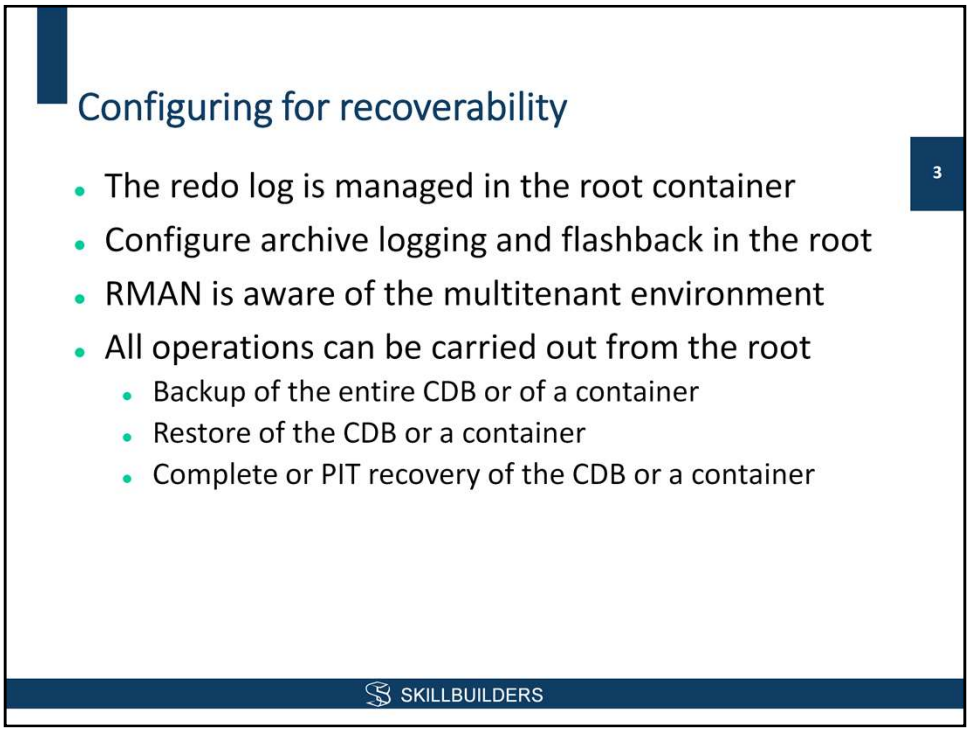
Lesson 5
Backup and Recovery

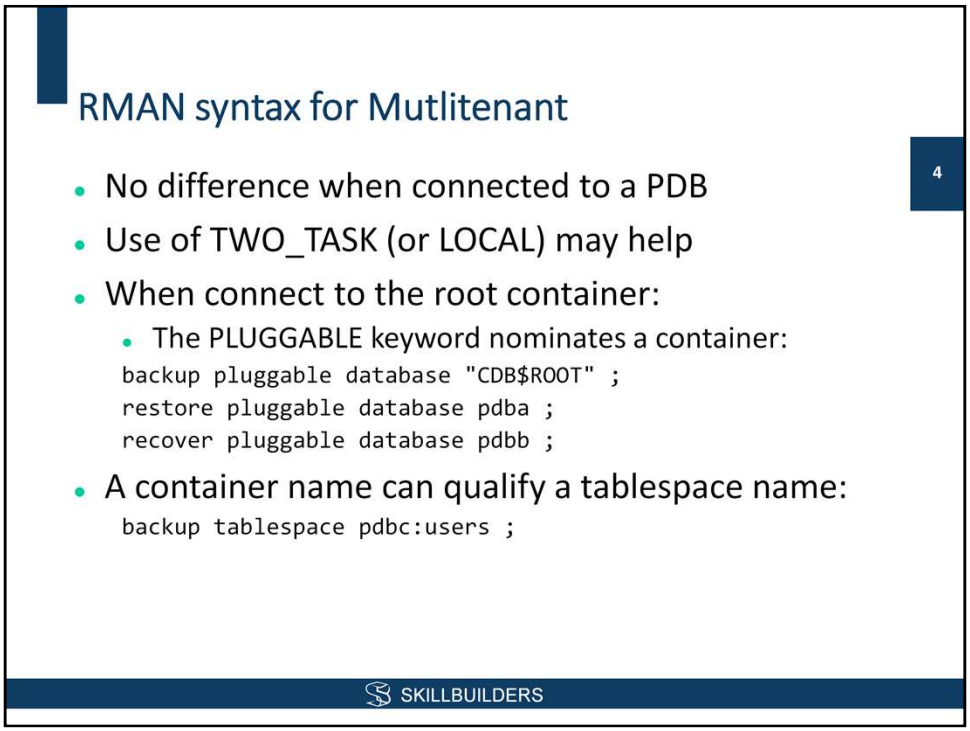
SKILLBUILDERS

Objectives

- Archive log mode
- Backup the CDB and PDBs
- Restore and recovery
  - Complete
  - Incomplete
- Database flashback
- Data Guard and Multitenant

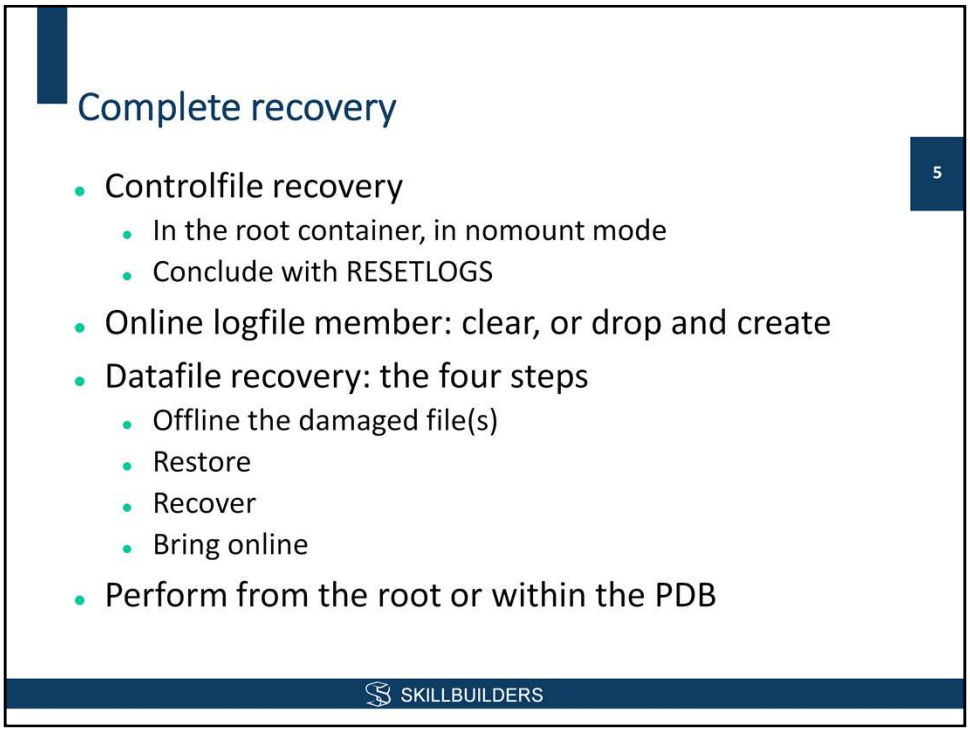


RMAN is fully multitenant aware, with syntax extensions to manage multiple containers. As a general rule, from the root container one can do anything; from within a PDB, one can perform backup and recovery operations for that PDB only.



When connected to a pluggable container as SYSDBA or SYSBACKUP (always using password file authentication) all RMAN commands will run as normal. From the root container, the entire environment can be backed up or recovered.

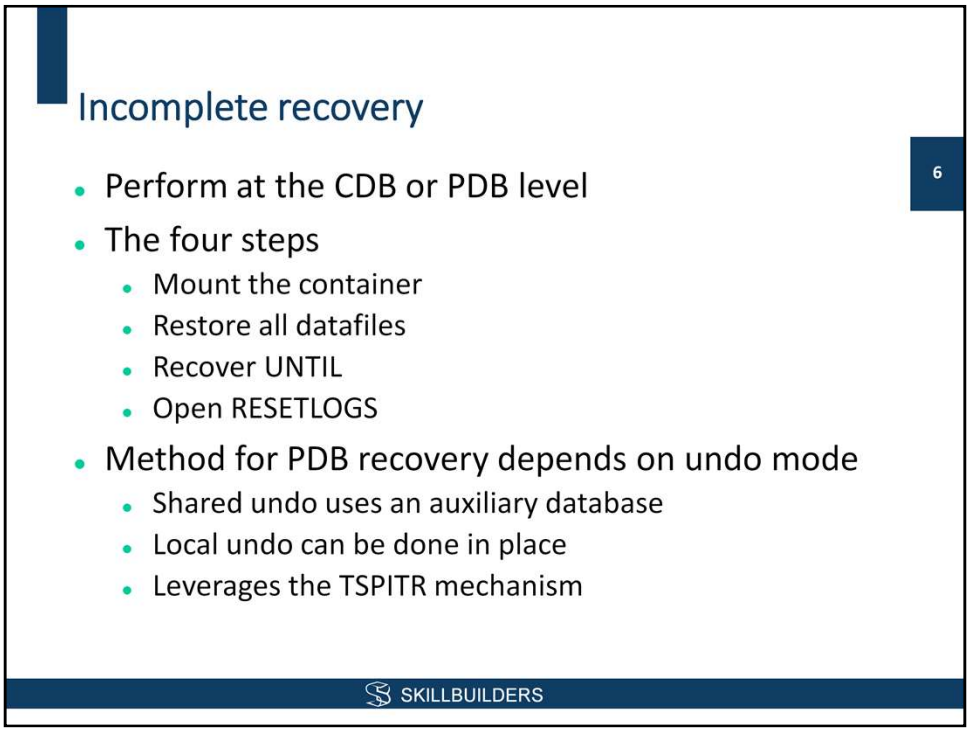
The restore and recover of an individual container is possible by leveraging the Tablespace Point In Time Recovery (TSPITR) mechanism. This is because there is an absolute guarantee that the tablespaces of one container are self-contained.



The usual rules for recovery apply.

If the controlfile is damaged, this must be restored in NOMOUNT mode. Damage to the online log does not require any downtime (assuming that the members are multiplexed).

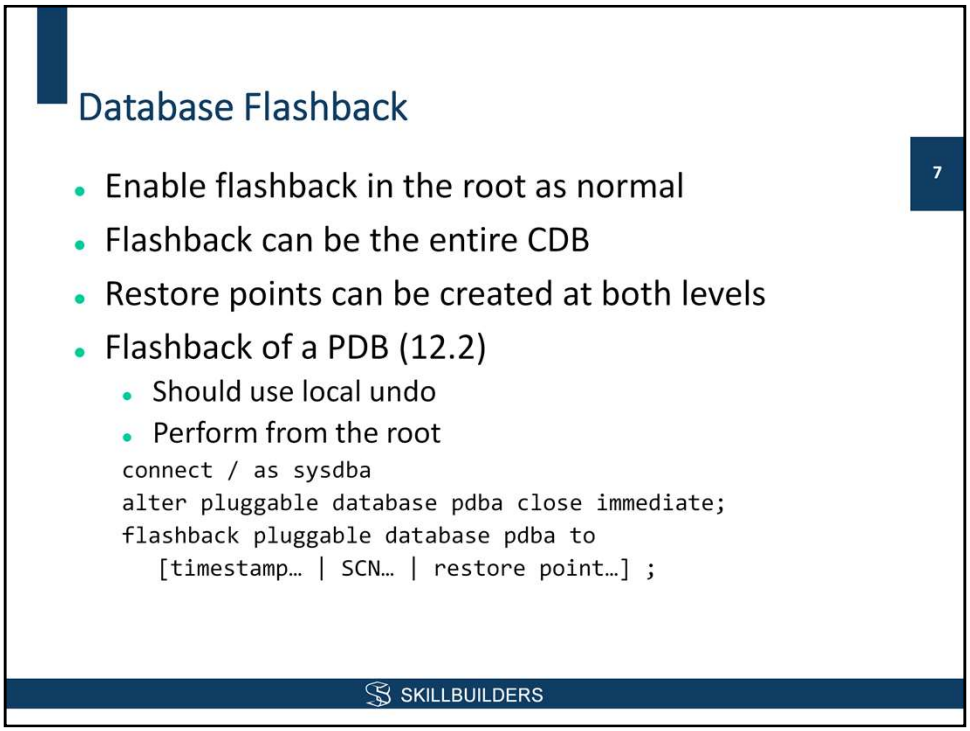
The critical datafiles (SYSTEM or UNDO datafiles) necessitate mount mode for restore and recover. This will be the entire CDB if the root container is damaged, or the individual PDB if the damage is restricted to one container. Damage to a non-critical datafile can be repaired while the container is open.



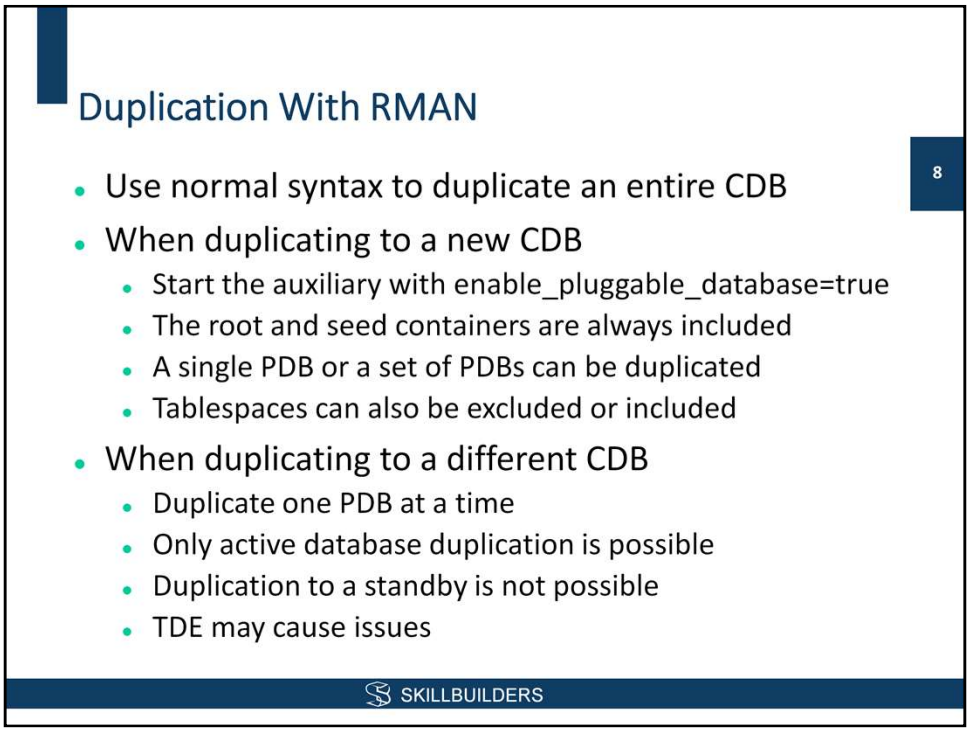
A CDB may be supporting many pluggable containers. It is therefore important that it should be possible to take one back in time without affecting the others. This can be accomplished with zero downtime for the bystander containers.

The process leverages the tablespace point in time recovery (TSPITR) mechanism. A requirement for TSPITR is the set of tablespace to be recovered should be "self contained", with no dependencies on any objects in other tablespaces. This is guaranteed by the Multitenant architecture: each container is isolated from the others. The exception is the undo tablespace, in shared undo mode. RMAN will be aware of this, and requires an auxiliary instance. For example:

```
RMAN> ALTER PLUGGABLE DATABASE JW1 CLOSE IMMEDIATE;
RMAN> RUN {
SET UNTIL TIME = 'SYSDATE – 12/24';
RESTORE pluggable DATABASE JW1;
RECOVER pluggable DATABASE JW1
AUXILIARY DESTINATION='/u01/auxdb';
ALTER PLUGGABLE DATABASE JW1 OPEN RESETLOGS;
}
```



In release 12.1, a flashback operation (though not point in time recovery) applied to the whole CDB. From 12.2 it is possible to flashback one container if local undo has been enabled. Without local undo, it is not possible because the undo tablespace, being shared, cannot be taken back in time.



To duplicate to a new CDB:

Start the auxiliary instance, with enable_pluggable_database=true

Ensure that backups are visible to the auxiliary

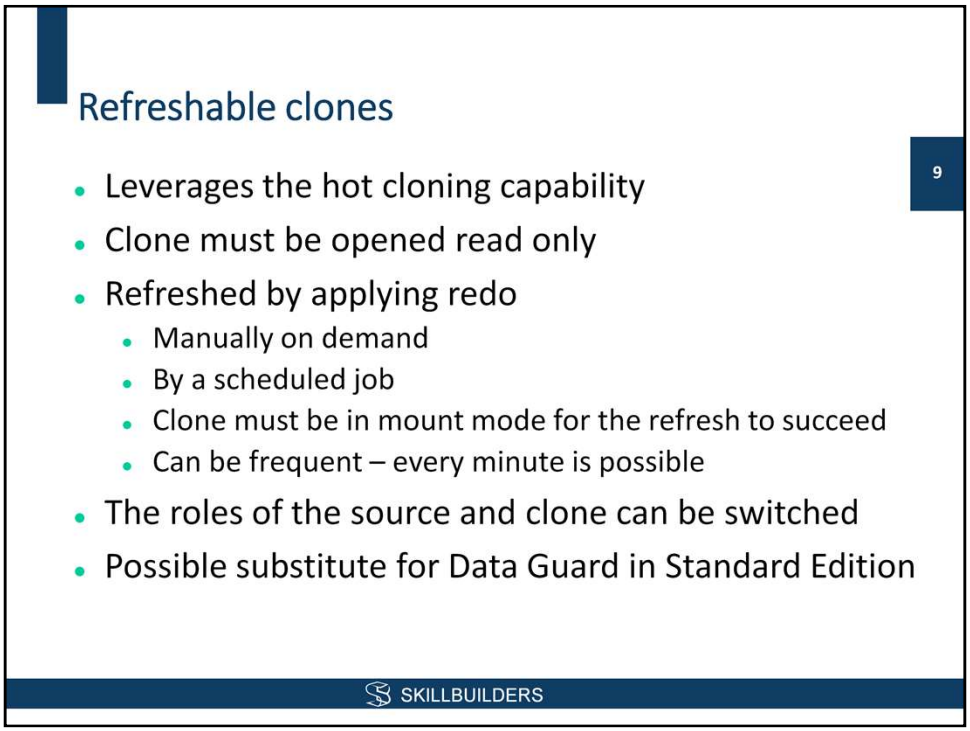
Example duplicate commands:

```
duplicate database to cdb2 pluggable database pdba;
duplicate database to cdb2 pluggable database pdba,pdbb;
duplicate database to cdb2 skip pluggable database pdbc;
```

To duplicate to an existing CDB, connect to the source as a target and the destination as an auxiliary and use a command such as

```
duplicate pluggable database pdba as pdbb to cdb2
db_file_name_convert ('cdb1','cdb2')
from active database;
```

Note that it is not possible to duplicate a PDB from a backup of one CDB into another CDB; only active duplication is possible.



To create a clone with manual refresh:

```
create pluggable database pdbe from pdba@cdb2
       refresh mode manual;
alter pluggable database pdbe open read only;
alter pluggable database pdbe close immediate;
alter session set container=pdbe;
alter pluggable database refresh;
alter pluggable database open read only;
```

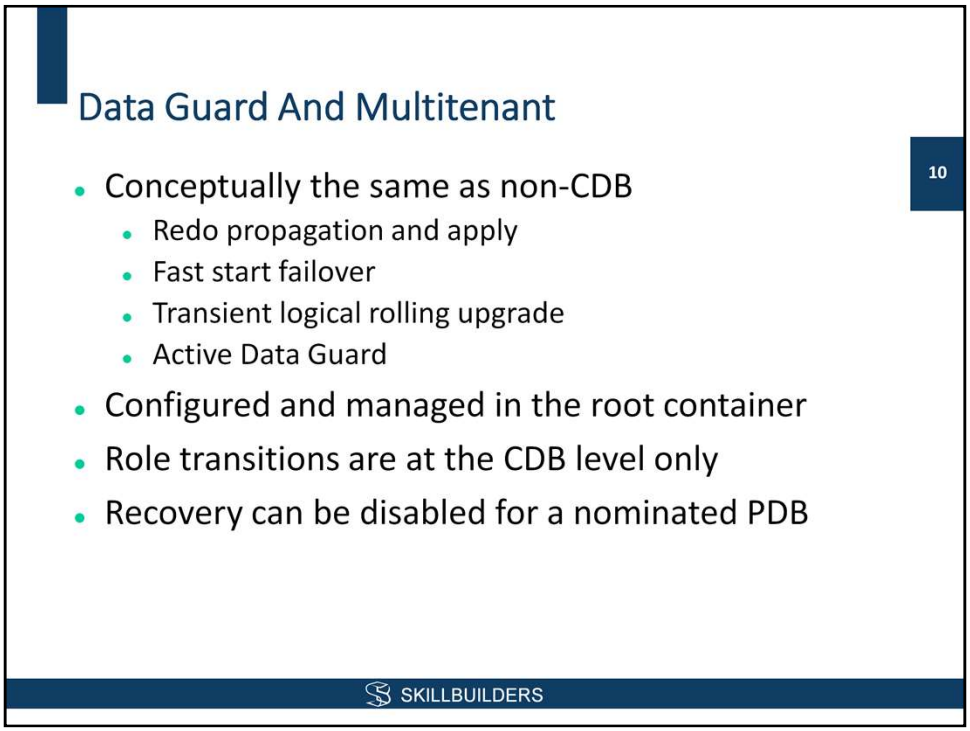
Or for automatic refresh:

```
create pluggable database pdbe from pdba@cdb2
     refresh mode every 60 minutes;
```

A job will be required to close the database or the refresh will not succeed. The refresh is accomplished by use of redo. Any archive logs necessary must therefore be available.

To perform a role reversal (Enterprise Edition on Exadata or ODA only):

```
alter pluggable database refresh mode manual from pdba@cdb2
       switchover;
```



The mechanisms of redo generation, propagation, and apply are not changed in a Multitenant environment. The configuration can be managed by the Data Guard Broker in the usual fashion.

All PDBs in the standby will have the same role and open mode. It is not, for example, possible to have some containers opened as snapshot standbys while others are mounted and applying redo. Similarly, the protection mode is an attribute of the entire configuration, not of individual containers. In an ADG environment, individual containers can however be open or closed.

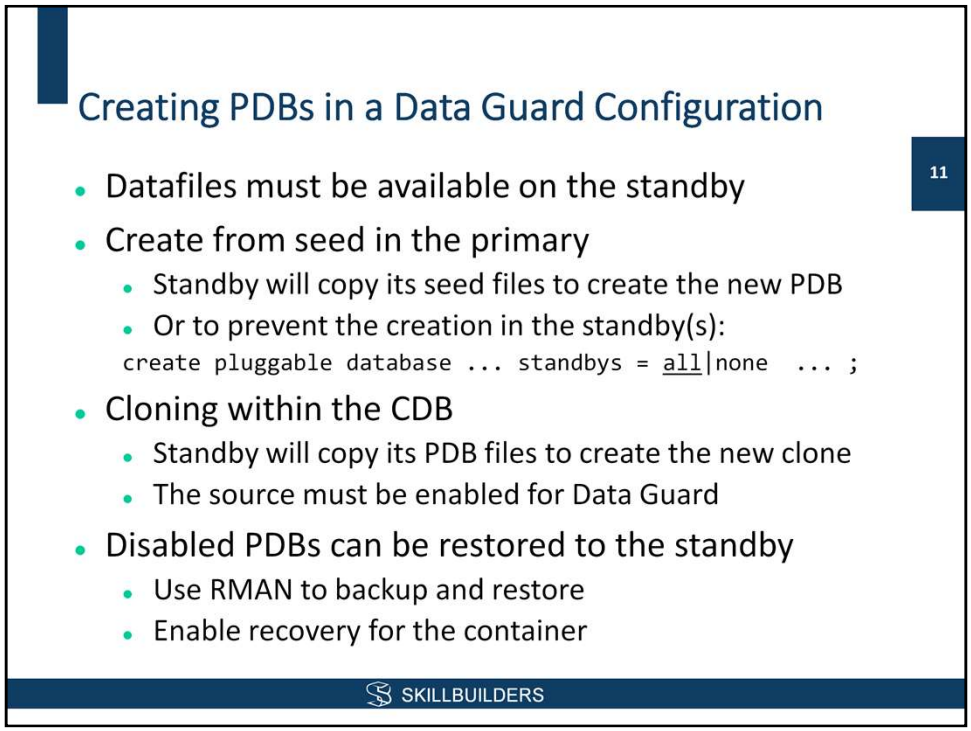
It is possible disable recovery for one or more PDBs. Stop recovery in the root container:

```
alter database recover managed standby database cancel;
```

And in the pluggable container, disable recovery:

```
alter pluggable database pdba disable recovery;
```

Then restart the recovery process. The recovery status of each container is shown in v$pdbs.recovery_status.



When creating PDBs from seed, because the standby does have a copy of the seed container the standby can use this to create the new PDB. When making a local clone, that too can be accomplished automatically by the standby.

If a PDB is create with STANDBYS=NONE or if recovery is disabled for a PDB, the logical structure is maintained in the standby but its datafiles are marked as UNNAMED and all change vectors for them are discarded.

To enable a previously disabled container:

Backup the container on the primary

Copy the backupset to the standby

Stop redo apply

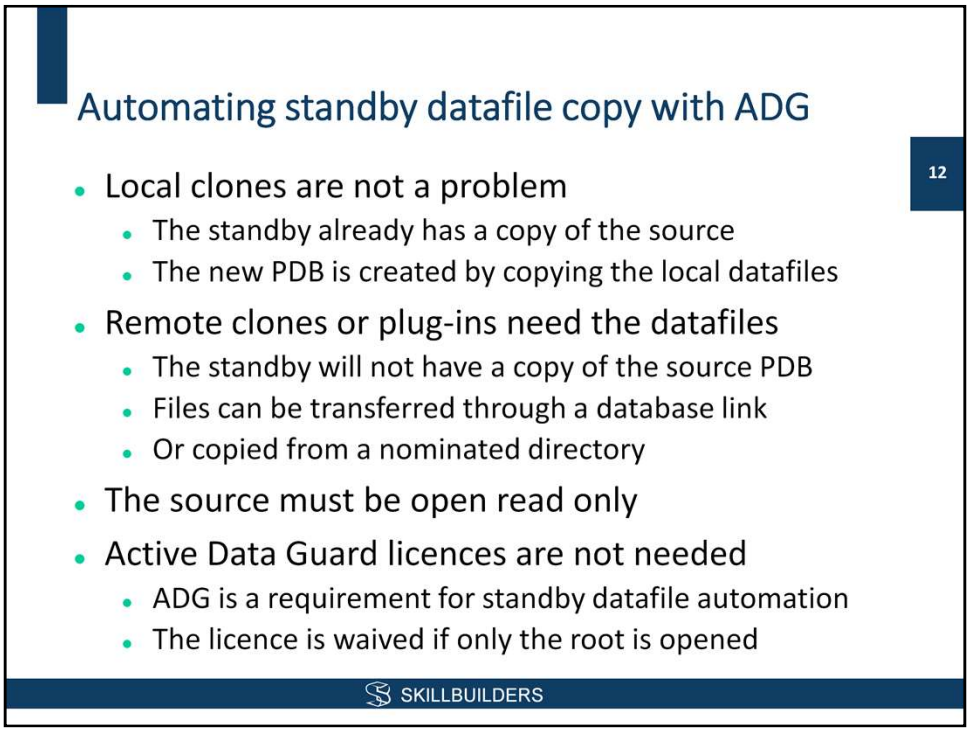
Catalog the backupset into the standby controlfile

Restore the PDB, using SET NEWNAME for files if necessary

Move your session to the PDB, and

alter pluggable database pdba enable recovery;

Start redo apply



In earlier releases, when creating a PDB via plugin or remote hot cloning over a database link the files had to be made visible to the standby in advance. By default, Oracle would look for them in the standby's OMF destination. If they were not there, redo apply would cease.

This issue can be avoided by setting STANDBY_PDB_SOURCE_FILE_DBLINK. The parameter is set to the name of the database link that primary will use to clone the remote PDB or non-CDB. The standby must be open read only, in order for it to be able to get the link details from its data dictionary.

Open the standby's root container read only, and set the parameter to point to the link. Then it should be possible to perform a remote hot clone: the datafiles will be copied to both primary and standby over the database link.

An alternative is to copy the datafiles to a directory on the standby server, create an Oracle directory pointing to this location, and set STANDBY_PDB_SOURCE_FILE_DIRECTORY to the directory. The files will be found there, and copied into the OMF destination. Using NFS may be the best way to do this: the directory can then point straight to the source (PDB or non-CDB) OMF location. Then plug in to primary using the .XML manifest file, and the standby will copy the datafiles into its OMF location.

Whether the plugin is by hot clone or XML file, the operation is not "hot" because the source PDB or non-CDB must be read only throughout the whole operation.

Backup and recovery: summary

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- Perform from the root or within a PDB
- Within a PDB, RMAN is unchanged
- Granularity can be the CDB, PDB, or datafile
- Incomplete recovery of one PDB is possible
- Flashback of one PDB may be possible
- Data Guard is Multitenant aware
- RMAN duplications can be at PDB level

Exercise

- Backup the CDB and PDBs
- Complete recovery of a PDB
- Incomplete recovery of a PDB
- Database flashback
- Configure and manage physical standby

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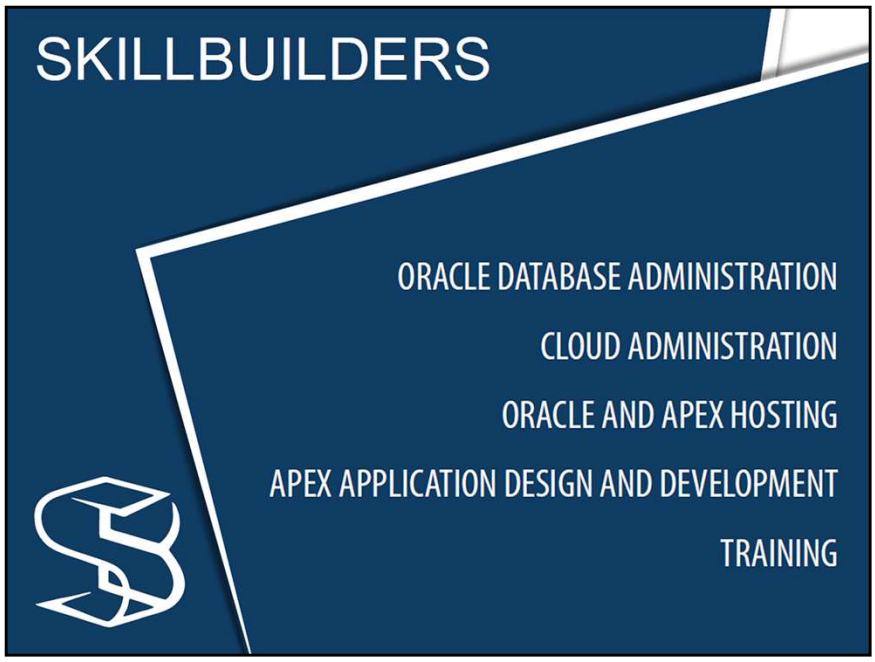
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ORACLE AND APEX HOSTING
APEX APPLICATION DESIGN AND DEVELOPMENT
TRAINING