ORACLE

1

CDB Basics

Objectives

After completing this lesson, you should be able to:

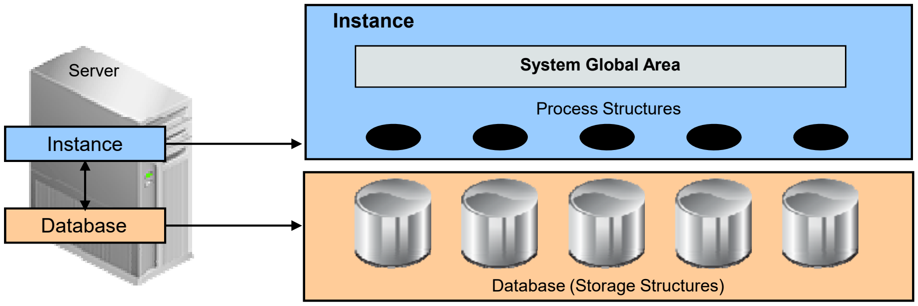
- Describe the multitenant architecture
- Describe the CDB root and pluggable database containers
- Differentiate the CDB root from a pluggable database
- Explain the terminology of commonality
- List impacts in various areas

Challenges

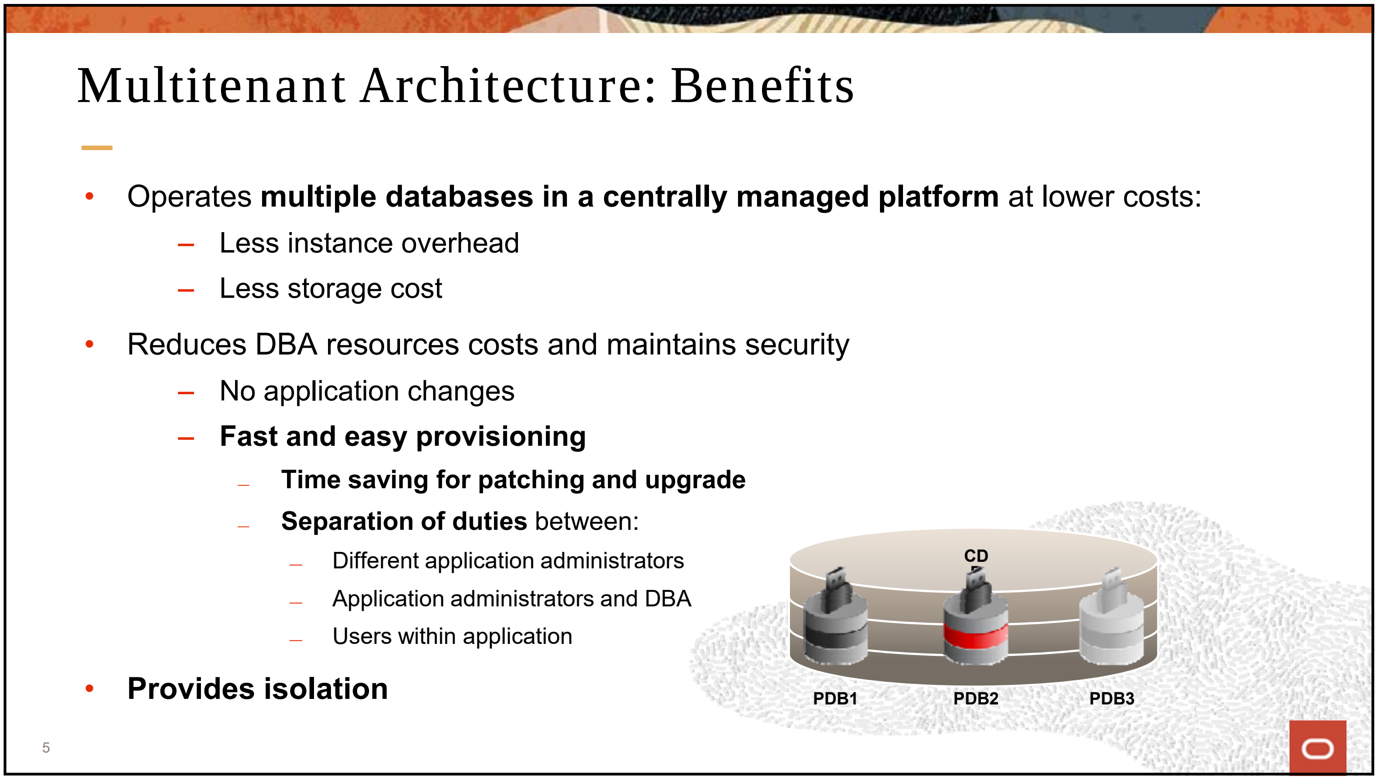
Many Oracle customers have large numbers of “departmental” applications built on Oracle RDBMS that:

- Do NOT use a significant percentage of the hardware on which they are deployed
- Have instance and storage overhead preventing large numbers of “departmental” databases from being placed on the same physical and storage server
- Are NOT sufficiently complex to require 100 percent of the attention of a full-time administrator
- Do require significant time to patch or upgrade all applications

Non-CDB Architecture

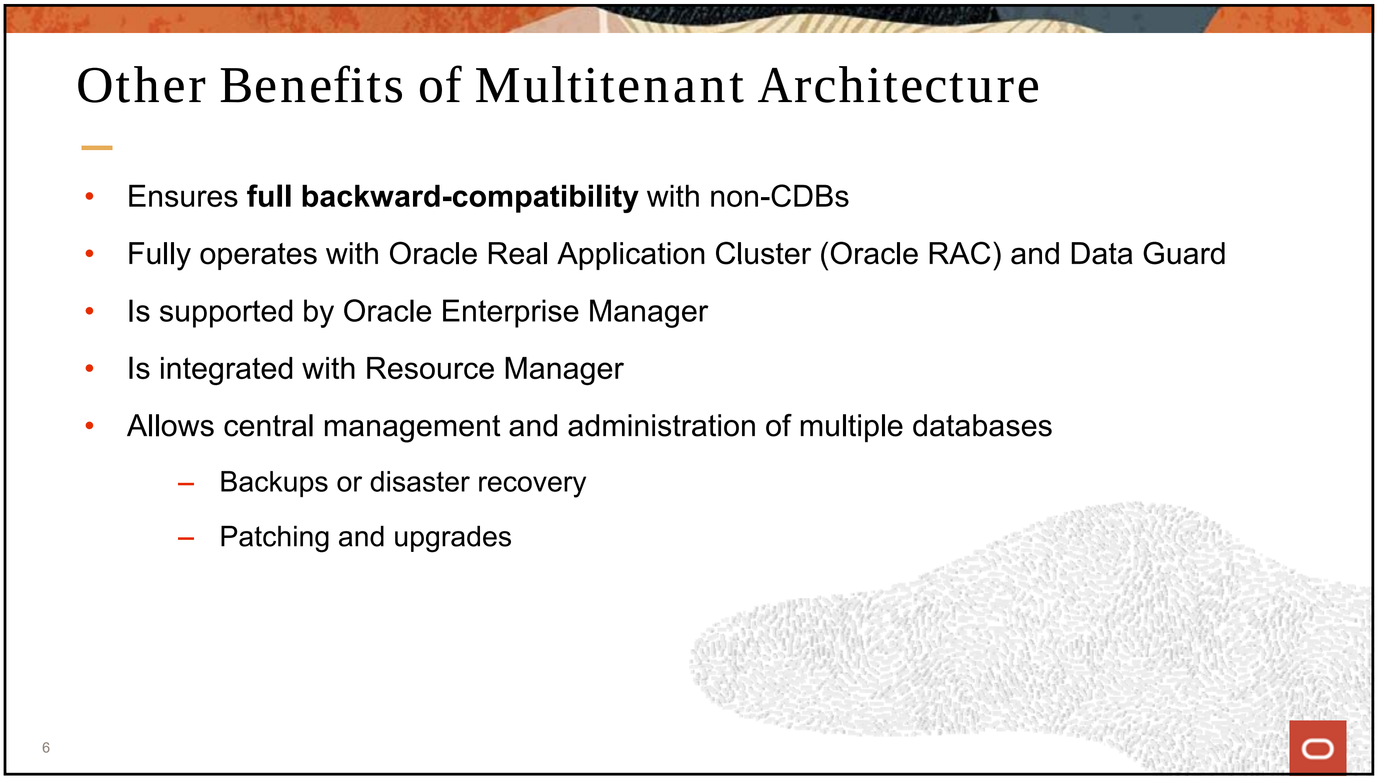


- Multiple non-CDBs share nothing:
  - Too many background processes
  - High shared/process memory
  - Many copies of Oracle metadata



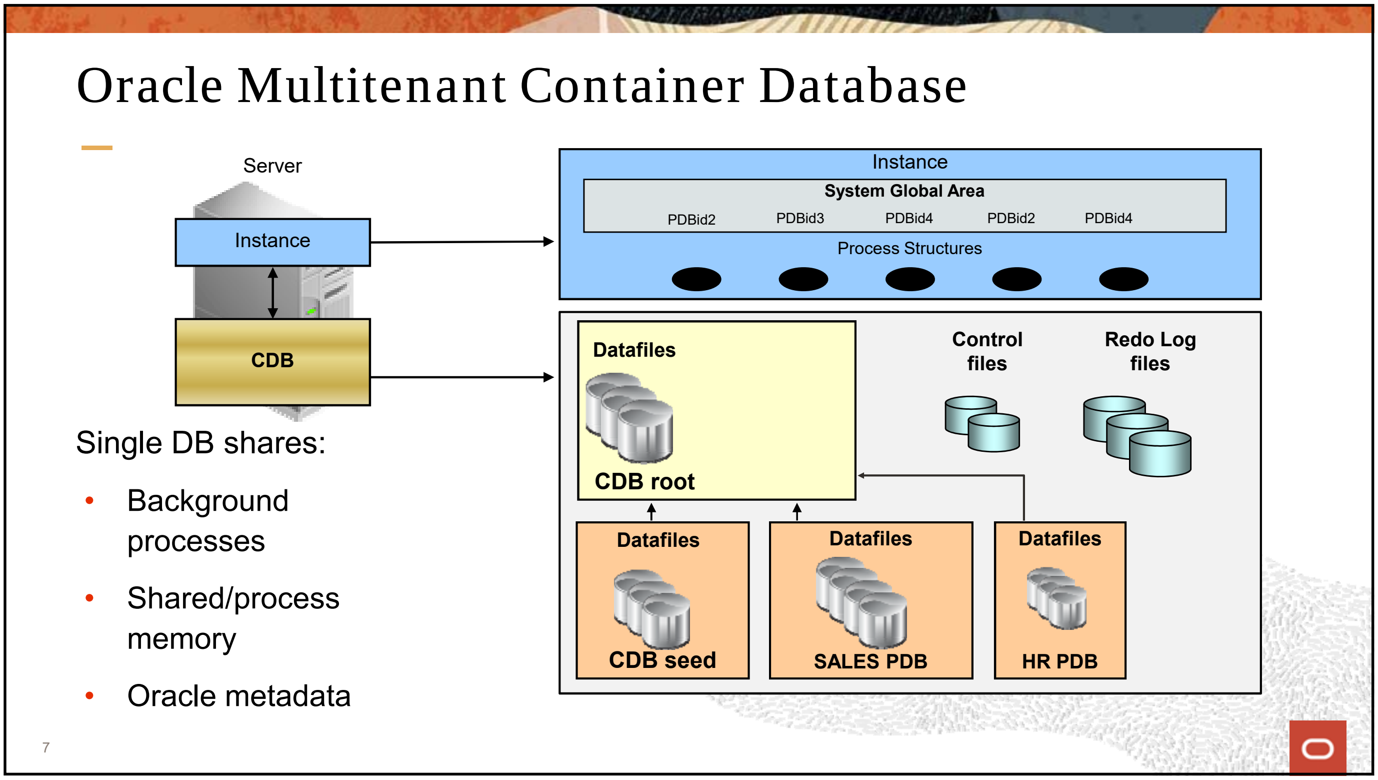
Multitenant Architecture: Benefits

- Operates **multiple databases in a centrally managed platform** at lower costs:
  - Less instance overhead
  - Less storage cost
- Reduces DBA resources costs and maintains security
  - No application changes
  - **Fast and easy provisioning**
    - **Time saving for patching and upgrade**
    - **Separation of duties** between:
      - Different application administrators
      - Application administrators and DBA
      - Users within application
- **Provides isolation**



Other Benefits of Multitenant Architecture

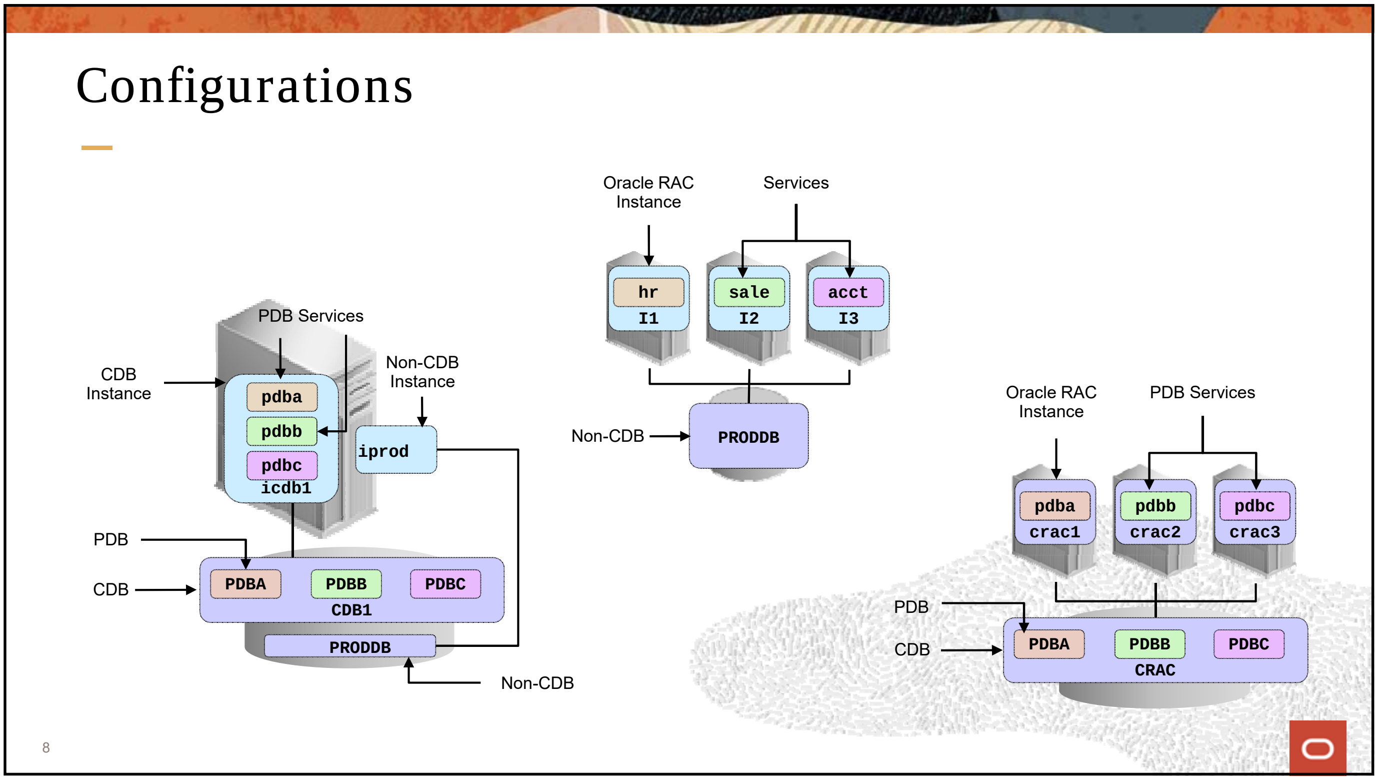
- Ensures **full backward-compatibility** with non-CDBs
- Fully operates with Oracle Real Application Cluster (Oracle RAC) and Data Guard
- Is supported by Oracle Enterprise Manager
- Is integrated with Resource Manager
- Allows central management and administration of multiple databases
  - Backups or disaster recovery
  - Patching and upgrades



Oracle Multitenant Container Database

Single DB shares:

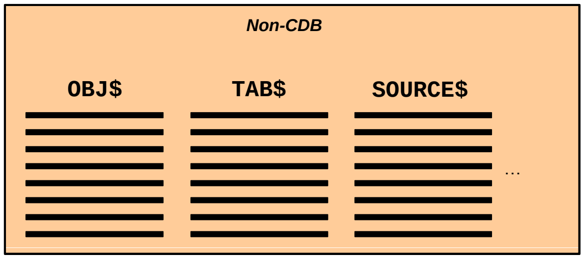
- Background processes
- Shared/process memory
- Oracle metadata



Configurations

Database Objects in a Non-CDB

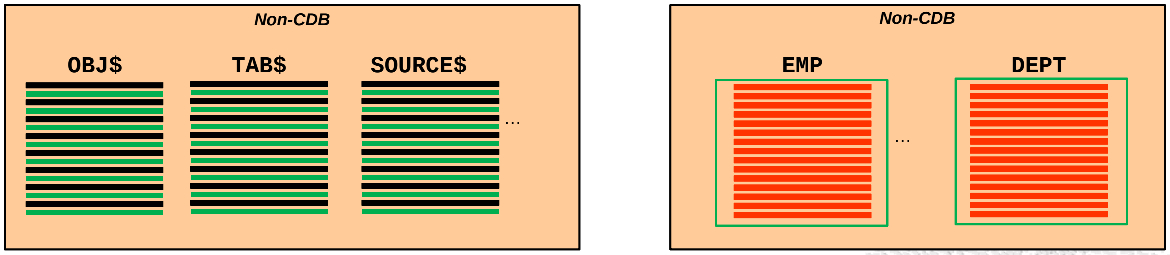
After the initial database creation, the only objects are Oracle-supplied objects.



Oracle System data

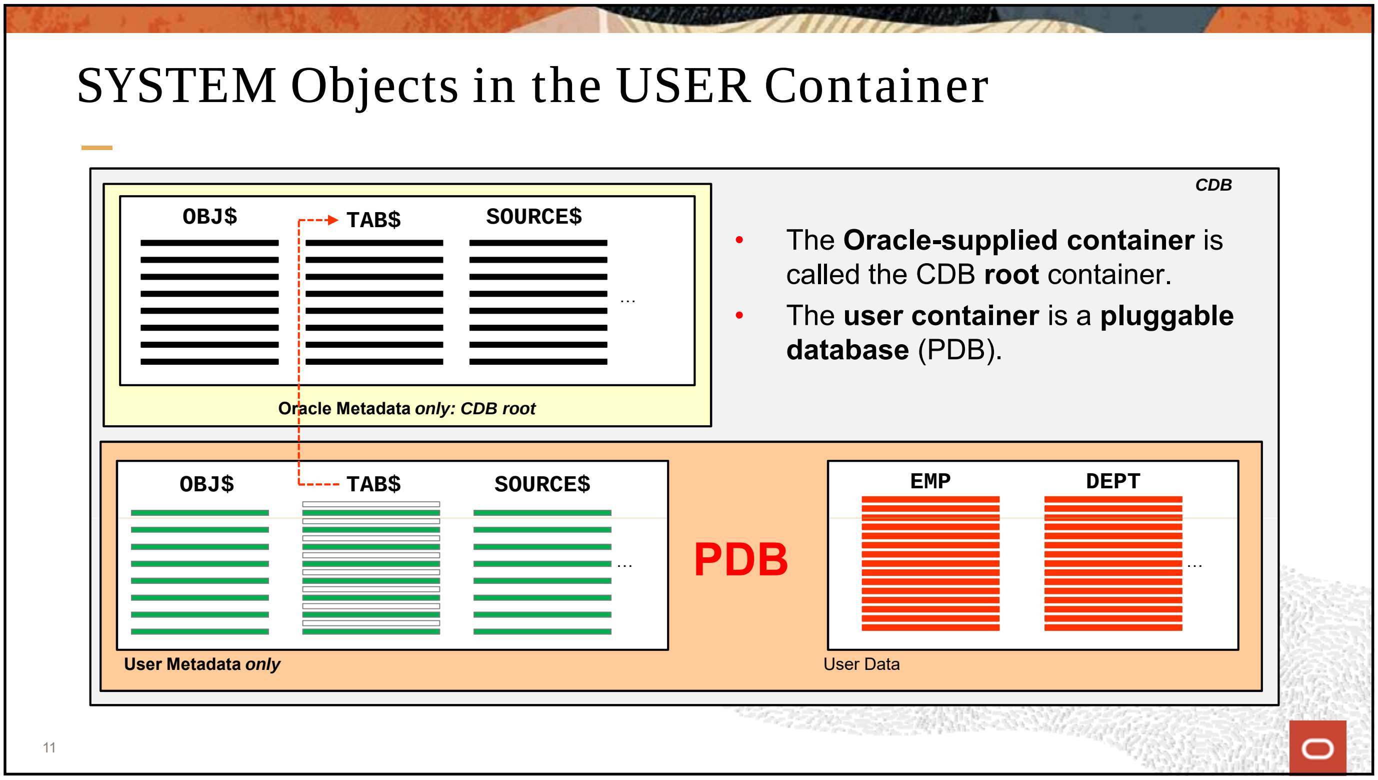
User-Added Objects to a Non-CDB

In a non-CDB, user data is added: The metadata is mixed with the Oracle-supplied data in the data dictionary.



Oracle System data mixed with user metadata

User data



SYSTEM Objects in the USER Container

CDB

OBJ$ TAB$ SOURCE$ …

Oracle Metadata *only: CDB root*

- The **Oracle-supplied container** is called the CDB **root** container.
- The **user container** is a **pluggable database** (PDB).

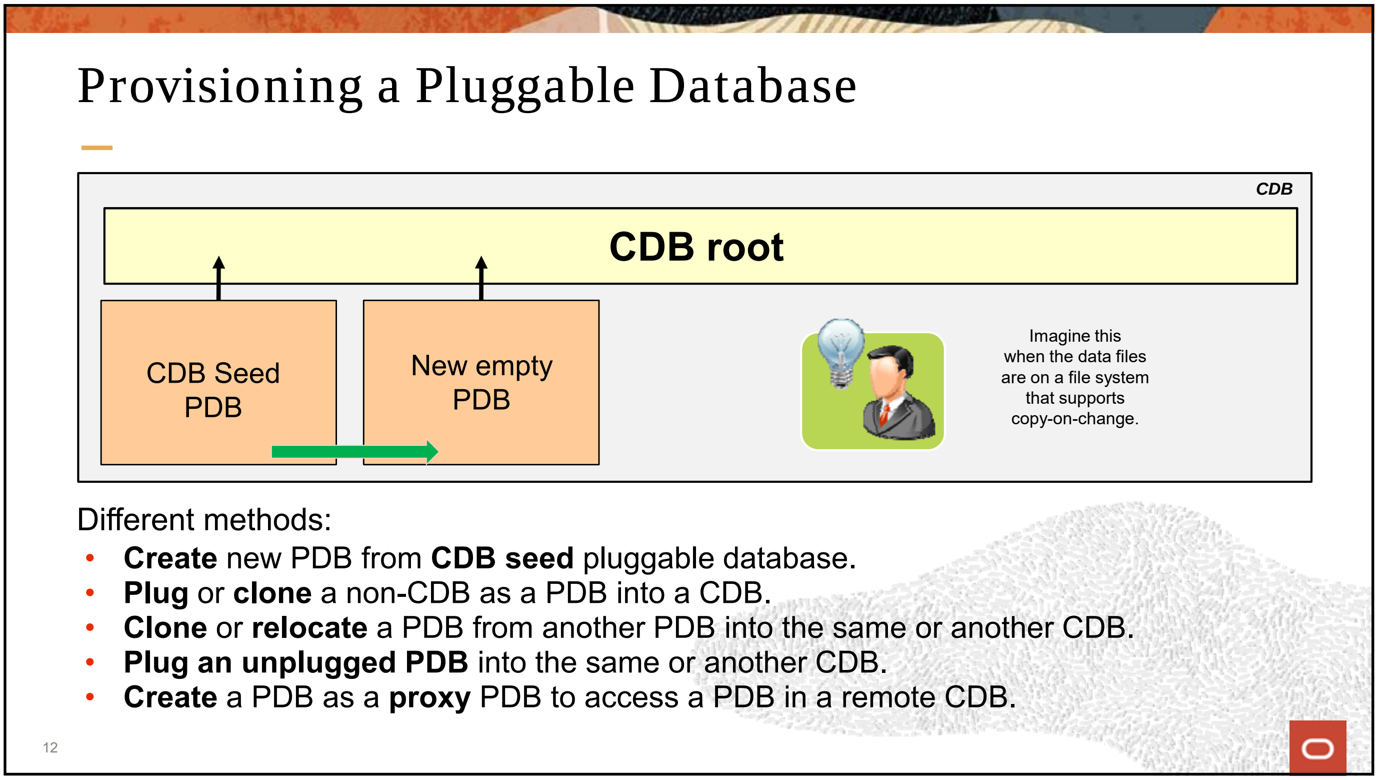
OBJ$ TAB$ SOURCE$ …

User Metadata *only*

PDB

EMP DEPT …

User Data



Provisioning a Pluggable Database

CDB

CDB root

CDB Seed PDB

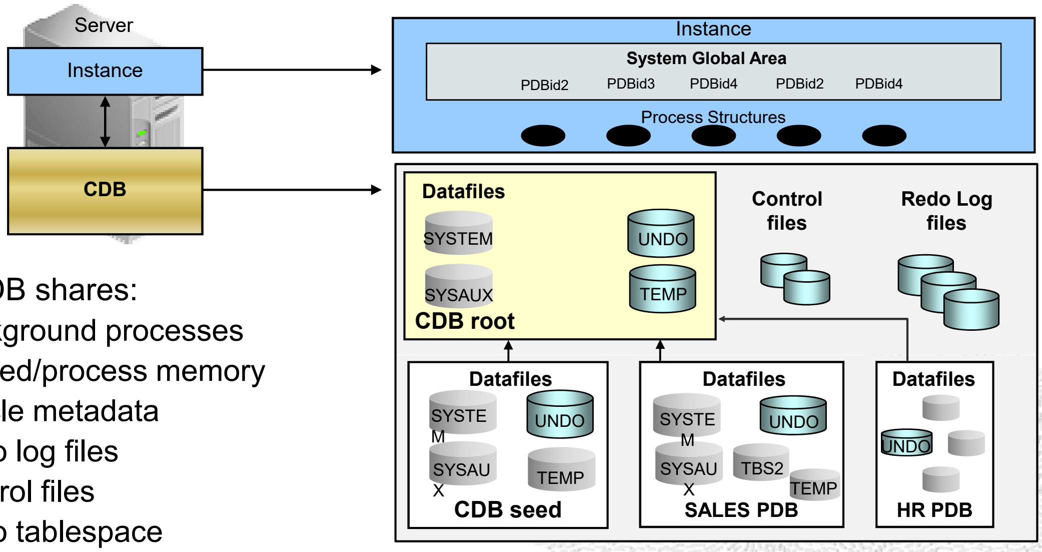
New empty PDB

Imagine this
when the data files
are on a file system
that supports
copy-on-change.

Different methods:

- **Create** new PDB from **CDB seed** pluggable database.
- **Plug** or **clone** a non-CDB as a PDB into a CDB.
- **Clone** or **relocate** a PDB from another PDB into the same or another CDB.
- **Plug an unplugged PDB** into the same or another CDB.
- **Create** a PDB as a **proxy** PDB to access a PDB in a remote CDB.

Multitenant Container Database Architecture



Single DB shares:

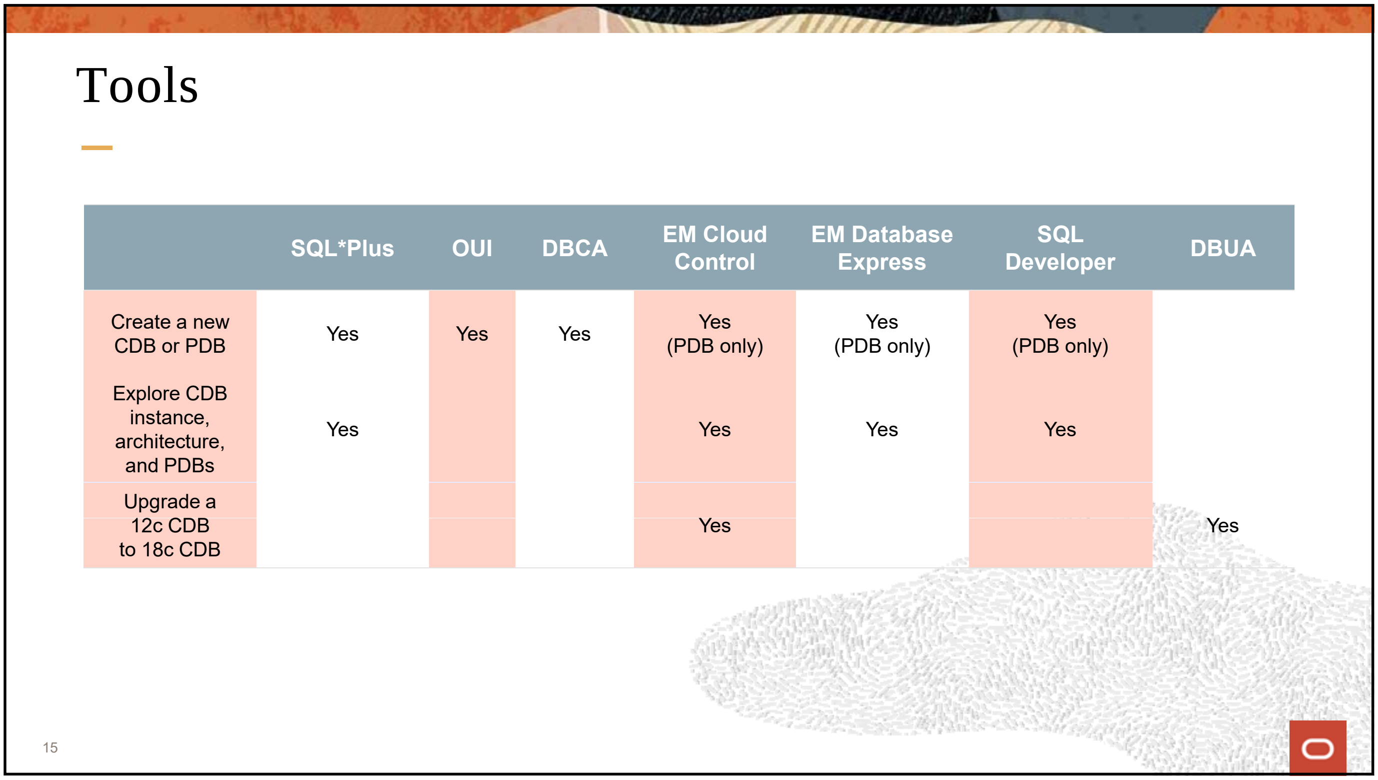
- Background processes
- Shared/process memory
- Oracle metadata
- Redo log files
- Control files
- Undo tablespace

Containers

CDB_PDBS
V$PDBS
V$CONTAINERS

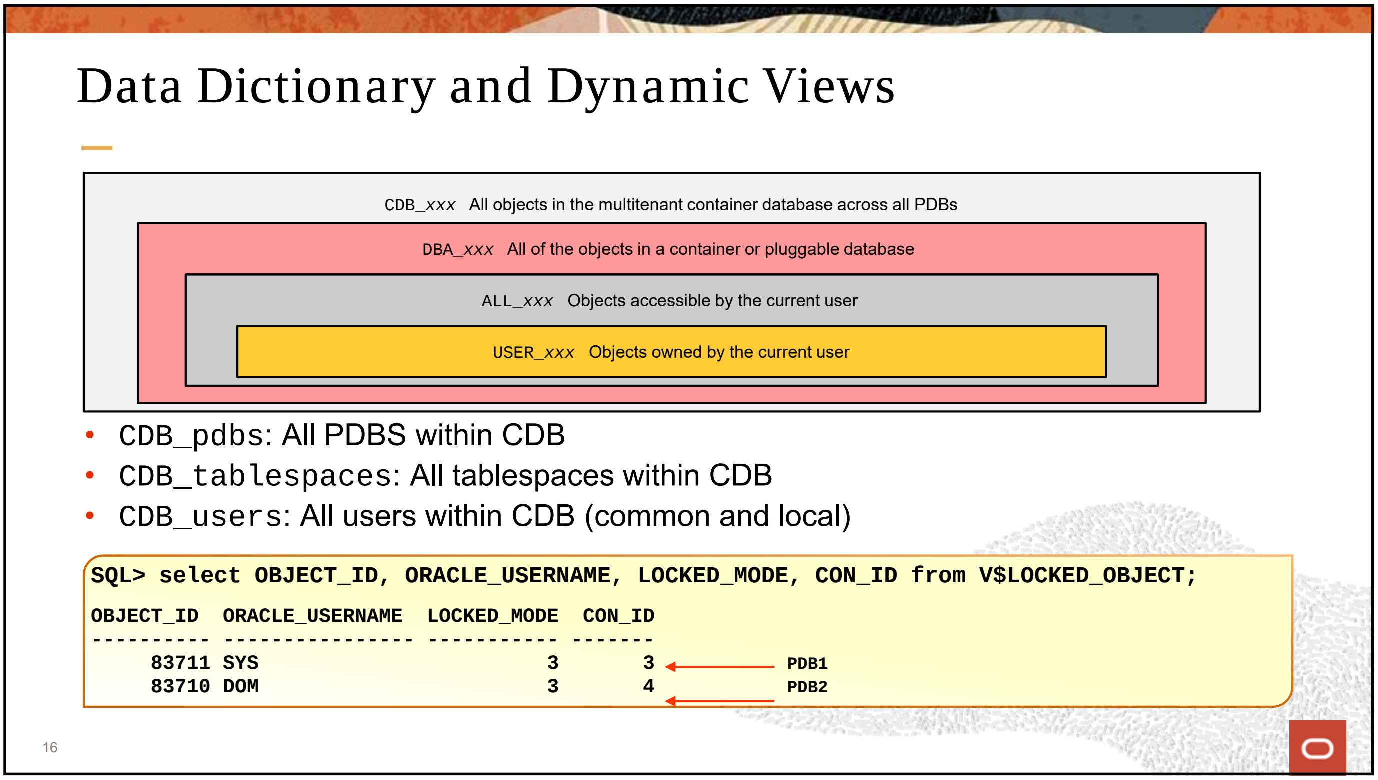
Types of containers in `V$CONTAINERS`:

- **CDB root**
  - The first mandatory container created at CDB creation
  - Oracle system–supplied common objects and metadata
  - Oracle system–supplied common users and roles
- **Pluggable database** (PDBs)
  - Tablespaces (permanent and temporary)
  - Schemas / Objects / Privileges
  - Created / cloned / unplugged / plugged / proxied
  - Particular PDB: CDB seed (`PDB$SEED`)used for fast provisioning of a new PDB



Tools

	SQL*Plus	OUI	DBCA	EM Cloud Control	EM Database Express	SQL Developer	DBUA
Create a new CDB or PDB	Yes	Yes	Yes	Yes (PDB only)	Yes (PDB only)	Yes (PDB only)	
Explore CDB instance, architecture, and PDBs	Yes			Yes	Yes	Yes	
Upgrade a 12c CDB to 18c CDB				Yes			Yes



Data Dictionary and Dynamic Views

CDB_*xxx* All objects in the multitenant container database across all PDBs

DBA_*xxx* All of the objects in a container or pluggable database

ALL_*xxx* Objects accessible by the current user

USER_*xxx* Objects owned by the current user

- CDB_pdbs: All PDBS within CDB
- CDB_tablespaces: All tablespaces within CDB
- CDB_users: All users within CDB (common and local)

```
SQL> select OBJECT_ID, ORACLE_USERNAME, LOCKED_MODE, CON_ID from V$LOCKED_OBJECT;
OBJECT_ID  ORACLE_USERNAME  LOCKED_MODE  CON_ID
---------- ---------------- ----------- -------
     83711 SYS                        3       3      PDB1
     83710 DOM                        3       4      PDB2
```

Terminology

- DBA, CDB_DBA, and PDB_DBA (roles assigned to administrators at different levels)
- Common vs Local:
  - Users
  - Privileges / Roles
  - Objects
  - Profiles
- CDB vs PDB level:
  - CDB Resource Manager plan vs PDB RM plan
  - Unified audit policies at CDB or PDB level
  - Encryption master keys at CDB and PDB level
  - Database Vault realms and command rules at CDB or PDB level
  - XStream at CDB or PDB level

Impacts

- Define a character set for the CDB and per PDB.
- Define PDB initialization parameters in a single SPFILE.
- Do not use PDB-qualified database object names. Instead use database links.

SQL> SELECT * FROM HR:~~apps.tab1~~;   SQL> SELECT * FROM apps.tab1@HR;

- Implement subset standbys at the PDB level.
- Configure Oracle Database Vault per PDB and on common objects.
- Create one TDE master encryption key per PDB to encrypt PDB data.
- Configure unified audit at CDB and PDB level.
- Benefit from Heat Maps and Automatic Data Optimization.
- Use Logminer for objects at all levels.
- Configure replication at PDB and application level with XStream and Oracle GoldenGate.

Summary

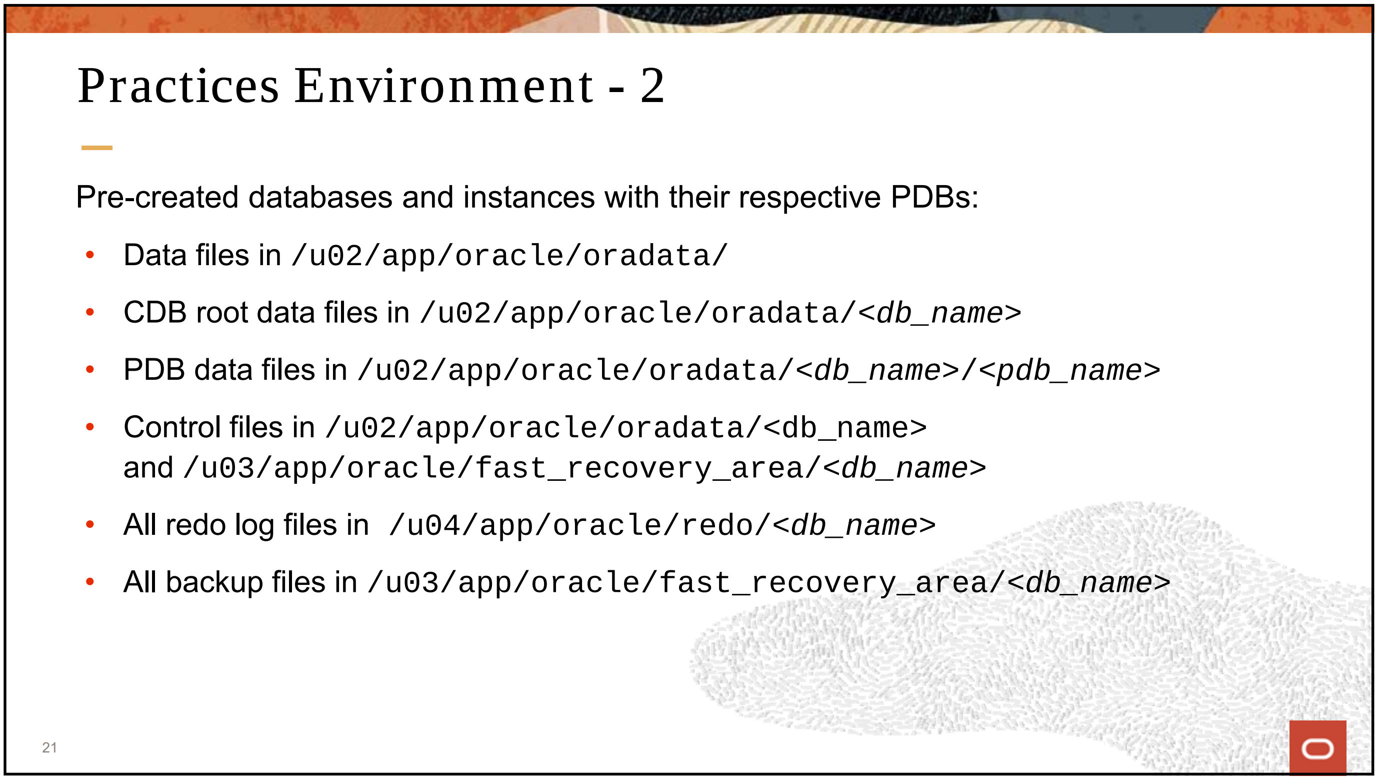
In this lesson, you should have learned how to:

- Describe the multitenant architecture
- Describe the CDB root and pluggable database containers
- Differentiate the CDB root from a pluggable database
- Explain the concept of commonality
- List impacts in various areas

Practices Environment - 1

Each student has two virtual machines (VM1 and VM2) to use during class.

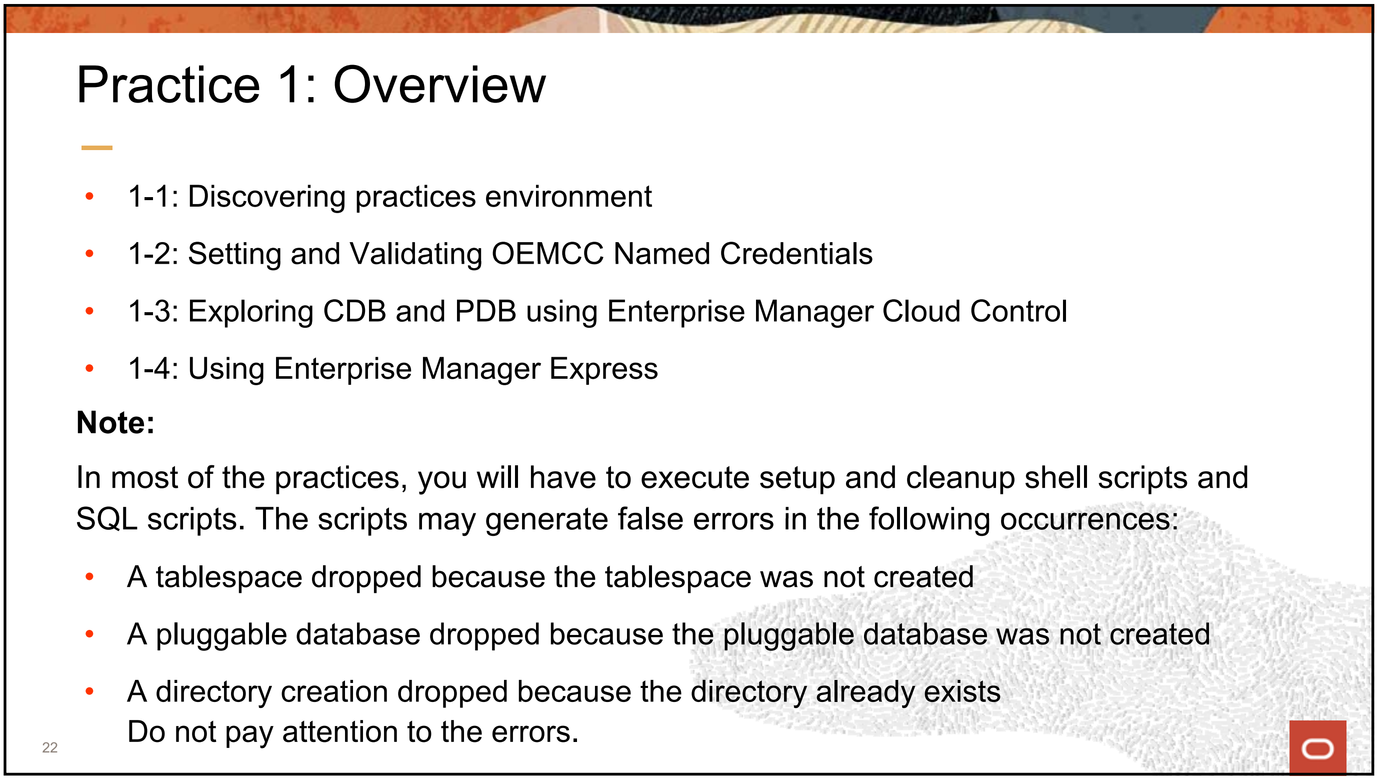
- **On VM1 (called host01)**:
  - Oracle Database 19c installed:
    - With one CDB named **ORCL** and one PDB named **PDB1**. The CDB has been set up for you in advance so that you can explore an existing configuration.
    - You will create another CDB, **CDB19,** and its PDB, **PDB19**.
  - Oracle Database 18c and 12.2 installed:
    - With one CDB named CDB12 and CDB18 and one PDB in each CDB named pdb12 and PDB18 to perform upgrade operations to Oracle Database 19c.
    - With a non-CDB named noncdb to perform plugging or cloning operations into one of the Oracle Database 19c CDBs. This shows you how to migrate a non-CDB into a CDB.
- **On VM2 (called em13c)**:
  - Enterprise Manager 13.3*c* deployed to monitor Oracle Database targets.
  - Oracle Database 19c installed with named ractcdb and a PDB named EMCCPDB that is used as the Oracle Management Repository (OMR).



Practices Environment - 2

Pre-created databases and instances with their respective PDBs:

- Data files in `/u02/app/oracle/oradata/`
- CDB root data files in `/u02/app/oracle/oradata/<db_name>`
- PDB data files in `/u02/app/oracle/oradata/<db_name>/<pdb_name>`
- Control files in `/u02/app/oracle/oradata/<db_name>`
  and `/u03/app/oracle/fast_recovery_area/<db_name>`
- All redo log files in `/u04/app/oracle/redo/<db_name>`
- All backup files in `/u03/app/oracle/fast_recovery_area/<db_name>`



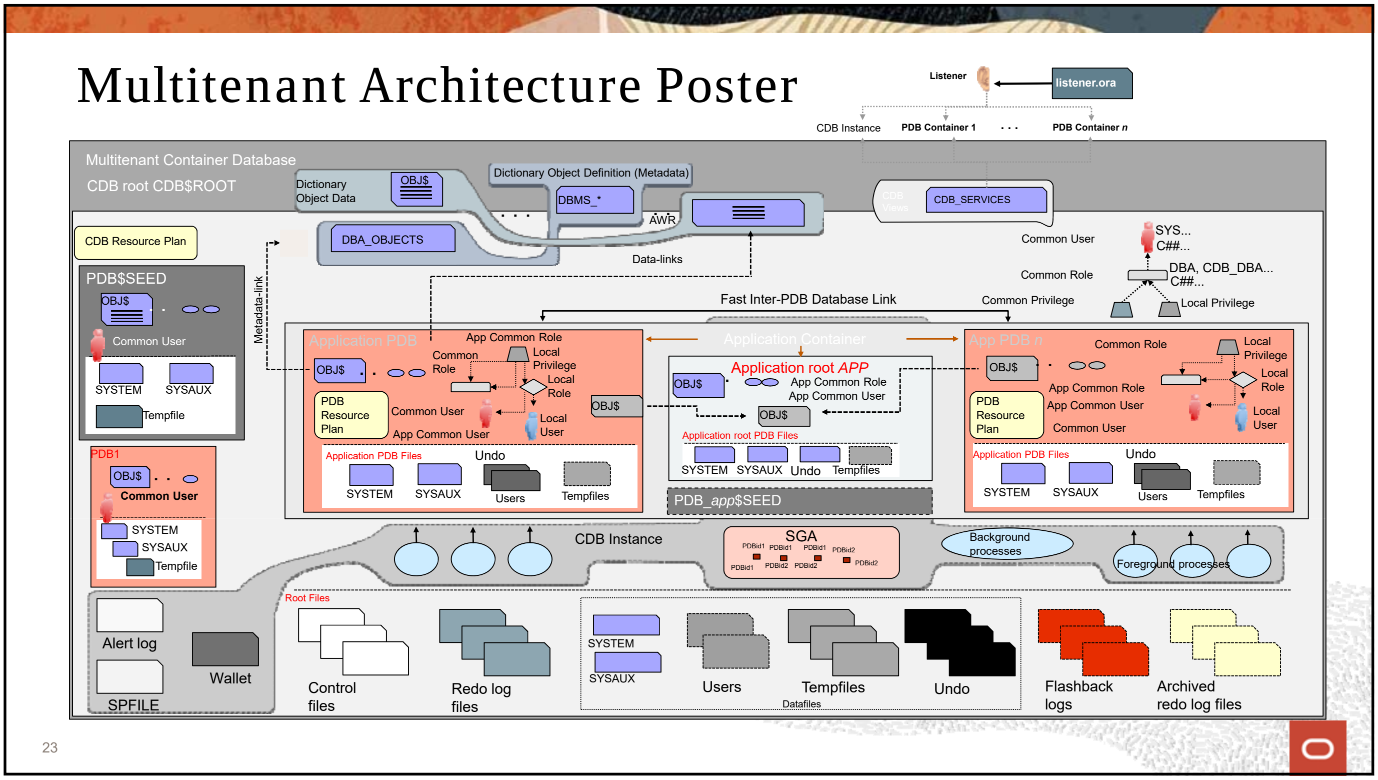
Practice 1: Overview

- 1-1: Discovering practices environment
- 1-2: Setting and Validating OEMCC Named Credentials
- 1-3: Exploring CDB and PDB using Enterprise Manager Cloud Control
- 1-4: Using Enterprise Manager Express

Note:

In most of the practices, you will have to execute setup and cleanup shell scripts and SQL scripts. The scripts may generate false errors in the following occurrences:

- A tablespace dropped because the tablespace was not created
- A pluggable database dropped because the pluggable database was not created
- A directory creation dropped because the directory already exists
  Do not pay attention to the errors.



Multitenant Architecture Poster