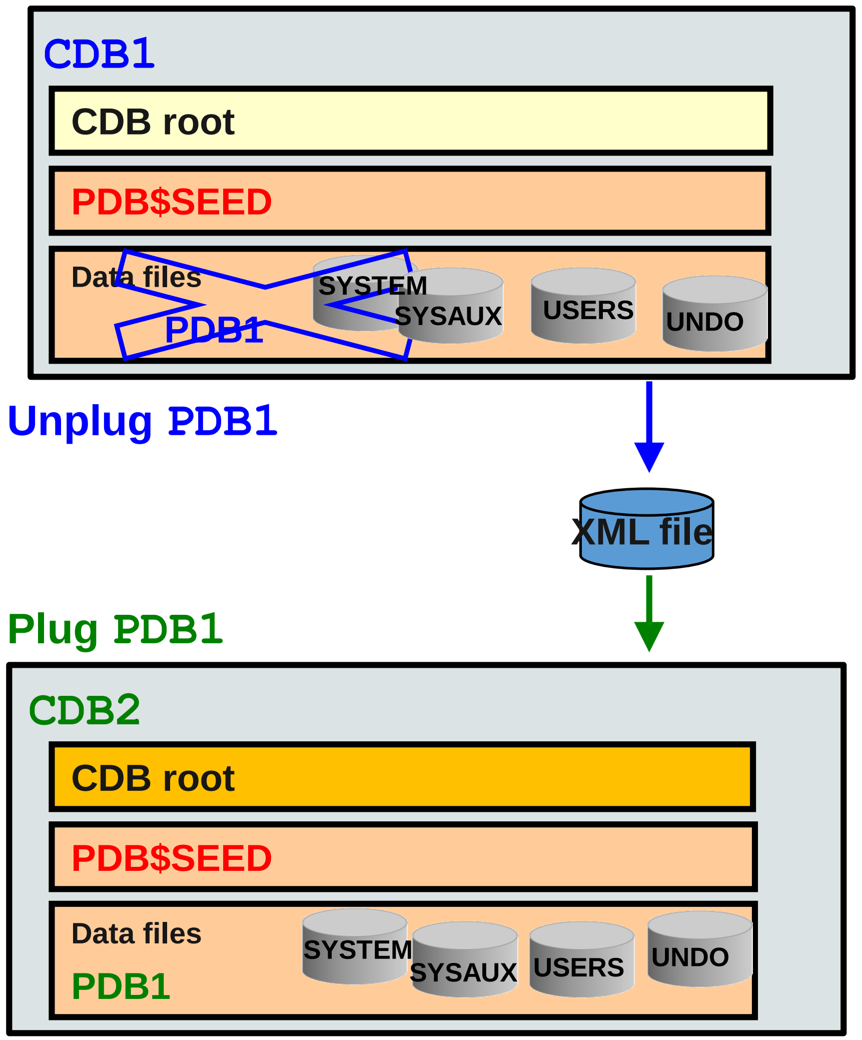
4. Run the `noncdb_to_pdb.sql` script.

```
SQL> CONNECT sys@pdb_orcl AS SYSDBA
SQL> @$ORACLE_HOME/rdbms/admin/noncdb_to_pdb
```

5. Open **PDB_ORCL** in read-write mode.

```
SQL> ALTER PLUGGABLE DATABASE pdb_orcl OPEN;
```

Plugging an Unplugged Regular PDB into CDB



Unplug **PDB1** from **CDB1**:

1. Connect to **CDB1** as a common user.
2. Verify that **PDB1** is closed.
3.
```
SQL> ALTER PLUGGABLE DATABASE pdb1
          UNPLUG INTO 'xmlfile1';
```
4. Drop **PDB1** from **CDB1**

Plug **PDB1** into **CDB2** :

1. Connect to **CDB2** as a common user.
2. Use the `DBMS_PDB` package to check the compatibility of **PDB1** with **CDB2**.
3.
```
SQL> CREATE PLUGGABLE DATABASE pdb1
          USING 'xmlfile1' NOCOPY;
```
4. Open **PDB1** in read write mode.

Flow

- Several clauses can be used in conjunction:

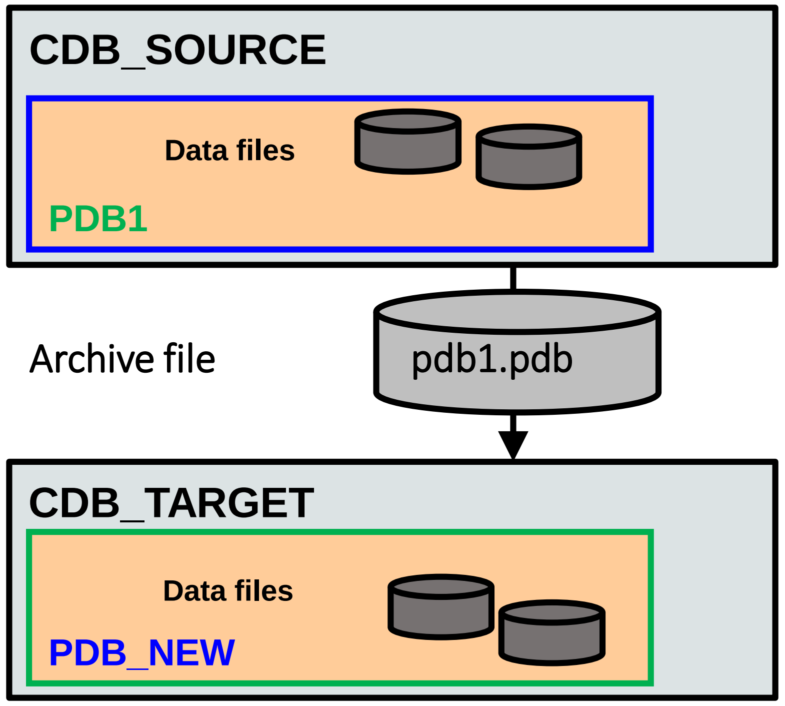
Are new PDB files based on same files that were used to create existing PDB in CDB?	If not, `AS CLONE` clause is required, and so it ensures that Oracle Database generates unique PDB DBID, GUID, and other identifiers expected for the new PDB.
Does XML file accurately describe current locations of files?	If not, the `SOURCE_FILE_NAME_CONVERT` clause is required.
Are files are in correct location?	If not, specify `COPY` to copy files to new location or `MOVE` to move them to another location. If yes, use `NOCOPY`. `COPY` is the default.
	• `FILE_NAME_CONVERT` clause of `CREATE PLUGGABLE DATABASE` statement • OMF: `DB_CREATE_FILE_DEST` parameter • `PDB_FILE_NAME_CONVERT` parameter
Do you want to specify storage limits for PDB?	If yes, specify the `STORAGE` clause.

Plugging Using Archive File

1.Unplugging a PDB into a single archive file includes:

- XML file
- Data files

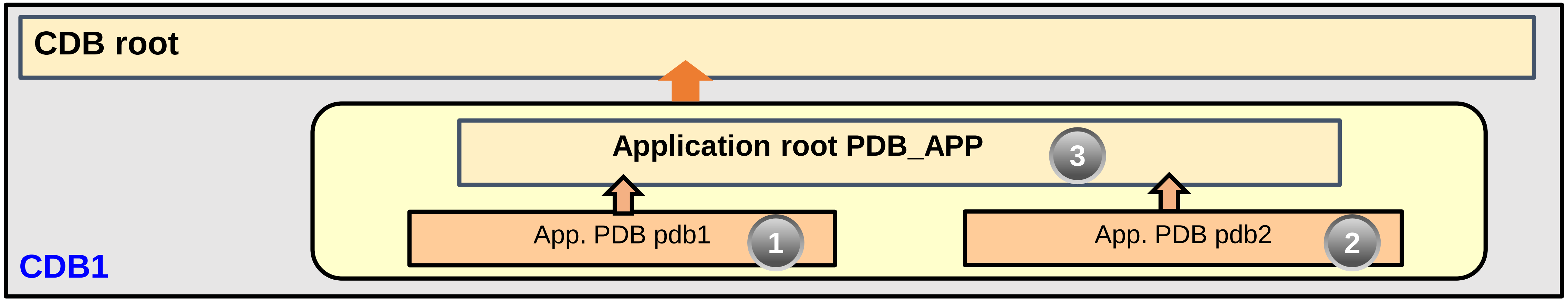
2.Plugging the PDB requires only the archive file.



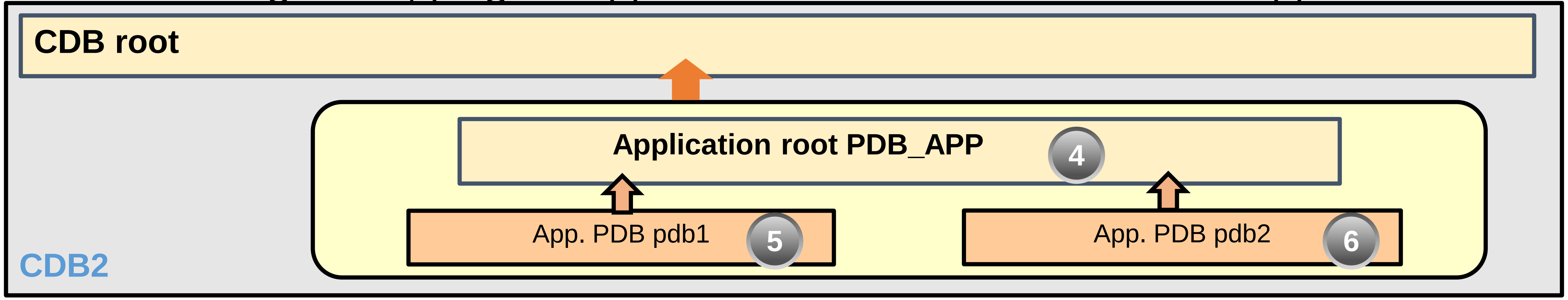
```
SQL> ALTER PLUGGABLE DATABASE pdb1
        UNPLUG INTO '/tmp/pdb1.pdb';
```

```
SQL> CREATE PLUGGABLE DATABASE pdb_new
        USING '/tmp/pdb1.pdb';
```

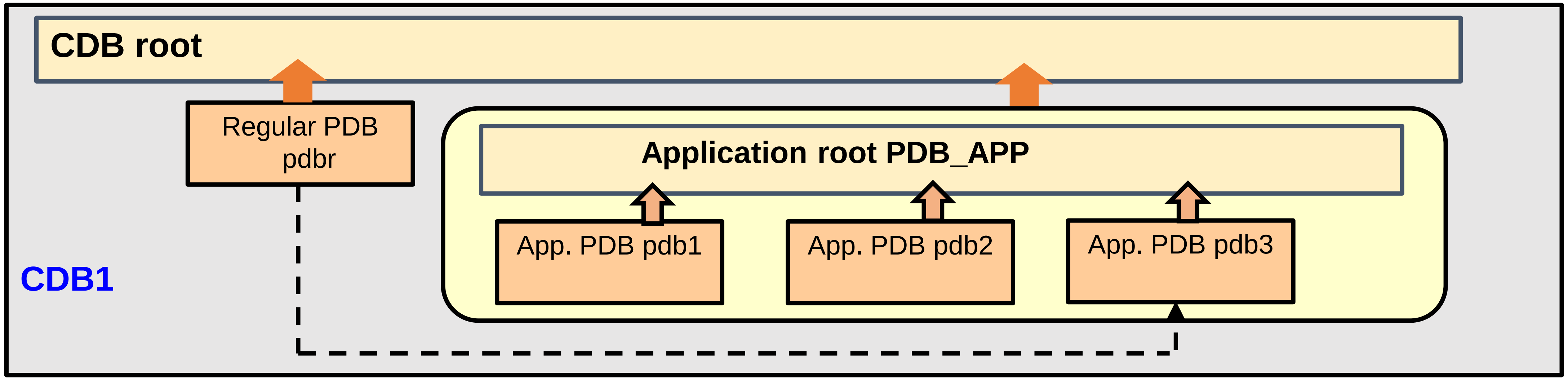
Unplugging and Plugging Application PDBs



1. In the source CDB, unplug all application PDBs and then the application root.
2. In the target CDB, plug the application root first and then all the application PDBs.



Converting Regular PDBs to Application PDBs



- Two methods to convert the regular PDB to an application PDB:
  - Clone the regular PDB into an application root.
  - Unplug the regular PDB to plug it into an application root.
- Connect to the application PDB to execute the `pdb_to_apppdb.sql` script.
- Synchronize the application PDB with the application root.

Unplugging and Plugging a PDB with Encrypted Data

1. Unplugging an encrypted PDB exports the master encryption key of the PDB.

```
SQL> ALTER PLUGGABLE DATABASE pdb1
          UNPLUG INTO '/tmp/pdb1.xml'
           ENCRYPT USING "tpwd1";
```

PDB wallet opened

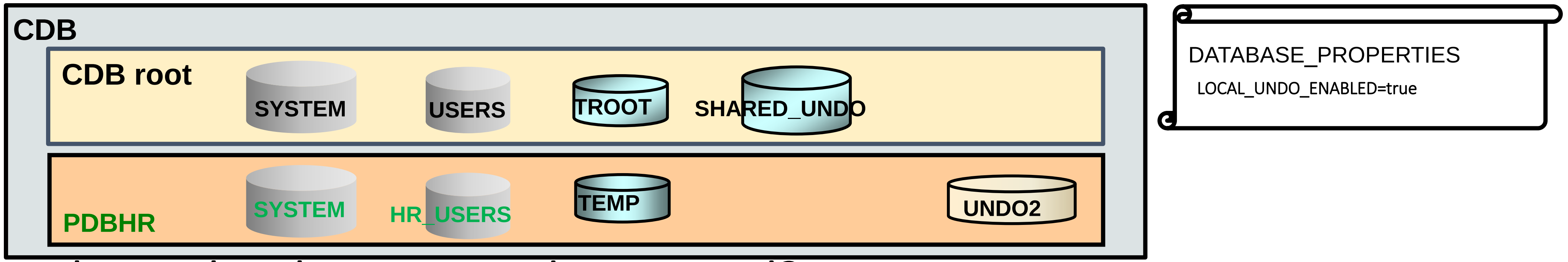
2. Plugging the encrypted PDB imports the master encryption key of the PDB into the CDB keystore.

```
SQL> CREATE PLUGGABLE DATABASE pdb1
            USING '/tmp/pdb1.xml'
            KEYSTORE IDENTIFIED BY keystore_pwd1
            DECRYPT USING "tpwd1";
```

Target CDB wallet opened

Local UNDO Mode Versus Shared UNDO Mode

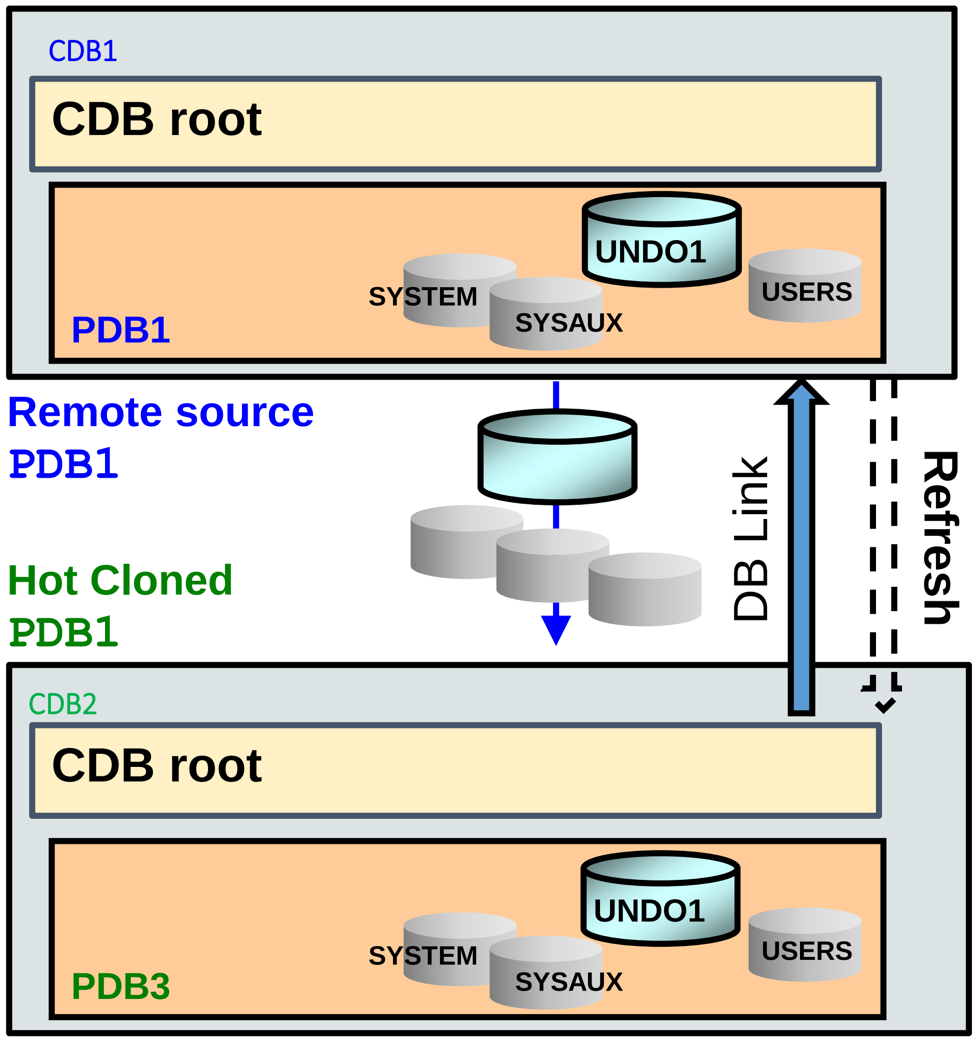
- Two UNDO modes: SHARED versus LOCAL
  - There is only one shared UNDO tablespace (in CDB root).
  - There can be a local UNDO tablespace in each PDB.



- When is local UNDO mode required?
  - Hot cloning
  - Near-zero downtime PDB relocation

```
SQL> STARTUP UPGRADE
SQL> ALTER DATABASE LOCAL UNDO ON;
```

Cloning Remote PDBs in Hot Mode



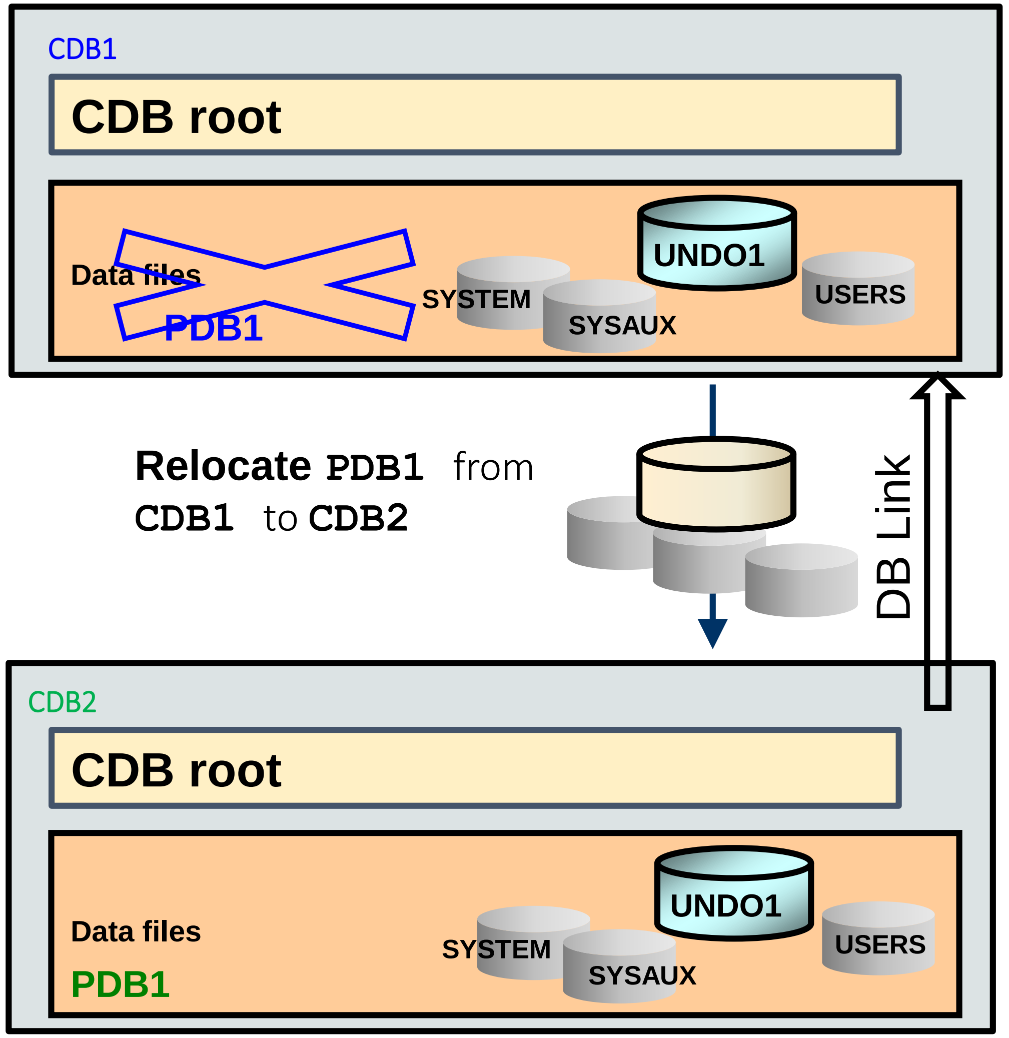
Remote source PDB still up and fully functional:

1. Connect to the target `CDB2` root to create the database link to `CDB1`.
2. Switch the shared UNDO mode to local UNDO mode in both the CDBs.
3. Clone the remote `PDB1` to `PDB3`.
4. Open `PDB3` in read-only or read-write mode.

Incremental refreshing:

- Manual
- Automatic (predefined interval)

Near-Zero Downtime PDB Relocation



Use a single statement to relocate **PDB1** from **CDB1** into **CDB2**:

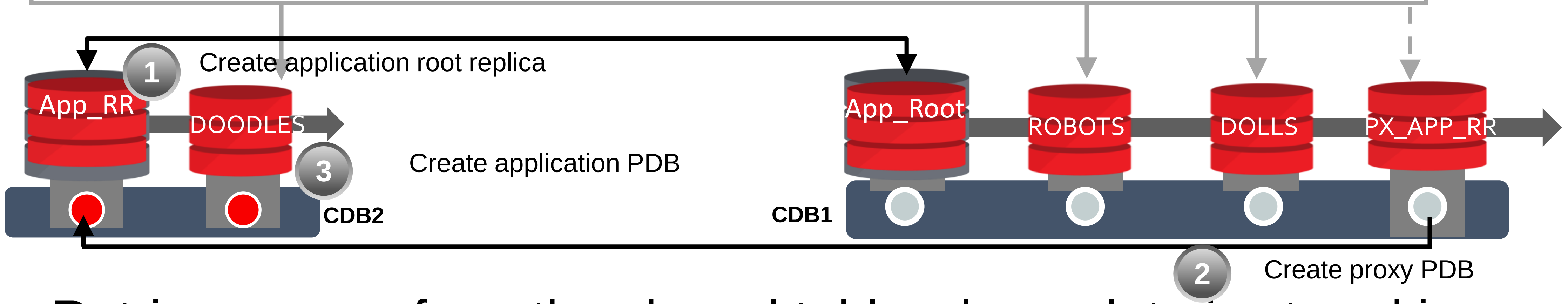
1. Switch the shared UNDO mode to local UNDO mode in both CDBs.
2. Set ARCHIVELOG mode in both CDBs.
3. Grant `SYSOPER` to the user connected to **CDB1** via the database link created in **CDB2**.
4. Connect to **CDB2** as a common user to create the database link.
5. Use the `CREATE PLUGGABLE DATABASE` statement with the new `RELOCATE` clause.
6. Open **PDB1** in read-write mode.

There is no need to:

- Unplug the PDB from the source CDB
- Copy or transfer the datafiles to a new location
- Plug the PDB in the target CDB
- Drop the source PDB from the source CDB

Proxy PDB: Query Across CDBs Proxying Root Replica

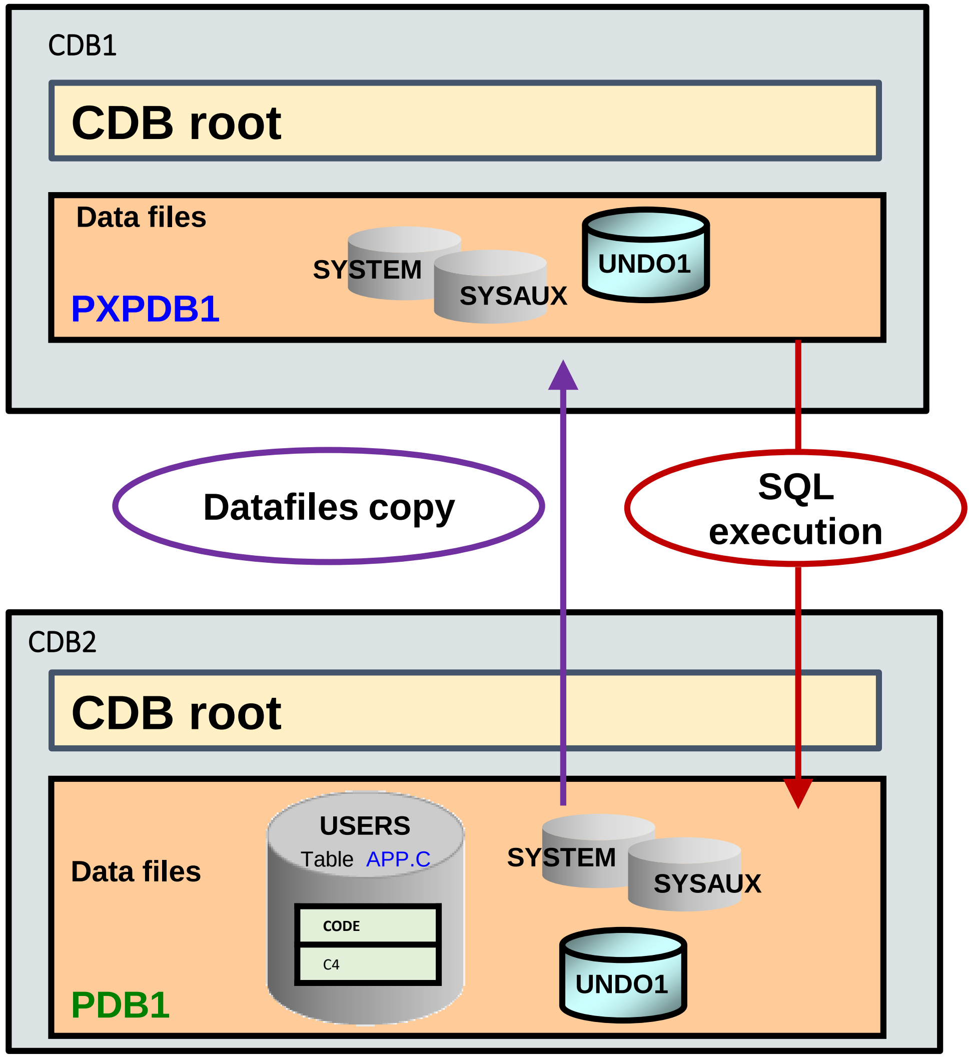
```
SELECT sum(revenue), year, CDB$NAME, CON$NAME
FROM   CONTAINERS(sales_data)
WHERE  year =  2014  GROUP  BY year, CDB$NAME, CON$NAME;
```



- ➔Retrieves rows from the shared table whose data is stored in application PDBs in the application root and replicas in CDBs

Revenue	Year	CDB$NAME	CON$NAME
15000000	2014	CDB1	ROBOTS
20000000	2014	CDB2	DOODLES
10000000	2014	CDB1	DOLLS

Creating a Proxy PDB



CDB_PDBS
IS_PROXY_PDB = *YES*
FOREIGN_CDB_DBID
FOREIGN_PDB_ID

A proxy PDB allows execution in a proxied PDB.

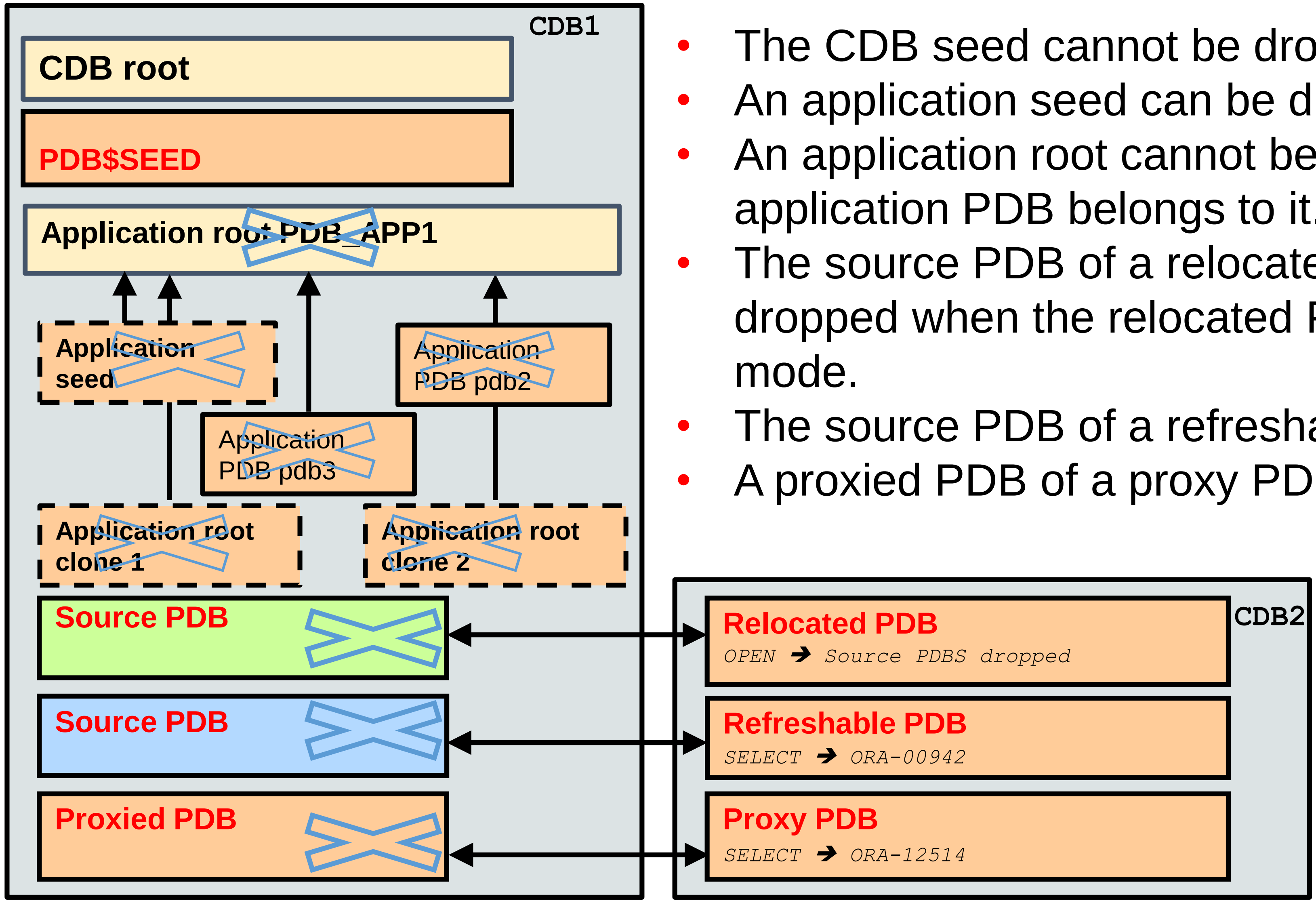
1. Switch the shared UNDO mode to local UNDO mode in both CDBs.
2. Set the ARCHIVELOG mode in both CDBs.
3. Connect to **CDB1** and create a database link (to **CDB2**).
4. Create the **PXPDB1** proxy PDB in **CDB1** as a view referencing the entire proxied **PDB1** in **CDB2**.

```
SQL> CONNECT sys@cdb1 AS SYSDBA
SQL> CREATE PLUGGABLE DATABASE pxpdb1 AS PROXY
                      FROM pdb1@link_cdb2;
```

5. Execute all the statements in the **PXPDB1** proxy PDB context to have them executed in the proxied **PDB1** PDB in **CDB2**.

```
SQL> CONNECT sys@pxpdb1 AS SYSDBA
SQL> ALTER PLUGGABLE DATABASE pxpdb1 OPEN;
SQL> SELECT * FROM app.c;
```

Dropping PDBs



- The CDB seed cannot be dropped.
- An application seed can be dropped.
- An application root cannot be dropped as long as an application PDB belongs to it.
- The source PDB of a relocated PDB is automatically dropped when the relocated PDB is opened in RW mode.
- The source PDB of a refreshable PDB can be dropped.
- A proxied PDB of a proxy PDB can be dropped.

The `DROP` operation updates controlfiles:

1. Removes PDB datafiles
2. Retain datafiles (default)

Summary

- In this lesson, you should have learned how to:
  - Clone a regular PDB
  - Clone an application container
  - Unplug and plug or clone a non-CDB
  - Unplug and plug a regular PDB
  - Unplug and plug an application container
  - Convert regular PDBs to application PDBs
  - Configure and use the local UNDO mode
  - Perform hot cloning
  - Perform near-zero downtime PDB relocation
  - Create and use a proxy PDB
  - Drop PDBs

Practice 4: Overview

- 4-1: Cloning remote regular PDBs in hot mode
- 4-2: Cloning an application container
- 4-3: Unplugging and plugging application containers
- 4-4: Converting a regular PDB to an application PDB
- 4-5: Relocating PDBs
- 4-6: Querying data across CDBs by using proxy PDBs
- 4-7: Dropping unnecessary PDBs