# 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 10 minutes to complete this practice.

Tasks

Open a terminal window and use the oraenv script to set the environment variables for the

ORCLCDB database.

Use the dbstart.sh script to start the database and listener. If your database is currently running, you will see ORA-01081, which you can safely ignore.

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

Verify that the control files are multiplexed.

Back up the control file to a trace file.

Exit SQL\*Plus.

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

List the files in this directory. Notice that the directory contains the alert log (alert\_orclcdb.log) and many trace files (.trc).

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.

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]$ **cat orclcdb\_ora\_8708.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";

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.

**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 5 minutes to complete this practice.

Tasks

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

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

setting.

**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.

Exit RMAN.

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

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

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.

100 PDB$SEED:UNDOTBS1 NO

/u01/app/oracle/oradata/ORCLCDB/pdbseed/undotbs01.dbf

280 ORCLPDB1:SYSTEM YES

/u01/app/oracle/oradata/ORCLCDB/orclpdb1/system01.dbf

370 ORCLPDB1:SYSAUX NO

/u01/app/oracle/oradata/ORCLCDB/orclpdb1/sysaux01.dbf

100 ORCLPDB1:UNDOTBS1 YES

/u01/app/oracle/oradata/ORCLCDB/orclpdb1/undotbs01.dbf

342 ORCLPDB1:USERS NO

/u01/app/oracle/oradata/ORCLCDB/orclpdb1/users01.dbf

280 ORCLPDB2:SYSTEM YES

/u01/app/oracle/oradata/ORCLCDB/orclpdb2/system01.dbf

370 ORCLPDB2:SYSAUX NO

/u01/app/oracle/oradata/ORCLCDB/orclpdb2/sysaux01.dbf

100 ORCLPDB2:UNDOTBS1 YES

/u01/app/oracle/oradata/ORCLCDB/orclpdb2/undotbs01.dbf

342 ORCLPDB2:USERS NO

/u01/app/oracle/oradata/ORCLCDB/orclpdb2/users01.dbf

List of Temporary Files

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File Size(MB) Tablespace Maxsize(MB) Tempfile Name

1 131 TEMP 32767

/u01/app/oracle/oradata/ORCLCDB/temp01.dbf

36 PDB$SEED:TEMP 32767

/u01/app/oracle/oradata/ORCLCDB/pdbseed/temp012019-05-08\_01-48-43-006-AM.dbf

36 ORCLPDB1:TEMP 32767

/u01/app/oracle/oradata/ORCLCDB/orclpdb1/temp01.dbf

36 ORCLPDB2:TEMP 32767

/u01/app/oracle/oradata/ORCLCDB/orclpdb2/temp01.dbf

RMAN>

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

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.

**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.

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

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

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

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

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

Exit RMAN.

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.

View the backup retention policy.

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

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

**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.

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.

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.

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

**Answer:** Increase the DB\_RECOVERY\_FILE\_DEST\_SIZE parameter value to 30G by issuing the following command:

**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.

Exit RMAN.

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

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

Back up ORCLPDB1, including the archived redo log files.

Exit RMAN.

**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.

Perform a partial database backup in ORCLPDB1 directly.

Start RMAN and connect to ORCLPDB1 as the SYS user.

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

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

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

Exit RMAN.

Back up the USERS tablespace in ORCLPDB2.

Connect to ORCLPDB2 as the SYS user.

Back up the USERS tablespace.

Exit RMAN.

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

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

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

**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.

Exit RMAN and close the terminal window.

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

Configure block change tracking to place the BCT file in the default data file creation destination.

Start SQL\*Plus and connect to your ORCLCDB database with administrator privileges.

Set the DB\_CREATE\_FILE\_DEST initialization parameter to

/u01/app/oracle/oradata/ORCLCDB.

Enable block change tracking by using the ALTER DATABASE statement.

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

Exit SQL\*Plus.

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 35 minutes to complete this practice.

Tasks

Perform the following steps to check if the ORCLPDB1 pluggable database is open, and open it if it is not.

Log in to SQL\*Plus as SYSDBA.

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

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

Exit from SQL\*Plus.

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.)

**Note:** This script can be run multiple times, but note that it completely resets the

INVENTORY schema each time it runs.

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.

Create the new directory.

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.

Open a new terminal window and start a workload that updates your database by executing the DBMod\_Backup\_workload.sh script.

**Note:** The script updates over 2000 rows.

In your RMAN terminal session, perform an incremental level 1 backup to the

/home/oracle/backup/orclcdb directory.

**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.

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

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

Exit RMAN and remove your test data by executing the

DBMod\_Backup\_cleanupINVENTORY.sh script.

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.

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

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

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

Exit RMAN.

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 10 minutes to complete this practice.

Tasks

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.

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

Use the ALTER DATABASE BACKUP CONTROLFILE TO TRACE SQL command.

Exit from SQL\*Plus.

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

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

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

Log in to RMAN as SYSBACKUP.

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

Log out of RMAN.