Oracle Database 19c: Backup and Recovery

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Course Practice Environment:
Security Credentials

Course Practice Environment: Security Credentials

For operating system (OS) user names and passwords:

- Ask your instructor for credential information.

For product-specific credentials used in this course, see the following table:

Product-Specific Credentials		
Product/Application	**Username**	**Password**
Database	`SYS`	`fenago`
Database	`SYSTEM`	`fenago`
Database	`RCATOWNER`	`fenago`
Database (ORCLCDB)	`SYS`	`fenago`
Database (ORCLCDB)	`SYSTEM`	`fenago`

Practices for Lesson 1:
Backup and Recovery Overview

Practices for Lesson 1

There are no practices for Lesson 1.

Practices for Lesson 2: Backup and Recovery Configuration

Practices for Lesson 2: Overview

Overview

In these practices, you learn how to configure your database to enable recovery from various losses. You verify the control file configuration, the fast recovery area (FRA), redo log groups, ARCHIVELOG mode, and redundant archive log destinations.

How to configure your database for recovery:

- Ensure redundancy of control files. If a control file is damaged or lost, recovery is easier if you have another copy.
- Review the fast recovery area configuration.
- Ensure that there are at least two redo log members in each group. If a redo log member is damaged or lost, recovery is easier when you have an additional member in the group.
- Place your database in ARCHIVELOG mode. In all cases, you will be able to recover the database either completely or incompletely depending on which database files have been damaged or lost.
- Configure redundant archive log destinations. In cases where you lost archive log files and you need them to recover the database, you will be able to perform an incomplete recovery, unless you have a duplicate version of the archive log in another destination.

Prerequisites:

- Ensure you have access to an Oracle 19c environment.
- You must have the necessary privileges to start the listener and the database.

Steps:

1. Open the Terminal: On your system, open the terminal (or command prompt) application.

2. Enter the following command as root user: **xhost +**

3. Switch to the Oracle User: To switch to the `oracle` user, enter the following command:

su - oracle

Password is not required for the oracle user.

4. Start the Listener: The listener is a crucial component in Oracle as it listens for incoming client connection requests and manages traffic to the database.

To start the listener, enter the following command:

lsnrctl start

lsnrctl status

Wait for a message indicating that the listener has successfully started.

Practice 2-1: Verifying that the Control File is Multiplexed

Overview

In this practice, you verify that the control file is multiplexed.

A control file is a small binary file that describes the structure of the database. It must be available for writing by the Oracle server whenever the database is mounted or opened. Without this file, the database cannot be mounted, and recovery or re-creation of the control file is required. Your database should have a minimum of two control files on different storage devices to minimize the impact of a loss of one control file. The loss of a single control file causes the instance to fail because all control files must be available at all times. However, recovery can be a simple matter of copying one of the other control files. The loss of all control files is slightly more difficult to recover from, but is not usually catastrophic.

Assumptions

You are logged in as the `oracle` user.

Time Estimate

It should take approximately 25 minutes to complete this practice.

Tasks

1. Open a terminal window and use the `oraenv` script to set the environment variables for the `orclcdb` container database.

```
$ . oraenv
ORACLE_SID = [orclcdb] ?
The Oracle base remains unchanged with value /u01/app/oracle
$
```

2. Start SQL*Plus and connect to the CDB root as the `SYS` user with the `SYSDBA` privilege.

```
$ sqlplus / AS SYSDBA
…
Connected to an idle instance.
SQL>
```

3. If the database instance is not started, start the instance and open the database.

```
SQL> startup
ORACLE instance started.
…
Database mounted.
Database opened.
SQL>
```

4. Find out how many control files exist in the database. The query returns the names of two control files (`control01.ctl` and `control02.ctl`), which verifies that the control files are multiplexed.

```
SQL> SELECT name FROM v$controlfile;

NAME
----------------------------------------------------------------
/u01/app/oracle/oradata/ORCLCDB/control01.ctl
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl
SQL>
```

   When the CDB was created, DBCA created two control files. When you use the `CREATE DATABASE` command in SQL*Plus to create a database, you configure the `CONTROL_FILES` parameter to generate two control files and set their names.

5. View the `CONTROL_FILES` parameter. Notice that the paths to the control files are stored in this parameter. The results below are formatted for easier viewing.

```
SQL> SHOW PARAMETER control_files

NAME                                                     TYPE
----------------------------------------------------     -------
VALUE
--------------------------------------------------------
control_files                                            string
/u01/app/oracle/oradata/ORCLCDB/control01.ctl,
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl
SQL>
```

6. Create a parameter file (PFILE) from the server parameter file (SPFILE).

```
SQL> CREATE PFILE FROM SPFILE;

File created.

SQL>
```

7. Shut down the database instance in `IMMEDIATE` mode.

```
SQL> SHUTDOWN IMMEDIATE
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL>
```

8. Exit SQL*Plus.

```
SQL> EXIT
```

9. Create a directory for the new control file.

```
$ mkdir -p /u01/app/oracle/controlfiles_dir/ORCLCDB
$
```

10. Before you edit your PFILE, make a backup of it.

```
$ cp $ORACLE_HOME/dbs/initorclcdb.ora
$ORACLE_HOME/dbs/backup_initorclcdb.ora
$
```

11. Copy one of the control files to the directory you created in a previous step (`/u01/app/oracle/controlfiles_dir/ORCLCDB`) and name the file `control03.ctl`.

```
$ cp /u01/app/oracle/oradata/ORCLCDB/control01.ctl
/u01/app/oracle/controlfiles_dir/ORCLCDB/control03.ctl
$
```

12. Open the PFILE (`initorclcdb.ora`) in the editor of your choice (`vi` or `gedit`) and add the name of the new control file to the end of the list of control files. Include the path. Be certain not to enter spaces between the single quotes and commas in the `control_files=` line. Be certain that this line is one continuous line, without line breaks. Save and close the file.

```
$ vi $ORACLE_HOME/dbs/initorclcdb.ora
...
*.control_files='/u01/app/oracle/oradata/ORCLCDB/control01.ctl',
'/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl',
'/u01/app/oracle/controlfiles_dir/ORCLCDB/control03.ctl'
...
$
```

13. Start SQL*Plus and connect to the root container as the `SYS` user with the `SYSDBA` privilege. You are connected to an idle instance.

```
$ sqlplus / AS SYSDBA
…
Connected to an idle instance.

SQL>
```

14. Start the database instance.

```
SQL> STARTUP
ORACLE instance started.
…
Database mounted.
Database opened.
SQL>
```

15. View the CONTROL_FILES parameter again.

```
SQL> SHOW PARAMETER control_files

NAME                                 TYPE
------------------------------------ -----------
VALUE
------------------------------
control_files                        string
/u01/app/oracle/oradata/ORCLCDB/control01.ctl,
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl
SQL>
```

Question: Why does the CONTROL_FILES parameter still show only two control files?

Answer: By default, the database instance starts up with the SPFILE. If an SPFILE does not exist, then the instance starts up with a PFILE. In this case, both an SPFILE and PFILE are present, so the SPFILE takes precedence. You configured the PFILE, not the SPFILE. The SPFILE still contains only two references.

16. Re-create the third control file because the current version is no longer an exact copy of the others.

    a. Shut down the database instance with the IMMEDIATE option.

```
SQL> SHUTDOWN IMMEDIATE
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL>
```

    b. Exit SQL*Plus.

```
SQL> EXIT
```

    c. Use the cp command to re-create control03.ctl.

```
$ yes | cp –rf /u01/app/oracle/oradata/ORCLCDB/control01.ctl
/u01/app/oracle/controlfiles_dir/ORCLCDB/control03.ctl
$
```

17. Re-create the SPFILE from the updated PFILE.

    a. Start SQL*Plus and connect to the CDB root as the SYS user with the SYSDBA privilege. You are connected to an idle instance.

```
$ sqlplus / AS SYSDBA
…
Connected to an idle instance.

SQL>
```

b. Create the SPFILE.

```
SQL> CREATE SPFILE FROM PFILE;

File created.

SQL>
```

18. Start the database instance.

```
SQL> STARTUP
ORACLE instance started.
…
Database mounted.
Database opened.
SQL>
```

19. View the `CONTROL_FILES` parameter again. The third control file is now included in the list, which indicates that the SPFILE is configured properly. The results below are formatted for easier viewing.

```
SQL> SHOW PARAMETER control_files

NAME                                 TYPE
------------------------------------ ----------------
VALUE
------------------------------
control_files                        string
/u01/app/oracle/oradata/ORCLCDB/control01.ctl,
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl,
/u01/app/oracle/controlfiles_dir/ORCLCDB/control03.ctl
SQL>
```

20. Query the `V$CONTROLFILE` view to confirm the number of control files. The result indicates that three control files are defined.

```
SQL> SELECT name FROM v$controlfile;

NAME
-----------------------------------------------------------------
/u01/app/oracle/oradata/ORCLCDB/control01.ctl
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl
/u01/app/oracle/controlfiles_dir/ORCLCDB/control03.ctl
SQL>
```

Practice 2-2: Configuring the Size of the Fast Recovery Area

Overview

In this practice, you review the fast recovery area (FRA) configuration and change its size to 12 GB.

Assumptions

You are logged in to SQL*Plus from the previous practice.

Time Estimate

It should take approximately 15 minutes to complete this practice.

Tasks

1. Evaluate the space needed for the FRA. The amount of disk space to allocate for the FRA depends on the size and activity levels of your database. As a general rule, the larger the FRA, the more useful it is. Ideally, the FRA should be large enough for copies of your data and control files, as well as for flashback, online redo, and archived logs needed to recover the database with the backups kept based on the retention policy (covered in one of the next practices). In short, the FRA should be at least twice the size of the database so that it can hold one backup and several archived logs.

   View the values of the DB_RECOVERY_FILE_DEST and DB_RECOVERY_FILE_DEST_SIZE initialization parameters.

   ```
   SQL> SHOW PARAMETER db_recovery_file_dest

   NAME                                 TYPE
   ------------------------------------ -----------
   VALUE
   ------------------------------
   db_recovery_file_dest                string
   /u01/app/oracle/fast_recovery_area
   db_recovery_file_dest_size           big integer
   14970M
   SQL>
   ```

   Question: Is the fast recovery area enabled?

   Answer: Yes. The DB_RECOVERY_FILE_DEST and DB_RECOVERY_FILE_DEST_SIZE parameters values are not null, indicating that the fast recovery area is enabled.

   Question: What changes can you make to the fast recovery area?

   Answer: You can change the location and size of the fast recovery area.

Question: Does changing the size of the fast recovery area require the database to be restarted?

Answer: No, a restart is not required for this change because the `DB_RECOVERY_FILE_DEST_SIZE` parameter is dynamic.

2. Change the size of the fast recovery area to `12GB` and set the scope to `BOTH`.

```
SQL> ALTER SYSTEM SET db_recovery_file_dest_size = 12G
SCOPE=both;

System altered.

SQL>
```

Note: If the archived redo log file destination fills up or cannot be written to, the database will halt. You would then need to remove archived redo log files from the archived redo log file destination so that the database could resume operations. This activity is covered in one of the next practices.

3. View the `DB_RECOVERY_FILE_DEST_SIZE` initialization parameter again. The result verifies that the size has been set to `12GB`.

```
SQL> SHOW PARAMETER db_recovery_file_dest_size

NAME                                TYPE        VALUE
----------------------------------- ----------- ------------------------------
db_recovery_file_dest_size          big integer 12G
SQL>
```

Practice 2-3: Verifying that the Redo Log File Is Multiplexed

Overview

Ensure that there are at least two redo log members in each group. If you are using file system storage, then each member should be distributed on separate disks or controllers so that no single equipment failure impacts an entire log group. The loss of an entire current log group is one of the most serious media failures because it can result in data loss. The loss of a single member of a multi-member log group does not affect database operation (other than causing an alert to be published in the alert log). One set of members should be stored in the FRA.

Assumptions

You are logged in to SQL*Plus from the previous practice.

Time Estimate

It should take approximately 30 minutes to complete this practice.

Tasks

1. Query `V$LOGFILE` to determine the configuration (number of members) for each redo log group. The result shows that there are currently three log groups (1, 2, and 3) and only one member in each group.

```
SQL> SELECT group#, status, member FROM v$logfile;

 GROUP# STATUS  MEMBER
------- ------- ----------------------------------------------
      3         /u01/app/oracle/oradata/ORCLCDB/redo03.log
      2         /u01/app/oracle/oradata/ORCLCDB/redo02.log
      1         /u01/app/oracle/oradata/ORCLCDB/redo01.log

SQL>
```

   Question: Why is it recommended to have three groups when two would be sufficient?

   Answer: The Oracle Database server treats the online redo log groups as a circular buffer in which to store transaction information, filling one group and then moving on to the next. After all groups have been written to, the Oracle Database server begins overwriting information in the first log group. If the database is configured in `ARCHIVELOG` mode, the LGWR cannot overwrite data in the first log group if it has not been archived.

   Question: Can multiplexing redo logs impact database performance?

   Answer: Multiplexing redo logs may heavily influence database performance because a commit cannot complete until the transaction information has been written to the logs by LGWR. You must place your redo log files on your fastest disks served by your fastest controllers. If possible, do not place any other database files on the same disks as your redo log files. Because only one group is written to at a given time, there is no performance impact in having members from several groups on the same disk.

2. Add another member to each redo log group. Name each member `redonnb.log`, where *nn* represents the group number.

```
SQL> ALTER DATABASE ADD LOGFILE MEMBER
'/u01/app/oracle/fast_recovery_area/ORCLCDB/redo01b.log' TO
GROUP 1;

Database altered.

SQL> ALTER DATABASE ADD LOGFILE MEMBER
'/u01/app/oracle/fast_recovery_area/ORCLCDB/redo02b.log' TO
GROUP 2;

Database altered.

SQL> ALTER DATABASE ADD LOGFILE MEMBER
'/u01/app/oracle/fast_recovery_area/ORCLCDB/redo03b.log' TO
GROUP 3;

Database altered.

SQL>
```

3. Verify that the redo log files are now multiplexed. The query result shows that each group has two members, and therefore, the redo log files are multiplexed. Observe the `INVALID` status of the newly added redo log members. This status is expected because the new members have not yet been written to by LGWR. When a log switch occurs and the group containing the new member becomes `CURRENT`, the new member's status will change to null.

```
SQL> SELECT group#, status, member FROM v$logfile ORDER BY 1, 3;

 GROUP# STATUS  MEMBER
---------- ---------- ------------------------------------------------------------
      1 INVALID
/u01/app/oracle/fast_recovery_area/ORCLCDB/redo01b.log

      1
/u01/app/oracle/oradata/ORCLCDB/redo01.log

      2 INVALID
/u01/app/oracle/fast_recovery_area/ORCLCDB/redo02b.log

      2
/u01/app/oracle/oradata/ORCLCDB/redo02.log
```

```
     3 INVALID
/u01/app/oracle/fast_recovery_area/ORCLCDB/redo03b.log

     3
/u01/app/oracle/oradata/ORCLCDB/redo03.log

6 rows selected.

SQL>
```

4. Switch the log files and observe the changes.

   a. Find out which log group is the current log group. In this example, the query result shows that group 1 is the current group. Your current group may be different.

```
SQL> SELECT group#, members, archived, status FROM v$log;

    GROUP#    MEMBERS ARC STATUS
---------- ---------- --- ----------------
         1          2 NO  CURRENT
         2          2 NO  INACTIVE
         3          2 NO  INACTIVE
SQL>
```

   b. Switch the log files three times.

```
SQL> ALTER SYSTEM SWITCH LOGFILE;

System altered.

SQL> ALTER SYSTEM SWITCH LOGFILE;

System altered.

SQL> ALTER SYSTEM SWITCH LOGFILE;

System altered.

SQL>
```

c. Query the V$LOGFILE view again. Notice that as a result of the log file switch, the new members' statuses have changed to null.

```
SQL> SELECT group#, status, member FROM v$logfile ORDER BY 1, 3;

GROUP# STATUS
--------- ----------
MEMBER
--------------------------------------------------------------------------------
     1
/u01/app/oracle/fast_recovery_area/ORCLCDB/redo01b.log

     1
/u01/app/oracle/oradata/ORCLCDB/redo01.log

     2
/u01/app/oracle/fast_recovery_area/ORCLCDB/redo02b.log

     2
/u01/app/oracle/oradata/ORCLCDB/redo02.log

     3
/u01/app/oracle/fast_recovery_area/ORCLCDB/redo03b.log

     3
/u01/app/oracle/oradata/ORCLCDB/redo03.log

6 rows selected.

SQL>
```

d. Query the V$LOG view again to learn which log group is now the current group. In this example, the results show that the LGWR is writing to group 1. Your group may be different. Your statuses may be different too. An INACTIVE status means the log group is no longer needed for database instance recovery.

```
SQL> SELECT group#, members, archived, status FROM v$log;

 GROUP#    MEMBERS ARC STATUS
---------- ---------- --- ----------------
      1          2 NO  CURRENT
      2          2 NO  INACTIVE
      3          2 NO  INACTIVE
SQL>
```

e. Switch the log file.

```
SQL> ALTER SYSTEM SWITCH LOGFILE;

System altered.

SQL>
```

f. Query the V$LOG view again. The current group has changed to group 2, and the former current group's status is now ACTIVE. Your current group may be different. An ACTIVE status means that the log group is active, but it's not the current log group. It is needed for crash recovery. It may be in use for block recovery.

```
SQL> SELECT group#, members, archived, status FROM v$log;

  GROUP#    MEMBERS ARC STATUS
---------- ---------- --- ----------------
         1          2 NO  ACTIVE
         2          2 NO  CURRENT
         3          2 NO  INACTIVE
SQL>
```

g. Switch the log file again.

```
SQL> ALTER SYSTEM SWITCH LOGFILE;

System altered.

SQL>
```

h. Query the V$LOG view again. The current group has changed again to group 3, and the status of both the other groups is now ACTIVE. Your current group may be different.

```
SQL> SELECT group#, members, archived, status FROM v$log;

  GROUP#    MEMBERS ARC STATUS
---------- ---------- --- ----------------
         1          2 NO  ACTIVE
         2          2 NO  ACTIVE
         3          2 NO  CURRENT

SQL>
```

Question: Can the LGWR background process write to only one member of the CURRENT group in case the other members are missing or damaged?

Answer: Yes, it can. As long as there is one member left in the CURRENT group, LGWR can work.

5. To save space in your course practice environment, drop the redo log file members you created in step 4.
   a. Determine which redo log group is current. You cannot drop a member of the current group.

```
SQL> SELECT group#, status FROM v$log;

    GROUP# STATUS
---------- ----------------
         1 ACTIVE
         2 ACTIVE
         3 CURRENT
SQL>
```

   b. Drop the member in the previous group and then perform a log switch. In this example, group 3 is current, so the command in this example drops a member in group 2.

```
SQL> ALTER DATABASE DROP LOGFILE MEMBER
'/u01/app/oracle/fast_recovery_area/ORCLCDB/redo02b.log';

Database altered.

SQL> alter system switch logfile;

System altered.

SQL>
```

   c. Drop the member in the next group and then perform a log switch.

```
SQL> ALTER DATABASE DROP LOGFILE MEMBER
'/u01/app/oracle/fast_recovery_area/ORCLCDB/redo03b.log';

Database altered.

SQL> alter system switch logfile;

System altered.

SQL>
```

d. Drop the member in the final group and then perform a log switch.

```
SQL> ALTER DATABASE DROP LOGFILE MEMBER
'/u01/app/oracle/fast_recovery_area/ORCLCDB/redo01b.log';

Database altered.

SQL> alter system switch logfile;

System altered.

SQL>
```

e. Verify that each group now has only one member.

```
SQL> SELECT group#, members, archived, status FROM v$log;

    GROUP#    MEMBERS ARC STATUS
---------- ---------- --- ----------------
         1          1 NO  ACTIVE
         2          1 NO  ACTIVE
         3          1 NO  CURRENT

SQL>
```

f. Exit from SQL*Plus.

```
SQL> exit
…
$
```

g. Remove the physical files from the operating system.

```
$ rm –rf /u01/app/oracle/fast_recovery_area/ORCLCDB/redo*.log
$
```

h. Verify that the redo log files have been removed.

```
$ ls /u01/app/oracle/fast_recovery_area/ORCLCDB
archivelog  control02.ctl  onlinelog
$
```

Practice 2-4: Configuring ARCHIVELOG Mode

Overview

In this practice, you configure your database for ARCHIVELOG mode so that redo logs are archived.

Assumptions

You are logged in as the oracle user.

Time Estimate

It should take approximately 10 minutes to complete this practice.

Tasks

1. Log in to SQL*Plus as the SYS user with the SYSDBA privilege.

```
$ sqlplus / AS SYSDBA
…
SQL>
```

2. Issue the ARCHIVE LOG LIST command to determine whether the database is in ARCHIVELOG mode.

```
SQL> archive log list
Database log mode            No Archive Mode
Automatic archival           Disabled
Archive destination          USE_DB_RECOVERY_FILE_DEST
Oldest online log sequence   25
Current log sequence         27
SQL>
```

3. You must put the database in MOUNT mode to enable archiving. Shut down the database instance, start it in MOUNT mode, and then enable archiving.

   a. Shut down the database instance.

```
SQL> shutdown immediate
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL>
```

b. Start the database instance and mount the database.

```
SQL> startup mount
ORACLE instance started.
…
Database mounted.
SQL>
```

c. Enable archiving.

```
SQL> alter database archivelog;

Database altered.

SQL>
```

d. Verify that the database is now in `ARCHIVELOG` mode.

```
SQL> archive log list
Database log mode              Archive Mode
Automatic archival             Enabled
Archive destination            USE_DB_RECOVERY_FILE_DEST
Oldest online log sequence     25
Next log sequence to archive   27
Current log sequence           27
SQL>
```

e. Open the database.

```
SQL> alter database open;

Database altered.

SQL>
```

4. Exit from SQL*Plus.

```
SQL> EXIT
…
$
```

Practices for Lesson 3: Using Recovery Manager (RMAN)

Practices for Lesson 3: Overview

Overview

In these practices, you will verify the default backup destination, set the RMAN display data and time format, verify that control file autobackup is configured, and verify the backup retention policy.

Practice 3-1: Configuring the Default Backup Destination

Overview

In this practice, you determine the default backup destination setting and create a backup in the default location.

Assumptions

You have a terminal window open with the environment variables set for the `ORCLCDB` database instance.

Timing Estimate

It should take approximately 5 minutes to complete this practice.

Tasks

1. The `DB_RECOVERY_FILE_DEST` parameter specifies the default location for the fast recovery area. View the parameter value by logging in to SQL*Plus and using the `SHOW PARAMETER` command.

```
$ sqlplus / as sysdba
…
SQL> show parameter db_recovery_file_dest

NAME                                 TYPE        VALUE
------------------------------------ ----------- ----------------
db_recovery_file_dest                string
/u01/app/oracle/fast_recovery_area
db_recovery_file_dest_size           big integer 12G

SQL> exit
$
```

2. Log in to RMAN, execute the `BACKUP DATABASE` command, and then exit RMAN.

```
$ rman target "'/ as sysbackup'"
…
RMAN> BACKUP DATABASE;
Starting backup at 18-JUN-19
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
…
Finished backup at 18-JUN-19
…
Finished Control File and SPFILE Autobackup at 18-JUN-19
RMAN> exit
```

Practice 3-2: Setting the Date and Time Format for RMAN

Overview

In this practice, you set the date/time format that RMAN uses for displaying time stamps. The default date format does not include the time of day information. You will be performing several backups and recoveries in the same day, and in some cases, you will need to determine which backup to use.

Assumptions

You completed Practice 3-1.

You have a terminal window open with the environment variables set for the `ORCLCDB` database instance.

Timing Estimate

It should take approximately 10 minutes to complete this practice.

Tasks

1. Set the `NLS_LANG` and `NLS_DATE_FORMAT` variables so that RMAN includes time information in any time stamp values.

   Use the editor of your choice (`vi`, `gedit`) and add the following two lines to the end of the `~/.bashrc` file:

   ```
   export NLS_LANG=american_america.al32utf8
   export NLS_DATE_FORMAT="yyyy-mm-dd:hh24:mi:ss"
   ```

   a. Run following command in the terminal as root user: **xhost +**

   b. In a terminal window, invoke your editor. This example uses the `gedit` editor.

   ```
   $ gedit ~/.bashrc
   ```

   c. Copy and paste by using the mouse buttons and icons in the editor, save your changes, and then close the `gedit` window.

   Note: If you are not copying and pasting the variables, double-check that the `NLS_LANG` value is written correctly with a letter “l”, not a digit “1”.

   d. View the modified file by using the `cat` command and apply the new settings.

   ```
   $ cat ~/.bashrc
   # .bashrc
   …
   export NLS_LANG=american_america.al32utf8
   export NLS_DATE_FORMAT="yyyy-mm-dd:hh24:mi:ss"

   $ . .bashrc
   $
   ```

2. Verify the settings by starting RMAN and listing the backups in the recovery catalog or from the control file.

   a. Log in to RMAN.

```
$ rman target "'/ as sysbackup'"
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN>
```

   a. List the backups and note the time stamp format. The output shows the most recent backups.

```
RMAN> list backup;
using target database control file instead of recovery catalog


List of Backup Sets
===================


BS Key  Type LV Size       Device Type Elapsed Time Completion
Time
---------- ------ --- -------------- --------------- ----------------- -----------------
----------
1       Full    1.37G      DISK        00:00:11     2019-06-
18:17:21:59
        BP Key: 1   Status: AVAILABLE  Compressed: NO  Tag:
TAG20190618T172148
        Piece Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019_06_18/
o1_mf_nnndf_TAG20190618T172148_gjl7fdf3_.bkp
  List of Datafiles in backup set 1
  File LV Type Ckp SCN    Ckp Time            Abs Fuz SCN Sparse
Name
  ------ --- ------ -------------- -------------------------- --------------- ---------
------
  1       Full 3133091    2019-06-18:17:21:48              NO
/u01/app/oracle/oradata/ORCLCDB/system01.dbf
…
BS Key  Type LV Size       Device Type Elapsed Time Completion
Time
---------- ------ --- -------------- --------------- ----------------- -----------------
----------
5       Full    17.95M     DISK        00:00:01     2019-06-
18:17:22:59
        BP Key: 5   Status: AVAILABLE  Compressed: NO  Tag:
TAG20190618T172258
```

```
        Piece Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/2019_06_18
/o1_mf_s_1011288178_gjl7hm7n_.bkp
  SPFILE Included: Modification time: 2019-06-18:14:56:57
  SPFILE db_unique_name: ORCLCDB
  Control File Included: Ckp SCN: 3133134      Ckp time: 2019-
06-18:17:22:58

RMAN>
```

3. **Tip:** Because the output of the RMAN commands can be quite long, consider using the RMAN `SPOOL LOG TO <file>` command to direct the output to your specified file.
   a. Optionally, enter `SPOOL LOG TO /tmp/test.log` in your RMAN window.
   b. Repeat the previous `LIST BACKUP` command.
   c. Note that the output is not displayed in your window. In a second terminal window, enter `cat /tmp/test.log` to view the output.
   d. Use `SPOOL LOG OFF` to stop directing output to the file.

Practice 3-3: Configuring RMAN Settings

Overview

In this practice, you configure or confirm RMAN settings for the following tasks:

- To back up the control file and server parameter file (SPFILE) each time RMAN takes a backup of anything in the `orclcdb` database
- To ensure that one redundant backup is kept

Then you perform a tablespace backup to verify these settings.

Assumptions

You completed Practice 3-2.

You have a terminal window open with the environment variables set for the `ORCLCDB` database instance.

Timing Estimate

It should take approximately 5 minutes to complete this practice.

Tasks

1. While still logged in to an RMAN session as `SYSBACKUP`, verify that control file autobackup is enabled.

```
RMAN> show controlfile autobackup;

RMAN configuration parameters for database with db_unique_name
ORCLCDB are:
CONFIGURE CONTROLFILE AUTOBACKUP ON; # default

RMAN>
```

2. View the current retention policy setting to verify that it is set to 1.

```
RMAN> show retention policy;

RMAN configuration parameters for database with db_unique_name
ORCLCDB are:
CONFIGURE RETENTION POLICY TO REDUNDANCY 1; # default

RMAN>
```

3. Determine which data file belongs to the `USERS` tablespace in `ORCLPDB1`.

```
RMAN> REPORT SCHEMA;
Report of database schema for database with db_unique_name
ORCLCDB

List of Permanent Datafiles
```

```
===========================
File Size(MB) Tablespace           RB segs Datafile Name
---- -------- -------------------- ------- ------------------------------
1    920      SYSTEM               YES
/u01/app/oracle/oradata/ORCLCDB/system01.dbf
3    850      SYSAUX               NO
/u01/app/oracle/oradata/ORCLCDB/sysaux01.dbf
…
12   342      ORCLPDB1:USERS       NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf
…
4    36       ORCLPDB2:TEMP        32767
/u01/app/oracle/oradata/ORCLCDB/orclpdb2/temp01.dbf

RMAN>
```

4. Back up the `USERS` tablespace in both the CDB and `ORCLPDB1`.

```
RMAN> BACKUP TABLESPACE users, ORCLPDB1:USERS;
Starting backup at 2019-06-18:18:04:29
using channel ORA_DISK_1
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00012
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf
…
Finished backup at 2019-06-18:18:04:31

Starting Control File and SPFILE Autobackup at 2019-06-
18:18:04:31
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_18/o1_mf_s_1011290671_gjl9xhwf_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 2019-06-
18:18:04:32

RMAN>
```

5. Exit RMAN.

```
RMAN> exit

Recovery Manager complete.
$
```

6. Close the terminal window opened for this practice.

Practices for Lesson 4: Backup Strategies

Practices for Lesson 4

There are no practices for Lesson 4.

Practices for Lesson 5: Creating Database Backups

Practices for Lesson 5: Overview

Overview

In these practices, you will create a script file that can be used to re-create the control file. You will also create a whole database backup and a partial database backup.

Practice 5-1: Backing Up the Control File

Overview

In this practice, you back up your control file to a trace file and then create a file of SQL commands that can be used to re-create the control file.

Tip

The loss of a single control file causes the database instance to fail because all control files must be available at all times. However, recovery can be a simple matter of copying one of the other control files. The loss of all control files is slightly more difficult to recover from, but is not usually catastrophic as long as you created a copy of the control file by backing it up to a trace file.

Assumptions

You are logged in as the `oracle` user.

Timing Estimate

It should take approximately 20 minutes to complete this practice.

Tasks

1. Open a terminal window and use the `oraenv` script to set the environment variables for the `ORCLCDB` database.

```
$ . oraenv
ORACLE_SID = [orclcdb] ?
The Oracle base remains unchanged with value /u01/app/oracle
$
```

2. Make sure the database and listener is running.

```
$ lsnrctl status


```

3. Start SQL*Plus and connect to the CDB root as the `SYS` user with `SYSDBA` privileges.

```
$ sqlplus / as sysdba
…

SQL>
```

4. Verify that the control files are multiplexed.

```
SQL> SELECT name FROM v$controlfile;

NAME
--------------------------------------------------------------------------------
/u01/app/oracle/oradata/ORCLCDB/control01.ctl
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl
/u01/app/oracle/controlfiles_dir/ORCLCDB/control03.ctl

SQL>
```

5. Back up the control file to a trace file.

```
SQL> ALTER DATABASE BACKUP controlfile TO trace;

Database altered.

SQL>
```

6. Exit SQL*Plus.

```
SQL> EXIT
…
$
```

7. Navigate to the directory that contains the alert log file and trace files.

```
$ cd /u01/app/oracle/diag/rdbms/orclcdb/orclcdb/trace
[trace]$
```

8. List the files in this directory. Notice that the directory contains the alert log (`alert_orclcdb.log`) and many trace files (`.trc`).

```
[trace]$ ls
alert_orclcdb.log               orclcdb_ora_8708.trc
orclcdb_dia0_12061_base_1.trc  orclcdb_ora_8708.trm
…
[trace]$
```

9. View the end of the alert log and make note of the last trace file created as a backup for the control file. In this example, it is `orclcdb_ora_8708.trc`. Your file name will be different.

```
[trace]$ tail alert_orclcdb.log
…
alter database backup controlfile to trace
2019-06-20T13:24:51.885054+00:00
Backup controlfile written to trace file
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/trace/orclcdb_ora_8708.trc
Completed: alter database backup controlfile to trace
…
```

```
[trace]$
```

10. View the content of the last generated trace file by using the `cat` command. Make sure to substitute the name of the trace file with your trace file name.

    Between the lines "` -- Set #1. NORESETLOGS case`" and "` -- Set #2. RESETLOGS case`", select the code from `STARTUP NOMOUNT` to `ALTER SESSION SET CONTAINER = CDB$ROOT;` and copy it to the clipboard.

    Note: The file names in your database will likely differ from the file names shown in this example.

```
[trace]$ gedit orclcdb_ora_UPDATE_FILE_NUMBER.trc
…
STARTUP NOMOUNT
CREATE CONTROLFILE REUSE DATABASE "ORCLCDB" NORESETLOGS
ARCHIVELOG
    MAXLOGFILES 16
    MAXLOGMEMBERS 3
    MAXDATAFILES 1024
    MAXINSTANCES 8
    MAXLOGHISTORY 292
LOGFILE
  GROUP 1 '/u01/app/oracle/oradata/ORCLCDB/redo01.log'  SIZE
200M BLOCKSIZE 512,
  GROUP 2 '/u01/app/oracle/oradata/ORCLCDB/redo02.log'  SIZE
200M BLOCKSIZE 512,
  GROUP 3 '/u01/app/oracle/oradata/ORCLCDB/redo03.log'  SIZE
200M BLOCKSIZE 512
-- STANDBY LOGFILE
DATAFILE
  '/u01/app/oracle/oradata/ORCLCDB/system01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/sysaux01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/undotbs01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/pdbseed/system01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/pdbseed/sysaux01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/users01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/pdbseed/undotbs01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/orclpdb1/sysaux01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/orclpdb2/system01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/orclpdb2/sysaux01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/orclpdb2/undotbs01.dbf',
  '/u01/app/oracle/oradata/ORCLCDB/orclpdb2/users01.dbf'
CHARACTER SET AL32UTF8
```

```
;
-- Commands to re-create incarnation table
-- Below log names MUST be changed to existing filenames on
-- disk. Any one log file from each branch can be used to
-- re-create incarnation records.
-- ALTER DATABASE REGISTER LOGFILE
'/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_06_2
0/o1_mf_1_1_%u_.arc';
-- ALTER DATABASE REGISTER LOGFILE
'/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_06_2
0/o1_mf_1_1_%u_.arc';
-- Recovery is required if any of the datafiles are restored
backups,
-- or if the last shutdown was not normal or immediate.
RECOVER DATABASE
-- All logs need archiving and a log switch is needed.
ALTER SYSTEM ARCHIVE LOG ALL;
-- Database can now be opened normally.
ALTER DATABASE OPEN;
-- Open all the PDBs.
ALTER PLUGGABLE DATABASE ALL OPEN;
-- Commands to add tempfiles to temporary tablespaces.
-- Online tempfiles have complete space information.
-- Other tempfiles may require adjustment.
ALTER TABLESPACE TEMP ADD TEMPFILE
'/u01/app/oracle/oradata/ORCLCDB/temp01.dbf'
     SIZE 137363456  REUSE AUTOEXTEND ON NEXT 655360  MAXSIZE
32767M;
ALTER SESSION SET CONTAINER = "PDB$SEED";
ALTER TABLESPACE TEMP ADD TEMPFILE
'/u01/app/oracle/oradata/ORCLCDB/pdbseed/temp012019-05-08_01-48-
43-006-AM.dbf'
     SIZE 37748736  REUSE AUTOEXTEND ON NEXT 655360  MAXSIZE
32767M;
ALTER SESSION SET CONTAINER = "ORCLPDB1";
ALTER TABLESPACE TEMP ADD TEMPFILE
'/u01/app/oracle/oradata/ORCLCDB/orclpdb1/temp01.dbf'
     SIZE 37748736  REUSE AUTOEXTEND ON NEXT 655360  MAXSIZE
32767M;
ALTER SESSION SET CONTAINER = "ORCLPDB2";
ALTER TABLESPACE TEMP ADD TEMPFILE
'/u01/app/oracle/oradata/ORCLCDB/orclpdb2/temp01.dbf'
     SIZE 37748736  REUSE AUTOEXTEND ON NEXT 655360  MAXSIZE
32767M;
ALTER SESSION SET CONTAINER = "CDB$ROOT";
```

```
…
[trace]$
```

11. Open an editor and paste the code you copied in the previous step into a new file named **ControlFileBackup.sql** in the /home/oracle directory and then save the file.

```
[trace]$ cd $HOME
$ vi ControlFileBackup.sql
Paste the code from the previous step into the file.
$
```

Question: Which command would allow the re-creation of the control files in case of a complete loss of the control files?

Answer: In the case where all control files are lost, the CREATE CONTROLFILE command in the trace file would re-create the missing control files with the right information, keeping the database file structure in terms of data files, redo log files, and other database attributes (ARCHIVELOG, maximum settings).

Question: How would you execute the command?

Answer: After trimming the trace file by keeping all commands from the STARTUP NOMOUNT up to ALTER SESSION SET CONTAINER = CDB$ROOT;, you would execute the file as a SQL script.

Question: Are the data files, temp files, and control files that structure the ORCLCDB database included in the SQL script?

Answer: Yes, they are included. All data and temp files of the different containers (the CDB root, CDB seed, PDB1, and so on) and the multiplexed redo log files are present.

Question: Which other attributes structure the ORCLCDB database?

Answer: The ARCHIVELOG mode, the character set, and the name of the CDB

Question: Why are there two cases—Set #1. NORESETLOGS and Set #2. RESETLOGS?

Answer: The first case from the STARTUP NOMOUNT to the ALTER SESSION SET CONTAINER = CDB$ROOT provides a script to execute a complete database recovery. Use this only if the current versions of all online logs are available. The second case provides a script to execute an incomplete database recovery. Use this only if online logs are damaged. The contents of online logs will be lost, and all backups will be invalidated.

Question: When would you have to regenerate the trace file from the current control files?

Answer: Because the control file changes after each data file or redo log file change (adding, removing, resizing) or database attribute change (ARCHIVELOG), you would have to redo the backup of your control file to a trace file.

Practice 5-2: Verifying Automatic Backups of the Control File and SPFILE

Overview

In this practice, you use Recovery Manager (RMAN) to configure automatic backups of the control file and server parameter file (SPFILE) when a backup of the database is made and when there is a structural change to the database.

Assumptions

You are logged in to the compute node as the `oracle` user.

Timing Estimate

It should take approximately 10 minutes to complete this practice.

Tasks

1. Start Recovery Manager and connect to the CDB root (target database) as the `SYS` user.

```
$ rman target /
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN>
```

2. Show all RMAN settings. Notice the `CONFIGURE CONTROLFILE AUTOBACKUP ON;` setting.

```
RMAN> SHOW ALL;
using target database control file instead of recovery catalog
RMAN configuration parameters for database with db_unique_name
ORCLCDB are:
CONFIGURE RETENTION POLICY TO REDUNDANCY 1; # default
CONFIGURE BACKUP OPTIMIZATION OFF; # default
CONFIGURE DEFAULT DEVICE TYPE TO DISK; # default
CONFIGURE CONTROLFILE AUTOBACKUP ON; # default
CONFIGURE CONTROLFILE AUTOBACKUP FORMAT FOR DEVICE TYPE DISK TO
'%F'; # default
CONFIGURE DEVICE TYPE DISK PARALLELISM 1 BACKUP TYPE TO
BACKUPSET; # default
CONFIGURE DATAFILE BACKUP COPIES FOR DEVICE TYPE DISK TO 1; #
default
CONFIGURE ARCHIVELOG BACKUP COPIES FOR DEVICE TYPE DISK TO 1; #
default
CONFIGURE MAXSETSIZE TO UNLIMITED; # default
CONFIGURE ENCRYPTION FOR DATABASE OFF; # default
CONFIGURE ENCRYPTION ALGORITHM 'AES128'; # default
CONFIGURE COMPRESSION ALGORITHM 'BASIC' AS OF RELEASE 'DEFAULT'
OPTIMIZE FOR LOAD TRUE ; # default
CONFIGURE RMAN OUTPUT TO KEEP FOR 7 DAYS; # default
CONFIGURE ARCHIVELOG DELETION POLICY TO NONE; # default
CONFIGURE SNAPSHOT CONTROLFILE NAME TO
'/u01/app/oracle/product/19.3.0/dbhome_1/dbs/snapcf_orclcdb.f';
# default
RMAN>
```

Question: In your configuration, does RMAN automatically back up the control file and server parameter file (SPFILE) with every backup and database structural change?

Answer: Yes, it does because the `CONTROLFILE AUTOBACKUP` attribute is set to `ON`.

Question: Will a backup operation back up all control files or only one of the multiplexed control files?

Answer: It will back up only one of the multiplexed control files because all control files in a database are identical.

3. Exit RMAN.

```
RMAN> EXIT

Recovery Manager complete.
$
```

Practice 5-3: Creating a Whole Database Backup

Overview

In this practice, you use Recovery Manager to back up your entire database, including the archived redo log files, the SPFILE, and the control files. The backup should be the base for an incremental backup strategy.

Assumptions

You are logged in as the `oracle` user.

Timing Estimate

It should take approximately 30 minutes to complete this practice.

Tasks

1. Start Oracle Recovery Manager (RMAN) and connect to the CDB root as the `SYS` user.

```
$ rman target /
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN>
```

2. View the structure of the CDB in terms of PDBs, tablespaces, and data files (permanent and temporary). Your file numbers will differ from those shown below.

```
RMAN> REPORT schema;
Report of database schema for database with db_unique_name
ORCLCDB


List of Permanent Datafiles
===========================
File Size(MB) Tablespace           RB segs Datafile Name
---- -------- -------------------- ------- ------------------------
1    920      SYSTEM               YES
/u01/app/oracle/oradata/ORCLCDB/system01.dbf
3    850      SYSAUX               NO
/u01/app/oracle/oradata/ORCLCDB/sysaux01.dbf
4    330      UNDOTBS1             YES
/u01/app/oracle/oradata/ORCLCDB/undotbs01.dbf
5    270      PDB$SEED:SYSTEM      NO
/u01/app/oracle/oradata/ORCLCDB/pdbseed/system01.dbf
6    330      PDB$SEED:SYSAUX      NO
/u01/app/oracle/oradata/ORCLCDB/pdbseed/sysaux01.dbf
7    5        USERS                NO
/u01/app/oracle/oradata/ORCLCDB/users01.dbf
```

```
8    100      PDB$SEED:UNDOTBS1    NO
/u01/app/oracle/oradata/ORCLCDB/pdbseed/undotbs01.dbf
9    280      ORCLPDB1:SYSTEM      YES
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf
10   370      ORCLPDB1:SYSAUX      NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/sysaux01.dbf
11   100      ORCLPDB1:UNDOTBS1    YES
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01.dbf
12   342      ORCLPDB1:USERS       NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf
13   280      ORCLPDB2:SYSTEM      YES
/u01/app/oracle/oradata/ORCLCDB/orclpdb2/system01.dbf
14   370      ORCLPDB2:SYSAUX      NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb2/sysaux01.dbf
15   100      ORCLPDB2:UNDOTBS1    YES
/u01/app/oracle/oradata/ORCLCDB/orclpdb2/undotbs01.dbf
16   342      ORCLPDB2:USERS       NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb2/users01.dbf


List of Temporary Files
=======================
File Size(MB) Tablespace           Maxsize(MB) Tempfile Name
------ ----------- ---------------------------- --------------- ------------------------
1    131      TEMP                 32767
/u01/app/oracle/oradata/ORCLCDB/temp01.dbf
2    36       PDB$SEED:TEMP        32767
/u01/app/oracle/oradata/ORCLCDB/pdbseed/temp012019-05-08_01-48-
43-006-AM.dbf
3    36       ORCLPDB1:TEMP        32767
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/temp01.dbf
4    36       ORCLPDB2:TEMP        32767
/u01/app/oracle/oradata/ORCLCDB/orclpdb2/temp01.dbf


RMAN>
```

3. Back up the whole database. Your results will be different from the results shown below; for example, the piece handle names will be different.

```
RMAN> BACKUP DATABASE;


Starting backup at 2019-06-20:15:46:55
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=39 device type=DISK
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00001
name=/u01/app/oracle/oradata/ORCLCDB/system01.dbf
```

```
input datafile file number=00003
name=/u01/app/oracle/oradata/ORCLCDB/sysaux01.dbf
input datafile file number=00004
name=/u01/app/oracle/oradata/ORCLCDB/undotbs01.dbf
input datafile file number=00007
name=/u01/app/oracle/oradata/ORCLCDB/users01.dbf
channel ORA_DISK_1: starting piece 1 at 2019-06-20:15:46:56
channel ORA_DISK_1: finished piece 1 at 2019-06-20:15:47:11
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
_06_20/o1_mf_nnndf_TAG20190620T154656_gjqbmjks_.bkp
tag=TAG20190620T154656 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:15
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00010
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/sysaux01.dbf
input datafile file number=00012
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf
input datafile file number=00009
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf
input datafile file number=00011
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01.dbf
channel ORA_DISK_1: starting piece 1 at 2019-06-20:15:47:11
channel ORA_DISK_1: finished piece 1 at 2019-06-20:15:47:18
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B36632797E
5CE0536210ED0ADAC7/backupset/2019_06_20/o1_mf_nnndf_TAG20190620T
154656_gjqbmzl3_.bkp tag=TAG20190620T154656 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00014
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb2/sysaux01.dbf
input datafile file number=00016
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb2/users01.dbf
input datafile file number=00013
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb2/system01.dbf
input datafile file number=00015
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb2/undotbs01.dbf
channel ORA_DISK_1: starting piece 1 at 2019-06-20:15:47:18
channel ORA_DISK_1: finished piece 1 at 2019-06-20:15:47:25
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B419BF707E
73E0536210ED0A54C7/backupset/2019_06_20/o1_mf_nnndf_TAG20190620T
154656_gjqbn6qg_.bkp tag=TAG20190620T154656 comment=NONE
```

```
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00006
name=/u01/app/oracle/oradata/ORCLCDB/pdbseed/sysaux01.dbf
input datafile file number=00005
name=/u01/app/oracle/oradata/ORCLCDB/pdbseed/system01.dbf
input datafile file number=00008
name=/u01/app/oracle/oradata/ORCLCDB/pdbseed/undotbs01.dbf
channel ORA_DISK_1: starting piece 1 at 2019-06-20:15:47:25
channel ORA_DISK_1: finished piece 1 at 2019-06-20:15:47:32
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8857888C961176
10E0536210ED0A12EE/backupset/2019_06_20/o1_mf_nnndf_TAG20190620T
154656_gjqbnfv8_.bkp tag=TAG20190620T154656 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
Finished backup at 2019-06-20:15:47:32

Starting Control File and SPFILE Autobackup at 2019-06-
20:15:47:32
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_20/o1_mf_s_1011455252_gjqbno6q_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 2019-06-
20:15:47:33

RMAN>
```

Question: Do you have to shut down the database to back it up?

Answer: No, as long as the database is in ARCHIVELOG mode, the backup can take place while the database is opened. This is a hot backup (or online backup). A cold backup (or offline backup) is a backup completed while the database is closed and is required if the database is in NOARCHIVELOG mode.

Question: Are hot backups consistent?

Answer: Online backups are inconsistent because with the database opened, there is no guarantee that the data files are synchronized with the control files. However, offline backups taken while the database is not opened are consistent because, at the time of the backup, the system change number (SCN) in data file headers matches the SCN in the control files.

Question: How can hot backups (inconsistent backups) be used in complete database recovery?

Answer: During a complete recovery, restored online backups are recovered until the current SCN is matched, with the use of the archive log files and online redo log files.

Question: Did the backup include the SPFILE and control files?

Answer: Yes. This is the last operation completed at the end of the backup command.

```
…
Starting Control File and SPFILE Autobackup at 2019-06-
20:15:47:32
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_20/o1_mf_s_1011455252_gjqbno6q_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 2019-06-
20:15:47:33


RMAN>
```

Question: Does the complete operation create a single backup set?

Answer: No. The operation creates multiple backup sets.

- Four backup sets including data files (one for each of the containers): CDB root, PDB seed, ORCLPDB1, and ORCLPDB2
- One backup set for the SPFILE and control files.

4. List the backup sets. Look for Piece Name in the results for each backup set.

```
RMAN> LIST BACKUP;



List of Backup Sets
===================
…
BS Key  Type LV Size       Device Type Elapsed Time Completion
Time
------- ---- -- ---------- ----------- ------------ ------------
18      Full    1.40G      DISK        00:00:03     2019-06-
20:15:46:59
        BP Key: 18   Status: AVAILABLE  Compressed: NO  Tag:
TAG20190620T154656
        Piece Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019_06_20/
o1_mf_nnndf_TAG20190620T154656_gjqbmjks_.bkp
  List of Datafiles in backup set 18
  File LV Type Ckp SCN    Ckp Time            Abs Fuz SCN Sparse
Name
  ---- -- ---- ---------- ------------------- ----------- ------
  1       Full 3357562    2019-06-20:15:46:56              NO
/u01/app/oracle/oradata/ORCLCDB/system01.dbf
```

```
  3       Full 3357562    2019-06-20:15:46:56              NO
/u01/app/oracle/oradata/ORCLCDB/sysaux01.dbf
  4       Full 3357562    2019-06-20:15:46:56              NO
/u01/app/oracle/oradata/ORCLCDB/undotbs01.dbf
  7       Full 3357562    2019-06-20:15:46:56              NO
/u01/app/oracle/oradata/ORCLCDB/users01.dbf

BS Key  Type LV Size       Device Type Elapsed Time Completion
Time
------- ---- -- ---------- ----------- ------------ ----------
19      Full    574.40M    DISK        00:00:01     2019-06-
20:15:47:12
        BP Key: 19  Status: AVAILABLE  Compressed: NO  Tag:
TAG20190620T154656
        Piece Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B36632797E5CE0536
210ED0ADAC7/backupset/2019_06_20/o1_mf_nnndf_TAG20190620T154656_
gjqbmzl3_.bkp
  List of Datafiles in backup set 19
  Container ID: 3, PDB Name: ORCLPDB1
  File LV Type Ckp SCN    Ckp Time            Abs Fuz SCN Sparse
Name
  ---- -- ---- ---------- ------------------- ----------- ------
  9       Full 3357568    2019-06-20:15:47:11              NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf
  10      Full 3357568    2019-06-20:15:47:11              NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/sysaux01.dbf
  11      Full 3357568    2019-06-20:15:47:11              NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01.dbf
  12      Full 3357568    2019-06-20:15:47:11              NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf

BS Key  Type LV Size       Device Type Elapsed Time Completion
Time
------- ---- -- ---------- ----------- ------------ ----------
20      Full    574.20M    DISK        00:00:01     2019-06-
20:15:47:19
        BP Key: 20  Status: AVAILABLE  Compressed: NO  Tag:
TAG20190620T154656
        Piece Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B419BF707E73E0536
210ED0A54C7/backupset/2019_06_20/o1_mf_nnndf_TAG20190620T154656_
gjqbn6qg_.bkp
  List of Datafiles in backup set 20
  Container ID: 4, PDB Name: ORCLPDB2
  File LV Type Ckp SCN    Ckp Time            Abs Fuz SCN Sparse
Name
  ---- -- ---- ---------- ------------------- ----------- ------
  13       Full 3357571    2019-06-20:15:47:18              NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb2/system01.dbf
  14       Full 3357571    2019-06-20:15:47:18              NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb2/sysaux01.dbf
  15       Full 3357571    2019-06-20:15:47:18              NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb2/undotbs01.dbf
  16       Full 3357571    2019-06-20:15:47:18              NO
/u01/app/oracle/oradata/ORCLCDB/orclpdb2/users01.dbf

BS Key  Type LV Size       Device Type Elapsed Time Completion
Time
------- ---- -- ---------- ----------- ------------ ----------
21      Full    554.96M    DISK        00:00:01     2019-06-
20:15:47:26
        BP Key: 21  Status: AVAILABLE  Compressed: NO  Tag:
TAG20190620T154656
        Piece Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/8857888C96117610E0536
210ED0A12EE/backupset/2019_06_20/o1_mf_nnndf_TAG20190620T154656_
gjqbnfv8_.bkp
  List of Datafiles in backup set 21
  Container ID: 2, PDB Name: PDB$SEED
  File LV Type Ckp SCN    Ckp Time            Abs Fuz SCN Sparse
Name
  ---- -- ---- ---------- ------------------- ----------- ------
  5        Full 2158685    2019-05-08:01:59:54              NO
/u01/app/oracle/oradata/ORCLCDB/pdbseed/system01.dbf
  6        Full 2158685    2019-05-08:01:59:54              NO
/u01/app/oracle/oradata/ORCLCDB/pdbseed/sysaux01.dbf
  8        Full 2158685    2019-05-08:01:59:54              NO
/u01/app/oracle/oradata/ORCLCDB/pdbseed/undotbs01.dbf

BS Key  Type LV Size       Device Type Elapsed Time Completion
Time
------- ---- -- ---------- ----------- ------------ ----------
22      Full    17.95M     DISK        00:00:01     2019-06-
20:15:47:33
        BP Key: 22   Status: AVAILABLE  Compressed: NO  Tag:
TAG20190620T154732
        Piece Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/2019_06_20
/o1_mf_s_1011455252_gjqbno6q_.bkp
  SPFILE Included: Modification time: 2019-06-20:05:00:49
  SPFILE db_unique_name: ORCLCDB
  Control File Included: Ckp SCN: 3357584      Ckp time: 2019-
06-20:15:47:32


RMAN>
```

5. Exit RMAN.

```
RMAN> EXIT
```

6. Verify that the files are stored on disk in the FRA.

```
$ cd /u01/app/oracle/fast_recovery_area/ORCLCDB
$ ls -ltR
…
./8857B36632797E5CE0536210ED0ADAC7:
total 4
drwxr-x--- 4 oracle oinstall 4096 Jun 20 15:47 backupset

./8857B36632797E5CE0536210ED0ADAC7/backupset:
total 8
drwxr-x--- 2 oracle oinstall 4096 Jun 20 15:47 2019_06_20
drwxr-x--- 2 oracle oinstall 4096 Jun 18 19:39 2019_06_18

./8857B36632797E5CE0536210ED0ADAC7/backupset/2019_06_20:
total 588196
-rw-r----- 1 oracle oinstall 602308608 Jun 20 15:47
o1_mf_nnndf_TAG20190620T154656_gjqbmzl3_.bkp

./8857B36632797E5CE0536210ED0ADAC7/backupset/2019_06_18:
total 1305840
-rw-r----- 1 oracle oinstall  66494464 Jun 18 19:39
o1_mf_nnndf_TAG20190618T193903_gjlhgq5r_.bkp
-rw-r----- 1 oracle oinstall 602128384 Jun 18 19:29
o1_mf_nnndf_TAG20190618T192926_gjlgx5j1_.bkp
-rw-r----- 1 oracle oinstall  66494464 Jun 18 18:04
o1_mf_nnndf_TAG20190618T180429_gjl9xfgb_.bkp
-rw-r----- 1 oracle oinstall 602054656 Jun 18 17:22
o1_mf_nnndf_TAG20190618T172148_gjl7g5kp_.bkp

./onlinelog:
total 0
$
```

Question: Where are the backups of control files and SPFILE located?

Answer: They are created in the `autobackup` subdirectory.

Question: How are backups deleted?

Answer: Space management in the FRA is governed by a backup retention policy. A retention policy determines when files are obsolete, which means that they are no longer needed to meet your data recovery objectives. The Oracle Database server automatically manages this storage by deleting files that are no longer needed.

7. View the backup retention policy.

   a. Start RMAN and connect to the CDB root as the `SYS` user.

```
$ rman target /
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN>
```

   b. Issue the `SHOW RETENTION POLICY` command. The policy is `REDUNDANCY 1`.

```
RMAN> SHOW RETENTION POLICY;
using target database control file instead of recovery catalog
RMAN configuration parameters for database with db_unique_name
ORCLCDB are:
CONFIGURE RETENTION POLICY TO REDUNDANCY 1; # default

RMAN>
```

Question: How does Oracle determine when files are obsolete?

Answer: There are two retention policy parameters that are mutually exclusive:

- If a retention policy is enabled with `RECOVERY WINDOW OF 5 DAYS`, the window stretches from the current time (`SYSDATE`) to the point of recoverability, which is the earliest date to which you want to recover. The point of recoverability is `SYSDATE - integer days in the past`.
- If a retention policy is enabled with `REDUNDANCY r`, then RMAN skips backups only if at least *n* backups of an identical file exist on the specified device, where `n=r+1` (default is 1).

RMAN automatically deletes obsolete backup sets and copies in the FRA when space is needed.

8. Manually delete obsolete files by issuing the `DELETE OBSOLETE` command. If there are obsolete files, respond `YES` when prompted. Your results will differ from this example.

```
RMAN> delete obsolete;
RMAN retention policy will be applied to the command
RMAN retention policy is set to redundancy 1
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=32 device type=DISK
Deleting the following obsolete backups and copies:
Type                 Key    Completion Time    Filename/Handle
-------------------- ------ ------------------ ------------------
Backup Set           2      2019-06-18:17:22:22
```

```
  Backup Piece       2      2019-06-18:17:22:22
/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B36632797E5CE0536
210ED0ADAC7/backupset/2019_06_18/o1_mf_nnndf_TAG20190618T172148_
gjl7g5kp_.bkp
Backup Set           3      2019-06-18:17:22:37
…
Do you really want to delete the above objects (enter YES or
NO)? YES
deleted backup piece
backup piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B36632797E
5CE0536210ED0ADAC7/backupset/2019_06_18/o1_mf_nnndf_TAG20190618T
172148_gjl7g5kp_.bkp RECID=2 STAMP=1011288133
…
deleted archived log
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_20/o1_mf_1_35_gjq0tnsk_.arc RECID=9 STAMP=1011445205
Deleted 25 objects


RMAN>
```

9. Back up the database and archive logs as image copies. At the same time, free space in the FRA by deleting the archive log files once they are backed up.

   a. Perform the backup (it will take few minutes) .

```
RMAN> BACKUP AS COPY DATABASE PLUS ARCHIVELOG DELETE INPUT;


Starting backup at 2019-06-20:16:05:18
current log archived
using channel ORA_DISK_1
channel ORA_DISK_1: starting archived log copy
input archived log thread=1 sequence=36 RECID=10
STAMP=1011456318
output file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_20/o1_mf_1_36_gjqcoyl6_.arc RECID=11 STAMP=1011456318
channel ORA_DISK_1: archived log copy complete, elapsed time:
00:00:01
channel ORA_DISK_1: deleting archived log(s)
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_20/o1_mf_1_36_gjqcoy6m_.arc RECID=10 STAMP=1011456318
Finished backup at 2019-06-20:16:05:19
…
Starting Control File and SPFILE Autobackup at 2019-06-
20:16:06:27
```

```
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_20/o1_mf_s_1011456388_gjqcr4bo_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 2019-06-
20:16:06:29


RMAN>
```

Question: What would you do if an error such as the following occurs?

```
RMAN-00571:
===========================================================
RMAN-00569: =============== ERROR MESSAGE STACK FOLLOWS
===============
RMAN-00571:
===========================================================
RMAN-03002: failure of backup plus archivelog command at
06/20/2019 11:05:08
ORA-19809: limit exceeded for recovery files
ORA-19804: cannot reclaim 67108864 bytes disk space from
19327352832 bytes limit
```

Answer: Increase the `DB_RECOVERY_FILE_DEST_SIZE` parameter value to `30G` by issuing the following command:

```
RMAN> ALTER SYSTEM SET db_recovery_file_dest_size = 30G
SCOPE=both;
```

Question: What is the advantage of creating backups as image copies?

Answer: The advantage of creating a backup as an image copy is improved granularity of the restore operation. With an image copy, only the file or files need to be retrieved from your backup location. With backup sets, the entire backup set must be retrieved from your backup location before you extract the file or files that are needed.

Question: What is the advantage of creating backups as backup sets?

Answer: The advantage of creating backups as backup sets is better space usage. In most databases, 20% or more of the data blocks are empty blocks. Image copies back up every data block, even if the data block is empty. Backup sets significantly reduce the space required by the backup. In most systems, the advantages of backup sets outweigh the advantages of image copies.

Question: How many image copies of the data files are created?

Answer: There are 15 image copies, one image copy for each data file in the CDB, PDBs included.

10. Exit RMAN.

```
RMAN> EXIT
```

Practice 5-4: Creating Partial Database Backups

Overview

In this practice, you use Recovery Manager to back up ORCLPDB1, including the archived redo log files. You also back up a specific tablespace in ORCLPDB2.

Assumptions

You are logged in as the oracle user.

Time Estimate

It should take approximately 20 minutes to complete this practice.

Tasks

1. Start Recovery Manager (RMAN) and connect to the CDB root as the SYS user.

```
$ rman target /
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN>
```

2. Back up ORCLPDB1, including the archived redo log files.

```
RMAN> BACKUP PLUGGABLE DATABASE ORCLPDB1 PLUS ARCHIVELOG;
Starting backup at 2019-06-20:17:57:57
current log archived
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=37 device type=DISK
channel ORA_DISK_1: starting archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=36 RECID=11
STAMP=1011456318
input archived log thread=1 sequence=37 RECID=13
STAMP=1011456386
input archived log thread=1 sequence=38 RECID=14
STAMP=1011463077
channel ORA_DISK_1: starting piece 1 at 2019-06-20:17:57:58
channel ORA_DISK_1: finished piece 1 at 2019-06-20:17:57:59
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
_06_20/o1_mf_annnn_TAG20190620T175758_gjql96rc_.bkp
tag=TAG20190620T175758 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 2019-06-20:17:57:59
```

```
…
Starting Control File and SPFILE Autobackup at 2019-06-
20:17:58:08
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_20/o1_mf_s_1011463088_gjql9jrr_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 2019-06-
20:17:58:09
RMAN>
```

3. Exit RMAN.

```
RMAN> EXIT
…
$
```

Question: Did the partial backup automatically include the SPFILE and control files?

Answer: Yes. Autobackup is also valid for partial backups.

Question: How many backup sets are created?

Answer: Four backup sets: one for the PDB data files, one for the SPFILE and control file, one for the archived log files before the data file backup set, and one for the archived log files after the data file backup set.

Question: In RMAN, can you connect directly to the PDB to perform the same backup?

Answer: Yes. In this case, you do not have to specify that you want to back up a PDB. Instead, you can use the `BACKUP DATABASE` command.

4. Perform a partial database backup in `ORCLPDB1` directly.
   a. Start RMAN and connect to `ORCLPDB1` as the `SYS` user.

```
$ export ORACLE_PDB_SID=ORCLPDB1

$ rman target SYS/fenago

```

   b. Execute the `BACKUP DATABASE` command. Notice that the SPFILE and control file are not backed up.

```
RMAN> BACKUP DATABASE;
Starting backup at 2019-06-20:18:14:59
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=32 device type=DISK
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00010
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/sysaux01.dbf
input datafile file number=00012
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf
```

```
input datafile file number=00009
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf
input datafile file number=00011
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01.dbf
channel ORA_DISK_1: starting piece 1 at 2019-06-20:18:15:00
channel ORA_DISK_1: finished piece 1 at 2019-06-20:18:15:07
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B36632797E
5CE0536210ED0ADAC7/backupset/2019_06_20/o1_mf_nnndf_TAG20190620T
181500_gjqm94sz_.bkp tag=TAG20190620T181500 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
Finished backup at 2019-06-20:18:15:07


RMAN>
```

5. Try to configure the recovery setting for the PDB so that the SPFILE and control file are backed up too.

```
RMAN> CONFIGURE CONTROLFILE AUTOBACKUP ON;
RMAN-00571:
===========================================================
RMAN-00569: =============== ERROR MESSAGE STACK FOLLOWS
===============
RMAN-00571:
===========================================================
RMAN-03002: failure of configure command at 06/20/2019 18:16:16
RMAN-07536: command not allowed when connected to a Pluggable
Database
RMAN>
```

You get an error message because you must be connected to the CDB root to configure any recovery settings.

6. Exit RMAN.

```
RMAN> EXIT
```

7. Back up the `USERS` tablespace in `ORCLPDB2`.

   a. Connect to `ORCLPDB2` as the `SYS` user.

```
$ export ORACLE_PDB_SID=ORCLPDB2
$ rman target SYS/fenago
…
connected to target database: ORCLCDB:ORCLPDB2 (DBID=1621666632)
```

   b. Back up the `USERS` tablespace.

```
RMAN> BACKUP TABLESPACE users;
Starting backup at 2019-06-20:18:18:13
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
```

```
channel ORA_DISK_1: SID=32 device type=DISK
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00016
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb2/users01.dbf
channel ORA_DISK_1: starting piece 1 at 2019-06-20:18:18:14
channel ORA_DISK_1: finished piece 1 at 2019-06-20:18:18:15
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B419BF707E
73E0536210ED0A54C7/backupset/2019_06_20/o1_mf_nnndf_TAG20190620T
181814_gjqmh6q3_.bkp tag=TAG20190620T181814 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 2019-06-20:18:18:15
RMAN>
```

c. Exit RMAN.

```
RMAN> EXIT
…
$
```

8. Can you connect to the CDB root and perform the same operation?

a. Start RMAN and connect to the CDB root as the `SYS` user.

```
$ export ORACLE_PDB_SID=
$ rman target /
…
connected to target database: ORCLCDB (DBID=2778750799)
```

b. Back up the `USERS` tablespace in `ORCLPDB2`. You must specify the PDB in which the tablespace exists.

```
RMAN> BACKUP TABLESPACE ORCLPDB2:users;
Starting backup at 2019-06-20:18:20:10
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=32 device type=DISK
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00016
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb2/users01.dbf
channel ORA_DISK_1: starting piece 1 at 2019-06-20:18:20:11
channel ORA_DISK_1: finished piece 1 at 2019-06-20:18:20:12
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B419BF707E
73E0536210ED0A54C7/backupset/2019_06_20/o1_mf_nnndf_TAG20190620T
182010_gjqmlv5s_.bkp tag=TAG20190620T182010 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 2019-06-20:18:20:12
```

```
Starting Control File and SPFILE Autobackup at 2019-06-
20:18:20:12
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_20/o1_mf_s_1011464412_gjqmlwjy_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 2019-06-
20:18:20:13
RMAN>
```

Question: Did the operation back up only the tablespace data files?

Answer: No. It also backed up the SPFILE and control file. It is only when you are connected to the CDB root to perform backups that the SPFILE and control file are backed up.

c. Exit RMAN and close the terminal window.

```
RMAN> EXIT
$
```

Practice 5-5: Configuring Block Change Tracking

Overview

In this practice, you will configure Block Change Tracking (BCT). Although BCT is optional, it reduces the time required for an incremental backup from the time to scan all the blocks in the database to a time proportional to the number of blocks that have changed since the last backup.

The BCT file can contain only 8 bitmaps, so the backup cannot be optimized if there have been more than 8 incremental backups since the parent level backup that the new incremental will be based on. Consider the 8-bitmap limit when developing your incremental backup strategy. For example, if you make a level 0 database backup followed by 7 differential incremental backups, the block change tracking file now includes 8 bitmaps. If you then make a cumulative level 1 incremental backup, RMAN cannot optimize the backup because the bitmap corresponding to the parent level 0 backup is overwritten with the bitmap that tracks the current changes.

Assumptions

You have a terminal window open with variables set for the `ORCLCDB` database instance.

Time Estimate

It should take approximately 5 minutes to complete this practice.

Tasks

1. Configure block change tracking to place the BCT file in the default data file creation destination.
   a. Start SQL*Plus and connect to your `ORCLCDB` database with administrator privileges.

```
$ sqlplus / as sysdba
…
SQL>
```

   b. Set the `DB_CREATE_FILE_DEST` initialization parameter to `/u01/app/oracle/oradata/ORCLCDB`.

```
SQL> ALTER SYSTEM SET DB_CREATE_FILE_DEST =
'/u01/app/oracle/oradata/ORCLCDB';

System altered.

SQL> SHOW PARAMETER DB_CREATE_FILE_DEST

NAME                   TYPE       VALUE
---------------------- ---------- ------------------------------------
db_create_file_dest    string     /u01/app/oracle/oradata/ORCLCDB

SQL>
```

c. Enable block change tracking by using the `ALTER DATABASE` statement.

```
SQL> ALTER DATABASE ENABLE BLOCK CHANGE TRACKING;

Database altered.

SQL>
```

Note: In another practice, you will disable block change tracking again, because it is not required for the practice environment.

2. Exit SQL*Plus.

```
SQL> exit
…
$
```

Practice 5-6: Using Incremental Backups

Overview

In this practice, you create an image copy of the target database for use as a base for an incremental backup strategy. You perform an incremental level 1 backup, and apply the incremental to the level 0 backup.

Note: Applying the incremental backup to the level 0 image copies makes the level 0 backup the same as if you had taken a level 0 instead of level 1.

Assumptions

You have two terminal windows open. Environment variables in both windows are set for the `ORCLCDB` database instance.

Time Estimate

It should take approximately 45 minutes to complete this practice.

Tasks

1. Perform the following steps to check if the `ORCLPDB1` pluggable database is open, and open it if it is not.
   a. Log in to SQL*Plus as `SYSDBA`.

   ```
   $ sqlplus / as sysdba
   …
   SQL>
   ```

   b. Check the open mode of the PDBs. If `ORCLPDB1` is open in `READ WRITE` mode, exit from SQL*Plus and proceed to step 2.

   ```
   SQL> show pdbs
   CON_ID     CON_NAME                       OPEN MODE  RESTRICTED
   ---------- ------------------------------ ---------- ----------
            2 PDB$SEED                       READ ONLY  NO
            3 ORCLPDB1                       READ WRITE NO
            4 ORCLPDB2                       READ WRITE NO
   SQL>
   ```

   c. Optionally, if `ORCLPDB1` is `MOUNTED`, open the PDB and then verify the change.

   ```
   SQL> alter pluggable database orclpdb1 open;
    Pluggable database altered.
   Note: You can ignore if you get already open ERROR

   SQL> show pdbs
   ```

```
CON_ID     CON_NAME                        OPEN MODE  RESTRICTED
---------- ------------------------------- ---------- ----------
         2 PDB$SEED                        READ ONLY  NO
         3 ORCLPDB1                        READ WRITE NO
         4 ORCLPDB2                        READ WRITE NO
```

d. Exit from SQL*Plus.

```
SQL> exit
…
$
```

2. Execute the `DBMod_Backup_CrINVENTORY.sh` script from the `/home/oracle/labs/DBMod_Backup` directory. This script creates the `INVENTORY` tablespace, the `INVENTORY` user, and populates the schema in `NOLOGGING` mode. (The execution of the script might take a while because several tables with over 90,000 rows are created. Your row count might be different.)

```
$ cd /home/oracle/labs/DBMod_Backup
[DBMod_Backup]$ ./DBMod_Backup_CrINVENTORY.sh
SQL> Connected.
SQL> SQL>
Session altered.

SQL> SQL> DROP TABLESPACE INVENTORY INCLUDING CONTENTS and
DATAFILES CASCADE CONSTRAINTS
*
ERROR at line 1:
ORA-00959: tablespace 'INVENTORY' does not exist
…
SQL>   2    3    4    5    6    7    8    9   10
72982 rows created.
…
[DBMod_Backup]$
```

Note: This script can be run multiple times, but note that it completely resets the `INVENTORY` schema each time it runs.

3. Create a directory named `/home/oracle/backup/orclcdb` and then back up the `ORCLCDB` database to this directory. Use the RMAN command line and set the incremental level to 0.

a. Create the new directory.

```
$ mkdir -p /home/oracle/backup/orclcdb
$
```

b. Perform a database incremental level 0 backup. Allocate a channel to use the `/home/oracle/backup/orclcdb` directory for the data file copies destination.

```
$ rman target "'/ as sysbackup'"
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN> run {
ALLOCATE CHANNEL "ch1" DEVICE TYPE DISK FORMAT
"/home/oracle/backup/orclcdb/%U";
BACKUP AS COPY TAG 'BASE01' INCREMENTAL LEVEL 0 DATABASE;
}
using target database control file instead of recovery catalog
allocated channel: ch1
channel ch1: SID=262 device type=DISK

Starting backup at 2019-06-20:21:03:40
channel ch1: starting datafile copy
…
Starting Control File and SPFILE Autobackup at 2019-06-
20:21:05:01
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_20/o1_mf_s_1011474301_gjqx7xj6_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 2019-06-
20:21:05:02
released channel: ch1

RMAN>
```

As the backup is performed, notice where the backup files are created.

4. Open a new terminal window and start a workload that updates your database by executing the `DBMod_Backup_workload.sh` script.

```
$ su - oracle
$ cd /home/oracle/labs/DBMod_Backup
$ ./DBMod_Backup_workload.sh
…
SQL>

SQL> Connected.
SQL> SQL> SQL> SQL> SQL>   2    3    4
2190 rows updated.

SQL>
Commit complete.
…
$
```

Note: The script updates over 2000 rows.

5. In your RMAN terminal session, perform an incremental level 1 backup to the `/home/oracle/backup/orclcdb` directory.

```
RMAN> run {
ALLOCATE CHANNEL "ch1" DEVICE TYPE DISK FORMAT
"/home/oracle/backup/orclcdb/%U";
BACKUP TAG 'incr_update' INCREMENTAL LEVEL 1 DATABASE;
}
…
allocated channel: ch1
channel ch1: SID=262 device type=DISK

Starting backup at 2019-06-20:21:10:34
channel ch1: starting incremental level 1 datafile backup set
…
Starting Control File and SPFILE Autobackup at 2019-06-
20:21:10:38
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_20/o1_mf_s_1011474638_gjqxlgh4_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 2019-06-
20:21:10:39
released channel: ch1

RMAN>
```

Note: The time of the incremental data file backup is faster than the original level 0 and some data files do not need to be backed up at all.

6. Apply the incremental backups to the existing level 0 backup. Notice the recovery of the data file copy and the restore operation.

```
RMAN> run {
ALLOCATE CHANNEL "ch1" DEVICE TYPE DISK FORMAT
"/home/oracle/backup/orclcdb/%U";
RECOVER COPY OF DATABASE WITH TAG 'BASE01';
}
…
Starting recover at 2019-06-20:21:12:44
no copy of datafile 5 found to recover
no copy of datafile 6 found to recover
no copy of datafile 8 found to recover
channel ch1: starting incremental datafile backup set restore
channel ch1: specifying datafile copies to recover
recovering datafile copy file number=00001
name=/home/oracle/backup/orclcdb/data_D-ORCLCDB_I-2778750799_TS-
SYSTEM_FNO-1_1ju4jnpc
```

```
…
Finished recover at 2019-06-20:21:12:48

Starting Control File and SPFILE Autobackup at 2019-06-
20:21:12:48
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_20/o1_mf_s_1011474768_gjqxpjsb_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 2019-06-
20:21:12:49
released channel: ch1

RMAN>
```

7. Disable block change tracking. It does not need to be enabled for any other practices.

```
RMAN> ALTER DATABASE DISABLE BLOCK CHANGE TRACKING;

Note: You will get error if it is already disabled. You can
ignore the error
```

8. Exit RMAN and remove your test data by executing the `DBMod_Backup_cleanupINVENTORY.sh` script.

```
RMAN> exit

$  cd /home/oracle/labs/DBMod_Backup
$ ./DBMod_Backup_cleanupINVENTORY.sh
```

9. Optionally, use your other terminal window to view the output in the `/tmp/cleanup.log` file while the `DBMod_Backup_cleanupINVENTORY.sh` script is executing.

```
$ cat /tmp/cleanup.log
```

10. Use the RMAN `DELETE OBSOLETE` command to delete obsolete backups. Be sure to respond `YES` when prompted.

```
$ rman target "'/ as sysbackup'"
…
connected to target database: ORCLCDB (DBID=2778750799

RMAN> delete obsolete;
…
Datafile Copy        45     2019-06-20:21:12:47
/home/oracle/backup/orclcdb/data_D-ORCLCDB_I-2778750799_TS-
INVENTORY_FNO-17_22u4jnrr


Do you really want to delete the above objects (enter YES or
NO)? YES
```

```
deleted datafile copy
datafile copy file name=/home/oracle/backup/orclcdb/data_D-
ORCLCDB_I-2778750799_TS-INVENTORY_FNO-17_22u4jnrr RECID=45
STAMP=1011474767
Deleted 40 objects


RMAN>
```

Note: Your output may be different depending on the repetition of practices.

11. Optionally, crosscheck all data file copies of the `ORCLCDB` database.

```
RMAN> crosscheck datafilecopy all;
released channel: ORA_DISK_1
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=43 device type=DISK
validation succeeded for datafile copy
datafile copy file name=/home/oracle/backup/orclcdb/data_D-
ORCLCDB_I-2778750799_TS-SYSTEM_FNO-1_1ju4jnpc RECID=37
STAMP=1011474765
…
validation succeeded for datafile copy
datafile copy file name=/home/oracle/backup/orclcdb/data_D-
ORCLCDB_I-2778750799_TS-USERS_FNO-16_1ou4jnqn RECID=47
STAMP=1011474767
Crosschecked 15 objects


RMAN>
```

12. Exit RMAN.

```
RMAN> exit
$
```

13. Close the second terminal window if you have not already done so.

Practice 5-7: Backing Up Additional Database Files

Overview

In this practice, you create backups of important database files that are not part of the default backup set.

Assumptions

You are using a terminal window with environment variables pointing to the ORCLCDB database instance.

Time Estimate

It should take approximately 15 minutes to complete this practice.

Tasks

1. Back up the control file to a trace file. Then exit SQL*Plus and view the trace file.

   Note: This command creates a SQL script to re-create a control file.

   a. Log in to SQL*Plus as the SYSDBA user.

   ```
   $ sqlplus / as sysdba
   …
   SQL>
   ```

   b. Use the ALTER DATABASE BACKUP CONTROLFILE TO TRACE SQL command.

   ```
   SQL> ALTER DATABASE BACKUP CONTROLFILE TO TRACE AS
   '/home/oracle/backup/orclcdb/control.sql';

   Database altered.


   SQL>
   ```

   c. Exit from SQL*Plus.

   ```
   SQL> exit
   …
   $
   ```

   d. View the trace file. What can you learn from its content?

   Note: The trace file requires some editing before it can be used.

   ```
   $ cat /home/oracle/backup/orclcdb/control.sql
   …
   -- the database with the NORESETLOGS option and should be used
   only if
   -- the current versions of all online logs are available. The
   second
   -- set opens the database with the RESETLOGS option and should
   be used
   ```

```
-- if online logs are unavailable.
-- The appropriate set of statements can be copied from the
trace into
-- a script file, edited as necessary, and executed when there
is a
-- need to re-create the control file.
…
$
```

2. Back up the archive log files of the `ORCLCDB` database, deleting all the archive files after the backup is complete.

    a. Log in to RMAN as `SYSBACKUP`.

```
$ rman target "'/ as sysbackup'"
…
connected to target database: ORCLCDB (DBID=2778750799)
RMAN>
```

    b. Back up the archive log files and delete the files after the backup completes.

```
RMAN> run {
allocate channel "CH1" DEVICE TYPE DISK FORMAT
'/home/oracle/backup/orclcdb/%U';
backup archivelog all delete all input;
}
…
Starting backup at 2019-06-20:21:34:57
current log archived
channel CH1: starting archived log backup set
…
channel CH1: backup set complete, elapsed time: 00:00:03
channel CH1: deleting archived log(s)
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_20/o1_mf_1_40_gjqz01js_.arc RECID=16 STAMP=1011476099
Finished backup at 2019-06-20:21:35:02
…
RMAN>
```

    c. Log out of RMAN.

```
RMAN> exit
…
$
```

Practices for Lesson 6: Using Optional Backup Features

Practices for Lesson 6: Overview

Overview

In this practice, you will use RMAN to create an archival backup.

Practice 6-1: Creating an Archival Backup

Overview

In this practice, you create an archival backup, that is, a backup that is not under your normal retention policies and it is not in your normal fast recovery area (FRA) destination. This `KEEP FOREVER` database backup could be used for recovery if some of your later hands-on activities were to require it. Archival backups can be created with an open or a mounted database.

You must use a recovery catalog to be able to create an archival backup of an `OPEN` database. Without a recovery catalog, you must put the database in a `MOUNTED` state.

Assumptions

You are using a terminal window as the oracle OS user, with environment variables pointing to the `ORCLCDB` database instance.

It is assumed that the database and listener are running. You can use the `pgrep -lf smon` command to verify that the database is started and the `pgrep -lf tns` command to verify that the listener is started. If you need to restart the database and listener, use the `dbstart.sh` script.

Timing Estimate

It should take approximately 25 minutes to complete this practice.

Tasks

1. Log in to RMAN.

```
$ rman target "'/ as sysbackup'"
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN>
```

2. Shut down and then restart the database instance in `MOUNT` mode so you can create a backup copy of the entire database in a mounted state.

```
RMAN> SHUTDOWN IMMEDIATE;

using target database control file instead of recovery catalog
database closed
database dismounted
Oracle instance shut down

RMAN> STARTUP MOUNT;

connected to target database (not started)
```

```
Oracle instance started
database mounted
…
RMAN>
```

3. Attempt to make an archival backup of your ORCLCDB database with the KEEP FOREVER option.

```
RMAN> BACKUP AS COPY DATABASE KEEP FOREVER;
Starting backup at 2019-06-21:15:00:29

allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=260 device type=DISK
RMAN-00571:
===========================================================
RMAN-00569: =============== ERROR MESSAGE STACK FOLLOWS
===============
RMAN-00571:
===========================================================
RMAN-03002: failure of backup command at 06/21/2019 15:00:30
RMAN-06522: KEEP FOREVER option is not supported without the
recovery catalog

RMAN>
```

Question: Why did the backup command fail?

Answer: It failed because a backup with the KEEP FOREVER option requires the use of a recovery catalog. A recovery catalog is required when KEEP FOREVER is specified because backup records will eventually age out of the control file.

4. Attempt to make an archival backup of your ORCLCDB database that will be kept for 365 days.

```
RMAN> BACKUP AS COPY DATABASE KEEP UNTIL TIME 'SYSDATE+365';

Starting backup at 2019-06-21:15:14:05

using channel ORA_DISK_1
backup will be obsolete on date 2020-06-20:15:14:05
archived logs required to recover from this backup will be
backed up
channel ORA_DISK_1: starting datafile copy
input datafile file number=00001
name=/u01/app/oracle/oradata/ORCLCDB/system01.dbf
RMAN-03009: failure of backup command on ORA_DISK_1 channel at
06/21/2019 15:14:05
ORA-19811: cannot have files in DB_RECOVERY_FILE_DEST with keep
attributes
```

```
continuing other job steps, job failed will not be re-run
…
RMAN-00571:
===========================================================
RMAN-00569: =============== ERROR MESSAGE STACK FOLLOWS
===============
RMAN-00571:
===========================================================
RMAN-03002: failure of backup command at 06/21/2019 15:14:07
ORA-19811: cannot have files in DB_RECOVERY_FILE_DEST with keep
attributes

RMAN>
```

Question: Why did the backup command fail?

Answer: It failed because a backup with the `KEEP` option (an archival backup) cannot be written to the Fast Recovery Area. Allowing this has the potential of causing the Fast Recovery Area to quickly run out of space.

5. Create an archival backup with a `FORMAT` clause that will direct RMAN to create the backup in the `/home/oracle/backup` directory and keep it for 365 days.

```
RMAN> BACKUP DATABASE FORMAT '/home/oracle/backup/%U' TAG
keep_db_tag KEEP UNTIL TIME 'SYSDATE+365';

Starting backup at 2019-06-21:15:39:34

using channel ORA_DISK_1
backup will be obsolete on date 2020-06-20:15:39:34
archived logs required to recover from this backup will be
backed up
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00001
name=/u01/app/oracle/oradata/ORCLCDB/system01.dbf
…
using channel ORA_DISK_1
backup will be obsolete on date 2020-06-20:15:40:12
archived logs will not be kept or backed up
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
including current control file in backup set
channel ORA_DISK_1: starting piece 1 at 2019-06-21:15:40:13
channel ORA_DISK_1: finished piece 1 at 2019-06-21:15:40:14
piece handle=/home/oracle/backup/32u4lp6s_1_1 tag=KEEP_DB_TAG
comment=NONE
```

```
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 2019-06-21:15:40:14

RMAN>
```

6. Open the database.

```
RMAN> alter database open;

Statement processed

RMAN>
```

7. Delete obsolete backups. Be sure to respond **YES** to the prompt.

```
RMAN> delete obsolete;

RMAN retention policy will be applied to the command
RMAN retention policy is set to redundancy 1
using channel ORA_DISK_1
Deleting the following obsolete backups and copies:
Type                 Key    Completion Time    Filename/Handle
-------------------- ------- ----------------------------------------------------------------------------
---
Backup Set           38     2019-06-20:21:12:48
  Backup Piece       38     2019-06-20:21:12:48
/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/2019_06_20
/o1_mf_s_1011474768_gjqxpjsb_.bkp
Backup Set           39     2019-06-20:21:24:02
  Backup Piece       39     2019-06-20:21:24:02
/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/2019_06_20
/o1_mf_s_1011475441_gjqycl1b_.bkp

Do you really want to delete the above objects (enter YES or
NO)? YES
deleted backup piece
backup piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_20/o1_mf_s_1011474768_gjqxpjsb_.bkp RECID=38
STAMP=1011474768
deleted backup piece
backup piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_20/o1_mf_s_1011475441_gjqycl1b_.bkp RECID=39
STAMP=1011475442
Deleted 2 objects

RMAN>
```

8. Exit RMAN.

```
RMAN> exit
…
$
```

Practices for Lesson 7: Tuning RMAN Backup Performance

Practices for Lesson 7: Overview

Overview

In these practices, you will monitor an RMAN backup job.

Practice 7-1: Monitoring an RMAN Backup Job

Overview

In this practice, you will monitor an RMAN backup job by using the `V$SESSION_LONGOPS` view.

Assumptions

You are logged in as the `oracle` user.

It is assumed that the database and listener are running. You can use the `pgrep -lf smon` command to verify that the database is started and the `pgrep -lf tns` command to verify that the listener is started. If you need to restart the database and listener, use the `dbstart.sh` script.

Time Estimate

It should take approximately 10 minutes to complete this practice.

Tasks

1. Log in to SQL*Plus. See *Course Practice Environment: Security Credentials* for password information.

```
$ sqlplus system/fenago
…
SQL>
```

2. Open a new terminal window and set the environment variables for the `ORCLCDB` database.

```
$ . oraenv
ORACLE_SID = [orclcdb] ?
The Oracle base remains unchanged with value /u01/app/oracle
$
```

3. In the same terminal window, start Recovery Manager and connect to the CDB root (target database) as the `SYS` user.

```
$ rman target /
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN>
```

4. Create a whole database backup.

```
RMAN> BACKUP DATABASE;
…
Starting backup at 2019-06-21:18:52:23
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=277 device type=DISK
channel ORA_DISK_1: starting full datafile backup set
…
Finished backup at 2019-06-21:18:53:01

Starting Control File and SPFILE Autobackup at 2019-06-
21:18:53:01
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_21/o1_mf_s_1011552781_gjt9wg1h_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 2019-06-
21:18:53:02

RMAN>
```

5. Return to your first terminal session and quickly execute the `$HOME/labs/DBMod_Backup/DBMod_Backup_MonitorBackup.sql` script approximately every 10-15 seconds to monitor the progress of the backup job.

```
SQL> @$HOME/labs/DBMod_Backup/DBMod_Backup_MonitorBackup

      SID    SERIAL#    CONTEXT      SOFAR  TOTALWORK %_COMPLETE
---------- ---------- ---------- ---------- ---------- ----------
      267      40731          5          0     638720          0

SQL> /

      SID    SERIAL#    CONTEXT      SOFAR  TOTALWORK %_COMPLETE
---------- ---------- ---------- ---------- ---------- ----------
      267      40731          5     269440     638720      42.18

SQL> /

no rows selected

SQL>
```

Question: How can you use this query to determine if there is something wrong with the backup job?

Answer: If you execute the query at intervals of 2 minutes or more and the `%_COMPLETE` column does not increase, then it is likely that RMAN is encountering a problem.

6. Return to your RMAN session. After the backup completes, log out of RMAN.

```
RMAN> exit
…
$
```

7. Return to your SQL*Plus session. Log out of SQL*Plus.

```
SQL> exit
…
$
```

8. Close all terminal windows opened for this practice.

Practices for Lesson 8: Recovery Catalog Overview

Practices for Lesson 8

There are no practices for Lesson 8.

Practices for Lesson 9: Creating a Recovery Catalog

Practices for Lesson 9: Overview

Overview

In these practices, you will perform the following one-time setup tasks:

- Create a recovery catalog owner.
- Create a recovery catalog.

Practice 9-1: Creating a Recovery Catalog Owner

Overview

In this practice, you create a user and grant appropriate privileges.

Assumptions

You are in a terminal window with the environment variables pointing to the `ORCLOEM` database instance.

Timing Estimate

It should take approximately 20 minutes to complete this practice.

Tasks

1. Open a terminal window. Use `oraenv` again to set the environment variables for the `ORCLOEM` database.

```
$ . oraenv
ORACLE_SID = [orclcdb] ? orcloem
The Oracle base remains unchanged with value /u01/app/oracle
$
```

2. Start the `ORCLOEM` database.

   a. Log in to SQL*Plus as `SYSDBA`.

```
$ sqlplus / as sysdba
…
Connected to an idle instance.

SQL>
```

   b. Start the instance.

```
SQL> startup
ORACLE instance started.
…
Database opened.
SQL>
```

3. Create a tablespace named `RCATTBS` for the recovery catalog.

   a. Use SQL*Plus to log in to the `ORCLOEM`

   b. Create the `RCATTBS` tablespace with a single `15 MB` datafile.

```
SQL> CREATE TABLESPACE rcattbs DATAFILE
'/u01/app/oracle/oradata/ORCLOEM/rcat01.dbf' SIZE 15M REUSE;


Tablespace created.


SQL>
```

4. Create a user that will own the recovery catalog data. Name the user `RCATOWNER`. The default tablespace should be the `RCATTBS` tablespace, and the user should have unlimited quota on that tablespace. Refer to the *Course Practice Environment: Security Credentials* document for the correct password to replace *`fenago`*.

```
SQL> CREATE USER rcatowner IDENTIFIED BY fenago DEFAULT
TABLESPACE rcattbs QUOTA unlimited on rcattbs;


User created.


SQL>
```

5. Grant the `RECOVERY_CATALOG_OWNER` role to the `RCATOWNER` user and exit from SQL*Plus.

```
SQL> GRANT recovery_catalog_owner TO rcatowner;


Grant succeeded.


SQL> exit
…
$
```

Practice 9-2: Creating the Recovery Catalog

Overview

In this practice, you use RMAN to create the recovery catalog in the RCATPDB pluggable database.

Assumptions

A terminal window is open with the environment variables pointing to the ORCLOEM database instance.

Timing Estimate

It should take approximately 15 minutes to complete this practice.

Tasks

1. Connect to the recovery catalog database by using RMAN. Log in as the recovery catalog owner you created in the previous practice. Refer to the *Course Practice Environment: Security Credentials* document for the correct password.

```
$ rman catalog rcatowner
…
recovery catalog database Password: fenago
connected to recovery catalog database

RMAN>
```

2. Create the recovery catalog. This command may take a few minutes to complete. When you see the RMAN> prompt, exit the RMAN session.

```
RMAN> create catalog;

recovery catalog created

RMAN> exit
…
$
```

Practices for Lesson 10: Managing Target Database Records

Practices for Lesson 10: Overview

Overview

In these practices, you will perform the following one-time setup tasks:

- Register the `ORCLOEM` database in the recovery catalog.

Practice 10-1: Registering a Database in the Recovery Catalog

Overview

In this practice, you use RMAN to register the `ORCLOEM` database in the recovery catalog that you created in a previous practice.

Assumptions

A terminal window is open.

Timing Estimate

It should take approximately 15 minutes to complete this practice.

Tasks

1. Set the environment variables for the `ORCLOEM` database.

```
$ . oraenv
ORACLE_SID = [orcloem] ? orcloem
The Oracle base remains unchanged with value /u01/app/oracle
$
```

2. Use RMAN to connect to the target database (to be registered) and to the recovery catalog database. Refer to the *Course Practice Environment: Security Credentials* document for the correct password.

```
$ rman target "'/ as sysbackup'" catalog rcatowner
…
connected to target database: ORCLCDB (DBID=2778750799)
recovery catalog database Password: fenago
connected to recovery catalog database

RMAN>
```

3. Register the database in the catalog.

```
RMAN> register database;

database registered in recovery catalog
starting full resync of recovery catalog
full resync complete

RMAN>
```

4. To verify that the registration was successful, execute the `REPORT SCHEMA` command. The output should list all of the data files associated with the `ORCLOEM` database that have been registered in the recovery catalog.

```
RMAN> REPORT SCHEMA;
Report of database schema for database with db_unique_name
ORCLOEM


List of Permanent Datafiles
------ ----------- --------------------------- ---------- -----------------------------
===========================
File Size(MB) Tablespace           RB segs Datafile Name


1    920      SYSTEM               YES
/u01/app/oracle/oradata/ORCLOEM/system01.dbf
3    850      SYSAUX               NO
...

 List of Temporary Files
 =======================
 File Size(MB) Tablespace

 …
```

5. Exit from RMAN.

```
RMAN> exit
…
$
```

Practice 10-2: Configuring the Recovery Catalog for Recovery

Overview

Your organization determined that if the recovery catalog is lost or damaged, it needs to be restored quickly and completely.

In this practice, you configure the retention policy for the recovery catalog (retaining two backups), configure the fast recovery area for ORCLOEM, enable archive log mode, and back up your ORCLOEM database.

Assumptions

A terminal window is open.

Timing Estimate

It should take approximately 30 minutes to complete this practice.

Tasks

1. Configure the retention policy with at least redundancy 2.
   a. Set your environment variables to point to the ORCLOEM database.

```
$ . oraenv
ORACLE_SID = [orclcdb] ? orcloem
The Oracle base remains unchanged with value /u01/app/oracle
$
```

   b. Start RMAN and use the recovery catalog database (ORCLOEM) as the target, with no catalog specified. Refer to the *Course Practice Environment: Security Credentials* document for the correct password.
   Note: The recovery parameters are configured at the CDB level.

```
$ rman target sys
…
target database Password: fenago
connected to target database: ORCLOEM (DBID=2073894879)

RMAN>
```

   c. Make sure that the retention policy for the recovery catalog is set to redundancy greater than 1. If it is not, set it to at least 2.

```
RMAN> show retention policy;

using target database control file instead of recovery catalog
```

```
RMAN configuration parameters for database with db_unique_name
ORCLOEM are:
CONFIGURE RETENTION POLICY TO REDUNDANCY 1; # default

RMAN> configure retention policy to redundancy 2;

new RMAN configuration parameters:
CONFIGURE RETENTION POLICY TO REDUNDANCY 2;
new RMAN configuration parameters are successfully stored

RMAN>
```

d. Exit RMAN.

```
RMAN> exit
…
$
```

2. To configure the fast recovery area for ORCLOEM, perform the following:

a. Ensure that the environment variables are set for the ORCLOEM database.

```
$ . oraenv
ORACLE_SID = [orcloem] ? orcloem
The Oracle base remains unchanged with value /u01/app/oracle
$
```

b. Log in to SQL*Plus.

```
$ sqlplus / as sysdba
…
SQL>
```

c. Set the size of the fast recovery area for ORCLOEM to 12 GB.

```
SQL> ALTER SYSTEM SET db_recovery_file_dest_size=12G SCOPE=BOTH;

System altered.

SQL>
```

3. Verify that the recovery catalog database is in ARCHIVELOG mode.

a. Check whether ORCLOEM is in ARCHIVELOG mode.

```
SQL> archive log list
Database log mode            No Archive Mode
Automatic archival           Disabled
Archive destination          USE_DB_RECOVERY_FILE_DEST
Oldest online log sequence   5
Current log sequence         7
SQL>
```

b. Shut down the database instance and restart it in `MOUNT` mode.

```
SQL> SHUTDOWN IMMEDIATE
Database closed.
Database dismounted.
ORACLE instance shut down.

SQL> STARTUP MOUNT
…
Database mounted.

SQL>
```

c. Put the database in `ARCHIVELOG` mode and then open the database.

```
SQL> ALTER DATABASE ARCHIVELOG;

Database altered.

SQL> ALTER DATABASE OPEN;

Database altered.

SQL>
```

d. Verify that the database is now in `ARCHIVELOG` mode.

```
SQL> archive log list
Database log mode              Archive Mode
Automatic archival             Enabled
Archive destination            USE_DB_RECOVERY_FILE_DEST
Oldest online log sequence     5
Next log sequence to archive   7
Current log sequence           7
SQL>
```

```
-------------- ------------------------------------------
```

e. Exit from SQL*Plus.

```
SQL> exit
...
$
```

4. Back up the recovery catalog database.

a. Start RMAN and use the recovery catalog database as the target, with no catalog specified. Refer to the *Course Practice Environment: Security Credentials* document for the correct password.

```
$ rman target sys
…
target database Password: fenago
connected to target database: ORCLOEM (DBID=2073894879)

RMAN>
```

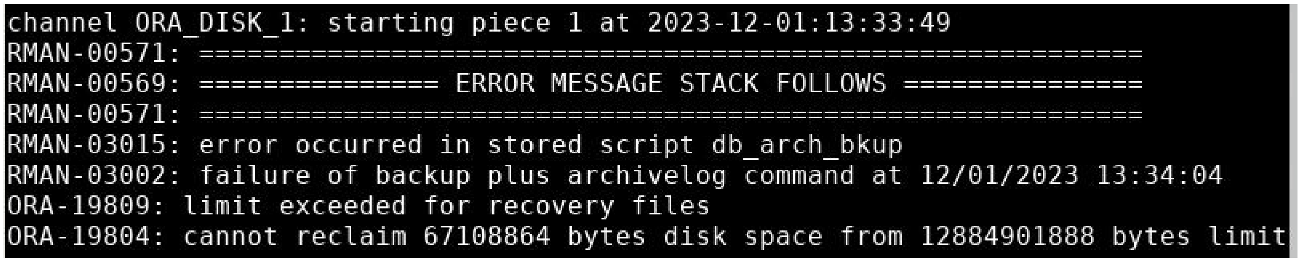
b. Back up the database. Review the output and find the data file for the tablespace that you created for the recovery catalog. **(Note: This command might take some time to complete)**

```
RMAN> BACKUP DATABASE;

starting backup at 2019-06-28:20:28:25
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=270 device type=DISK
channel ORA_DISK_1: starting datafile copy
input datafile file number=00001
name=/u01/app/oracle/oradata/ORCLOEM/system01.dbf
output file
name=/u01/app/oracle/fast_recovery_area/ORCLOEM/datafile/o1_mf_s
```

c. Delete all backups and Exit RMAN.

```
RMAN> DELETE NOPROMPT BACKUP;

RMAN> exit
```

Note: If you get limit following error in any of the exercises while creating backup, you can run the above command.



```
channel ORA_DISK_1: starting piece 1 at 2023-12-01:13:33:49
RMAN-00571: ===========================================================
RMAN-00569: =============== ERROR MESSAGE STACK FOLLOWS ===============
RMAN-00571: ===========================================================
RMAN-03015: error occurred in stored script db_arch_bkup
RMAN-03002: failure of backup plus archivelog command at 12/01/2023 13:34:04
ORA-19809: limit exceeded for recovery files
ORA-19804: cannot reclaim 67108864 bytes disk space from 12884901888 bytes limit
```

Practices for Lesson 11: Using Stored Scripts

Practices for Lesson 11: Overview

Overview

In these practices, you will create and execute a stored script.

Practice 11-1: Creating a Stored Script

Overview

In this practice, you create a stored script.

Assumptions

You have a terminal window open.

Timing Estimate

It should take approximately 10 minutes to complete this practice.

Tasks

1. Set the environment variables for the target database, `orcloem`.

```
$ . oraenv
ORACLE_SID = [ORCLOEM] ? orcloem
The Oracle base remains unchanged with value /u01/app/oracle
$
```

2. Invoke RMAN and connect to the target database and the `ORCLOEM` recovery catalog. Refer to the *Course Practice Environment: Security Credentials* document for the correct password for the recovery catalog owner.

```
$ rman target / catalog rcatowner
…
connected to target database: ORCLOEM (DBID=2778750799)
recovery catalog database Password: ******
connected to recovery catalog database

RMAN>
```

3. Display the names of the stored scripts.

```
RMAN> LIST SCRIPT NAMES;
List of Stored Scripts in Recovery Catalog

        No scripts in recovery catalog

RMAN>
```

4. Create a local script named `db_arch_bkup` to perform a database backup, including the archived log files.

```
RMAN> CREATE SCRIPT db_arch_bkup
 {
  BACKUP DATABASE PLUS ARCHIVELOG;
 }

created script db_arch_bkup

RMAN>
```

5. List the contents of the script you created.

```
RMAN> PRINT SCRIPT db_arch_bkup;

printing stored script: db_arch_bkup
{
BACKUP DATABASE PLUS ARCHIVELOG;
}

RMAN>
```

6. Modify the `db_arch_bu` script so that it also deletes obsolete archived log files.

```
RMAN> REPLACE SCRIPT db_arch_bkup
 {
  BACKUP DATABASE PLUS ARCHIVELOG;
  DELETE OBSOLETE;
 }

replaced script db_arch_bkup

RMAN>
```

7. Once again list the contents of the script.

```
RMAN> PRINT SCRIPT db_arch_bkup;

printing stored script: db_arch_bkup
{
BACKUP DATABASE PLUS ARCHIVELOG;
DELETE OBSOLETE;
}

RMAN>
```

8. Log out of RMAN.

```
RMAN> exit

Recovery Manager complete.
$
```

Practice 11-2: Executing a Stored Script

Overview

In this practice, you execute a stored script.

Assumptions

You have a terminal window. You successfully completed the practice to create a stored script named `db_arch_bkup`.

Timing Estimate

It should take approximately 15 minutes to complete this practice.

Tasks

1. Set the environment variables for the target database, `orcloem`.

```
$ . oraenv
ORACLE_SID = [orclcdb] ? orcloem
The Oracle base remains unchanged with value /u01/app/oracle
$
```

2. Invoke RMAN and connect to the target database and the `ORCLOEM` recovery catalog. Refer to the *Course Practice Environment: Security Credentials* document for the correct password for the recovery catalog owner.

```
$ rman target / catalog rcatowner
…
connected to target database: ORCLOEM (DBID=2778750799)
recovery catalog database Password:
connected to recovery catalog database

RMAN>
```

3. Execute the `db_arch_bkup` script. Be sure to respond `YES` when prompted to delete the obsolete backups.

```
RMAN> run
 {
  EXECUTE SCRIPT db_arch_bkup;
 }

executing script: db_arch_bkup



Starting backup at 2019-06-28:21:19:40
current log archived
```

```
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=38 device type=DISK
channel ORA_DISK_1: starting archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=41 RECID=17
STAMP=1012157788
input archived log thread=1 sequence=42 RECID=18
STAMP=1012166381
channel ORA_DISK_1: starting piece 1 at 2019-06-28:21:19:43
channel ORA_DISK_1: finished piece 1 at 2019-06-28:21:19:46
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
_06_28/o1_mf_annnn_TAG20190628T211943_gkf13hcp_.bkp
tag=TAG20190628T211943 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:03
Finished backup at 2019-06-28:21:19:46
…
  Backup Piece       423    2019-06-28:21:19:45
/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019_06_28/
o1_mf_annnn_TAG20190628T211943_gkf13hcp_.bkp
Backup Set           436    2019-06-28:21:20:50
  Backup Piece       442    2019-06-28:21:20:50
/u01/app/oracle/fast_recovery_area/ORCLCDB/8857888C96117610E0536
210ED0A12EE/backupset/2019_06_28/o1_mf_nnndf_TAG20190628T211946_
gkf15cs1_.bkp

Do you really want to delete the above objects (enter YES or
NO)? YES
deleted archived log
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_28/o1_mf_1_41_gkdrpsqt_.arc RECID=17 STAMP=1012157788
…
backup piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8857888C961176
10E0536210ED0A12EE/backupset/2019_06_28/o1_mf_nnndf_TAG20190628T
211946_gkf15cs1_.bkp RECID=72 STAMP=1012166443
Deleted 13 objects

RMAN>
```

4. Verify that your script created a full database backup.

```
RMAN> list backup;


List of Backup Sets
===================


BS Key  Type LV Size       Device Type Elapsed Time Completion
Time
---------- ------ --- -------------- --------------- ----------------- -----------------
299     Full    1.42G      DISK        00:00:03     2019-06-
21:15:39:37
        BP Key: 319   Status: AVAILABLE  Compressed: NO  Tag:
KEEP_DB_TAG
        Piece Name: /home/oracle/backup/2tu4lp5m_1_1
        Keep: BACKUP_LOGS        Until: 2020-06-20:15:39:34
…
List of Archived Logs in backup set 464
  Thrd Seq     Low SCN    Low Time            Next SCN   Next
Time
  ------ ---------- -------------- ------------------------- -------------- ----------
  1    43      3504011    2019-06-28:21:19:40 3504086    2019-
06-28:21:20:50


BS Key  Type LV Size       Device Type Elapsed Time Completion
Time
---------- ------ --- -------------- --------------- ----------------- -----------------
476     Full    17.95M     DISK        00:00:01     2019-06-
28:21:20:54
        BP Key: 478   Status: AVAILABLE  Compressed: NO  Tag:
TAG20190628T212053
        Piece Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/2019_06_28
/o1_mf_s_1012166453_gkf15oy7_.bkp
  SPFILE Included: Modification time: 2019-06-28:18:26:24
  SPFILE db_unique_name: ORCLCDB
  Control File Included: Ckp SCN: 3504115      Ckp time: 2019-
06-28:21:20:53


RMAN>
```

5. Exit RMAN.

```
RMAN> exit


Recovery Manager complete.
$
```

Practices for Lesson 12: Creating and Using Virtual Private Catalogs

Practices for Lesson 12: Overview

Overview

In these practices, you will create a virtual catalog and use the virtual catalog when taking a backup.

Practice 12-1: Enabling the Virtual Private Database (VPD) Functionality

Overview

In this practice, you enable the Virtual Private Database (VPD) functionality.

RMAN uses the VPD functionality to implement virtual private catalogs. The VPD functionality is not enabled by default when the RMAN base recovery catalog is created. You need to explicitly enable the VPD model for a base recovery catalog by running the `$ORACLE_HOME/rdbms/admin/dbmsrmanvpc.sql` script.

Assumptions

You have an open terminal window. You completed the practices to create the recovery catalog.

Timing Estimate

It should take approximately 20 minutes to complete this practice.

Tasks

1. Set the environment variables for the recovery catalog database (`ORCLOEM`).

```
$ . oraenv
ORACLE_SID = [orcldb] ? orcloem
The Oracle base remains unchanged with value /u01/app/oracle
$
```

2. Invoke SQL*Plus and log in to `RCATPDB` as the `SYSDBA` user. Refer to the *Course Practice Environment: Security Credentials* document for the correct password.

```
$ sqlplus / as sysdba
…
…
SQL>
```

3. Execute the `$ORACLE_HOME/rdbms/admin/dbmsrmanvpc.sql` script to enable the VPD model for all the virtual private catalogs of the base catalog schema, `RCATOWNER`.

```
SQL> @$ORACLE_HOME/rdbms/admin/dbmsrmanvpc.sql -vpd rcatowner
Checking the operating user... Passed

Granting VPD privileges to the owner of the base catalog schema
RCATOWNER


========================================
VPD SETUP STATUS:
```

```
VPD privileges granted successfully!
Connect to RMAN base catalog and perform UPGRADE CATALOG.

Disconnected from Oracle Database …

$
```

4. Upgrade the recovery catalog.

   a. Invoke RMAN and connect to the recovery catalog database. Refer to the *Course Practice Environment: Security Credentials* document for the correct password.

```
$ rman catalog rcatowner
…
recovery catalog database Password:
connected to recovery catalog database

RMAN>
```

   b. Execute the `UPGRADE CATALOG` command. Be sure to enter the command a second time when prompted.

```
RMAN> upgrade catalog;

recovery catalog owner is RCATOWNER
enter UPGRADE CATALOG command again to confirm catalog upgrade

RMAN> upgrade catalog;

recovery catalog upgraded to version 19.03.00.00.00
DBMS_RCVMAN package upgraded to version 19.03.00.00
DBMS_RCVCAT package upgraded to version 19.03.00.00.

RMAN>
```

   c. Exit from RMAN.

```
RMAN> exit
…
$
```

Practices for Lesson 13: Restore and Recovery Concepts

Practices for Lesson 13

There are no practices for Lesson 13.

Practices for Lesson 14: Diagnosing Failures

Practices for Lesson 14: Overview

Overview

In these practices, you will use the Data Recovery Advisor to diagnose database failure.

Practice 14-1: Diagnosing and Repairing Database Failure

Overview

In this practice, you will use Data Recovery Advisor via the RMAN client interface to diagnose and repair the loss of a data file.

Assumptions

You have two terminal windows open in which `$HOME/labs/DBMod_Recovery` is the current directory, and environment variables point to the `orclcdb` database instance.

Tasks

1. Open a terminal window and execute the `rec_config.sh` script from the `$HOME/labs/DBMod_Recovery/` directory. This script configures a minimal configuration to ensure that the database is recoverable. If you have already done the configuration the script does nothing and exits.

```
$ $HOME/labs/DBMod_Recovery/rec_config.sh
Verify controlfiles are multiplexed
The control files are multiplexed
Verify Pfile Exists
PFILE
/u01/app/oracle/product/19.3.0/dbhome_1/dbs/initorclcdb.ora
exists
Verify database is in Archivelog
ARCHIVELOG
Database in Archivelog
Verify fast recovery area is configured

PL/SQL procedure successfully completed.

Verify if redo logfiles mulitplexed
file_name is
/u01/app/oracle/fast_recovery_area/ORCLCDB/onlinelog/redo1a.log
sqlstr is ALTER DATABASE ADD LOGFILE MEMBER
'/u01/app/oracle/fast_recovery_area/ORCLCDB/onlinelog/redo1a.log
' TO GROUP 1
file_name is
/u01/app/oracle/fast_recovery_area/ORCLCDB/onlinelog/redo2a.log
sqlstr is ALTER DATABASE ADD LOGFILE MEMBER
'/u01/app/oracle/fast_recovery_area/ORCLCDB/onlinelog/redo2a.log
' TO GROUP 2
file_name is
/u01/app/oracle/fast_recovery_area/ORCLCDB/onlinelog/redo3a.log
sqlstr is ALTER DATABASE ADD LOGFILE MEMBER
```

```
'/u01/app/oracle/fast_recovery_area/ORCLCDB/onlinelog/redo3a.log
' TO GROUP 3
$
```

2. Execute the `setup_02_01.sh` script. This script creates the `BAR91TBS` tablespace in the file system, the `BAR91` user, and the `BARCOPY` table, and populates the table. The script continues and takes a backup of the tablespace and updates the table. You can view the script output in the `/tmp/setup.log` file.

```
$ cd $HOME/labs/DBMod_Recovery
$ ./setup_02_01.sh
$
```

3. Execute the `break_02_01.sh` script. This script deletes a data file and causes the database to fail. You can view the script output in the `/tmp/break.log` file.

```
$ ./break_02_01.sh
$
```

4. Open a new terminal window, as the `oracle` user with your environment variables pointing to `orclcdb`. Attempt to start the instance and open the `ORCLPDB1` pluggable database. Observe the error messages, then exit SQL*Plus.

   Note: The error messages may occur while trying to open the `ORCLCDB` database or while trying to open the `ORCLPDB1` PDB, or possibly both.

```
$ sqlplus / as sysdba
…
Connected to an idle instance.

SQL> startup
ORACLE instance started.
...

SQL> show pdbs

    CON_ID CON_NAME                       OPEN MODE  RESTRICTED
---------- ------------------------------ ---------- ----------
         2 PDB$SEED                       READ ONLY NO
         3 ORCLPDB1                       MOUNTED
         4 ORCLPDB2                       MOUNTED


SQL> alter pluggable database orclpdb1 open;
alter pluggable database orclpdb1 open
*
ERROR at line 1:
```

```
ORA-01157: cannot identify/lock data file 190 - see DBWR trace
file
ORA-01110: data file 190:
'/u01/app/oracle/oradata/ORCLCDB/orclpdb1/bar91tbs01.dbf'

SQL> exit
$
```

5. Use the Data Recovery Advisor to list the database failure. **Note:** You might see one or more failure IDs.

```
$ rman target "'/ as sysbackup'"
…
RMAN> LIST FAILURE;

using target database control file instead of recovery catalog
Database Role: PRIMARY

List of Database Failures
=========================

Failure ID Priority Status    Time Detected Summary
---------- -------- --------- ------------- -------
62         CRITICAL OPEN      02-JUL-19     System datafile 9:
'/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf' needs
media recovery
62         HIGH     OPEN      02-JUL-19     One or more non-
system datafiles need media recovery
62           HIGH     OPEN    02-JUL-19     One or more non-
system datafiles are missing

RMAN>
```

6. Use the Data Recovery Advisor to obtain advice on how to repair the failure. **Note:** During a manual recovery, if you see more than one optional manual action, you would focus on the one that references `bar91tbs01.dbf`, the missing file.

```
RMAN> ADVISE FAILURE;
Database Role: PRIMARY

List of Database Failures
=========================

Failure ID Priority Status    Time Detected Summary
---------- -------- --------- ------------- -------
```

```
62        CRITICAL OPEN        02-JUL-19     System datafile 9:
'/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf' needs
media recovery
62        HIGH     OPEN        02-JUL-19     One or more non-
system datafiles need media recovery
62          HIGH     OPEN      02-JUL-19     One or more non-
system datafiles are missing

analyzing automatic repair options; this may take some time
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=40 device type=DISK
analyzing automatic repair options complete

Mandatory Manual Actions
========================
no manual actions available

Optional Manual Actions
=======================
1. If you restored the wrong version of data file
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf, then
replace it with the correct one
2. Automatic repairs may be available if you shutdown the
database and restart it in mount mode
3. If you restored the wrong version of data file
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/sysaux01.dbf, then
replace it with the correct one
4. If you restored the wrong version of data file
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01.dbf, then
replace it with the correct one
5. If you restored the wrong version of data file
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf, then
replace it with the correct one
6. If file
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/bar91tbs01.dbf was
unintentionally renamed or moved, restore it

Automated Repair Options
========================
Option Repair Description
------ ------------------
1      Restore and recover datafile 19 …
  Strategy: The repair includes complete media recovery with no
data loss
  Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_991361536.hm
```

```

RMAN>
```

7. Use the Data Recovery Advisor to repair the failure. Examine the contents of the repair script that was generated for this repair before it executes. Enter `Y` or `YES` when prompted to execute the script.

```
RMAN> repair failure;

Strategy: The repair includes complete media recovery with no
data loss
Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_991361536.hm

contents of repair script:
   # restore and recover datafile
   sql 'ORCLPDB1' 'alter database datafile 19 offline';
   restore ( datafile 19 );
   recover datafile 19;
   sql 'ORCLPDB1' 'alter database datafile 19 online';
   # recover datafile
   sql 'ORCLPDB1' 'alter database datafile 9, 10, 11, 12
offline';
   recover datafile 9, 10, 11, 12;
   sql 'ORCLPDB1' 'alter database datafile 9, 10, 11, 12
online';

Do you really want to execute the above repair (enter YES or
NO)? YES
executing repair script

...

channel ORA_DISK_1: restoring datafile 00190
input datafile copy RECID=19 STAMP=1012576702 file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/8C28E6F854EB7DBB
E0536210ED0AFDD9/datafile/o1_mf_bar91tbs_gkpxfy1o_.dbf
destination for restore of datafile 00190:
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/bar91tbs01.dbf
...
repair failure complete

RMAN>
```

8. Open the ORCLPDB1 pluggable database.

```
RMAN> alter pluggable database orclpdb1 open;

Statement processed

RMAN> exit
…
$
```

9. Confirm that ORCLPDB1 is open.

```
$ sqlplus / as sysdba
…
SQL> show PDBS

    CON_ID CON_NAME                       OPEN MODE  RESTRICTED
---------- ------------------------------ ---------- ----------
         2 PDB$SEED                       READ ONLY  NO
         3 ORCLPDB1                       READ WRITE NO
         4 ORCLPDB2                       MOUNTED

SQL> exit
$
```

10. Return to the first terminal window. Clean up the environment following this practice by executing the cleanup_02_01.sh. script. You can view the script output in the /tmp/cleanup.log file.

```
$ ./cleanup_02_01.sh
$
```

11. Close the second terminal window.

Practices for Lesson 15: Performing Complete Recovery

Practices for Lesson 15: Overview

Overview

In these practices, you will initiate a recovery operation by using RMAN commands. You will use the Data Recovery Advisor to recover a datafile.

Practice 15-1: Recovering from the Loss of a System-Critical Data File

Overview

In this practice, you recover your CDB after the data file for the `SYSTEM` tablespace (in the CDB root) has been inadvertently removed.

Tip

Because you use several windows at the same time in this practice, you may find it helpful to change the name of each of them in their banner at the top.

To set a title for a terminal window:

1. In the terminal window's menu, select **Terminal** and then **Set Title**. A Set Title dialog box is displayed.
2. In the Title box, enter the window number.
3. Click **OK**.

Assumptions

- You are logged in as the `oracle` user.
- You have configured the database for recovery.
- It is assumed that the database and listener are running. You can use the `pgrep -lf smon` command to verify that the database is started and the `pgrep -lf tns` command to verify that the listener is started.

Tasks

Configure the Database for Recovery

1. Execute the `rec_config.sh` script from the `$HOME/labs/DBMod_Recovery/` directory. This script configures a minimal configuration to ensure that the database is recoverable. If you have already done the configuration the script does nothing and exits.

```
$ $HOME/labs/DBMod_Recovery/rec_config.sh
Verify controlfiles are multiplexed
The control files are multiplexed
Verify Pfile Exists
PFILE
/u01/app/oracle/product/19.3.0/dbhome_1/dbs/initorclcdb.ora
exists
Verify database is in Archivelog
ARCHIVELOG
Database in Archivelog
Verify fast recovery area is configured
```

```

PL/SQL procedure successfully completed.

Verify if redo logfiles mulitplexed
Redo log group 1 is Multiplexed
Redo log group 2 is Multiplexed
Redo log group 3 is Multiplexed
$
```

2. Perform a cold database backup.
   a. Create a directory to preserve the backup.

```
$ mkdir -p /u01/app/oracle/donttouch
```

   b. Start RMAN.

```
$ rman target /
...
connected to target database: ORCLCDB (DBID=2778750799)
(Make sure you are not connected to PDB)
```

   c. Shut down the database, and bring it to the mount stage.

```
RMAN> SHUTDOWN IMMEDIATE;
...
RMAN> STARTUP MOUNT;
...
```

   d. Perform the backup to a separate location that will be not be accessed unless the practice fails.

```
RMAN> BACKUP DATABASE FORMAT
"/u01/app/oracle/donttouch/backup_%U";
...
```

   e. Open the database.

```
RMAN> ALTER DATABASE OPEN;
```

   f. Exit RMAN.

```
RMAN> EXIT
```

3. Create a hot backup to the RMAN configured location.
   a. The default location for the automatic channel allocation is the `db_recovery_file_dest`.

```
$ sqlplus / as sysdba

SQL> show parameter db_recovery_file_dest

NAME                           TYPE        VALUE
------------------------------ ----------- ------------------------------
db_recovery_file_dest          string      /u01/app/oracle/fast_reco
```

```
                                                 very_area
db_recovery_file_dest_size big integer 15G

SQL> EXIT
```

b. Perform the backup to the default location.

```
$ rman target /
...
connected to target database: ORCLCDB (DBID=2778750799)

RMAN> BACKUP DATABASE;
Starting backup at 27-JUN-19
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=280 device type=DISK
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00003
name=/u01/app/oracle/oradata/ORCLCDB/sysaux01.dbf
input datafile file number=00001
name=/u01/app/oracle/oradata/ORCLCDB/system01.dbf
input datafile file number=00004
name=/u01/app/oracle/oradata/ORCLCDB/undotbs01.dbf
input datafile file number=00007
name=/u01/app/oracle/oradata/ORCLCDB/users01.dbf
channel ORA_DISK_1: starting piece 1 at 27-JUN-19
channel ORA_DISK_1: finished piece 1 at 27-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
_06_27/o1_mf_nnndf_TAG20190627T160931_gk9tkztr_.bkp
tag=TAG20190627T160931 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:45
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00161
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/sysaux01.dbf
input datafile file number=00163
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf
input datafile file number=00160
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf
input datafile file number=00162
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01.dbf
input datafile file number=00172
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/INVENTORY01.DBF
channel ORA_DISK_1: starting piece 1 at 27-JUN-19
channel ORA_DISK_1: finished piece 1 at 27-JUN-19
```

```
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8C28E6F854EB7D
BBE0536210ED0AFDD9/backupset/2019_06_27/o1_mf_nnndf_TAG20190627T
160931_gk9tm8nb_.bkp tag=TAG20190627T160931 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00014
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb2/sysaux01.dbf
input datafile file number=00016
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb2/users01.dbf
input datafile file number=00013
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb2/system01.dbf
input datafile file number=00015
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb2/undotbs01.dbf
channel ORA_DISK_1: starting piece 1 at 27-JUN-19
channel ORA_DISK_1: finished piece 1 at 27-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B419BF707E
73E0536210ED0A54C7/backupset/2019_06_27/o1_mf_nnndf_TAG20190627T
160931_gk9tmhpl_.bkp tag=TAG20190627T160931 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00006
name=/u01/app/oracle/oradata/ORCLCDB/pdbseed/sysaux01.dbf
input datafile file number=00005
name=/u01/app/oracle/oradata/ORCLCDB/pdbseed/system01.dbf
input datafile file number=00008
name=/u01/app/oracle/oradata/ORCLCDB/pdbseed/undotbs01.dbf
channel ORA_DISK_1: starting piece 1 at 27-JUN-19
channel ORA_DISK_1: finished piece 1 at 27-JUN-19


...


Starting Control File and SPFILE Autobackup at 27-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_27/o1_mf_s_1012061437_gk9tmych_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 27-JUN-19
```

c. Exit RMAN.

```
RMAN> exit
```

Create a Loss of a System-Critical Data File

Window 1

1. Use the same terminal window as *Window 1*.
2. Execute the `$HOME/labs/DBMod_Recovery/RMAN_crash.sh` shell script to remove the data file of the `SYSTEM` tablespace in the CDB root.

   Note: This script may end with an error showing that data file `system01.dbf` cannot be opened.

```
$ $HOME/labs/DBMod_Recovery/RMAN_crash.sh

System altered.

System altered.

Select username from dba_users where username = '1'
                     *
ERROR at line 1:
ORA-00604: error occurred at recursive SQL level 1
ORA-01116: error in opening database file 1
ORA-01110: data file 1:
'/u01/app/oracle/oradata/ORCLCDB/system01.dbf'
ORA-27041: unable to open file
Linux-x86_64 Error: 2: No such file or directory
Additional information: 3

$
```

3. Attempt an administrative task, such as creating a user.

   a. Start SQL*Plus and connect to the CDB root as the `SYSTEM` user. Refer to *Course Practice Environment: Security Credentials* for the password value.

   Note: At this point, any SQL statement gives an error.

```
$ sqlplus system/fenago
…
ERROR:
ORA-00604: error occurred at recursive SQL level 1
ORA-01116: error in opening database file 1
ORA-01110: data file 1:
'/u01/app/oracle/oradata/ORCLCDB/system01.dbf'
ORA-27041: unable to open file
Linux-x86_64 Error: 2: No such file or directory
Additional information: 3
ORA-00604: error occurred at recursive SQL level 2
ORA-01116: error in opening database file 1
```

```
ORA-01110: data file 1:
'/u01/app/oracle/oradata/ORCLCDB/system01.dbf'
ORA-27041: unable to open file
Linux-x86_64 Error: 2: No such file or directory
Additional information: 3

Enter user-name: ^C

$
```

4. Consider your recovery options.

   a. **Question:** Which type of recovery is possible in this case?

   Answer: A complete recovery is possible as long as you have all available backups required. This means that you have a backup (backup set or image copy) of the missing data file, all archive log files required to recover the restored data file up to the current SCN of the CDB including all redo log files (one member in each group will be sufficient).

   b. **Question:** Which methods can you use to recover the data file?

   c. **Answer:** RMAN is the best utility to recover data. You can use the `RESTORE` and `RECOVER` commands or get help by using the `LIST FAILURE` command.

5. Determine the state of the database to choose the course of action in the next step. The output of step 3 matches with item b in this example.

   a. If the SQL*Plus `login` displays "`ORA-01034: ORACLE not available`", then the database instance is down. ***Action:*** *Read case 3 in step 6.*

   b. If the SQL*Plus `login` displays an error that includes "`ORA-01116: error in opening database file 1`", then database instance is still running, but impaired and must be terminated with `shutdown abort`. ***Action:*** *Read case 1 in step 6*

   c. If the `rman target /` command shows an error and immediately disconnects then the database instance is down.

   d. If RMAN connects but the `restore datafile 1` command fails with errors about datafile 1, then the database is impaired and must be terminated with `shutdown abort`.

6. The exact commands that you will use vary based on the state of the database instance. Follow each case in order.

   a. Case 1: The database instance is not down, but impaired and must be terminated with `shutdown abort`.The database instance will likely shutdown automatically at some point. Use RMAN to `shutdown abort` the database instance, then skip to Case 3.

```
$ rman target /
RMAN> Shutdown abort
```

b. Case 2: The RMAN utility will not connect. Use SQL*Plus to `shutdown abort` the database instance. Proceed to Case 3 to bring the database instance to the mount state using RMAN.

```
$ sqlplus / as sysdba
SQL> SHUTDOWN ABORT
SQL> EXIT
```

c. Case 3: The database instance is down. Use RMAN or SQL*Plus to bring the database instance to the mount state.

```
$ rman target /
RMAN> STARTUP MOUNT
```

Recover the Database by Using the `RESTORE` and `RECOVER` Commands

Window 1

1. Restore the missing data file.

```
RMAN> RESTORE DATAFILE 1;

Starting restore at 27-JUN-19
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=256 device type=DISK

channel ORA_DISK_1: starting datafile backup set restore
channel ORA_DISK_1: specifying datafile(s) to restore from
backup set
channel ORA_DISK_1: restoring datafile 00001 to
/u01/app/oracle/oradata/ORCLCDB/system01.dbf
channel ORA_DISK_1: reading from backup piece
/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019_06_27/
o1_mf_nnndf_TAG20190627T160931_gk9tkztr_.bkp
channel ORA_DISK_1: piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
_06_27/o1_mf_nnndf_TAG20190627T160931_gk9tkztr_.bkp
tag=TAG20190627T160931
channel ORA_DISK_1: restored backup piece 1
channel ORA_DISK_1: restore complete, elapsed time: 00:00:07
Finished restore at 27-JUN-19
RMAN>
```

2. Recover the missing data file.

```
RMAN> RECOVER DATAFILE 1;

Starting recover at 27-JUN-19
using channel ORA_DISK_1

starting media recovery
media recovery complete, elapsed time: 00:00:00

Finished recover at 27-JUN-19

RMAN>
```

3. Open the CDB root.

```
RMAN> ALTER DATABASE OPEN;

Statement processed

RMAN>
```

4. Open all PDBs.

```
RMAN> ALTER PLUGGABLE DATABASE ALL OPEN;

Statement processed

RMAN>
```

5. Exit RMAN.

```
RMAN> EXIT

Recovery Manager complete.
$
```

6. Start SQL*Plus and connect to the CDB root as the `SYSDBA` user.

```
$ sqlplus / as sysdba
…
SQL>
```

7. Show pdb status.

```
SQL> show pdbs

    CON_ID CON_NAME                       OPEN MODE  RESTRICTED
---------- ------------------------------ ---------- ----------
         2 PDB$SEED                       READ ONLY  NO
         3 ORCLPDB1                       READ WRITE NO
         4 ORCLPDB2                       READ WRITE NO
```

8. Exit SQL*Plus. Keep Window 1 open for the next section.

```
SQL> Exit
```

Use the Data Recovery Advisor to Recover the Database

1. **Window 2:** Open a new terminal window and execute the `RMAN_crash.sh` script to create a failure. This window will be referred to as *Window 2*.

   Note: This script may end with an error showing that data file `system01.dbf` cannot be opened.

```
$ su - oracle

$ $HOME/labs/DBMod_Recovery/RMAN_crash.sh

System altered.


System altered.


Select username from dba_users where username = '1'
ERROR at line 1:
ORA-00604: error occurred at recursive SQL level 1
ORA-01116: error in opening database file 1
ORA-01110: data file 1:
'/u01/app/oracle/oradata/ORCLCDB/system01.dbf'
ORA-27041: unable to open file
Linux-x86_64 Error: 2: No such file or directory
Additional information: 3
```

2. **Window 1:** Try to connect to the database.

```
$ sqlplus / as sysdba
…
```

3. If the database appears to be running attempt a simple query.

```
SQL> select username from dba_users;

Note: You might get different based on database state. And this
might work if you run this sql query immediately
```

```
ORA-00604: error occurred at recursive SQL level 1
ORA-01116: error in opening database file 1
ORA-01110: data file 1:
'/u01/app/oracle/oradata/ORCLCDB/system01.dbf'
ORA-27041: unable to open file
Linux-x86_64 Error: 2: No such file or directory
Additional information: 3
```

4. **Window 1:** Shut down the database instance.

```
SQL> shutdown abort
```

5. **Window 1:** Exit SQL*Plus.

```
SQL> EXIT
…
$
```

6. **Window 1:** Start RMAN and connect to the target database.

```
$ rman target /
…
connected to target database (not started)

RMAN>
```

7. **Window 1:** Start the database instance in `MOUNT` mode.

```
RMAN> STARTUP MOUNT;
database mounted
…

RMAN>
```

8. **Window 1:** Use the `LIST FAILURE` command to determine the error. The value in the `Summary` column tells you that `system01.dbf` is missing.

```
RMAN> LIST FAILURE;

using target database control file instead of recovery catalog
Database Role: PRIMARY

List of Database Failures
=========================

Failure ID Priority Status    Time Detected Summary
---------- -------- --------- ------------- -------
417        CRITICAL OPEN      27-JUN-19     System datafile 1:
'/u01/app/oracle/oradata/ORCLCDB/system01.dbf' is missing

RMAN>
```

9. **Window 1:** Display repair options. At the very end of the results, a repair script is listed.

```
RMAN> ADVISE FAILURE;

Database Role: PRIMARY

List of Database Failures
=========================

Failure ID Priority Status    Time Detected Summary
---------- -------- --------- ------------- -------
417        CRITICAL OPEN      27-JUN-19     System datafile 1:
'/u01/app/oracle/oradata/ORCLCDB/system01.dbf' is missing

analyzing automatic repair options; this may take some time
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=19 device type=DISK
analyzing automatic repair options complete

Mandatory Manual Actions
========================
no manual actions available

Optional Manual Actions
=======================
1. If file /u01/app/oracle/oradata/ORCLCDB/system01.dbf was
unintentionally renamed or moved, restore it

Automated Repair Options
========================
Option Repair Description
------ ------------------
1      Restore and recover datafile 1
  Strategy: The repair includes complete media recovery with no
data loss
  Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_3469874817.hm

RMAN>
```

10. **Window 1:** Use the `REPAIR FAILURE PREVIEW` command to generate a script with all repair actions and comments.

```
RMAN> REPAIR FAILURE PREVIEW;

Strategy: The repair includes complete media recovery with no
data loss
Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_3469874817.hm

contents of repair script:
   # restore and recover datafile
   restore ( datafile 1 );
   recover datafile 1;
   sql 'alter database datafile 1 online';

RMAN>
```

11. **Window 1:** Use the `REPAIR FAILURE` command to repair database failures identified by the Data Recovery Advisor. When prompted, enter `YES` to execute the repair. When prompted to open the database, enter `YES`.

```
RMAN> REPAIR FAILURE;

Strategy: The repair includes complete media recovery with no
data loss
Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_3469874817.hm

contents of repair script:
   # restore and recover datafile
   restore ( datafile 1 );
   recover datafile 1;
   sql 'alter database datafile 1 online';

Do you really want to execute the above repair (enter YES or
NO)? YES
executing repair script

Starting restore at 27-JUN-19
using channel ORA_DISK_1

channel ORA_DISK_1: starting datafile backup set restore
channel ORA_DISK_1: specifying datafile(s) to restore from
backup set
```

```
channel ORA_DISK_1: restoring datafile 00001 to
/u01/app/oracle/oradata/ORCLCDB/system01.dbf
channel ORA_DISK_1: reading from backup piece
/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019_06_27/
o1_mf_nnndf_TAG20190627T160931_gk9tkztr_.bkp
channel ORA_DISK_1: piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
_06_27/o1_mf_nnndf_TAG20190627T160931_gk9tkztr_.bkp
tag=TAG20190627T160931
channel ORA_DISK_1: restored backup piece 1
channel ORA_DISK_1: restore complete, elapsed time: 00:00:15
Finished restore at 27-JUN-19

Starting recover at 27-JUN-19
using channel ORA_DISK_1

starting media recovery

archived log for thread 1 with sequence 118 is already on disk
as file
/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_06_27
/o1_mf_1_118_gk9vttl1_.arc
archived log for thread 1 with sequence 119 is already on disk
as file
/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_06_27
/o1_mf_1_119_gk9vttmm_.arc
archived log for thread 1 with sequence 120 is already on disk
as file
/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_06_27
/o1_mf_1_120_gk9wo0l1_.arc
archived log for thread 1 with sequence 121 is already on disk
as file
/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_06_27
/o1_mf_1_121_gkb16db7_.arc
archived log for thread 1 with sequence 122 is already on disk
as file
/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_06_27
/o1_mf_1_122_gkb16dck_.arc
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_27/o1_mf_1_118_gk9vttl1_.arc thread=1 sequence=118
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_27/o1_mf_1_119_gk9vttmm_.arc thread=1 sequence=119
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_27/o1_mf_1_120_gk9wo0l1_.arc thread=1 sequence=120
media recovery complete, elapsed time: 00:00:00
```

```
Finished recover at 27-JUN-19

sql statement: alter database datafile 1 online
repair failure complete

Do you want to open the database (enter YES or NO)? YES
database opened

RMAN>
```

12. **Window 1:** Open all the PDBs.

```
RMAN> ALTER PLUGGABLE DATABASE ALL OPEN;

Statement processed

RMAN>
```

13. **Window 1:** Exit RMAN.

```
RMAN> EXIT

Recovery Manager complete.
$
```

14. **Window 2:** Close the second terminal window.

Practice 15-2: Recovering from the Loss of an Application Data File

Overview

In this practice, you recover a PDB data file that has been inadvertently removed.

Assumptions

You are logged in as the `oracle` user and `orclcdb` and the listener are started.

Tasks

Set Up Your Environment for the Practice

1. Execute the `$HOME/labs/DBMod_Recovery/setup_pdb1.sh` shell script. This script creates the `TBS_APP` tablespace and `ODR` schema in `ORCLPDB1`. You can ignore object creation error messages.

```
$ $HOME/labs/DBMod_Recovery/setup_pdb1.sh
…
1 row created.


1 row created.


Commit complete.

$
```

2. Start RMAN and connect to the CDB root as the `SYS` user.

```
$ rman target /
…
connected to target database: ORCLCDB (DBID=1500451933)

RMAN>
```

3. Back up `ORCLPDB1`.

```
RMAN> BACKUP PLUGGABLE DATABASE ORCLPDB1;

Starting backup at 27-JUN-19
using target database control file instead of recovery catalog
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=35 device type=DISK
channel ORA_DISK_1: starting full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
```

```
input datafile file number=00177
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/tbs_app01.dbf
input datafile file number=00161
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/sysaux01.dbf
input datafile file number=00163
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf
input datafile file number=00160
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf
input datafile file number=00162
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01.dbf
input datafile file number=00172
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/INVENTORY01.DBF
channel ORA_DISK_1: starting piece 1 at 27-JUN-19
channel ORA_DISK_1: finished piece 1 at 27-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8C28E6F854EB7D
BBE0536210ED0AFDD9/backupset/2019_06_27/o1_mf_nnndf_TAG20190627T
182426_gkb2gvt1_.bkp tag=TAG20190627T182426 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
Finished backup at 27-JUN-19

Starting Control File and SPFILE Autobackup at 27-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_27/o1_mf_s_1012069474_gkb2h2gx_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 27-JUN-19

RMAN>
```

4. Exit RMAN.

```
RMAN> EXIT

Recovery Manager complete.
$
```

Remove a Data File

In this section, you run a script that removes a data file from `ORCLPDB1`. You research the problem and discover which data file is missing.

1. Execute the `$HOME/labs/DBMod_Recovery/RMAN_crash_app.sh` script.

   Note: A file that has been removed by the OS in Unix-based systems is still available to any application that has it open until the application closes the file. By default the Oracle database opens all the files when the database instance is opened, and holds them open. A database health checker runs frequently, when then data file is detected as missing the PDB is aborted. An attempt to write to the file will also trigger detection.

```
$ $HOME/labs/DBMod_Recovery/RMAN_crash_app.sh

System altered.

System altered.

$
```

2. Create an application table and insert data into it.

   a. Connect to the CDB root as the `SYS` user with the `SYSDBA` privilege.

```
$ sqlplus / AS SYSDBA
…
SQL>
```

   b. Connect to `ORCLPDB1` as the `SYS` user.

```
SQL> ALTER SESSION SET CONTAINER = ORCLPDB1;

Session altered.

SQL>
```

   c. Create a table named `ODR.TEST`. and insert a row into the table.

```
SQL> CREATE TABLE odr.test (c NUMBER);

Table created.

SQL> INSERT into ODR.TEST VALUES ( 14 );
insert into ODR.test values (14)
                *
ERROR at line 1:
ORA-01116: error in opening database file 177
ORA-01110: data file 177:
'/u01/app/oracle/oradata/ORCLCDB/orclpdb1/tbs_app01.dbf'
ORA-27041: unable to open file
Linux-x86_64 Error: 2: No such file or directory
Additional information: 3
```

d. What is the status of the PDB?

```
SQL> SHOW PDBs
ERROR:
ORA-03135: connection lost contact
Process ID: 21970
Session ID: 48 Serial number: 65393



SP2-1545: This feature requires Database availability.
```

Note: The output could also be as below, if the checker has not aborted the PDB yet.

```
SQL> SHOW PDBs

    CON_ID CON_NAME                       OPEN MODE  RESTRICTED
---------- ------------------------------ ---------- ----------
         3 ORCLPDB1                       READ WRITE NO
```

e. Exit and reconnect to the database as `sys`.

```
SQL> Exit
…
$ sqlplus / as sysdba
…
SQL> SHOW PDBS

    CON_ID CON_NAME                       OPEN MODE  RESTRICTED
---------- ------------------------------ ---------- ----------
         2 PDB$SEED                       READ ONLY  NO
         3 ORCLPDB1                       READ WRITE NO
         4 ORCLPDB2                       READ WRITE NO
```

f. If PDB `ORCLPDB` is open, close it. This may show an error.

```
SQL> ALTER PLUGGABLE DATABASE ORCLPDB1 CLOSE;

Pluggable database altered.
```

g. Attempt to open the PDB.

```
SQL> ALTER PLUGGABLE DATABASE ORCLPDB1 OPEN;
ALTER PLUGGABLE DATABASE ORCLPDB1 OPEN
*
ERROR at line 1:
ORA-01157: cannot identify/lock data file 177 - see DBWR trace
file
ORA-01110: data file 177:
'/u01/app/oracle/oradata/ORCLCDB/orclpdb1/tbs_app01.dbf'
```

3. Exit SQL*Plus.

```
SQL> EXIT
…
$
```

Restore and Recover ORCLPDB1

In this section, you use Recovery Manager to restore and recover `ORCLPDB1`.

1. **Question:** Which type of recovery is possible in this case?

   Answer: A complete recovery is possible as long as you have all available backups required. This means that you have a backup (backup set or image copy) of the missing data file and all archive log files required to recover the restored data file up to the current SCN of the PDB including all redo log files (one member in each group will be sufficient).

2. **Question:** Which methods can you use to recover?

   Answer: RMAN is the best utility to recover data. You can use the `RESTORE` and `RECOVER` commands, or you can get help with the `LIST FAILURE` commands. You can also use the simple `REPAIR` command.

Use the REPAIR Command

Let’s use RMAN's `REPAIR` command to perform all the necessary operations (for example, restore and recovery) to fully recover the data file.

1. Start RMAN and log in to the target database as the `SYS` user.

```
$ rman target /
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN>
```

2. Execute the `REPAIR` command. This command restores and recovers the data file.

```
RMAN> REPAIR PLUGGABLE DATABASE ORCLPDB1;

Starting restore at 27-JUN-19
using target database control file instead of recovery catalog
```

```
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=274 device type=DISK
Executing: alter database datafile 160 offline
Executing: alter database datafile 161 offline
Executing: alter database datafile 162 offline
Executing: alter database datafile 163 offline
Executing: alter database datafile 172 offline
Executing: alter database datafile 177 offline

channel ORA_DISK_1: starting datafile backup set restore
channel ORA_DISK_1: specifying datafile(s) to restore from
backup set
channel ORA_DISK_1: restoring datafile 00160 to
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf
…
channel ORA_DISK_1: restoring datafile 00177 to
/u01/app/oracle/oradata/ORCLCDB/orclpdb1/tbs_app01.dbf
channel ORA_DISK_1: reading from backup piece
/u01/app/oracle/fast_recovery_area/ORCLCDB/8C28E6F854EB7DBBE0536
210ED0AFDD9/backupset/2019_06_27/o1_mf_nnndf_TAG20190627T182426_
gkb2gvt1_.bkp
channel ORA_DISK_1: piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/8C28E6F854EB7D
BBE0536210ED0AFDD9/backupset/2019_06_27/o1_mf_nnndf_TAG20190627T
182426_gkb2gvt1_.bkp tag=TAG20190627T182426
channel ORA_DISK_1: restored backup piece 1
channel ORA_DISK_1: restore complete, elapsed time: 00:00:15
Finished restore at 27-JUN-19

Starting recover at 27-JUN-19
using channel ORA_DISK_1

starting media recovery

archived log for thread 1 with sequence 124 is already on disk
as file
/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_06_27
/o1_mf_1_124_gkb2l6wf_.arc
…
archived log for thread 1 with sequence 129 is already on disk
as file
/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_06_27
/o1_mf_1_129_gkb9grvl_.arc
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_27/o1_mf_1_124_gkb2l6wf_.arc thread=1 sequence=124
```

```
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_27/o1_mf_1_125_gkb2l6xk_.arc thread=1 sequence=125
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_27/o1_mf_1_126_gkb2lqsg_.arc thread=1 sequence=126
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
06_27/o1_mf_1_127_gkb2lqtd_.arc thread=1 sequence=127
media recovery complete, elapsed time: 00:00:01
Executing: alter database datafile 160 online
Executing: alter database datafile 161 online
Executing: alter database datafile 162 online
Executing: alter database datafile 163 online
Executing: alter database datafile 172 online
Executing: alter database datafile 177 online
Finished recover at 27-JUN-19

RMAN>
```

3. Open `ORCLPDB1`.

```
RMAN> ALTER PLUGGABLE DATABASE ORCLPDB1 OPEN;

Statement processed

RMAN>
```

4. Exit RMAN.

```
RMAN> EXIT

Recovery Manager complete.
$
```

5. Try again to create a table named `ODR.TEST` in `ORCLPDB1`.

   a. Connect to the CDB root as the `SYS` user with the `SYSDBA` privilege.

```
$ sqlplus / AS SYSDBA
…
SQL>
```

   b. Connect to `ORCLPDB1` as the `SYS` user.

```
SQL> ALTER SESSION SET CONTAINER = ORCLPDB1;

Session altered.

SQL>
```

c. Try to re-create the odr.test table.

```
SQL> CREATE TABLE odr.test (c NUMBER);
CREATE TABLE odr.test (c NUMBER)
                 *
ERROR at line 1:
ORA-00955: name is already used by an existing object
SQL>
```

d. The table exists. Are there any rows?

```
SQL> SELECT * FROM ODR.TEST;

no rows selected
```

Note: The table was not created because the table definition exists in the SYSTEM tablespace, but there are no rows because the tablespace TBS_APP was missing when you attempted to insert the row.

6. Try to insert data into the ODR.TEST table again.

a. Issue the INSERT command. The operation succeeds, which means the REPAIR command recovered the data file.

```
SQL> INSERT INTO odr.test VALUES (2);

1 row created.

SQL>
```

b. Commit the transaction.

```
SQL> commit;

Commit complete.

SQL>
```

c. Exit SQL*Plus.

```
SQL> EXIT
…
$
```

Practices for Lesson 16: Performing Point-in-Time Recovery

Practices for Lesson 16: Overview

Overview

In this practice, you will recover a table from a backup set without affecting other objects in thetablespace or schema.

Practice 16-1: Recovering a Table from a Backup

Overview

In this practice, you will recover a table from a backup set (without affecting other objects in the tablespace or schema). The tasks include the following:

- Set up your test environment and confirm the configuration, which typically is a one-time task.
- In RMAN, perform a level 0 backup plus archive logs and delete obsolete backups.
- In SQL*Plus, create and populate a new `TEST_TABLE`. Note the SCN after commit.
- In RMAN, perform a level 1 backup.
- In SQL*Plus, create the need to recover a table by purging `TEST_TABLE`.
- In RMAN, recover your test table to the SCN.
- In SQL*Plus, confirm the success of the recovery.
- Clean up your practice environment.

Assumptions

You have two terminal windows open in which you are logged in as the `oracle` OS user, `$HOME/labs/DBMod_Recovery` is the current directory, and environment variables point to the `orclcdb` database instance.

Tasks

1. Prepare for this practice by executing the `setup_04_02.sh` script from the `$HOME/labs/DBMod_Recovery` directory. This script should be run as **oracle** user:
   - Creates a new tablespace and user
   - As the new user, creates a table and populates it
   - Saves its output in the `/tmp/setup.log` file.

```
$ cd $HOME/labs/DBMod_Recovery
$ ./setup_04_02.sh
```

2. Start a SQL*Plus session and verify your test configuration.
   a. Log in as the `SYS` user.

```
$ sqlplus / as sysdba
…
SQL>
```

   b. Confirm that the database is in `ARCHIVELOG` mode.

```
SQL> SELECT NAME, LOG_MODE, OPEN_MODE FROM V$DATABASE;

NAME      LOG_MODE     OPEN_MODE
--------- ------------ --------------------
ORCLCDB      ARCHIVELOG   READ WRITE
```

```
SQL>
```

c. Confirm that compatibility is set to `19.0` or higher.

```
SQL> show parameter compatible

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------------------------------
compatible                           string      19.0.0
noncdb_compatible                    boolean     FALSE
SQL>
```

d. Confirm your backup location and size.

```
SQL> show parameter recovery_file

NAME                           TYPE        VALUE
------------------------------ ----------- ------------------------------
db_recovery_file_dest          string
/u01/app/oracle/fast_recovery_area
db_recovery_file_dest_size big integer 15G
remote_recovery_file_dest      string
SQL>
```

e. Connect to `ORCLPDB1`, then confirm the setup by executing the `lab_04_02a.sql` script from the `$HOME/labs/DBMod_Recovery` directory. The `BAR` user should own the `BARCOPY` table.

```
SQL> alter session set container=ORCLPDB1;

Session altered.

SQL> @lab_04_02a.sql
SQL> COL TABLE_NAME      FORMAT A30
SQL> COL TABLESPACE_NAME FORMAT A15
SQL> COL OWNER           FORMAT A10
SQL>
SQL> SELECT TABLE_NAME, TABLESPACE_NAME, STATUS
  2  FROM DBA_TABLES
  3  WHERE OWNER = 'BAR'
  4  /

TABLE_NAME                     TABLESPACE_NAME STATUS
------------------------------ --------------- --------
BARCOPY                        BARTBS          VALID

SQL>
```

3. In your second terminal window, start an RMAN session and connect to your `orclcdb` database as the target instance.

   Note: Some of the following steps generate a lot of output. The easiest way to send RMAN output both to a log file and to standard output is to use the Linux `tee` command or its equivalent. There is no need to do this if your standard output allows you to scroll as much as you wish. Using the following command example, you can view the output in the `/home/oracle/rman_04.log` file.

```
$ rman target "'/ as sysbackup'"| tee /home/oracle/rman_04.log
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN>
```

4. Confirm or configure autobackup of the control file and perform a level 0 backup. It will take few minutes to complete.

```
RMAN> show CONTROLFILE AUTOBACKUP;

using target database control file instead of recovery catalog
RMAN configuration parameters for database with db_unique_name
ORCLCDB are:
CONFIGURE CONTROLFILE AUTOBACKUP ON; # default

RMAN> backup incremental level 0 database plus archivelog;


Starting backup at 29-JUN-19
current log archived
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=279 device type=DISK
channel ORA_DISK_1: starting archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=140 RECID=33
STAMP=1012139222
input archived log thread=1 sequence=141 RECID=34
STAMP=1012139224
input archived log thread=1 sequence=142 RECID=35
STAMP=1012139226
…
input archived log thread=1 sequence=159 RECID=61
STAMP=1012243668
input archived log thread=1 sequence=160 RECID=59
STAMP=1012243664
channel ORA_DISK_1: starting piece 1 at 29-JUN-19
channel ORA_DISK_1: finished piece 1 at 29-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
```

```
_06_29/o1_mf_annnn_TAG20190629T203255_gkhlqqtq_.bkp
tag=TAG20190629T203255 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:03
channel ORA_DISK_1: starting archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=118 RECID=12
STAMP=1012062683
…
input archived log thread=1 sequence=135 RECID=28
STAMP=1012138240
channel ORA_DISK_1: starting piece 1 at 29-JUN-19
channel ORA_DISK_1: finished piece 1 at 29-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
_06_29/o1_mf_annnn_TAG20190629T203255_gkhlqtz1_.bkp
tag=TAG20190629T203255 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
channel ORA_DISK_1: starting archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=1 RECID=62 STAMP=1012247798
channel ORA_DISK_1: starting piece 1 at 29-JUN-19
channel ORA_DISK_1: finished piece 1 at 29-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
_06_29/o1_mf_annnn_TAG20190629T203255_gkhlr231_.bkp
tag=TAG20190629T203255 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:03
channel ORA_DISK_1: starting archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=2 RECID=63 STAMP=1012249687
…
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 29-JUN-19

Starting backup at 29-JUN-19
using channel ORA_DISK_1
channel ORA_DISK_1: starting incremental level 0 datafile backup
set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00003
name=/u01/app/oracle/oradata/ORCLCDB/sysaux01.dbf
channel ORA_DISK_1: finished piece 1 at 29-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
```

```
_06_29/o1_mf_nnnd0_TAG20190629T203311_gkhlr7qg_.bkp
tag=TAG20190629T203311 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:25
…
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:15
Finished backup at 29-JUN-19
…
Starting Control File and SPFILE Autobackup at 29-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_29/o1_mf_s_1012250063_gkhlthwx_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 29-JUN-19
RMAN>
```

5. In your SQL*Plus session, create and populate a new table named `BAR.TEST_TABLE` by executing the `lab_04_02b.sql` script. Note the SCN after the commit.

```
SQL> @lab_04_02b.sql
…
SQL>
SQL> -- **** Note the SCN!
SQL> SELECT NAME, CURRENT_SCN FROM V$DATABASE;

NAME      CURRENT_SCN
--------- -----------
ORCLCDB      10631091

SQL> SELECT * FROM BAR.TEST_TABLE;

      NUM NAME                 NOW
---------- -------------------- ---------
         1 First test row       03-JUL-19
         2 Second test row      03-JUL-19
         3 Third test row
```

Be sure to note the SCN value displayed in the `CURRENT_SCN` column. You will use it for recovery!

6. In your RMAN session, perform a level 1 backup. If you started your RMAN session with the `tee` command, then your output is redirected to the `/home/oracle/rman_04.log` file.

```
RMAN> backup incremental level 1 database plus archivelog;
Starting backup at 29-JUN-19
current log archived
using channel ORA_DISK_1
channel ORA_DISK_1: starting archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=140 RECID=33
STAMP=1012139222
…
Starting backup at 29-JUN-19
current log archived
using channel ORA_DISK_1
channel ORA_DISK_1: starting archived log backup set
channel ORA_DISK_1: specifying archived log(s) in backup set
input archived log thread=1 sequence=7 RECID=68 STAMP=1012250592
channel ORA_DISK_1: starting piece 1 at 29-JUN-19
channel ORA_DISK_1: finished piece 1 at 29-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019
_06_29/o1_mf_annnn_TAG20190629T204312_gkhmc0cl_.bkp
tag=TAG20190629T204312 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:01
Finished backup at 29-JUN-19

Starting Control File and SPFILE Autobackup at 29-JUN-19
piece
handle=/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/201
9_06_29/o1_mf_s_1012250593_gkhmc1pv_.bkp comment=NONE
Finished Control File and SPFILE Autobackup at 29-JUN-19

RMAN>
```

7. In your SQL*Plus session, create the need to recover a table by purging it. Optionally, view your SCN before and after the `DROP TABLE` command.

```
SQL> SELECT NAME, CURRENT_SCN FROM V$DATABASE;

NAME            CURRENT_SCN
--------------------- ----------------
ORCLCDB            10631264

SQL> drop table BAR.test_table purge;
```

```
Table dropped.

SQL> SELECT NAME, CURRENT_SCN FROM V$DATABASE;

NAME                CURRENT_SCN
------------------- -----------
ORCLCDB                10631475

SQL>
```

8. Optionally, view the current tables that the `BAR` user owns. The `TEST_TABLE` should not be displayed.

```
SQL> SELECT table_name FROM dba_tables WHERE owner = 'BAR';

TABLE_NAME
--------------------------------------------------------------
BARCOPY

SQL>
```

9. In your RMAN session, recover your test table to **YOUR SCN** that you recorded in **Step 5**. Provide the following input with the `RECOVER` command:

- Names of tables or table partitions to be recovered
- SCN (or point in time) to which the tables or table partitions need to be recovered
- Whether the recovered tables or table partitions must be imported into the target database (default is `Yes`.)
- Auxiliary destination '`/u01/app/oracle/backup/test`'.

First, confirm that the directory of the auxiliary destination is empty and then execute your `RECOVER` command. The recover command takes approximately 4 minutes.

```
RMAN> HOST "ls /u01/app/oracle/backup/test/*";

ls: cannot access /u01/backup/test/*: No such file or directory
host command complete
RMAN-00571:
===========================================================
RMAN-00569: =============== ERROR MESSAGE STACK FOLLOWS
===============
RMAN-00571:
===========================================================
RMAN-06135: error executing host command: Additional
information: 512

RMAN>
```

Note: This positive error prior to the `RECOVER` command confirms that the auxiliary destination is empty.

```
RMAN> RECOVER TABLE BAR.TEST_TABLE OF PLUGGABLE DATABASE
ORCLPDB1 UNTIL SCN UPDATE_HERE <<Your SCN from Step 5
 AUXILIARY DESTINATION '/u01/app/oracle/backup/test';

Starting recover at 29-JUN-19
using channel ORA_DISK_1
RMAN-05026: warning: presuming following set of tablespaces
applies to specified point-in-time

List of tablespaces expected to have UNDO segments
Tablespace SYSTEM
Tablespace ORCLPDB1:SYSTEM
Tablespace UNDOTBS1
Tablespace ORCLPDB1:UNDOTBS1

Creating automatic instance, with SID='mcFq'

initialization parameters used for automatic instance:
db_name=ORCLCDB
db_unique_name=mcFq_pitr_ORCLPDB1_ORCLCDB
…
auxiliary instance file
/u01/app/oracle/backup/test/ORCLCDB/8C28E6F854EB7DBBE0536210ED0A
FDD9/datafile/o1_mf_undotbs1_gkhmrq50_.dbf deleted
auxiliary instance file
/u01/app/oracle/backup/test/ORCLCDB/datafile/o1_mf_undotbs1_gkhm
qn2h_.dbf deleted
auxiliary instance file
/u01/app/oracle/backup/test/ORCLCDB/8C28E6F854EB7DBBE0536210ED0A
FDD9/datafile/o1_mf_system_gkhmrq4t_.dbf deleted
auxiliary instance file
/u01/app/oracle/backup/test/ORCLCDB/datafile/o1_mf_system_gkhmqn
21_.dbf deleted
auxiliary instance file
/u01/app/oracle/backup/test/ORCLCDB/controlfile/o1_mf_gkhmqfrp_.
ctl deleted
auxiliary instance file tspitr_mcFq_44423.dmp deleted
Finished recover at 29-JUN-19

RMAN>
```

Note: RMAN uses your input to automate the process of recovering the specified table. RMAN performs the following tasks:

a. Determines the backup based on the SCN you provide

b. Creates an auxiliary instance

c. Recovers your tables or table partitions, up to the specified point in time, into this auxiliary instance

d. Creates a Data Pump export dump file that contains the recovered objects

e. Imports the recovered objects into the target database

f. Removes the auxiliary instance

10. Delete obsolete archive logs and then exit RMAN.

```
RMAN> delete noprompt obsolete;

RMAN retention policy will be applied to the command
RMAN retention policy is set to redundancy 1
using channel ORA_DISK_1
Deleting the following obsolete backups and copies:
Type                 Key    Completion Time    Filename/Handle
-------------------- ------ ------------------ ------------------
Backup Set           6      27-JUN-19
  Backup Piece       6      27-JUN-19

/u01/app/oracle/fast_recovery_area/ORCLCDB/backupset/2019_06_27/
o1_mf_nnndf_TAG20190627T160931_gk9tkztr_.bkp
Backup Set           8      27-JUN-19
  Backup Piece       8      27-JUN-19
/u01/app/oracle/fast_recovery_area/ORCLCDB/8857B419BF707E73E0536
210ED0A54C7/backupset/2019_06_27/o1_mf_nnndf_TAG20190627T160931_
gk9tmhpl_.bkp
…
Deleted 9 objects

RMAN> exit
…
$
```

11. In your SQL*Plus session, query all rows of the test table to confirm the success of the recovery. Then exit SQL*Plus.

```
SQL> SELECT * FROM BAR.TEST_TABLE;

       NUM NAME                 NOW
---------- -------------------- ---------
         1 First test row       29-JUN-19
         2 Second test row      29-JUN-19
         3 Third test row

SQL> exit
…
$
```

12. Clean up the practice environment by executing the `cleanup_04_02.sh` script. This script removes the original and the transported tablespace, as well as the backup and dump files. The script saves its output in the `/tmp/cleanup.log` file.

```
$ ./cleanup_04_02.sh
$
```

13. Keep all terminal windows open for the next practice.

Practices for Lesson 17:
Performing Block Media Recovery

Practices for Lesson 17: Overview

Overview

In these practices, you will use the Data Recovery Advisor to diagnose database failure.

Practice 17-1: Repairing Block Corruption

Overview

In this practice, you will use the Data Recovery Advisor to set up, discover, and repair a corrupted block in a data file.

Assumptions

You have a terminal window open in which `$HOME/labs/DBMod_Recovery` is the current directory, and environment variables point to the `orclcdb` database instance.

Tasks

1. Prepare for this practice by executing the `setup_05_01.sh script`. This script creates the `BC` user, the `BCTBS` tablespace, and the `BCCOPY` table. To prepare for this practice the script populates the table, creates a backup, and updates the table. You can view the script output in the `/tmp/setup.log` file.

```
$ cd $HOME/labs/DBMod_Recovery
$ ./setup_05_01.sh
```

2. Corrupt a data file created in the previous step by executing the `break_05_01.sql` script. When prompted, enter the block number that is displayed in the `BLOCK_NO` column.

   Note: The corrupt block error is expected. The script performs a query against the `BCCOPY` table to force the corrupt block to be discovered.

```
$ sqlplus /nolog @break_05_01.sql
…
Connected.

   FILE_NO   BLOCK_NO
---------- ----------
        18        129


System altered.

'Enter Block number when prompted'
Enter value for block_no: 129
0+1 records in
0+1 records out
80 bytes (80 B) copied, 0.000151458 s, 528 kB/s
0+1 records in
0+1 records out
79 bytes (79 B) copied, 0.000120032 s, 658 kB/s
```

```
SELECT * from bc.bccopy
       *
ERROR at line 1:
ORA-01578: ORACLE data block corrupted (file # 18, block # 129)
ORA-01110: data file 18: '/u01/backup/orclcdb/pdb1/bctbs01.dbf'
…
$
```

3. Using RMAN as `SYSBACKUP`, connect to the `orclcdb` instance and check for failures with the `LIST FAILURE` command.

```
$ rman target "'/ as sysbackup'"
…
connected to target database: ORCLCDB (DBID=2778750799)

RMAN> LIST FAILURE;
using target database control file instead of recovery catalog
Database Role: PRIMARY

List of Database Failures
=========================

Failure ID Priority Status    Time Detected        Summary
---------- -------- --------- ------------------- -------
1889       HIGH     OPEN      01-JUL-19     Datafile 179:
'/u01/app/oracle/oradata/ORCLCDB/orclpdb1/bctbs01.dbf' contains
one or more corrupt blocks

RMAN>
```

4. Use the RMAN `ADVISE FAILURE` command and view the suggested repair strategy.

```
RMAN> ADVISE FAILURE;
Database Role: PRIMARY

List of Database Failures
=========================

Failure ID Priority Status    Time Detected Summary
---------- -------- --------- ------------- -------
1889       HIGH     OPEN      01-JUL-19     Datafile 179:
'/u01/app/oracle/oradata/ORCLCDB/orclpdb1/bctbs01.dbf' contains
one or more corrupt blocks

analyzing automatic repair options; this may take some time
allocated channel: ORA_DISK_1
```

```
channel ORA_DISK_1: SID=275 device type=DISK
analyzing automatic repair options complete

Mandatory Manual Actions
========================
no manual actions available

Optional Manual Actions
=======================
no manual actions available

Automated Repair Options
========================
Option Repair Description
------ -------------------------
1      Recover multiple corrupt blocks in datafile 179
  Strategy: The repair includes complete media recovery with no
data loss
  Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_3585523541.hm

RMAN>
```

5. Use the RMAN `REPAIR FAILURE` command to recover the corrupted blocks.

```
RMAN> REPAIR FAILURE;
Strategy: The repair includes complete media recovery with no
data loss
Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_3585523541.hm

contents of repair script:
   # block media recovery for multiple blocks
   recover datafile 179 block 129 to 130;

Do you really want to execute the above repair (enter YES or
NO)? YES
executing repair script

Starting recover at 01-JUL-19
using channel ORA_DISK_1

channel ORA_DISK_1: restoring block(s) from datafile copy
/u01/app/oracle/fast_recovery_area/ORCLCDB/8C28E6F854EB7DBBE0536
210ED0AFDD9/datafile/o1_mf_bctbs_gkn2jj8m_.dbf
```

```
starting media recovery
media recovery complete, elapsed time: 00:00:03

Finished recover at 01-JUL-19
repair failure complete
RMAN>
```

6. Optionally, confirm that there is no other failure.

```
RMAN> list failure;

Database Role: PRIMARY

no failures found that match specification

RMAN>
```

7. Exit RMAN.

```
RMAN> exit
…
```

Note: This script may end with an error showing that data file `system01.dbf` cannot be opened.

8. Verify that the corrupt block has been recovered by running a full table scan on `bc.bccopy`.

```
$ sqlplus / as sysdba
…
SQL> alter session set container = orclpdb1;

Session altered.

SQL> SELECT * FROM BC.BCCOPY;
…
SQL> EXIT
```

9. Clean up from the block corruption practice by executing the `cleanup_05_01.sh` script. You can view the script output in the `/tmp/cleanup.log` file.

```
$ ./cleanup_05_01.sh
$
```

10. Keep all terminal windows open for the next practice.

Practices for Lesson 18:

Performing Additional Recovery Operations

Practices for Lesson 18: Overview

Overview

In these practices, you will recover from a number of different database failures. It is highly recommended to complete those that you start, because earlier ones affect practices that follow.

In preparation for the next practice, back up your `orclcdb` database,
and ensure that no failures are listed.

```
$ rman target /

RMAN> BACKUP DATABASE;
…
RMAN> list failure;

Database Role: PRIMARY

no failures found that match specification

RMAN> exit
…
```

Practice 18-1: Restoring the Control File

Overview

In this practice, you first create an issue for recovery by deleting the `control02.ctl` control file. After creating the issue, you *must* restore this single "lost" control file.

Assumptions

A full backup of the database is available.

You have two terminal windows open in which you are logged in as the `oracle` OS user, `$HOME/labs/DBMod_Recovery` is the current directory, and environment variables point to the `orclcdb` database instance.

Tasks

1. Prepare for this practice by executing the `setup_06_02.sh` script from the `$HOME/labs/DBMod_Recovery` directory. This script creates a new tablespace and user. As the new user, the script creates a table and populates it. The script creates a backup of the tablespace, and then updates the table.

   The script saves its output in the `/tmp/setup.log` file. You can view this log file while the script executes.

   ```
   $ ./setup_06_02.sh
   $
   ```

2. Cause a failure in the database by executing the `break_06_02.sh` script from the `$HOME/labs/DBMod_Recovery` directory. The script saves its output in the `/tmp/break.log` file.

   ```
   $ ./break_06_02.sh
   $
   ```

3. Attempt to start the database. Review the error messages. Then exit SQL*Plus.

   ```
   $ sqlplus / as sysdba
   …
   Connected to an idle instance.

   SQL> startup
   ORACLE instance started.
   …
   ORA-00205: error in identifying control file, check alert log
   for more info

   SQL> exit
   …
   $
   ```

4. Use adrci to view the `orclcdb/orclcdb` alert log. Scroll to the most recent entries to see the errors from this practice. The list of diagnostic homes may vary. Select the home for `orclcdb/orclcdb` (*option 2* in this example). Your option number may be different.

```
$ adrci
…
adrci> set editor gedit

adrci> show alert

Choose the home from which to view the alert log:

1: diag/rdbms/dummy/orclcdb
2: diag/rdbms/orcldg/orcldg
2: diag/rdbms/orclcdb/orclcdb
4: diag/rdbms/ORCLOEM/ORCLOEM
5: diag/tnslsnr/edvmr1p0/listener
Q: to quit

Please select option: 3 (Choose according to your environment)

/* Scroll to bottom of the file in gedit to see the following */
...
ALTER DATABASE   MOUNT
ORA-00210: cannot open the specified control file
ORA-00202: control file:
'/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl'
ORA-27037: unable to obtain file status
Linux-x86_64 Error: 2: No such file or directory
Additional information: 7
ORA-205 signalled during: ALTER DATABASE   MOUNT...
Errors in file
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/trace/orclcdb_mz00_76
15.trc:
ORA-00202: control file:
'/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl'
ORA-27037: unable to obtain file status
Linux-x86_64 Error: 2: No such file or directory
Additional information: 7
2019-07-01 17:28:25.169000 +00:00
Checker run found 1 new persistent data failures 2018-07-25
19:52:00.135000 +00:00
```

5. Close the `gedit` window by clicking the close window icon (`x`) and then exit `adrci`.

```
Please select option: Q
adrci> exit
$
```

6. Check the Data Recovery Advisor for a solution. Preview the suggested solution before executing it.

   a. Log in to RMAN and run the `LIST FAILURE` command.

```
$ rman target "'/ as sysbackup'"
…
connected to target database: ORCLCDB (not mounted)

RMAN> LIST FAILURE;

using target database control file instead of recovery catalog
List of Database Failures
=========================

Failure ID Priority Status    Time Detected       Summary
---------- -------- --------- ------------------- -------
2312       CRITICAL OPEN      01-JUL-19           Control file
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl is
missing

RMAN>
```

   b. Run the `ADVISE FAILURE` command.

```
RMAN> ADVISE FAILURE;

List of Database Failures
=========================

2312       CRITICAL OPEN      01-JUL-19     Control file
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl is
missing

analyzing automatic repair options; this may take some time
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=255 device type=DISK
analyzing automatic repair options complete

Mandatory Manual Actions
========================
no manual actions available
```

```
Optional Manual Actions
=======================
no manual actions available

Automated Repair Options
========================
Option Repair Description
--------- -------------------------
1      Use a multiplexed copy to restore control file
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl
  Strategy: The repair includes complete media recovery with no
data loss
  Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_3850033214.hm

RMAN>
```

c. Run the `REPAIR FAILURE PREVIEW` command.

```
RMAN> REPAIR FAILURE PREVIEW;

Strategy: The repair includes complete media recovery with no
data loss
Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_3850033214.hm

contents of repair script:
   # restore control file using multiplexed copy
   restore controlfile from
'/u01/app/oracle/oradata/ORCLCDB/control01.ctl';
   sql 'alter database mount';

RMAN>
```

7. Restore the control file. You can either execute the commands via the RMAN command line, or use the `REPAIR FAILURE` command to perform the task for you.

   Note: Any existing copy of the control file can be used to restore the missing copy.

   Enter `Y` or `YES` when prompted to execute the repair and to open the database.

```
RMAN> REPAIR FAILURE;

Strategy: The repair includes complete media recovery with no
data loss
Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_3850033214.hm

```

```
contents of repair script:
   # restore control file using multiplexed copy
   restore controlfile from
'/u01/app/oracle/oradata/ORCLCDB/control01.ctl';
   sql 'alter database mount';

Do you really want to execute the above repair (enter YES or
NO)? YES
executing repair script

Starting restore at 01-JUL-19
using channel ORA_DISK_1

channel ORA_DISK_1: copied control file copy
output file name=/u01/app/oracle/oradata/ORCLCDB/control01.ctl
output file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl
Finished restore at 01-JUL-19

sql statement: alter database mount
released channel:  ORA_DISK_1
repair failure complete

Do you want to open the database (enter YES or NO)? YES
database opened

RMAN>
```

8. Use the `LIST FAILURE` command to verify that the failure has been repaired.

```
RMAN> list failure;

Database Role: PRIMARY

no failures found that match specification

RMAN>
```

9. In your second terminal window, clean up the practice environment by running the `cleanup_06_02.sh` script. The script saves its output in the /`tmp/cleanup.log` file.

```
$ ./cleanup_06_02.sh
$
```

10. Return to the RMAN terminal session. In preparation for the next practice, back up your `orclcdb` database, remove obsolete backups, and ensure that no failures are listed.

```
RMAN> BACKUP DATABASE PLUS ARCHIVELOG DELETE INPUT;
…
RMAN> delete noprompt obsolete;
…
RMAN> list failure;

Database Role: PRIMARY

no failures found that match specification

RMAN> exit
…
$
```

Practice 18-2: Recovering from the Loss of All Control Files

Overview

In this practice, you create an issue by removing control files. After creating the issue, you must restore the control files.

Assumptions

A full backup of the database is available. Autobackup of the control file and `SPFILE` is configured.

You have two terminal windows open in which you are logged in as the `oracle` OS user, `$HOME/labs/DBMod_Recovery` is the current directory, and environment variables point to the `orclcdb` database instance.

Tasks

1. Prepare for this practice by executing the `setup_06_03.sh` script from the `$HOME/labs/DBMod_Recovery` directory. This script creates a new tablespace and user. As the new user, the script creates a table and populates it. The script creates a backup of the tablespace, and then updates the table.
   The script saves its output in the `/tmp/setup.log` file. You can view this log file while the script executes.

   ```
   $ ./setup_06_03.sh
   $
   ```

2. Cause a failure in the database by executing the `break_06_03.sh` script from the `$HOME/labs/DBMod_Recovery` directory. The script saves its output in the `/tmp/break.log` file.

   ```
   $ ./break_06_03.sh
   $
   ```

3. Log in to SQL*Plus and attempt to start the database. Notice the error message. Exit from SQL*Plus.

   ```
   $ sqlplus / as sysdba
   …
   Connected to an idle instance.

   SQL> startup
   ORACLE instance started.
   …
   ORA-00205: error in identifying control file, check alert log
   for more info
   ```

```
SQL> exit
```

4. View the alert log (*option* 2 in this example). Your option number may be different. Scroll to the most recent entries to see the errors from this practice.

```
$ adrci
…
ADR base = "/u01/app/oracle"
adrci> set editor gedit
adrci> show alert

Choose the home from which to view the alert log:

1: diag/rdbms/dummy/orclcdb
1: diag/rdbms/orcldg/
orcldg
3: diag/rdbms/orclcdb/orclcdb
3: diag/rdbms/ubff_pitr_orclpdb1_orclcdb/uBFF
4: diag/rdbms/ORCLOEM/ORCLOEM
5: diag/tnslsnr/edvmr1p0/listener
Q: to quit

Please select option: 3 (Choose as per your environment)

/* Scroll to bottom of the file in gedit to see the following */
...
ORA-00202: control file:
'/u01/app/oracle/controlfiles_dir/ORCLCDB/control03.ctl'
ORA-27037: unable to obtain file status
ORA-00210: cannot open the specified control file
ORA-00202: control file:
'/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl'
ORA-27037: unable to obtain file status
Linux-x86_64 Error: 2: No such file or directory
Additional information: 7
ORA-00210: cannot open the specified control file
ORA-00202: control file:
'/u01/app/oracle/oradata/ORCLCDB/control01.ctl'
ORA-27037: unable to obtain file status
Linux-x86_64 Error: 2: No such file or directory
Additional information: 7
Checker run found 3 new persistent data failures
```

Note: There are three failures, all control files are missing.

5. Exit from viewing the alert log by clicking the "`x`" icon to close the `gedit` window. Exit `adrci` by entering `Q`, and then `exit`.

```
…
Please select option: Q
adrci> exit
$
```

6. Use the RMAN `LIST FAILURE` and `ADVISE FAILURE` commands to determine the failures and proposed solutions.

```
$ rman target "'/ as sysbackup'"
…
connected to target database: ORCLCDB (not mounted)

RMAN> list failure;

using target database control file instead of recovery catalog
List of Database Failures
=========================

Failure ID Priority Status    Time Detected Summary
---------- -------- --------- ------------- -------
4030       CRITICAL OPEN      02-JUL-19     Control file
/u01/app/oracle/controlfiles_dir/ORCLCDB/control03.ctl is
missing
4035       CRITICAL OPEN      02-JUL-19     Control file
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl is
missing
4032       CRITICAL OPEN      02-JUL-19     Control file
/u01/app/oracle/oradata/ORCLCDB/control01.ctl is missing

RMAN> advise failure;

List of Database Failures
=========================

Failure ID Priority Status    Time Detected Summary
---------- -------- --------- ------------- -------
4030       CRITICAL OPEN      02-JUL-19     Control file
/u01/app/oracle/controlfiles_dir/ORCLCDB/control03.ctl is
missing
4035       CRITICAL OPEN      02-JUL-19     Control file
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl is
missing
```

```
4032       CRITICAL OPEN      02-JUL-19     Control file
/u01/app/oracle/oradata/ORCLCDB/control01.ctl is missing

analyzing automatic repair options; this may take some time
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=237 device type=DISK
analyzing automatic repair options complete

Mandatory Manual Actions
========================
no manual actions available

Optional Manual Actions
=======================
1. If file
/u01/app/oracle/controlfiles_dir/ORCLCDB/control03.ctl was
unintentionally renamed or moved, restore it
2. If file
/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl was
unintentionally renamed or moved, restore it
3. If file /u01/app/oracle/oradata/ORCLCDB/control01.ctl was
unintentionally renamed or moved, restore it
4. If this is a standby database, restore the controlfile for a
standby database using RESTORE STANDBY CONTROLFILE FROM
AUTOBACKUP command
5. If this is a primary database and a standby database is
available, then perform a Data Guard failover initiated from the
standby

Automated Repair Options
========================
Option Repair Description
------ -------------------
1      Restore a backup control file
  Strategy: The repair includes complete media recovery with no
data loss
  Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_1494177699.hm

RMAN>
```

7. Review the commands generated by the `REPAIR FAILURE PREVIEW` command.

```
RMAN> repair failure preview;

Strategy: The repair includes complete media recovery with no
data loss
Repair script:
/u01/app/oracle/diag/rdbms/orclcdb/orclcdb/hm/reco_1494177699.hm

contents of repair script:
   # restore control file
   restore controlfile from autobackup;
   sql 'alter database mount';

RMAN>
```

8. One option now would be to use the automated recovery command `REPAIR FAILURE`. However, doing so introduces new failures, such that you would subsequently need to run these RMAN commands in a series, repeated as needed to correct the failures:

```
LIST FAILURE;
ADVISE FAILURE;
REPAIR FAILURE PREVIEW;
REPAIR FAILURE;
```

So to avoid going through the above steps repeatedly with the Data Recovery Advisor, follow steps 8 through 11 of this practice exactly as described.

Use the RMAN command line to restore the control files and mount the database.

```
RMAN> restore controlfile from autobackup;

Starting restore at 02-JUL-19
using channel ORA_DISK_1

recovery area destination: /u01/app/oracle/fast_recovery_area
database name (or database unique name) used for search: ORCLCDB
channel ORA_DISK_1: AUTOBACKUP
/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/2019_07_01
/o1_mf_s_1012509894_gknw675v_.bkp found in the recovery area
AUTOBACKUP search with format "%F" not attempted because DBID
was not set
channel ORA_DISK_1: restoring control file from AUTOBACKUP
/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/2019_07_01
/o1_mf_s_1012509894_gknw675v_.bkp
channel ORA_DISK_1: control file restore from AUTOBACKUP
complete
output file name=/u01/app/oracle/oradata/ORCLCDB/control01.ctl
output file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/control02.ctl
Finished restore at 02-JUL-19

RMAN> ALTER DATABASE MOUNT;

released channel: ORA_DISK_1
Statement processed

RMAN>
```

9. Attempt to open the database.

```
RMAN> ALTER DATABASE OPEN;

RMAN-00571: ====================================================
RMAN-00569: =========== ERROR MESSAGE STACK FOLLOWS ============
RMAN-00571: ====================================================
RMAN-03002: failure of sql statement command at 07/02/2019
14:48:28
ORA-01589: must use RESETLOGS or NORESETLOGS option for database
open

RMAN>
```

Question: Why is `RESETLOGS` necessary?

Answer: `RESETLOGS` is required because the SCN in the restored control file does not match the SCN recorded in the data files.

10. Attempt to open the database with the `RESETLOGS` option.

```
RMAN> ALTER DATABASE OPEN RESETLOGS;

RMAN-00571: ====================================================
RMAN-00569: =========== ERROR MESSAGE STACK FOLLOWS ============
RMAN-00571: ====================================================
RMAN-03002: failure of sql statement command at 07/02/2019
14:48:39
ORA-01194: file 1 needs more recovery to be consistent
ORA-01110: data file 1:
'/u01/app/oracle/oradata/ORCLCDB/system01.dbf'

RMAN>
```

Question: Why did the database open still fail with the `RESETLOGS` option?

Answer: The SCN in the control file is older than the SCN in the data files and the data files have not been restored with the `UNTIL` cause. The database needs to be recovered so that the control file can be synchronized with the data files.

11. Recover the database.

```
RMAN> recover database;

Starting recover at 02-JUL-19
Starting implicit crosscheck backup at 02-JUL-19
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=258 device type=DISK
Crosschecked 12 objects
Finished implicit crosscheck backup at 02-JUL-19

Starting implicit crosscheck copy at 02-JUL-19
using channel ORA_DISK_1
Finished implicit crosscheck copy at 02-JUL-19

searching for all files in the recovery area
cataloging files...
cataloging done

List of Cataloged Files
=======================
File Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/autobackup/2019_07_01
/o1_mf_s_1012509894_gknw675v_.bkp
File Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_07_02
/o1_mf_1_6_gkp095or_.arc
File Name:
/u01/app/oracle/fast_recovery_area/ORCLCDB/8C28E6F854EB7DBBE0536
210ED0AFDD9/datafile/o1_mf_bartbs_gkpv2ngh_.dbf

using channel ORA_DISK_1

starting media recovery

archived log for thread 1 with sequence 6 is already on disk as
file
/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_07_02
/o1_mf_1_6_gkp095or_.arc
archived log for thread 1 with sequence 7 is already on disk as
file
/u01/app/oracle/fast_recovery_area/ORCLCDB/onlinelog/redo1a.log
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/archivelog/2019_
07_02/o1_mf_1_6_gkp095or_.arc thread=1 sequence=6
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/onlinelog/redo1a
.log thread=1 sequence=7
```

```
creating datafile file number=189
name=/u01/app/oracle/oradata/ORCLCDB/orclpdb1/bartbs.dbf
archived log file
name=/u01/app/oracle/fast_recovery_area/ORCLCDB/onlinelog/redo1a
.log thread=1 sequence=7
media recovery complete, elapsed time: 00:00:01
Finished recover at 02-JUL-19

RMAN>
```

12. Open the database with `RESETLOGS`.

```
RMAN> ALTER DATABASE OPEN RESETLOGS;

Statement processed

RMAN> ALTER PLUGGABLE DATABASE ORCLPDB1 OPEN;

Statement processed
```

13. Use the `LIST FAILURE` command to verify that the failure has been repaired.

```
RMAN> list failure;

Database Role: PRIMARY

no failures found that match specification

RMAN>
```

14. In your second terminal window, optionally log in to SQL*Plus and query `V$DATABASE` to view the values of `DBID` and `CURRENT_SCN` of both `orclcdb` and `orclpdb1`. Exit SQL*Plus when finished.

```
$ sqlplus / as sysdba
…
SQL> SELECT NAME, DBID, CURRENT_SCN, LOG_MODE, OPEN_MODE FROM
V$DATABASE;

NAME            DBID CURRENT_SCN LOG_MODE     OPEN_MODE
--------- ---------- ----------- ------------ ------------------
ORCLCDB   2778750799    11419045 ARCHIVELOG   READ WRITE

SQL> alter session set container=orclpdb1;

Session altered.

SQL> SELECT NAME, DBID, CURRENT_SCN, LOG_MODE, OPEN_MODE FROM
V$DATABASE;
```

```
NAME              DBID CURRENT_SCN LOG_MODE     OPEN_MODE
--------- ------------ ----------- ------------ --------------------
ORCLCDB   2778750799     11419154 ARCHIVELOG    READ WRITE

SQL> exit
…
$
```

15. Clean up the practice environment by using the `cleanup_06_03.sh` script from the `$HOME/labs/DBMod_Recovery` directory. The script saves its output in the `/tmp/cleanup.log` file.

```
$ ./cleanup_06_03.sh
$
```

16. Return to the RMAN terminal session. In preparation for the next practice, back up your `orclcdb` database, remove obsolete backups, and ensure that no failures are listed. Then exit from RMAN.

```
RMAN> BACKUP DATABASE PLUS ARCHIVELOG DELETE INPUT;
…
RMAN> delete noprompt obsolete;
…
RMAN> list failure;

Database Role: PRIMARY

no failures found that match specification

RMAN> exit
…
$
```

Practice 18-3: Restoring the Password File

Overview

In this practice, you recover from the loss of the database password file. The database password is required for remote access to the database by SYSDBA privileged users.

Assumptions

A full backup of the database is available.

You have two terminal windows open in which you are logged in as the oracle OS user, $HOME/labs/DBMod_Recovery is the current directory, and environment variables point to the orclcdb database instance.

Tasks

1. Cause a failure in the database by executing the break_06_04.sh script from the $HOME/labs/DBMod_Recovery directory. The script saves its output in the /tmp/break.log file. You can view this file while and after the script executes.

```
$ ./break_06_04.sh
$
```

2. Attempt to connect to the database using a remote connection. Notice the error messages. Refer to the "*Course Practice Environment: Security Credentials*" document for the correct password.

```
$ sqlplus sys@orclcdb as sysdba
…
Enter password: *********
ERROR:
ORA-01017: invalid username/password; logon denied

Enter user-name: ^C
$
```

   Note: The remote connection requires the use of a password file.

3. Check if the password file exists. The name of the orclcdb database password file for Linux and UNIX systems is $ORACLE_HOME/dbs/orapworclcdb.

```
$ ls $ORACLE_HOME/dbs/orapw*
```

   The orapworclcdb.ora should not be listed because it was deleted by the break_06_04.sh script. But files for other databases will exist, ignore it.

   Note: It is critically important to the security of your system that you protect your password file and the environment variables that identify the location of the password file. Any user with access to these could potentially compromise the security of the connection.

4. Optionally, view the description of the `orapwd` parameters. Invoke `orapwd` in a terminal window.

```
$ orapwd

Usage: orapwd file=<fname> force=<y/n> asm=<y/n>
       dbuniquename=<dbname> format=<12/12.2>
       delete=<y/n> input_file=<input-fname>
       sys=<y/password/external(<sys-external-name>)>
       sysbackup=<y/password/external(<sysbackup-external-name>)>
       sysdg=<y/password/external(<sysdg-external-name>)>
       syskm=<y/password/external(<syskm-external-name>)>

Usage: orapwd describe file=<fname>

  where
    file - name of password file (required),
    password - password for SYS will be prompted
               if not specified at command line.
               Ignored, if input_file is specified,
    force - whether to overwrite existing file (optional),
    asm - indicates that the password to be stored in
          Automatic Storage Management (ASM) disk group
          is an ASM password. (optional),
    dbuniquename - unique database name used to identify database
                   password files residing in ASM diskgroup only.
                   Ignored when asm option is specified (optional),
    format - use format=12 for new 12c features like SYSBACKUP, SYSDG
and
             SYSKM support, longer identifiers, SHA2 Verifiers etc.
             use format=12.2 for 12.2 features like enforcing user
             profile (password limits and password complexity) and
             account status for administrative users.
             If not specified, format=12.2 is default (optional),
    delete - drops a password file. Must specify 'asm',
             'dbuniquename' or 'file'. If 'file' is specified,
             the file must be located on an ASM diskgroup (optional),
    input_file - name of input password file, from where old user
                 entries will be migrated (optional),
    sys - specifies if SYS user is password or externally
authenticated.
          For external SYS, also specifies external name.
          SYS={y/password} specifies if SYS user password needs
          to be changed when used with input_file,
    sysbackup - creates SYSBACKUP entry (optional).
                Specifies if SYSBACKUP user is password or externally
                authenticated. For external SYSBACKUP, also specifies
```

```
                 external name. Ignored, if input_file is specified,
    sysdg - creates SYSDG entry (optional).
            Specifies if SYSDG user is password or externally
authenticated.
            For external SYSDG, also specifies external name.
            Ignored, if input_file is specified,
    syskm - creates SYSKM entry (optional).
            Specifies if SYSKM user is password or externally
authenticated.
            For external SYSKM, also specifies external name.
            Ignored, if input_file is specified,
    describe - describes the properties of specified password file
               (required).

  There must be no spaces around the equal-to (=) character.
$
```

5. Create a new password file by using the `orapwd` utility. Use the password specified for this step in the "*Course Practice Environment: Security Credentials*" document. Replace *`fenago`* with the correct password.

```
$ orapwd FILE=$ORACLE_HOME/dbs/orapworclcdb ENTRIES=15 force=Y
password=fenago format=12
```

Note: When you exceed the allocated number of password entries, you must create a new password file. To avoid this necessity, allocate more entries than you think you will ever need.

6. Test the remote `SYSDBA` login. Now it should be successful. Use the password specified for this step in the "*Course Practice Environment: Security Credentials*" document. Replace *`fenago`* with the correct password.

```
$ sqlplus sys@orclcdb as sysdba
…
Enter password: <password> <<< Not displayed
…
SQL>
```

7. Optionally, review the `V$PWFILE_USERS` view.

```
SQL> desc V$PWFILE_USERS
 Name                          Null?    Type
 ----------------------------- -------- ----------------------------
 USERNAME                               VARCHAR2(128)
 SYSDBA                                 VARCHAR2(5)
 SYSOPER                                VARCHAR2(5)
 SYSASM                                 VARCHAR2(5)
 SYSBACKUP                                 VARCHAR2(5)
 SYSDG                                     VARCHAR2(5)
 SYSKM                                     VARCHAR2(5)
 ACCOUNT_STATUS                            VARCHAR2(30)
 PASSWORD_PROFILE                          VARCHAR2(128)
 LAST_LOGIN                                TIMESTAMP(9) WITH TIME ZONE
 LOCK_DATE                                 DATE
 EXPIRY_DATE                               DATE
 EXTERNAL_NAME                             VARCHAR2(1024)
 AUTHENTICATION_TYPE                       VARCHAR2(8)
 COMMON                                    VARCHAR2(3)
 CON_ID                                    NUMBER

SQL> set pagesize 100
SQL> SELECT * FROM V$PWFILE_USERS;

USERNAME
-----------------------------------------------------------------
SYSDB SYSOP SYSAS SYSBA SYSDG SYSKM ACCOUNT_STATUS
----- ----- ----- ----- ----- ----- ----------------------------
PASSWORD_PROFILE
-----------------------------------------------------------------
LAST_LOGIN
-----------------------------------------------------------------
LOCK_DATE           EXPIRY_DATE
------------------- -------------------
EXTERNAL_NAME
-----------------------------------------------------------------
AUTHENTI COM     CON_ID
-------- --- ----------
SYS
TRUE  TRUE  FALSE FALSE FALSE FALSE OPEN

26-JUL-18 02.14.37.000000000 PM +00:00



PASSWORD YES          0

SQL>
```

8. Exit SQL*Plus.

```
SQL> exit
…
$
```

9. Close all terminal windows open.

Practices for Lesson 19: Oracle Flashback Technology Overview

Practices for Lesson 19

There are no practices for Lesson 19.

Practices for Lesson 20: Using Logical Flashback Features

Practices for Lesson 20: Overview

Overview

In these practices, you will configure your database for the use of flashback technologies. You will then use flashback technologies to restore a dropped table and reverse the actions of a transaction.

Practice 20-1: Preparing to Use Flashback Technologies

Overview

In this practice, you will configure the database to use the flashback transaction and flashback table features.

Assumptions

You have two terminal windows open in which you are logged in as the `oracle` OS user and `/home/oracle/labs/DBMod_Flashback` is the current directory. Each terminal window is connected to the `orclpdb1` instance.

Tasks

1. Open a terminal window. Use SQL*Plus to connect to `ORCLPDB1` as the `SYS` user.

```
$ sqlplus sys/fenago as sysdba

SQL> alter session set container=orclpdb1;
```

2. Determine how far the undo data will allow you to flash back transactions in the database. The `V$UNDOSTAT` view contains up to four days of statistics, over each 10-minute interval. The first row contains the current (partial) time period statistics. (*Your value may be different.*)

```
SQL> select tuned_undoretention from v$undostat where rownum =
1;

TUNED_UNDORETENTION
---------------------------
                900

SQL>
```

Question: What does the value of the `TUNED_UNDORETENTION` time represent?

Answer: The number of seconds the data is being retained in the database at any given time. Undo retention is not guaranteed by default. If the system needs more space, the Oracle Database server can overwrite unexpired undo with more recently generated undo data.

3. Set the UNDO_RETENTION parameter and RETENTION GUARANTEE clause on the undo tablespace to guarantee retention for 24 hours. Change the properties of the tablespace so you will not run out of space in the tablespace.

   a. Change the UNDO_RETENTION parameter to 14400 seconds (4 hours).

      Note: Increasing the value of UNDO_RETENTION to more than a few days can cause unreasonable growth of the undo tablespace.

      ```
      SQL> ALTER SYSTEM SET UNDO_RETENTION = 14400 SCOPE=BOTH;

      System altered.

      SQL>
      ```

   b. Determine the name of the undo tablespace.

      ```
      SQL> SHOW PARAMETER UNDO

      NAME                                 TYPE        VALUE
      ------------------------------------ ----------- ---------------
      temp_undo_enabled                    boolean     FALSE
      undo_management                      string      AUTO
      undo_retention                       integer     14400
      undo_tablespace                      string      UNDOTBS1
      SQL>
      ```

   c. Change the RETENTION GUARANTEE value of the undo tablespace.

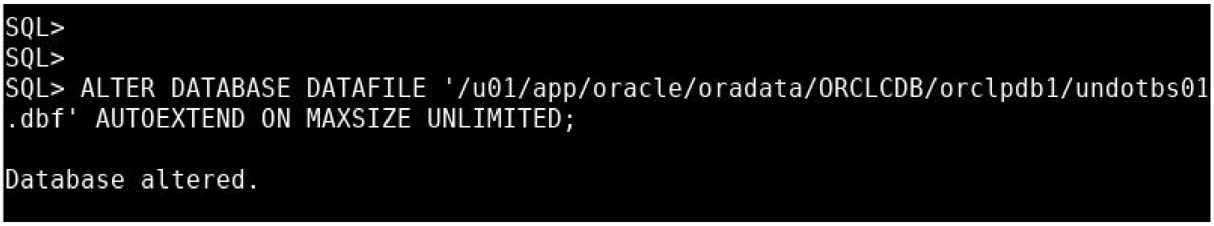
      ```
      SQL> ALTER TABLESPACE UNDOTBS1 RETENTION GUARANTEE;

      Tablespace altered.

      SQL>
      ```

   d. Find the names of the data files associated with the UNDOTBS1 tablespace. Note the FILE_ID value.

      ```
      SQL> select file_name, file_id from dba_data_files where
      tablespace_name like '%UNDO%';

      FILE_NAME                                                  FILE_ID
      ------------------------------------------------------- ----------


      /u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01.dbf   11

      SQL>
      ```

e. Configure the undo tablespace data file to automatically extend if more space is needed to keep unexpired undo and active undo records. Use your own FILE_ID value from previous command instead of UPDATE_HERE.

```
SQL> ALTER DATABASE DATAFILE 'UPDATE_HERE' AUTOEXTEND
ON MAXSIZE UNLIMITED;


Database altered.


SQL>
```



```
SQL>
SQL>
SQL> ALTER DATABASE DATAFILE '/u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01
.dbf' AUTOEXTEND ON MAXSIZE UNLIMITED;

Database altered.
```

Question: What happens if undo retention is guaranteed and no more space is available for active undo records (either because the undo tablespace has filled, reached the maximum size, or there is no more space left on the storage device [disk])?

Answer: Transactions fail due to lack of space in the undo tablespace.

4. View the value of the RECYCLEBIN parameter, then exit SQL*Plus.
   Note: ON is the default value.

```
SQL> show parameter recyclebin

NAME                                 TYPE        VALUE
------------------------------------ ----------- ------------------------------
recyclebin                           string      on

SQL> exit
…
$
```

Practice 20-2: Restoring a Dropped Table

Overview

In this practice, you will recover a table that has been dropped.

Assumptions

The RECYCLEBIN parameter is set to ON (which you confirmed in Practice 2-1 Step 4).

You have two terminal windows open in which you are logged in as the oracle OS user and /home/oracle/labs/DBMod_Flashback is the current directory. Each terminal window is connected to the orclpdb1 instance.

Tasks

1. Execute the setup_02_02.sh script to create the practice environment. The script saves its output in the /home/oracle/labs/DBMod_Flashback/setup.log file.

```
$ cd /home/oracle/labs/DBMod_Flashback
$ ./setup_02_02.sh
$
```

2. Execute the break_02_02.sh script to simulate the work done by a developer. The script saves its output in the /home/oracle/labs/DBMod_Flashback/break.log file.

```
$ ./break_02_02.sh
$
```

3. A developer, who has been using the BAR Oracle user account comes to you and asks you to restore a table that was dropped. This table has had several iterations but the one the developer needs was named BAR102 in the BAR schema. It should have 12 columns, one of which was named LOCATION_ID. There is currently a BAR102 table in the BAR schema. Restore the requested table to BAR102A.

   a. Attempt to use the SHOW RECYCLEBIN command to view the contents of the recycle bin for orclpdb1.

```
$ sqlplus sys/fenago as sysdba
SQL> ALTER PLUGGABLE DATABASE ALL OPEN;
SQL> alter session set container=orclpdb1;
SQL> show recyclebin
```

   Note: The SHOW RECYCLEBIN command shows only those objects that belong to the *current* user. Because you are logged in as the SYS user, the SHOW RECYCLEBIN command does not show the dropped tables you are interested in restoring.

b. Examine the objects in the `DBA_RECYCLEBIN` view. Optionally, change the SQL*Plus page size to 99 lines.

```
SQL> set pages 99
SQL> select original_name, object_name, droptime from
dba_recyclebin where owner ='BAR';

ORIGINAL_NAME
-----------------------------------------------------------------
OBJECT_NAME
-----------------------------------------------------------------
DROPTIME
-------------------
BAR102
BIN$jNKlrSHcInLgU6YR7Qqg/Q==$0
2019-07-04:02:22:19

BAR102
BIN$jNKlrSHhInLgU6YR7Qqg/Q==$0
2019-07-04:02:22:19

BAR101
BIN$jNKlrSHmInLgU6YR7Qqg/Q==$0
2019-07-04:02:22:19
 Note: Your lab environment will have different object names.
```

Note: In the preceding output, you see the same object dropped twice at different points in time. With the time stamp, you determine which version of the table you really want to restore.

c. Determine which object contains the column of interest. *Your object names will be different*. *Use your own values from the previous step*.
Hint: Select the column from the tables, the one which does not report an error is the one you want.

Note: The object name from the recycle bin must be in double quotation marks because it may contain special chars (update objectname in below commands)

```
SQL> SELECT location_id
     FROM BAR.BIN$jNKlrSHcInLgU6YR7Qqg/Q==$0
     WHERE rownum = 1;
Select location_id
       *
ERROR at line 1:
ORA-00904: "LOCATION_ID": invalid identifier
```

```
SQL> SELECT location_id
     FROM BAR."BIN$jNKlrSHhInLgU6YR7Qqg/Q==$0"
     where rownum = 1;

LOCATION_ID
-----------
SQL>
```

d. Restore the object that has the correct columns. *Use the correct object name that you found in the previous steps.*

```
SQL> FLASHBACK TABLE BAR."BIN$jNKlrSHhInLgU6YR7Qqg/Q==$0" TO
BEFORE DROP RENAME TO BAR102A;

Flashback complete.

SQL>
```

4. Confirm that the BAR.BAR102A table has been restored by selecting the first row. Then exit SQL*Plus.

   Note: It does not matter which row is displayed from the query.

```
SQL> select * from BAR.BAR102A where rownum = 1;

EMPLOYEE_ID FIRST_NAME           LAST_NAME
----------- -------------------- -------------------------
EMAIL                   PHONE_NUMBER         HIRE_DATE JOB_ID
    SALARY
------------------------- -------------------- --------- ----------
--- ----------
COMMISSION_PCT MANAGER_ID DEPARTMENT_ID LOCATION_ID
-------------- ---------- ------------- -----------
    100 Steven        King
SKING                   515.123.4567         17-JUN-03 AD_PRES
24001
                          90
SQL> exit
$
```

5. Clean up from this practice by executing the cleanup_02_02.sh script.

   Note: This script uses the PURGE DBA_RECYCLEBIN command to remove all objects from the recycle bin. The script saves its output in the /home/oracle/labs/DBMod_Flashback/cleanup.log file.

```
$ ./cleanup_02_02.sh
$
```

Practice 20-3: Using Flashback Table

Overview

In this practice, you will use flashback table to reverse a transaction.

Assumptions

Practice 2-1 has been completed.

You have two terminal windows open in which you are logged in as the `oracle` OS user and `/home/oracle/labs/DBMod_Flashback` is the current directory. Each terminal window is connected to the `orclpdb1` instance.

Tasks

1. Execute the `setup_02_03.sh` script to create the user and tables used in this practice. The tables have a foreign-key relationship. The script saves its output in the `/home/oracle/labs/DBMod_Flashback/setup.log` file.

```
$ ./setup_02_03.sh
$
```

2. Determine the current time to the nearest second. Record this as T1.

   Note: Your date will be different.

```
$ sqlplus sys/fenago as sysdba
SQL> alter session set container=orclpdb1;
SQL> select to_char(sysdate, 'yyyy-mm-dd:hh24:mi:ss') from dual;

SYSDATE
---------------------------
CHECK_OUTPUT

SQL>
```

3. Open a new terminal window and execute the `break_02_03.sh` script. This simulates a transaction that scrambles the data in the `BARCOPY` and `BARDEPT` tables. There is a foreign key constraint between `BARCOPY` and `BARDEPT`. The script saves its output in the `/home/oracle/labs/DBMod_Flashback/break.log` file.

```
$ cd /home/oracle/labs/DBMod_Flashback
$ ./break_02_03.sh
$
```

4. Return to the SQL*Plus terminal session connected to ORCLPDB1 as the SYS user. The HR representative reports that an employee has incorrectly changed the names of the departments, and scrambled which employees are assigned to which departments. The tables were correct at time T1 and no authorized changes have been made since that time. The tables involved are BAR.BARCOPY and BAR.DEPT. Restore the tables to the state they were at T1 (determined in step 2).

   Because there is a foreign-key relationship, both tables must be restored. Continue in your existing SQL*Plus session.

```
SQL> ALTER TABLE BAR.BARDEPT ENABLE ROW MOVEMENT;

Table altered.

SQL> ALTER TABLE BAR.BARCOPY ENABLE ROW MOVEMENT;

Table altered.

SQL> FLASHBACK TABLE BAR.BARDEPT TO TIMESTAMP
TO_TIMESTAMP('UPDATE_HERE','YYYY-MM-DD:HH24:MI:SS');

Flashback complete.

SQL> FLASHBACK TABLE BAR.BARCOPY TO TIMESTAMP
TO_TIMESTAMP('UPDATE_HERE','YYYY-MM-DD:HH24:MI:SS');

Flashback complete.

SQL>
```

5. Check that you have correctly restored the tables. The results of the following query should match yours, although the row order may be different. Then exit SQL*Plus.

   Note: Make sure to sqlplus is opened from **/home/oracle/labs/DBMod_Flashback** path in terminal. Otherwise, you will get script not found error.

```
SQL> @check_02_03.sql

DEPARTMENT_ID DEPARTMENT_NAME                  COUNT(*)
------------- ------------------------------ ----------
           10 Administration                          4
           20 Marketing                               8
           30 Purchasing                             24
           40 Human Resources                         4
           50 Shipping                              180
           60 IT                                     20
           70 Public Relations                        4
           80 Sales                                 136
           90 Executive                              12
```

```
          100 Finance                                 24
          110 Accounting                               8

11 rows selected.

SQL> exit
…
$
```

6. Clean up the practice environment by running the `cleanup_02_03.sh` script.

```
$ ./cleanup_02_03.sh
$
```

Practices for Lesson 21:
Using Flashback Database

Practices for Lesson 21: Overview

Overview

In these practices, you will enable flashback logging and perform flashback database.

Practice 21-1: Enabling Flashback Logging

Overview

In this practice, you will enable flashback logging.

Assumptions

You have two terminal windows open in which you are logged in as the `oracle` OS user and `/home/oracle/labs/DBMod_Flashback` is the current directory. Each terminal window is connected to the `orclpdb1` instance.

Tasks

1. Determine whether flashback logging is enabled while still connected to the container database.

```
$ sqlplus / as sysdba
…
SQL> SELECT flashback_on FROM v$database;

FLASHBACK_ON
------------------
YES

SQL>
```

2. **Note:** Enable flashback logging and verify if you get NO in previous command.

```
SQL> ALTER DATABASE FLASHBACK ON;

Database altered.

SQL> select FLASHBACK_ON from v$database;
FLASHBACK_ON
------------------
YES
```

3. In preparation for the next practice, back up your `orclpdb1` database, remove obsolete backups, and ensure that no failures are listed. Then exit RMAN.

```
SQL> host

$ rman target "'/ as sysbackup'"
…
RMAN> BACKUP DATABASE PLUS ARCHIVELOG DELETE INPUT;
…
RMAN> delete noprompt obsolete;
…
```

```
RMAN> list failure;

Database Role: PRIMARY

no failures found that match specification

RMAN> exit

Recovery Manager complete.
$ exit
```

4. Alter your session to point to the `orclpdb1` database and create a guaranteed restore point. Check your current `FLASHBACK_ON` status.

   Note that guaranteed restore points affect your space usage.

```
SQL> alter session set container = orclpdb1;

Session altered.

SQL> CREATE RESTORE POINT rp1 GUARANTEE FLASHBACK DATABASE;

Restore point created.

SQL> SELECT FLASHBACK_ON FROM V$DATABASE;

FLASHBACK_ON
------------------
YES
SQL>
```

5. Keep the terminal windows open for the next practice.

Practice 21-2: Performing Flashback Database

Overview

In this practice, you will flash back your pluggable database after some incorrect updates to the database. *This practice is for learning purposes. If you had a scenario similar to this in a production environment, you would probably choose a different solution to limit your flashback to the affected objects, rather than choose a flashback of the entire pluggable database.*

Assumptions

You have completed practice 3-1.

You have two terminal windows open in which you are logged in as the `oracle` OS user and `/home/oracle/labs/DBMod_Flashback` is the current directory. Each terminal window is connected to the `orclpdb1` instance.

Tasks

1. There are several ways in which you can perform a flashback database operation. You can use a guaranteed restore point, SCN, time value, threads, and so on. This example uses the SCN, but you could also use the `RP1` restore point you created in the Practice 3-1 Step 5.

   Determine your current SCN. *You will need to use it in a later practice step*.

```
SQL> SELECT current_scn FROM v$database;

CURRENT_SCN
-----------
    3285954 (CHECK OUTPUT)

SQL>
```

2. View `HR` data. You will use this information for comparison during this practice.

   a. Determine the sum of the `SALARY` column in the `HR.EMPLOYEES` table.

```
SQL> SELECT sum(salary) FROM hr.employees;

SUM(SALARY)
-----------
     691416

SQL>
```

b. Determine the total number of employees in department 90.

```
SQL> SELECT count(*) FROM hr.employees where department_id=90;

  COUNT(*)
----------
         3

SQL>
```

3. Execute the lab_03_02_03.sql script to update tables in the HR schema. It creates issues from which you will “recover” by flashing back the database in this practice.

```
SQL> @lab_03_02_03.sql
SQL> update hr.employees
  2  set department_id = 90
  3  where job_id = 'IT_PROG'
  4  /

5 rows updated.

SQL> update hr.employees e
  2  set salary = least(e.salary,
  3  (select (min_salary + max_salary)/2 * 1.10
  4  from hr.jobs j
  5  where j.job_id = e.job_id))
  6  where job_id not like 'AD_%'
  7  /

103 rows updated.

SQL>
```

4. Commit your data and determine the current SCN.

```
SQL> COMMIT;

Commit complete.

SQL> SELECT current_scn FROM v$database;

CURRENT_SCN
-----------
   32886103

SQL>
```

5. Query the data in the HR schema again and compare the results to the values you received in the queries in step 2.

   a. Determine the sum of the SALARY column in the HR.EMPLOYEES table.

```
SQL> SELECT sum(salary) FROM hr.employees;

SUM(SALARY)
-----------
   679092.4

SQL>
```

   b. Determine the total number of employees in department 90, and then exit SQL*Plus.

```
SQL> SELECT count(*) FROM hr.employees where department_id=90;

  COUNT(*)
----------
         8

SQL> exit
…
$
```

6. You need to restore the pluggable database so that the data is as it was when you started this practice. For training purposes, use Flashback Database for this operation.

   a. Close the pluggable database orclpdb1.

```
$ sqlplus / as sysdba
…
SQL> alter pluggable database orclpdb1 CLOSE;

Pluggable database altered.
```

   b. Use the FLASHBACK PLUGGABLE DATABASE command to flash back the database to the SCN you noted in step 1.

```
SQL> flashback pluggable database orclpdb1 to scn UPDATE_HERE;

Flashback complete.
```

   c. Attempt to open the pluggable database orclpdb1.

```
SQL> alter pluggable database orclpdb1 open;
alter pluggable database orclpdb1 open
*
ERROR at line 1:
ORA-01113: file 12 needs media recovery
```

```
ORA-01110: data file 12:
'/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf'
```

d. Open the pluggable database `orclpdb1` using the `resetlogs` option.

```
SQL> alter pluggable database orclpdb1 open resetlogs;

Pluggable database altered.
```

e. Switch to the `ORCLPDB1` container and verify that the database was flashed back correctly by querying the `HR.EMPLOYEES` table again. The values should match the values you obtained in the queries in step 2.

```
SQL> alter session set container = orclpdb1;

Session altered.

SQL> SELECT sum(salary) FROM hr.employees;

SUM(SALARY)
-----------
     691416

SQL> SELECT count(*) FROM hr.employees where department_id=90;

  COUNT(*)
----------
         3

SQL>
```

7. Drop the `RP1` guaranteed restore point. Then exit SQL*Plus.

```
SQL> DROP RESTORE POINT rp1;

Restore point dropped.

SQL> exit
…
$
```

8. Close all terminal windows open for this practice.