



Integrated Cloud Applications & Platform Services

Oracle Database 19c: New Features for Administrators

Activity Guide

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Course Practice
Environment: Security
Credentials

Course Practice Environment: Security Credentials

Overview

For OS usernames and passwords, ask your instructor or LVC producer for OS credential information.

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

Product-Specific Credentials		
Product/Application	Username	Password
VM1		
ORCL and PDB1	Any user	Welcome_1
Other PDBs created in ORCL	Any user	Welcome_1
Other CDBs created and PDBs	Any user	Welcome_1

**Practices for Lesson 1: Using
General Database Overall
Enhancements**

Practices for Lesson 1: Overview

Practices Overview

All practices are independent from one lesson to another.

Your system currently has one VM dedicated to RDBMS.

- Oracle Database 19.3.0.0 is already installed in `/u01/app/oracle/product/19.3.0/dbhome_1`
- The ORCL CDB with one PDB, PDB1, is precreated.
- Net service names for any of the future CDBs and PDBs that you will create through the practices are already logged in the `$ORACLE_HOME/network/admin/tnsnames.ora` file.

To clean up your PDBs at the beginning of the practices of each lesson, you can execute the `/home/oracle/labs/admin/cleanup_PDBs.sh` shell script. The shell script drops all PDBs that may have been created by any of the practices, and finally recreates PDB1.

```
$ $HOME/labs/admin/cleanup_PDBs.sh
...
$
```

In case you need to **re-create the ORCL CDB and its PDB1 PDB**, use the `/home/oracle/labs/admin/recreate_ORCL.sh` shell script.

```
$ $HOME/labs/admin/recreate_ORCL.sh
...
$
```


Practice 1-1: Discovering the Practices Environment

Overview

In this practice, you discover the CDB and PDB that exist on your server.

Tasks

1. Log in to the VM as the oracle UNIX user. Check the connections to the ORCL CDB and verify that the status of PDB PDB1 is open.

```
$ env | grep ORA
ORACLE_SID=ORCL
ORACLE_BASE=/u01/app/oracle
ORACLE_HOME=/u01/app/oracle/product/19.3.0/dbhome_1
$
```

If you are working in a Database Cloud environment, the output would be the following one.

```
$ env | grep ORA
ORACLE_UNQNAME=ORCL
ORACLE_SID=ORCL
ORACLE_BASE=/u01/app/oracle
ORACLE_HOSTNAME=<your_vm>
ORACLE_HOME=/u01/app/oracle/product/19.3.0/dbhome_1
$
```

```
$ sqlplus / AS SYSDBA

SQL> SELECT name, cdb FROM V$DATABASE;

NAME          CDB
-----
ORCL          YES

SQL> SHOW PDBS

          CON_ID CON_NAME                                OPEN MODE  RESTRICTED
-----
          2 PDB$SEED                                READ ONLY  NO
          3 PDB1                                    READ WRITE NO

SQL> EXIT
$
```

Practice 1-2: Installing Oracle Database 19c with Automatic `root.sh` Execution

Overview

In this practice, you will install the Oracle Database 19c and use the capability to have the `root.sh` script automatically executed.

You can also use the Oracle By Example “Installing Oracle Database 19c with Automatic Root Scripts Execution” to see how to proceed. Launch a browser and click the bookmark from the Bookmarks toolbar of the browser. The URL is `file:///home/oracle/labs/OBEs/F11836_01/html/index.html`.

Tasks

1. On your VM, run the installer to install the Oracle Database 19c. Because the Oracle Database 19c is already installed for other lessons in `/u01/app/oracle/product/19.3.0/dbhome_1`, you will use another Oracle home directory to install.
Open TigerVNC as big as possible in order to see options at bottom of installer window.

```
$ cd /u01/app/oracle/product/19.3.0/dbhome_2
$ ./runInstaller
```

2. On the Select Configuration Option page, select Set Up Software Only.
3. On the Select Database Installation Option page, click Next.
4. On the Select Database Edition page, click Next.
5. On the Specify Installation Location page, click Next.
6. On the Privileged Operating System Groups page, click Next.
7. On the Root script execution configuration page, check “Automatically run configuration scripts”, and provide the password for the `root` user. Click Next.
8. In Perform Prerequisite Checks, check “Ignore All” and click Next. If there is a warning message, choose Yes.
9. On the Summary page, click the Save Response File... because you only need to observe the root scripts recorded in the response file and do not need to install.
10. Select the `/tmp` directory as the Location to save the `db.rsp` response file. Click Save and then Cancel. A message asks you if you want to exit, meaning that you do not want to install right now. Click Yes.

11. Read the /tmp/db.rsp response file.

```
$ cat /tmp/db.rsp
...
#####
#
#                               Root script execution configuration
#
#####
#-----
# Specify the root script execution mode.
#
#   - true  : To execute the root script automatically by using
the appropriate configuration methods.
#   - false : To execute the root script manually.
#
# If this option is selected, password should be specified on
the console.
#-----
oracle.install.db.rootconfig.executeRootScript=true
#-----
# Specify the configuration method to be used for automatic root
script execution.
#
# Following are the possible choices:
#   - ROOT
#   - SUDO
#-----
oracle.install.db.rootconfig.configMethod=ROOT
#-----
# Specify the absolute path of the sudo program.
#
# Applicable only when SUDO configuration method was chosen.
#-----
oracle.install.db.rootconfig.sudoPath=
#-----
# Specify the name of the user who is in the sudoers list.
# Applicable only when SUDO configuration method was chosen.
# Note:For Single Instance database installations,the sudo user
name must be the username of the user installing the database.
#-----
oracle.install.db.rootconfig.sudoUserName=
...
$
```

Practice 1-3: Cloning a PDB by Using DBCA in Silent Mode

Overview

In this practice, you will clone PDB1 from ORCL as PDB19 in CDB19 by using DBCA in silent mode.

You can also use the Oracle By Example “Cloning PDBs Using DBCA in Silent Mode” to see how to proceed. Launch a browser and click the bookmark from the Bookmarks toolbar of the browser. The URL is

file:///home/oracle/labs/OBEs/F11839_01/html/index.html.

Tasks

1. Create CDB19 with no PDBs. Execute the `/home/oracle/labs/admin/create_CDB19.sh` shell script to create CDB19.

```
$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ /home/oracle/labs/admin/create_CDB19.sh
...
$
```

2. Before proceeding to the next steps, execute the `$HOME/labs/DB/glogin.sh` shell script. It sets formatting for all columns selected in queries.

```
$ $HOME/labs/DB/glogin.sh
...
$
```

3. Before cloning PDB1 from ORCL as PDB19 in CDB19, verify that PDB1 contains the HR.EMPLOYEES table.

```
$ sqlplus system@PDB1
Enter password: password
SQL> SELECT count(*) FROM hr.employees;

      COUNT (*)
-----
           107

SQL> EXIT
$
```

4. Launch DBCA to clone PDB1 from ORCL as PDB19 in CDB19. Do not omit to set the right passwords in the following command.

```
$ dbca -silent -createPluggableDatabase -createFromRemotePDB -
remotePDBName PDB1 -remoteDBConnString ORCL -
remoteDBSYSDBAUserName SYS -remoteDBSYSDBAUserPassword password
-sysDBAUserName sys -sysDBAPassword password -dbLinkUsername
c##remote_user -dbLinkUserPassword password -sourceDB CDB19 -
pdbName PDB19
[FATAL] [DBT-19404] Specified database link user
(C##REMOTE_USER) does not exist in the database(ORCL).
ACTION: Specify an existing database link user.
$
```

Q1/ What does the error message mean?

A1/ You must create the common user in ORCL that is required for the database link that will be automatically created in CDB19.

```
$ sqlplus system@ORCL
Enter password: password

SQL> CREATE USER c##remote_user IDENTIFIED BY password
CONTAINER=ALL;

User created.
SQL> GRANT create session TO c##remote_user CONTAINER=ALL;
Grant succeeded.
SQL> EXIT
$
```

```
$ dbca -silent -createPluggableDatabase -createFromRemotePDB
-remotePDBName PDB1 -remoteDBConnString ORCL
-remoteDBSYSDBAUserName SYS -remoteDBSYSDBAUserPassword password
-sysDBAUserName sys -sysDBAPassword password -dbLinkUsername
c##remote_user -dbLinkUserPassword password -sourceDB CDB19 -
pdbName PDB19
[FATAL] [DBT-19403] (C##REMOTE_USER) user does not have ("CREATE
PLUGGABLE DATABASE") privilege in the remote container database.
ACTION: Specify user with ("CREATE PLUGGABLE DATABASE")
privilege in the remote container database to perform the
operation.
$
```

Q2/ Did you grant enough privileges to the common user used in the database link to connect to CDB19?

A2/ No. You must grant the common user the *CREATE PLUGGABLE DATABASE* system privilege in *ORCL*.

```
$ sqlplus system@ORCL
Enter password: password
SQL> GRANT create pluggable database TO c##remote_user
        CONTAINER=ALL;

2
Grant succeeded.
SQL> EXIT
$
```

```
$ dbca -silent -createPluggableDatabase -createFromRemotePDB
-remotePDBName PDB1 -remoteDBConnString ORCL
-remoteDBSYSDBAUserName SYS -remoteDBSYSDBAUserPassword password
-sysDBAUserName sys -sysDBAPassword password -dbLinkUsername
c##remote_user -dbLinkUserPassword password -sourceDB CDB19 -
pdbName PDB19
Prepare for db operation
50% complete
Create pluggable database using remote clone operation
100% complete
Pluggable database "PDB19" plugged successfully.
Look at the log file
"/u01/app/oracle/cfgtoollogs/dbca/CDB19/PDB19/CDB19.log" for
further details.
$
```

5. Launch SQL*Plus to connect to PDB19. Verify that the cloned PDB contains the HR.EMPLOYEES table as in PDB1.

```
$ sqlplus system@PDB19
Enter password: password
SQL> SELECT count(*) FROM hr.employees;

COUNT (*)
-----
          107
SQL> EXIT
$
```

Practice 1-4: Relocating a PDB by Using DBCA in Silent Mode

Overview

In this practice, you will relocate PDB19 from CDB19 as PDB19_IN_ORCL in ORCL by using DBCA in silent mode.

You can also use the Oracle By Example “Relocating PDBs Using DBCA in Silent Mode” to see how to proceed. Launch a browser and click the bookmark from the Bookmarks toolbar of the browser. The URL is

file:///home/oracle/labs/OBEs/F11840_01/html/index.html.

Tasks

1. Launch DBCA to relocate PDB19 from CDB19 as PDB19_IN_ORCL in ORCL. Do not omit to set the right passwords in the following command.

```
$ . oraenv
ORACLE_SID = [oracle] ? CDB19
The Oracle base has been set to /u01/app/oracle
$ dbca -silent -relocatePDB -remotePDBName PDB19 -
remoteDBConnString CDB19 -sysDBAUserName SYSTEM -sysDBAPassword
password -remoteDBSYSDBAUserName SYS -remoteDBSYSDBAUserPassword
password -dbLinkUsername c##remote_user -dbLinkUserPassword
password -sourceDB ORCL -pdbName PDB19_IN_ORCL
[FATAL] [DBT-19404] Specified database link user
(C##REMOTE_USER) does not exist in the database(CDB19).
ACTION: Specify an existing database link user.
$
```

Q1/ What does the error message mean?

A1/ You must create the common user in CDB19 that is required for the database link that will be automatically created in ORCL.

```
$ sqlplus system@CDB19
Enter password: password
SQL> CREATE USER c##remote_user IDENTIFIED BY password
CONTAINER=ALL;

2
User created.
SQL> GRANT create session, create pluggable database
TO c##remote_user CONTAINER=ALL;

2
Grant succeeded.
SQL> EXIT
$
```

```
$ dbca -silent -relocatePDB -remotePDBName PDB19 -
remoteDBConnString CDB19 -sysDBAUserName SYSTEM -sysDBAPassword
password -remoteDBSYSDBAUserName SYS -remoteDBSYSDBAUserPassword
password -dbLinkUsername c##remote_user -dbLinkUserPassword
password -sourceDB ORCL -pdbName PDB19_IN_ORCL
[FATAL] [DBT-19403] (C##REMOTE_USER) user does not have
("SYSOPER") privilege in the remote container database.
ACTION: Specify user with ("SYSOPER") privilege in the remote
container database to perform the operation.
$
```

Q2/ Did you grant enough privileges to the common user used in the database link to connect to CDB19?

A2/ No. You must grant the common user the SYSOPER system privilege in CDB19 for the relocation PDB operation.

```
$ sqlplus sys@CDB19 AS SYSDBA
Enter password: password
SQL> GRANT sysoper TO c##remote_user CONTAINER=ALL;
Grant succeeded.
SQL> EXIT
$
```

```
$ dbca -silent -relocatePDB -remotePDBName PDB19 -
remoteDBConnString CDB19 -sysDBAUserName SYSTEM -sysDBAPassword
password -remoteDBSYSDBAUserName SYS -remoteDBSYSDBAUserPassword
password -dbLinkUsername c##remote_user -dbLinkUserPassword
password -sourceDB ORCL -pdbName PDB19_IN_ORCL
Prepare for db operation
50% complete
Create pluggable database using relocate PDB operation
100% complete
Pluggable database "PDB19_IN_ORCL" plugged successfully.
Look at the log file
"/u01/app/oracle/cfgtoollogs/dbca/ORCL/PDB19_IN_ORCL/ORCL.log"
for further details.
$
```

2. Launch SQL*Plus to connect to PDB19_IN_ORCL. Verify that PDB19 is relocated as PDB19_IN_ORCL in ORCL.

```
$ sqlplus sys@CDB19 AS SYSDBA
Enter password: password
SQL> SHOW PDBS
```


CON_ID	CON_NAME	OPEN MODE	RESTRICTED
2	PDB\$SEED	READ ONLY	NO

```

SQL> EXIT
$

```

```

$ sqlplus sys@ORCL AS SYSDBA
Enter password: password
SQL> SHOW PDBS

```

CON_ID	CON_NAME	OPEN MODE	RESTRICTED
2	PDB\$SEED	READ ONLY	NO
3	PDB1	READ WRITE	NO
4	PDB19_IN_ORCL	READ WRITE	NO

```

SQL> EXIT
$

```

Practice 1-5: Duplicating a CDB by Using DBCA in Silent Mode

Overview

In this practice, you will duplicate ORCL as DUPORCL by using DBCA in silent mode.

You can also use the Oracle By Example “Duplicating CDBs Using DBCA in Silent Mode” to see how to proceed. Launch a browser and click the bookmark from the Bookmarks toolbar of the browser. The URL is

file:///home/oracle/labs/OBEs/F11841_01/html/index.html.

Tasks

1. Launch DBCA to duplicate ORCL as DUPORCL by using DBCA in silent mode. Do not omit to set the right password in the following command and replace the *hostname* by your host name.

```
$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ dbca -silent -createDuplicateDB -gdbName DUPORCL -
primaryDBConnectionString hostname:1521/ORCL -sid DUPORCL -
databaseConfigType SI -initParams db_unique_name=DUPORCL -
sysPassword password

[FATAL] [DBT-06607] The data file
(/u02/app/oracle/oradata/ORCL/users01.dbf) already exists on the
file system.

CAUSE: This configuration is going to create the data file
location (/u02/app/oracle/oradata/ORCL/users01.dbf). But it is
detected that there is an existing database using this data file
location or the data files from a previous configuration may be
left behind.

ACTION: Clean up the existing data files, or provide a
different db_unique_name.
[FATAL] [DBT-06607] The data file
(/u02/app/oracle/oradata/ORCL/sysaux01.dbf) already exists on
the file system.

CAUSE: This configuration is going to create the data file
location (/u02/app/oracle/oradata/ORCL/sysaux01.dbf). But it is
detected that there is an existing database using this data file
location or the data files from a previous configuration may be
left behind.

ACTION: Clean up the existing data files, or provide a
different db_unique_name.
[FATAL] [DBT-06607] The data file
(/u02/app/oracle/oradata/ORCL/system01.dbf) already exists on
the file system.
```

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/system01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/undotbs01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/undotbs01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/pdbseed/sysaux01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/pdbseed/sysaux01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/pdbseed/system01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/pdbseed/system01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/pdbseed/undotbs01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/pdbseed/undotbs01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/PDB1/sysaux01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/PDB1/sysaux01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/PDB1/undotbs01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/PDB1/undotbs01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/PDB1/users01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/PDB1/users01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/PDB1/system01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/PDB1/system01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/system01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/system01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/users01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location

(/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/users01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/sysaux01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location

(/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/sysaux01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/undotbs01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location

(/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/undotbs01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/temp01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/temp01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/pdbseed/temp012019-05-07_11-39-50-925-AM.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/pdbseed/temp012019-05-07_11-39-50-925-AM.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/PDB1/temp01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/PDB1/temp01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/temp01.dbf) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/temp01.dbf). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/control01.ctl) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/control01.ctl). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

[FATAL] [DBT-06607] The data file (/u02/app/oracle/oradata/ORCL/redo01.log) already exists on the file system.

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/redo01.log). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

```
[FATAL] [DBT-06607] The data file
(/u02/app/oracle/oradata/ORCL/redo02.log) already exists on the
file system.
```

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/redo02.log). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

```
[FATAL] [DBT-06607] The data file
(/u02/app/oracle/oradata/ORCL/redo03.log) already exists on the
file system.
```

CAUSE: This configuration is going to create the data file location (/u02/app/oracle/oradata/ORCL/redo03.log). But it is detected that there is an existing database using this data file location or the data files from a previous configuration may be left behind.

ACTION: Clean up the existing data files, or provide a different db_unique_name.

```
$
```

Q1/ What does the error message exactly mean?

A1/ The message means that the command considers that the datafile and controlfile destination for DUPORCL is the destination of ORCL. The operation cannot be completed under these conditions because the duplication would overwrite the source CDB. Add the appropriate clauses in the command.

```
$ dbca -silent -createDuplicateDB -gdbName DUPORCL -sid DUPORCL
-primaryDBConnectionString hostname:1521/ORCL -
databaseConfigType SI -initParams db_unique_name=DUPORCL -
sysPassword password -datafileDestination
/u02/app/oracle/oradata
```

```
Prepare for db operation
```

```
22% complete
```

```
Listener config step
```

```
44% complete
```

```
Auxiliary instance creation
```

```
67% complete
```

```
RMAN duplicate
```

```
89% complete
```

```
Post duplicate database operations
```

```
100% complete
```

```

Look at the log file
"/u01/app/oracle/cfgtoollogs/dbca/DUPORCL/DUPORCL.log" for
further details.
$

```

2. Launch SQL*Plus to connect to the CDB root of DUPORCL.

```

$ . oraenv
ORACLE_SID = [oracle] ? DUPORCL
The Oracle base has been set to /u01/app/oracle
$ sqlplus / AS SYSDBA

SQL> SELECT name FROM v$database;

NAME
-----
DUPORCL

SQL> SHOW PDBS

          CON_ID CON_NAME                                OPEN MODE  RESTRICTED
          -----
          2 PDB$SEED                                READ ONLY  NO
          3 PDB1                                      READ WRITE NO
          4 PDB19_IN_ORCL                             READ WRITE NO

SQL> SELECT name FROM v$datafile;

NAME
-----
/u02/app/oracle/oradata/DUPORCL/system01.dbf
/u02/app/oracle/oradata/DUPORCL/sysaux01.dbf
/u02/app/oracle/oradata/DUPORCL/undotbs01.dbf
/u02/app/oracle/oradata/DUPORCL/pdbseed/system01.dbf
/u02/app/oracle/oradata/DUPORCL/pdbseed/sysaux01.dbf
/u02/app/oracle/oradata/DUPORCL/users01.dbf
/u02/app/oracle/oradata/DUPORCL/pdbseed/undotbs01.dbf
/u02/app/oracle/oradata/DUPORCL/PDB1/system01.dbf
/u02/app/oracle/oradata/DUPORCL/PDB1/sysaux01.dbf
/u02/app/oracle/oradata/DUPORCL/PDB1/undotbs01.dbf
/u02/app/oracle/oradata/DUPORCL/PDB1/users01.dbf
/u02/app/oracle/oradata/DUPORCL/PDB19_IN_ORCL/system01.dbf
/u02/app/oracle/oradata/DUPORCL/PDB19_IN_ORCL/sysaux01.dbf
/u02/app/oracle/oradata/DUPORCL/PDB19_IN_ORCL/undotbs01.dbf
/u02/app/oracle/oradata/DUPORCL/PDB19_IN_ORCL/users01.dbf

```



```
15 rows selected.
```

```
SQL>
```

Q1/ Which is the default value used with the `-useOMF` parameter?

A1/ The default value used is `FALSE`. The command used in step 1 is equivalent to the following command.

```
dbca -silent -createDuplicateDB -gdbName DUPORCL -sid DUPORCL -
primaryDBConnectionString hostname:1521/ORCL -databaseConfigType
SI -initParams db_unique_name=DUPORCL -sysPassword password -
datafileDestination /u02/app/oracle/oradata -useOMF false
```

3. Connect to PDB19_IN_ORCL. Verify that the PDB contains the HR.EMPLOYEES table as in PDB1 of ORCL.

```
SQL> CONNECT system@PDB19_IN_ORCL
Enter password: password
Connected.
SQL> SELECT name FROM v$database;

NAME
-----
DUPORCL

SQL> SELECT count(*) FROM hr.employees;

COUNT (*)
-----
          107

SQL> EXIT
$
```

4. Drop the DUPORCL CDB. Execute the `/home/oracle/labs/DB/drop_DUPORCL.sh` shell script to drop DUPORCL.

```
$ /home/oracle/labs/DB/drop_DUPORCL.sh
...
$
```

Practice 1-6: Decreasing TTS Import Time

Overview

In this practice, you will use new Data Pump parameters to decrease the transportable tablespace import time.

Tasks

1. Execute the `/home/oracle/labs/DB/create_drop_TBS.sh` shell script. The script creates the `TEST` tablespace and the directory for Data Pump in `PDB1` in `ORCL`, and drops the `TEST` tablespace in `PDB19_IN_ORCL`.

```
$ /home/oracle/labs/DB/create_drop_TBS.sh
...
$
```

2. You plan to transport the `TEST` tablespace from `PDB1` into `PDB19_IN_ORCL` in `ORCL` and keep the transported tablespace in read-only mode after import.
 - a. First export the `TEST` tablespace from `PDB1` from `ORCL` with the transportable tablespace mode.
 - 1) Set the `TEST` user-defined tablespace that stores the `HR.EMPLOYEES` table to read-only before exporting.

```
$ sqlplus system@PDB1
Enter password: password

SQL> SELECT * FROM hr.tabtest;

LABEL
-----
DATA FROM system.tabtest ON TABLESPACE test

SQL> ALTER TABLESPACE test READ ONLY;

Tablespace altered.

SQL> EXIT
$
```

- 2) Export the `TEST` tablespace from `PDB1` with the transportable tablespace mode.

```
$ expdp \"sys@PDB1 as sysdba\" DIRECTORY=dp_pdb1
dumpfile=PDB1.dmp TRANSPORT_TABLESPACES=test
TRANSPORT_FULL_CHECK=YES LOGFILE=tts.log REUSE_DUMPFILES=YES
...
Password: password
```

```

Starting "SYS"."SYS_EXPORT_TRANSPORTABLE_01":
"sys/*****@PDB1 AS SYSDBA" DIRECTORY=dp_pdb1
dumpfile=PDB1.dmp TRANSPORT_TABLESPACES=test
TRANSPORT_FULL_CHECK=YES LOGFILE=tts.log REUSE_DUMPFILERS=YES
Processing object type
TRANSPORTABLE_EXPORT/STATISTICS/TABLE_STATISTICS
Processing object type TRANSPORTABLE_EXPORT/STATISTICS/MARKER
Processing object type TRANSPORTABLE_EXPORT/PLUGTS_BLK
Processing object type
TRANSPORTABLE_EXPORT/POST_INSTANCE/PLUGTS_BLK
Processing object type TRANSPORTABLE_EXPORT/TABLE
Master table "SYS"."SYS_EXPORT_TRANSPORTABLE_01" successfully
loaded/unloaded
*****
Dump file set for SYS.SYS_EXPORT_TRANSPORTABLE_01 is:
  /tmp/PDB1.dmp
*****
Datafiles required for transportable tablespace TEST:
  /u02/app/oracle/oradata/ORCL/pdb1/test01.dbf
Job "SYS"."SYS_EXPORT_TRANSPORTABLE_01" successfully completed
at Thu Sep 6 16:51:49 2018 elapsed 0 00:00:43
$

```

3. Create the directory for Data Pump in PDB19_IN_ORCL in ORCL.

```

$ sqlplus system@PDB19_IN_ORCL
Enter password: password

SQL> CREATE DIRECTORY dp_pdb19_in_orcl AS '/tmp';

Directory created.

SQL>

```

4. Verify that the tablespace TEST does not exist in PDB19_IN_ORCL.

```

SQL> SELECT tablespace_name FROM dba_tablespaces;

TABLESPACE_NAME
-----
SYSTEM
SYSAUX
UNDOTBS1
TEMP
USERS

SQL>

```

If the tablespace already exists, drop it.

```
SQL> DROP TABLESPACE test INCLUDING CONTENTS AND DATAFILES;

DROP TABLESPACE test INCLUDING CONTENTS AND DATAFILES
*
ERROR at line 1:
ORA-00959: tablespace 'TEST' does not exist
SQL> EXIT
$
```

5. Copy the datafiles of the TEST tablespace of PDB1 of ORCL to the target directory of PDB19_IN_ORCL.

```
$ cp /u02/app/oracle/oradata/ORCL/pdb1/test01.dbf
/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL
$
```

6. Import the PDB1 TEST tablespace in PDB19_IN_ORCL in ORCL and keep the imported tablespace in read-only mode.

```
$ impdp \ 'sys@PDB19_IN_ORCL as sysdba\ '
DIRECTORY=dp_pdb19_in_orcl DUMPFILE=PDB1.dmp
TRANSPORT_DATAFILES='/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/
test01.dbf' TRANSPORTABLE=KEEP_READ_ONLY
...
Password: password
Master table "SYS"."SYS_IMPORT_TRANSPORTABLE_01" successfully
loaded/unloaded
Starting "SYS"."SYS_IMPORT_TRANSPORTABLE_01":
"sys/*****@PDB19_IN_ORCL AS SYSDBA"
DIRECTORY=dp_pdb19_in_orcl DUMPFILE=PDB1.dmp
TRANSPORT_DATAFILES=/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/t
est01.dbf TRANSPORTABLE=KEEP_READ_ONLY
Processing object type TRANSPORTABLE_EXPORT/PLUGTS_BLK
Processing object type TRANSPORTABLE_EXPORT/TABLE
Processing object type
TRANSPORTABLE_EXPORT/STATISTICS/TABLE_STATISTICS
Processing object type TRANSPORTABLE_EXPORT/STATISTICS/MARKER
Processing object type
TRANSPORTABLE_EXPORT/POST_INSTANCE/PLUGTS_BLK
Job "SYS"."SYS_IMPORT_TRANSPORTABLE_01" successfully completed
at Thu Sep 6 17:06:15 2018 elapsed 0 00:00:27
$
```

7. Verify that PDB19_IN_ORCL is still in read-only mode after import. For a huge tablespace import, the KEEP_READ_ONLY parameter can decrease the time spent.

```
$ sqlplus system@PDB19_IN_ORCL
Enter password: password
SQL> SELECT status FROM dba_tablespaces
      WHERE tablespace_name='TEST';

2
STATUS
-----
READ ONLY

SQL> EXIT
$
```

8. Execute the /home/oracle/labs/DB/drop_TBS.sh shell script to drop the tablespace imported in PDB19_IN_ORCL.

```
$ /home/oracle/labs/DB/drop_TBS.sh
...
$
```

9. You now plan to transport the TEST tablespace from PDB1 into PDB19_IN_ORCL. After import, the bitmaps in the datafile are not rebuilt but the tablespace can be set to read/write. This type of operation decreases the time at import time. As you already exported the tablespace in the previous steps, you can reuse the /tmp/PDB1.dmp dump file.
- a. Copy the datafiles of the TEST tablespace of PDB1 of ORCL to the target directory of PDB19_IN_ORCL.

```
$ cp /u02/app/oracle/oradata/ORCL/pdb1/test01.dbf
/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL
$
```

- b. Import the TEST tablespace from PDB1 into PDB19_IN_ORCL with no bitmap rebuild.

```
$ impdp \sys@PDB19_IN_ORCL as sysdba\
DIRECTORY=dp_pdb19_in_orcl DUMPFILE=PDB1.dmp
TRANSPORT_DATAFILES='/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/
test01.dbf' TRANSPORTABLE=NO_BITMAP_REBUILD
...
Password: password
Master table "SYS"."SYS_IMPORT_TRANSPORTABLE_01" successfully
loaded/unloaded
Starting "SYS"."SYS_IMPORT_TRANSPORTABLE_01":
"sys/*****@PDB19_IN_ORCL AS SYSDBA"
DIRECTORY=dp_pdb19_in_orcl DUMPFILE=PDB1.dmp
TRANSPORT_DATAFILES=/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/t
est01.dbf TRANSPORTABLE=NO_BITMAP_REBUILD
Processing object type TRANSPORTABLE_EXPORT/PLUGTS_BLK
Processing object type TRANSPORTABLE_EXPORT/TABLE
```

```

Processing object type
TRANSPORTABLE_EXPORT/STATISTICS/TABLE_STATISTICS
Processing object type TRANSPORTABLE_EXPORT/STATISTICS/MARKER
Processing object type
TRANSPORTABLE_EXPORT/POST_INSTANCE/PLUGTS_BLK
Job "SYS"."SYS_IMPORT_TRANSPORTABLE_01" successfully completed
at Thu Sep 6 17:09:54 2018 elapsed 0 00:00:25
$

```

10. Verify that PDB19_IN_ORCL is in read-only mode after import. For a huge tablespace import, the NO_BITMAP_REBUILD parameter can decrease the time spent.

```

$ sqlplus sys@PDB19_IN_ORCL AS SYSDBA
Enter password: password
SQL> SELECT status FROM dba_tablespaces
      WHERE tablespace_name='TEST';

 2
STATUS
-----
READ ONLY

SQL>

```

Q1/ Can you set the tablespace to read write although the bitmaps are not rebuilt?

```

SQL> ALTER TABLESPACE test READ WRITE;

Tablespace altered.

SQL>

```

A1/ Yes, the tablespace can be set to read/write. The bitmaps can be rebuilt later with the DBMS_SPACE_ADMIN.TABLESPACE_REBUILD_BITMAPS procedure.

```

SQL> exec DBMS_SPACE_ADMIN.TABLESPACE_REBUILD_BITMAPS('TEST')
PL/SQL procedure successfully completed.

SQL> EXIT
$

```

Practice 1-7: Decreasing TTS Export Time

Overview

In this practice, you will use new Data Pump parameters to decrease the transportable tablespace export time.

Tasks

1. Execute the `/home/oracle/labs/DB/create_drop_TBS.sh` shell script. The script creates the `TEST` tablespace and the directory for Data Pump in `PDB1` in `ORCL`, and drops the `TEST` tablespace in `PDB19_IN_ORCL`.

```
$ /home/oracle/labs/DB/create_drop_TBS.sh
...
$
```

2. You plan to transport the `TEST` tablespace from `PDB1` into `PDB19_IN_ORCL`. Because the time it takes to conduct the closure check can be long, the closure check can be unnecessary when the DBA knows that the transportable set is self-contained. Skipping the closure check allows the tablespaces to remain read/write. First, determine the length of time that tablespace files are required to be read-only during transportable operations. Running the data pump transportable operation with the `TTS_CLOSURE_CHECK=TEST_MODE` parameter in `TEST_MODE` mode provides timing estimation of the TTS export operation.

```
$ expdp \"sys@PDB1 as sysdba\" DIRECTORY= dp_pdb1
dumpfile=PDB1.dmp TRANSPORT_TABLESPACES=test
TRANSPORT_FULL_CHECK=YES TTS_CLOSURE_CHECK=TEST_MODE
LOGFILE=tts.log REUSE_DUMPFILES=YES
...
Password: password
Starting \"SYS\".\"SYS_EXPORT_TRANSPORTABLE_01\":
\"sys/*****@PDB1 AS SYSDBA\" DIRECTORY=dp_pdb1
dumpfile=PDB1.dmp TRANSPORT_TABLESPACES=test
TRANSPORT_FULL_CHECK=YES TTS_CLOSURE_CHECK=TEST_MODE
LOGFILE=tts.log REUSE_DUMPFILES=YES
Processing object type
TRANSPORTABLE_EXPORT/STATISTICS/TABLE_STATISTICS
Processing object type TRANSPORTABLE_EXPORT/STATISTICS/MARKER
Processing object type TRANSPORTABLE_EXPORT/PLUGTS_BLK
Processing object type
TRANSPORTABLE_EXPORT/POST_INSTANCE/PLUGTS_BLK
Processing object type TRANSPORTABLE_EXPORT/TABLE
Master table \"SYS\".\"SYS_EXPORT_TRANSPORTABLE_01\" successfully
loaded/unloaded
*****
Dump file set for SYS.SYS_EXPORT_TRANSPORTABLE_01 is:
/tmp/PDB1.dmp
```

```

Dump file set is unusable. TEST_MODE requested.
*****
Datafiles required for transportable tablespace TEST:
  /u02/app/oracle/oradata/ORCL/pdb1/test01.dbf
Job "SYS"."SYS_EXPORT_TRANSPORTABLE_01" successfully completed
at Mon Sep 10 09:34:05 2018 elapsed 0 00:00:37
$

```

Q1/ Can you use the dump file to import the TEST tablespace into PDB19_IN_ORCL?

```

$ impdp \ "sys@PDB19_IN_ORCL as sysdba\"
DIRECTORY=dp_pdb19_in_orcl dumpfile=PDB1.dmp
TRANSPORT_DATAFILES='/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/
test01.dbf' LOGFILE=tts.log
...
Password: password
ORA-39001: invalid argument value
ORA-39000: bad dump file specification
ORA-39398: Cannot load data. Data Pump dump file "/tmp/PDB1.dmp"
was created in TEST_MODE.
$

```

A1/ The resulting export dump file is not available for use by Data Pump import.

- The timing estimation leads you to complete the data pump export transportable operation with the possibility to decrease the time required for Data Pump TTS to complete with the TTS_CLOSURE_CHECK parameter set to OFF. Of course, you are sure that the transportable tablespace set is contained.

```

$ expdp \ "sys@PDB1 as sysdba\" DIRECTORY= dp_pdb1
dumpfile=PDB1.dmp TRANSPORT_TABLESPACES=test
TTS_CLOSURE_CHECK=OFF LOGFILE=tts.log REUSE_DUMPFILES=YES
...
Password: password
Starting "SYS"."SYS_EXPORT_TRANSPORTABLE_01":
"sys/*****@PDB1 AS SYSDBA" DIRECTORY=dp_pdb1
dumpfile=PDB1.dmp TRANSPORT_TABLESPACES=test
TTS_CLOSURE_CHECK=OFF LOGFILE=tts.log REUSE_DUMPFILES=YES
Processing object type
TRANSPORTABLE_EXPORT/STATISTICS/TABLE_STATISTICS
Processing object type TRANSPORTABLE_EXPORT/STATISTICS/MARKER
ORA-39123: Data Pump transportable tablespace job aborted
ORA-39185: The transportable tablespace failure list is

```



```
ORA-29335: tablespace 'TEST' is not read only
Job "SYS"."SYS_EXPORT_TRANSPORTABLE_01" stopped due to fatal
error at Mon Sep 10 10:14:22 2018 elapsed 0 00:00:03
$
```

Q1/ Does the `TTS_CLOSURE_CHECK` parameter set to another value than the `TEST_MODE` allow you to export the tablespace in read/write mode?

A1/ No. Only the `TEST_MODE` value allows you to test the export operation timing. If you use other values such as `ON`, `OFF` and `FULL`, the tablespace needs to be set to read-only.

- a. Set the `TEST` user-defined tablespace that stores the `HR.EMPLOYEES` table to read-only before exporting.

```
$ sqlplus system@PDB1
Enter password: password
SQL> SELECT * FROM hr.tabtest;

LABEL
-----
DATA FROM system.tabtest ON TABLESPACE test

SQL> ALTER TABLESPACE test READ ONLY;

Tablespace altered.

SQL> EXIT
$
```

- b. Export the tablespace.

```
$ expdp \"sys@PDB1 as sysdba\" DIRECTORY= dp_pdb1
dumpfile=PDB1.dmp TRANSPORT_TABLESPACES=test
TTS_CLOSURE_CHECK=OFF LOGFILE=tts.log REUSE_DUMPFILES=YES
...
Password: password
Starting "SYS"."SYS_EXPORT_TRANSPORTABLE_01":
"sys/*****@PDB1 AS SYSDBA" DIRECTORY=dp_pdb1
dumpfile=PDB1.dmp TRANSPORT_TABLESPACES=test
TTS_CLOSURE_CHECK=OFF LOGFILE=tts.log REUSE_DUMPFILES=YES
Processing object type
TRANSPORTABLE_EXPORT/STATISTICS/TABLE_STATISTICS
Processing object type TRANSPORTABLE_EXPORT/STATISTICS/MARKER
Processing object type TRANSPORTABLE_EXPORT/PLUGTS_BLK
Processing object type
TRANSPORTABLE_EXPORT/POST_INSTANCE/PLUGTS_BLK
```

```

Processing object type TRANSPORTABLE_EXPORT/TABLE
Master table "SYS"."SYS_EXPORT_TRANSPORTABLE_01" successfully
loaded/unloaded
*****
Dump file set for SYS.SYS_EXPORT_TRANSPORTABLE_01 is:
  /tmp/PDB1.dmp
*****
Datafiles required for transportable tablespace TEST:
  /u02/app/oracle/oradata/ORCL/pdb1/test01.dbf
Job "SYS"."SYS_EXPORT_TRANSPORTABLE_01" successfully completed
at Mon Sep 10 10:26:47 2018 elapsed 0 00:00:11
$

```

4. Copy the datafiles of the TEST tablespace of PDB1 of ORCL to the target directory of PDB19_IN_ORCL.

```

$ cp /u02/app/oracle/oradata/ORCL/pdb1/test01.dbf
/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL
$

```

5. Import the PDB1 TEST tablespace in PDB19_IN_ORCL.

```

$ impdp \sys@PDB19_IN_ORCL as sysdba\
DIRECTORY=dp_pdb19_in_orcl DUMPFILE=PDB1.dmp
TRANSPORT_DATAFILES='/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/
test01.dbf'
...
Password: password
Master table "SYS"."SYS_IMPORT_TRANSPORTABLE_01" successfully
loaded/unloaded
Starting "SYS"."SYS_IMPORT_TRANSPORTABLE_01":
"sys/*****@PDB19_IN_ORCL AS SYSDBA"
DIRECTORY=dp_pdb19_in_orcl DUMPFILE=PDB1.dmp
TRANSPORT_DATAFILES=/u02/app/oracle/oradata/ORCL/PDB19_IN_ORCL/t
est01.dbf
Processing object type TRANSPORTABLE_EXPORT/PLUGTS_BLK
Processing object type TRANSPORTABLE_EXPORT/TABLE
Processing object type
TRANSPORTABLE_EXPORT/STATISTICS/TABLE_STATISTICS
Processing object type TRANSPORTABLE_EXPORT/STATISTICS/MARKER
Processing object type
TRANSPORTABLE_EXPORT/POST_INSTANCE/PLUGTS_BLK
Job "SYS"."SYS_IMPORT_TRANSPORTABLE_01" successfully completed
at Mon Sep 10 10:34:49 2018 elapsed 0 00:00:24
$

```

6. Verify that PDB19_IN_ORCL is in read-only mode after import. For a huge tablespace to export, the TTS_CLOSURE_CHECK parameter can decrease the time spent during the export operation.

```
$ sqlplus system@PDB19_IN_ORCL
Enter password: password
SQL> SELECT status FROM dba_tablespaces
      WHERE tablespace_name='TEST';

 2
STATUS
-----
READ ONLY

SQL> EXIT
$
```

Practice 1-8: Omitting the Column Encryption Attribute During Import

Overview

In this practice, you will export tables with encrypted columns to import them in a database that does not support the encrypted column feature as this is the case in the Oracle Public Cloud environment. In the Oracle Public Cloud environment, data is encrypted by default using TDE and the encrypted tablespace feature, and not the encrypted column feature.

Tasks

1. Create the table `HR.TABENC` with an encrypted column in `PDB1` of `ORCL` by executing the `/home/oracle/labs/DB/create_TABENC.sh` shell script. Ignore any error at the end of the script like `ORA-46665: master keys not activated for all PDBs` during `REKEY`.

```
$ /home/oracle/labs/DB/create_TABENC.sh
...
$
```

2. Verify that the `HR.TABENC` table in `PDB1` PDB in `ORCL` has an encrypted column.

```
$ . oraenv
ORACLE_SID = [ORCL] ? ORCL
The Oracle base remains unchanged with value /u01/app/oracle
$ sqlplus system@PDB1
Enter password: password
SQL> DESC hr.tabenc
Name                                     Null?      Type
-----
C1                                     NUMBER
LABEL                                VARCHAR2(50) ENCRYPT

SQL> SELECT * FROM hr.tabenc;

          C1 LABEL
-----
          1 DATA encrypted with column TDE

SQL> EXIT
$
```

3. Export the `HR.TABENC` table from `PDB1` in `ORCL`.

```
$ expdp system@PDB1 DIRECTORY=dp_pdb1 dumpfile=PDB1_TAB.dmp
TABLES=hr.tabenc LOGFILE=tts.log REUSE_DUMPFILES=YES
...
Password: password
```

```

Starting "SYSTEM"."SYS_EXPORT_TABLE_01":  system/*****@PDB1
DIRECTORY=dp_pdb1 dumpfile=PDB1_TAB.dmp TABLES=hr.tabenc
LOGFILE=tts.log REUSE_DUMPFILES=YES
Processing object type TABLE_EXPORT/TABLE/TABLE_DATA
Processing object type
TABLE_EXPORT/TABLE/STATISTICS/TABLE_STATISTICS
Processing object type TABLE_EXPORT/TABLE/STATISTICS/MARKER
Processing object type TABLE_EXPORT/TABLE/TABLE
. . exported "HR"."TABENC"                    5.5 KB          1 rows
ORA-39173: Encrypted data has been stored unencrypted in dump
file set.
Master table "SYSTEM"."SYS_EXPORT_TABLE_01" successfully
loaded/unloaded
*****
Dump file set for SYSTEM.SYS_EXPORT_TABLE_01 is:
  /tmp/PDB1_TAB.dmp
Job "SYSTEM"."SYS_EXPORT_TABLE_01" successfully completed at Thu
Oct 18 08:55:42 2018 elapsed 0 00:00:27
$

```

4. Execute the /home/oracle/labs/DB/setup_CDB19_TDE_TBS.sh shell script. The script creates the PDB19 PDB in CDB19, the HR user, the dp_pdb19 directory, and the TEST encrypted tablespace.

If the script encounters the “ORA-28374: typed master key not found in wallet” error during the TEST tablespace creation, first execute the /home/oracle/labs/admin/create_CDB19.sh shell script, then the /home/oracle/labs/DB/setup_CDB19_TDE.sh shell script, and finally retry the /home/oracle/labs/DB/setup_CDB19_TDE_TBS.sh shell script.

```

$ /home/oracle/labs/DB/setup_CDB19_TDE_TBS.sh
...
$

```

5. Verify that the TEST tablespace in PDB19 PDB in CDB19 is encrypted.

```

$ sqlplus system@PDB19
Enter password: password
SQL> SELECT encrypted, tablespace_name FROM dba_tablespaces;

ENC TABLESPACE_NAME
-----
NO    SYSTEM
NO    SYSAUX
NO    UNDOTBS1
NO    TEMP
YES TEST

```

```
SQL> EXIT
$
```

6. Use the Data Pump parameter to suppress the encryption clause associated with the HR.TABENC table creation during the import operation into PDB19.

```
$ impdp system@PDB19 DIRECTORY=dp_pdb19 dumpfile=PDB1_TAB.dmp
LOGFILE=tts.log TRANSFORM=OMIT_ENCRYPTION_CLAUSE:Y
TABLE_EXISTS_ACTION=REPLACE
...
Password: password
Master table "SYSTEM"."SYS_IMPORT_FULL_01" successfully
loaded/unloaded
Starting "SYSTEM"."SYS_IMPORT_FULL_01": system/*****@PDB19
DIRECTORY=dp_pdb19 dumpfile=PDB1_TAB.dmp LOGFILE=tts.log
TRANSFORM=OMIT_ENCRYPTION_CLAUSE:Y TABLE_EXISTS_ACTION=REPLACE
Processing object type TABLE_EXPORT/TABLE/TABLE
ORA-39083: Object type TABLE:"HR"."TABENC" failed to create with
error:
ORA-01950: no privileges on tablespace 'TEST'

Failing sql is:
CREATE TABLE "HR"."TABENC" ("C1" NUMBER, "LABEL" VARCHAR2(50
BYTE)) SEGMENT CREATION IMMEDIATE PCTFREE 10 PCTUSED 40 INITRANS
1 MAXTRANS 255 NOCOMPRESS LOGGING STORAGE(INITIAL 65536 NEXT
1048576 MINEXTENTS 1 MAXEXTENTS 2147483645 PCTINCREASE 0
FREELISTS 1 FREELIST GROUPS 1 BUFFER_POOL DEFAULT FLASH_CACHE
DEFAULT CELL_FLASH_CACHE DEFAULT) TABLESPACE "TEST"

Processing object type TABLE_EXPORT/TABLE/TABLE_DATA
Processing object type
TABLE_EXPORT/TABLE/STATISTICS/TABLE_STATISTICS
Processing object type TABLE_EXPORT/TABLE/STATISTICS/MARKER
Job "SYSTEM"."SYS_IMPORT_FULL_01" completed with 1 error(s) at
Thu Oct 18 09:05:01 2018 elapsed 0 00:00:06
$
```

The missing privilege has not been granted on purpose in order to display the CREATE TABLE statement that fails during the import operation. Observe that the ENCRYPT clause is omitted in the column description for LABEL.

7. Grant the UNLIMITED TABLESPACE privilege to HR in PDB19.

```
$ sqlplus system@PDB19
Enter password: password
SQL> GRANT unlimited TABLESPACE TO hr;

Grant succeeded.
```

```
SQL> EXIT
$
```

8. Import the table.

```
$ impdp system@PDB19 DIRECTORY=dp_pdb19 dumpfile=PDB1_TAB.dmp
LOGFILE=tts.log TRANSFORM=OMIT_ENCRYPTION_CLAUSE:Y
TABLE_EXISTS_ACTION=REPLACE
...
Password: password
Master table "SYSTEM"."SYS_IMPORT_FULL_01" successfully
loaded/unloaded
Starting "SYSTEM"."SYS_IMPORT_FULL_01":  system/*****@PDB19
DIRECTORY=dp_pdb19 dumpfile=PDB1_TAB.dmp LOGFILE=tts.log
TRANSFORM=OMIT_ENCRYPTION_CLAUSE:Y TABLE_EXISTS_ACTION=REPLACE
Processing object type TABLE_EXPORT/TABLE/TABLE
Processing object type TABLE_EXPORT/TABLE/TABLE_DATA
. . imported "HR"."TABENC"                5.5 KB          1 rows
Processing object type
TABLE_EXPORT/TABLE/STATISTICS/TABLE_STATISTICS
Processing object type TABLE_EXPORT/TABLE/STATISTICS/MARKER
Job "SYSTEM"."SYS_IMPORT_FULL_01" successfully completed at Thu
Oct 18 09:08:26 2018 elapsed 0 00:00:28
$
```

9. Verify that the HR.TABENC table does not hold the column encryption attribute.

```
$ sqlplus system@PDB19
Enter password: password
SQL> DESC hr.tabenc
Name                                Null?      Type
-----
C1                                  NUMBER
LABEL                               VARCHAR2(50)
SQL> SELECT * FROM hr.tabenc;

C1 LABEL
-----
1 DATA encrypted with column TDE

SQL> EXIT
$
```

Q1/ What happens if on a Cloud environment, you do not use the Data Pump parameter that suppresses the encryption clause associated with the table creation during the import operation?

A1/ The import operation fails because the Cloud environment does not support the encrypted column feature.

Practice 1-9: Avoiding Errors Due to Values Generated by LISTAGG

Overview

In this practice, you will use new clauses of the `LISTAGG` function in order to avoid `ORA-01489: result of string concatenation is too long` when the combined length of values generated exceeds the maximum length supported by `VARCHAR2`.

Tasks

1. Before starting the practice, execute the `/home/oracle/labs/admin/cleanup_PDBs.sh` shell script. The shell script drops all PDBs that may have been created by any of the practices, removes TDE usage and finally recreates PDB1.

```
$ $HOME/labs/admin/cleanup_PDBs.sh
...
$
```

2. Execute the `/home/oracle/labs/DB/create_CITIES.sh` shell script to create the `HR.CITIES` table.

```
$ /home/oracle/labs/DB/create_CITIES.sh
...
$
```

3. Query the `HR.CITIES` table to order the rows by city code and use the `LISTAGG` function to concatenate the resulting city names for each city code into a single string.

```
$ sqlplus system@PDB1
Enter password: password
SQL> SELECT code,
           LISTAGG(name, ',') WITHIN GROUP (ORDER BY code)
     FROM hr.cities
     GROUP BY code
     ORDER BY code;
 2      3      4      5 ERROR:
ORA-01489: result of string concatenation is too long

no rows selected

SQL>
```

Q1/ Which is the new clause for the `LISTAGG` function that truncates the string to fit within the limit of the `VARCHAR2` object?

```
SQL> SELECT code,
        LISTAGG (name, ',' ON OVERFLOW TRUNCATE '...'
                WITHOUT COUNT)
        WITHIN GROUP (ORDER BY code) AS CITIES
FROM   hr.cities
GROUP BY code
ORDER BY code;
```

2	3	4	5	6	7
CODE					

CITIES					

0					
City1	,City1	,Mexico	,Mexico		
10					
Aix	,Aix	,City10	,City10	,City	
11	,City11	,City12	,City12	,City13	
	,City13	,City14	,City14	,City15	
	,City15	,City16	,City16	,City17	,City17
		,City18	,City18	,City19	,City19
	,City2	,City2	,City20	,City20	,City
21	,City21	,City22	,City22	,City23	
	,City23	,City24	,City24	,City25	,C
ity25	,City26	,City26	,City3	,City3	
	,City4	,City4	,City5	,City5	,C
ity6	,City6	,City7	,City7	,City8	
	,City8	,City9	,City9	,Dijon	,D
ijon	,Lyon	,Lyon	,Marseille	,Marseil	
le	,Paris	,Paris			
20					
City27	,City28	,City29	,City30	,City	
31	,City32	,City33	,City34	,City35	
	,Dallas	,Houston	,LA	,NY	
	,Nashville	,Philadelphia	,SF	,Toronto	,Was
					hington
30					
Bogota	,Bogota10	,Bogota11	,Bogota12	,Bogo	
tal3	,Bogota14	,Bogota15	,Bogota16	,Bogota17	
	,Bogota18	,Bogota19	,Bogota20	,Bogota21	
	,Bogota22	,Bogota23	,Bogota24	,Bogota25	,Bo

```

gota26      ,Bogota27      ,Bogota28      ,Bogota29      ,Bogota
30      ,Bogota31      ,Bogota32      ,Bogota33      ,Bogota34
      ,Bogota35      ,Bogota36      ,Bogota37      ,Bogota38      ,B
ogota39      ,Bogota39      ,Bogota40      ,Bogota41      ,Bogota42
      ,Bogota43      ,Bogota44      ,Bogota45      ,Bogota46
      ,Bogota47      ,Bogota48      ,Bogota49      ,Bogota50      ,Bogot
a51      ,Bogota52      ,Bogota8      ,Bogota9      ,Brasilia
      ,Brasilia10      ,Brasilia11      ,Brasilia12      ,Brasilia13      ,
Brasilia14      ,Brasilia15      ,Brasilia16      ,Brasilia17      ,Bras
ilia18      ,Brasilia19      ,Brasilia20      ,Brasilia21      ,Brasilia2
2      ,Brasilia23      ,Brasilia24      ,Brasilia25      ,Brasilia26
      ,Brasilia27      ,Brasilia28      ,Brasilia29      ,Brasilia30      ,Br
asilia31      ,Brasilia32      ,Brasilia33      ,Brasilia34      ,Brasil
ia35      ,Brasilia36      ,Brasilia37      ,Brasilia8      ,Brasilia9
      ,Buenos Aires      ,Buenos Aires10,Buenos Aires11,Buenos
Aires12,Buenos Aires13,Buenos Aires14,Buenos Aires15,Buenos
Aires16,Buenos Aires17,Buenos Aires18,Buenos Aires19,Buenos
Aires20,Buenos Aires21,Buenos Aires22,Buenos Aires23,Buenos
Aires24,Buenos Aires25,Buenos Aires26,Buenos Aires27,Buenos
Aires28,Buenos Aires29,Buenos Aires30,Buenos Aires31,Buenos
Aires32,Buenos Aires33,Buenos Aires34,Buenos Aires35,Buenos
Aires36,Buenos Aires37,Buenos Aires38,Buenos Aires39,Buenos
Aires39,Buenos Aires40,Buenos Aires41,Buenos Aires42,Buenos
Aires43,Buenos Aires44,Buenos Aires45,Buenos Aires46,Buenos
Aires47,Buenos Aires48,Buenos Aires49,Buenos Aires50,Buenos
Aires51,Buenos Aires52,Buenos Aires8 ,Buenos
Aires9 ,City36      ,City37      ,City38      ,City39
      ,City40      ,City41      ,City42      ,City43      ,Cit
y44      ,City45      ,City46      ,City47      ,City48
      ,City49      ,City50      ,City51      ,City52
      ,City53      ,City54      ,City55      ,City56      ,Ci
ty57      ,City58      ,City59      ,City60      ,City61
      ,City62      ,City63      ,City64      ,City65
      ,City66      ,City67      ,City68      ,City69      ,City70
      ,City71      ,City72      ,City73      ,City74
      ,City75      ,City76      ,City77      ,City78
      ,City79      ,City80      ,City81      ,City82
City83      ,City84      ,City85      ,City86      ,City
87 ,City88      ,City89      ,La Paz      ,La
Paz10      ,La Paz11      ,La Paz12      ,La Paz13      ,La
Paz14      ,La Paz15      ,La Paz16      ,La Paz17      ,La
Paz18      ,La Paz19      ,La Paz20      ,La Paz21      ,La
Paz22      ,La Paz23      ,La Paz24      ,La Paz25      ,La
Paz26      ,La Paz27      ,La Paz28      ,La Paz29      ,La
Paz30      ,La Paz31      ,La Paz32      ,La Paz33      ,La
Paz34      ,La Paz35      ,La Paz36      ,La Paz37      ,La
Paz38      ,La Paz39      ,La Paz39      ,La Paz40      ,La
Paz41      ,La Paz42      ,La Paz43      ,La Paz44      ,La
Paz45      ,La Paz46      ,La Paz47      ,La Paz48      ,La
Paz49      ,La Paz50      ,La Paz51      ,La Paz52      ,La
Paz8      ,La
Paz9      ,Lima      ,Lima10      ,Lima11      ,Lima12

```

```

,Lima13      ,Lima14      ,Lima15      ,Lima16      ,Li
ma17      ,Lima18      ,Lima19      ,Lima20      ,Lima21
,Lima22      ,Lima23      ,Lima24      ,Lima25      ,
Lima26      ,Lima27      ,Lima28      ,Lima29      ,Lima30
,Lima31      ,Lima32      ,Lima33      ,Lima34
,Lima35      ,Lima36      ,Lima37      ,Lima38      ,Lima39
,Lima40      ,Lima40      ,Lima41      ,Lima42
,Lima43      ,Lima44      ,Lima45      ,Lima46      ,Lima
47      ,...

SQL>

```

A1/ The *LISTAGG* function can be used with the *ON OVERFLOW TRUNCATE* clause. The value defined with the *ON OVERFLOW TRUNCATE* clause is the value that is displayed to replace the missing values, which is '...'.

Q2/ How do you know the number of values missing?

```

SQL> SELECT code,
        LISTAGG (name, ',' ON OVERFLOW TRUNCATE '...' WITH COUNT)
        WITHIN GROUP (ORDER BY code) AS CITIES
FROM   hr.cities
GROUP BY code
ORDER BY code;

 2      3      4      5      6
0
City1      ,City1      ,Mexico      ,Mexico

10
Aix      ,Aix      ,City10      ,City10      ,City
11      ,City11      ,City12      ,City12      ,City13
,Lima13      ,City14      ,City14      ,City15
,Lima15      ,City16      ,City16      ,City17      ,City17
,Lima18      ,City18      ,City19      ,City19
,Lima21      ,City2      ,City2      ,City20      ,City20      ,City
21      ,City21      ,City22      ,City22      ,City23
,Lima23      ,City24      ,City24      ,City25      ,C
ity25      ,City26      ,City26      ,City3      ,City3
,Lima26      ,City4      ,City4      ,City5      ,City5      ,C
ity6      ,City6      ,City7      ,City7      ,City8
,Lima27      ,City8      ,City9      ,City9      ,Dijon      ,D
ijon      ,Lyon      ,Lyon      ,Marseille      ,Marseil
le      ,Paris      ,Paris

20

```

```

City27          ,City28          ,City29          ,City30          ,City
31          ,City32          ,City33          ,City34          ,City35
          ,Dallas          ,Houston          ,LA          ,NY
,Nashville          ,Philadelphia          ,SF          ,Toronto          ,Was
hington

30
Bogota          ,Bogota10          ,Bogota11          ,Bogota12          ,Bogo
ta13          ,Bogota14          ,Bogota15          ,Bogota16          ,Bogota17
          ,Bogota18          ,Bogota19          ,Bogota20          ,Bogota21
          ,Bogota22          ,Bogota23          ,Bogota24          ,Bogota25          ,Bo
gota26          ,Bogota27          ,Bogota28          ,Bogota29          ,Bogota
30          ,Bogota31          ,Bogota32          ,Bogota33          ,Bogota34
          ,Bogota35          ,Bogota36          ,Bogota37          ,Bogota38          ,B
ogota39          ,Bogota39          ,Bogota40          ,Bogota41          ,Bogota42
          ,Bogota43          ,Bogota44          ,Bogota45          ,Bogota46
          ,Bogota47          ,Bogota48          ,Bogota49          ,Bogota50          ,Bogot
a51          ,Bogota52          ,Bogota8          ,Bogota9          ,Brasilia
          ,Brasilia10          ,Brasilia11          ,Brasilia12          ,Brasilia13
          ,Brasilia14          ,Brasilia15          ,Brasilia16          ,Brasilia17          ,Bras
ilia18          ,Brasilia19          ,Brasilia20          ,Brasilia21          ,Brasilia2
2          ,Brasilia23          ,Brasilia24          ,Brasilia25          ,Brasilia26
          ,Brasilia27          ,Brasilia28          ,Brasilia29          ,Brasilia30          ,Br
asilia31          ,Brasilia32          ,Brasilia33          ,Brasilia34          ,Brasil
ia35          ,Brasilia36          ,Brasilia37          ,Brasilia8          ,Brasilia9
          ,Buenos Aires          ,Buenos Aires10,Buenos Aires11,Buenos
Aires12,Buenos Aires13,Buenos Aires14,Buenos Aires15,Buenos
Aires16,Buenos Aires17,Buenos Aires18,Buenos Aires19,Buenos
Aires20,Buenos Aires21,Buenos Aires22,Buenos Aires23,Buenos
Aires24,Buenos Aires25,Buenos Aires26,Buenos Aires27,Buenos
Aires28,Buenos Aires29,Buenos Aires30,Buenos Aires31,Buenos
Aires32,Buenos Aires33,Buenos Aires34,Buenos Aires35,Buenos
Aires36,Buenos Aires37,Buenos Aires38,Buenos Aires39,Buenos
Aires39,Buenos Aires40,Buenos Aires41,Buenos Aires42,Buenos
Aires43,Buenos Aires44,Buenos Aires45,Buenos Aires46,Buenos
Aires47,Buenos Aires48,Buenos Aires49,Buenos Aires50,Buenos
Aires51,Buenos Aires52,Buenos Aires8 ,Buenos
Aires9 ,City36          ,City37          ,City38          ,City39
          ,City40          ,City41          ,City42          ,City43          ,Cit
y44          ,City45          ,City46          ,City47          ,City48
          ,City49          ,City50          ,City51          ,City52
          ,City53          ,City54          ,City55          ,City56          ,Ci
ty57          ,City58          ,City59          ,City60          ,City61
          ,City62          ,City63          ,City64          ,City65
          ,City66          ,City67          ,City68          ,City69          ,City70
          ,City71          ,City72          ,City73          ,City74
          ,City75          ,City76          ,City77          ,City78
          ,City79          ,City80          ,City81          ,City82
City83          ,City84          ,City85          ,City86          ,City
87 ,City88          ,City89          ,La Paz          ,La
Paz10          ,La Paz11          ,La Paz12          ,La Paz13          ,La
Paz14          ,La Paz15          ,La Paz16          ,La Paz17          ,La

```

```

Paz18      ,La Paz19      ,La Paz20      ,La Paz21      ,La
Paz22      ,La Paz23      ,La Paz24      ,La Paz25      ,La
Paz26      ,La Paz27      ,La Paz28      ,La Paz29      ,La
Paz30      ,La Paz31      ,La Paz32      ,La Paz33      ,La
Paz34      ,La Paz35      ,La Paz36      ,La Paz37      ,La
Paz38      ,La Paz39      ,La Paz39      ,La Paz40      ,La
Paz41      ,La Paz42      ,La Paz43      ,La Paz44      ,La
Paz45      ,La Paz46      ,La Paz47      ,La Paz48      ,La
Paz49      ,La Paz50      ,La Paz51      ,La Paz52      ,La
Paz8       ,La
Paz9       ,Lima      ,Lima10      ,Lima11      ,Lima12
,Lima13      ,Lima14      ,Lima15      ,Lima16      ,Li
ma17      ,Lima18      ,Lima19      ,Lima20      ,Lima21
,Lima22      ,Lima23      ,Lima24      ,Lima25      ,
Lima26      ,Lima27      ,Lima28      ,Lima29      ,Lima30
,Lima31      ,Lima32      ,Lima33      ,Lima34
,Lima35      ,Lima36      ,Lima37      ,Lima38      ,Lima39
,Lima40      ,Lima40      ,Lima41      ,Lima42
,Lima43      ,Lima44      ,Lima45      ,... (147)

SQL>

```

A2/ The way to display the number of missing values is to use the `WITH COUNT` clause in conjunction with the `ON OVERFLOW TRUNCATE` clause. This is the default in the `ON OVERFLOW TRUNCATE` clause. Observe that the information of the number of missing values takes characters in place of possible values (*Lima46* and *Lima47*).

Q3/ Is there a way to eliminate the duplicate values for all codes from the specified expression before concatenating the values into a single string?

```

SQL> SELECT code,
        LISTAGG (DISTINCT name, ','
                ON OVERFLOW TRUNCATE 'other values')
        WITHIN GROUP (ORDER BY code) AS CITIES
FROM   hr.cities
GROUP BY code
ORDER BY code;

  2    3    4    5    6    7
CODE
----
CITIES
-----
CODE

```

```

-----
CITIES
-----

0
City1          ,Mexico

10
Aix            ,City10          ,City11          ,City12          ,City
13            ,City14          ,City15          ,City16          ,City17
            ,City18          ,City19          ,City2          ,City20
, City21        ,City22        ,City23        ,City24        ,City25
            ,City26          ,City3          ,City4          ,City5
            ,City6          ,City7          ,City8          ,City9          ,DiJo
n              ,Lyon          ,Marseille        ,Paris

20
City27          ,City28          ,City29          ,City30          ,City
31            ,City32          ,City33          ,City34          ,City35
            ,Dallas          ,Houston          ,LA          ,NY
, Nashville      ,Philadelphia  ,SF          ,Toronto      ,Was
hington

30
Bogota          ,Bogota10        ,Bogota11        ,Bogota12        ,Bogo
ta13          ,Bogota14        ,Bogota15        ,Bogota16        ,Bogota17
            ,Bogota18        ,Bogota19        ,Bogota20        ,Bogota21
            ,Bogota22        ,Bogota23        ,Bogota24        ,Bogota25        ,Bo
gota26          ,Bogota27        ,Bogota28        ,Bogota29        ,Bogota
30            ,Bogota31        ,Bogota32        ,Bogota33        ,Bogota34
            ,Bogota35        ,Bogota36        ,Bogota37        ,Bogota38        ,B
ogota39          ,Bogota40        ,Bogota41        ,Bogota42        ,Bogota43
            ,Bogota44        ,Bogota45        ,Bogota46        ,Bogota47
            ,Bogota48        ,Bogota49        ,Bogota50        ,Bogota51        ,Bogot
a52            ,Bogota8          ,Bogota9          ,Brasilia          ,Brasilia1
0            ,Brasilia11        ,Brasilia12        ,Brasilia13        ,Brasilia14
, Brasilia15      ,Brasilia16        ,Brasilia17        ,Brasilia18        ,Bra
silia19          ,Brasilia20        ,Brasilia21        ,Brasilia22        ,Brasilia
23            ,Brasilia24        ,Brasilia25        ,Brasilia26        ,Brasilia27
            ,Brasilia28        ,Brasilia29        ,Brasilia30        ,Brasilia31        ,B
rasilia32          ,Brasilia33        ,Brasilia34        ,Brasilia35        ,Brasi
lia36            ,Brasilia37        ,Brasilia8          ,Brasilia9          ,Buenos
Aires          ,Buenos Aires10, Buenos Aires11, Buenos Aires12, Buenos Ai
res13, Buenos Aires14, Buenos Aires15, Buenos Aires16, Buenos
Aires17, Buenos Aires18, Buenos Aires19, Buenos Aires20, Buenos
Aires21, Buenos Aires22, Buenos Aires23, Buenos Aires24, Buenos
Aires25, Buenos Aires26, Buenos Aires27, Buenos Aires28, Buenos
Aires29, Buenos Aires30, Buenos Aires31, Buenos Aires32, Buenos
Aires33, Buenos Aires34, Buenos Aires35, Buenos Aires36, Buenos

```

```

Aires37,Buenos Aires38,Buenos Aires39,Buenos Aires40,Buenos
Aires41,Buenos Aires42,Buenos Aires43,Buenos Aires44,Bueno
s Aires45,Buenos Aires46,Buenos Aires47,Buenos Aires48,Buenos
Aires49,Buenos Aires50,Buenos Aires51,Buenos Aires52,Buenos
Aires8 ,Buenos
Aires9 ,City36          ,City37          ,City38          ,City39
,City40          ,City41          ,City42          ,City43          ,Cit
y44          ,City45          ,City46          ,City47          ,City48
,City49          ,City50          ,City51          ,City52
,City53          ,City54          ,City55          ,City56          ,Cit
y57          ,City58          ,City59          ,City60          ,City61
,City62          ,City63          ,City64          ,City65
,City66          ,City67          ,City68          ,City69          ,Cit
y70          ,City71          ,City72          ,City73          ,City74
,City75          ,City76          ,City77          ,City78          ,
City79          ,City80          ,City81          ,City82          ,City83
,City84          ,City85          ,City86          ,City87
,City88          ,City89 ,La Paz          ,La Paz10          ,La
Paz11          ,La Paz12          ,La Paz13          ,La Paz14          ,La
Paz15          ,La Paz16          ,La Paz17          ,La Paz18          ,La
Paz19          ,La Paz20          ,La Paz21          ,La Paz22          ,La
Paz23          ,La Paz24          ,La Paz25          ,La Paz26          ,La
Paz27          ,La Paz28          ,La Paz29          ,La Paz30          ,La Paz3
1          ,La Paz32          ,La Paz33          ,La Paz34          ,La
Paz35          ,La Paz36          ,La Paz37          ,La Paz38          ,La
Paz39          ,La Paz40          ,La Paz41          ,La Paz42          ,La
Paz43          ,La Paz44          ,La Paz45          ,La Paz46          ,La
Paz47          ,La Paz48          ,La Paz49          ,La Paz50          ,La
Paz51          ,La Paz52          ,La Paz8          ,La
Paz9          ,Lima          ,Lima10          ,Lima11          ,Lima12
,Lima13          ,Lima14          ,Lima15          ,Lima16
,Lima17          ,Lima18          ,Lima19          ,Lima20          ,Lim
a21          ,Lima22          ,Lima23          ,Lima24          ,Lima25
,Lima26          ,Lima27          ,Lima28          ,Lima29          ,L
ima30 ,Lima31          ,Lima32          ,Lima33          ,Lima34
,Lima35          ,Lima36          ,Lima37          ,Lima38          ,
Lima39 ,Lima40          ,Lima41          ,Lima42          ,Lima43
,Lima44          ,Lima45          ,Lima46          ,Lima47          ,
Lima48          ,Lima49          ,other values (140)

SQL>
SQL> EXIT
$

```


A3/ Two identical strings such as 'Paris' and 'Paris ' with trailing spaces are treated as duplicates. The *DISTINCT* and *ON OVERFLOW TRUNCATE* clauses used together allow the elimination of duplicates before the concatenation of the values into a single string. This reduces the chance to miss values as this is the case in the example where *Lima48* and *Lima49* are now displayed.

Note: Oracle uses blank-padded comparison semantics only when both values in the comparison are either expressions of data type *CHAR*, *NCHAR*, text literals, or values returned by the *USER* function.

Practices for Lesson 2: Using Security Enhancements

Practices for Lesson 2: Overview

Overview

In these practices, you will discover and practice new Oracle Database 19c enhancements related to security such as Oracle-supplied schemas defined as schema only accounts, enable Database Vault operations control to protect application data in PDBs against common users, constrain `AUDIT POLICY` and `NOAUDIT POLICY` SQL commands with Oracle Database Vault command rules, audit direct user activities, and finally manage operations on Oracle-managed and user-managed tablespaces encrypted in TDE.

Practice 2-1: Exploring Oracle-supplied Schemas Only Accounts

Overview

In this practice, you will find which Oracle-supplied schemas are schema only accounts.

Tasks

1. If DUPORCL CDB was not dropped during Practice 1-4 step 4, execute the `/home/oracle/labs/DB/drop_DUPORCL.sh` shell script to drop DUPORCL.

```
$ /home/oracle/labs/DB/drop_DUPORCL.sh
...
$
```

2. Execute the `/home/oracle/labs/admin/cleanup_PDBs.sh` shell script. The shell script drops all PDBs that may have been created by any of the practices in ORCL, and finally recreates PDB1.

```
$ $HOME/labs/admin/cleanup_PDBs.sh
...
$
```

3. Before starting the practice, execute the `$HOME/labs/SEC/glogin.sh` shell script. It sets formatting for all columns selected in queries.

```
$ $HOME/labs/SEC/glogin.sh
...
$
```

4. In ORCL, find the Oracle-supplied schemas that are now schemas only accounts.

```
$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ sqlplus / AS SYSDBA

SQL> SELECT username FROM dba_users
      WHERE authentication_type = 'NONE'
      ORDER BY 1;

   2      3
USERNAME
-----
APPQOSSYS
AUDSYS
DBSFUSER
DIP
DVF
DVSYS
```

```

GGSYS
GSMADMIN_INTERNAL
GSMCATUSER
GSMROOTUSER
GSMUSER
LBACSYS
MDDATA
MDSYS
OJVMSYS
OLAPSYS
ORACLE_OCM
ORDDATA
ORDPLUGINS
ORDSYS
OUTLN
REMOTE_SCHEDULER_AGENT
SI_INFORMTN_SCHEMA
SYS$UMF
SYSBACKUP
SYSDG
SYSKM
SYSRAC
WMSYS
XDB

30 rows selected.

SQL>

```

Q1/ Can there be any administrative privileged users that are schema only accounts?

```

SQL> CREATE USER c##user NO AUTHENTICATION CONTAINER=ALL;

User created.

SQL> GRANT sysoper TO c##user CONTAINER=ALL;

Grant succeeded.

SQL> SELECT username, authentication_type FROM dba_users
       WHERE username = 'C##USER';

2

```

```

USERNAME                                AUTHENTI
-----                                -
C##USER                                NONE

SQL> SELECT username, authentication_type FROM v$pwfile_users;

USERNAME                                AUTHENTI
-----                                -
SYS                                    PASSWORD
C##USER                                NONE

SQL> EXIT
$

```

A1/ Yes, in Oracle Database 19c, administrative privileged users can be schema only accounts.

Practice 2-2: Protecting Application Data by Using Database Vault Operations Control

Overview

In this practice you will enable Database Vault operations control and observe how application data in PDBs is protected against common users.

Tasks

1. Create the `HR.EMPLOYEES` table and its application data in `PDB1` by executing the `/home/oracle/labs/SEC/appdata.sh`.

```
$ /home/oracle/labs/SEC/appdata.sh
...
$
```

Q1/ Can SYS read the HR.EMPLOYEES table data in PDB?

```
$ sqlplus sys@PDB1 AS SYSDBA
Enter password: password
SQL> SELECT count(*) FROM hr.employees;

COUNT (*)
-----
          107

SQL>
```

A2/ Neither Oracle Database Vault nor Database Vault operations control is configured in PDB1.

```
SQL> CONNECT / AS SYSDBA
Connected.
SQL> SELECT * FROM dba_dv_status;

NAME                                STATUS
-----
DV_APP_PROTECTION                   NOT CONFIGURED
DV_CONFIGURE_STATUS                 FALSE
DV_ENABLE_STATUS                    FALSE

SQL>
```


2. Execute the `/home/oracle/labs/SEC/drop_create_user_sec_admin.sql` SQL script. The script creates the `C##SEC_ADMIN` and `C##ACCTS_ADMIN` accounts in `ORCL`.

```
SQL> @/home/oracle/labs/SEC/drop_create_user_sec_admin.sql
...
SQL>
```

3. Configure Database Vault operations control at the CDB root level in `ORCL` ensuring that the `DV_OWNER` role is granted locally in the CDB root to the common Oracle Database Vault owner.

```
SQL> exec DVSYS.CONFIGURE_DV( -
        dvowner_uname =>'c##sec_admin',-
        dvacctmgr_uname =>'c##accts_admin', -
        force_local_dvowner => TRUE)
> > >
PL/SQL procedure successfully completed.
SQL>
```

4. Observe the Oracle Database Vault status and application protection status in the CDB root and in `PDB1`.

```
SQL> SELECT * FROM dba_dv_status;

NAME                                STATUS
-----
DV_APP_PROTECTION                   NOT CONFIGURED
DV_CONFIGURE_STATUS                 TRUE
DV_ENABLE_STATUS                    FALSE

SQL>
```

- a. Connect to `PDB1`.

```
SQL> CONNECT sys@PDB1 AS SYSDBA
Enter password: password
Connected.
SQL> SELECT * FROM dba_dv_status;

NAME                                STATUS
-----
DV_APP_PROTECTION                   NOT CONFIGURED
DV_CONFIGURE_STATUS                 FALSE
DV_ENABLE_STATUS                    FALSE

SQL>
```

Q1/ Can SYS read the HR.EMPLOYEES table data in PDB?

```
SQL> SELECT count(*) FROM hr.employees;

COUNT (*)
-----
          107

SQL>
```

A2/ Yes. sys can still read the application data in PDB1. Oracle Database Vault is configured in the CDB root but Oracle Database Vault is not configured in PDB1 and Database Vault operations control is not enabled in the CDB root and PDB1.

5. Enable Database Vault operations control in the CDB root.
 - a. Create a common user granted the CREATE SESSION and SELECT ANY TABLE privileges.

```
SQL> CONNECT c##accts_admin
Enter password: password
Connected.
SQL> CREATE USER c##common_user IDENTIFIED BY password
          CONTAINER=ALL;

2
User created.

SQL> CONNECT / AS SYSDBA
Connected.
SQL> GRANT create session, select any table TO c##common_user
          CONTAINER=ALL;

2
Grant succeeded.

SQL>
```

- b. Connect as the common user and check if the common user can access the application data in PDB1.

```
SQL> CONNECT c##common_user@PDB1
Enter password: password
Connected.
SQL> SELECT count(*) FROM hr.employees;
```

```

COUNT (*)
-----
          107

SQL>

```

- c. Enable the application protection via the Database Vault operations control in the CDB root.

```

SQL> CONNECT / AS SYSDBA
Connected.
SQL> EXEC dvsys.dbms_macadm.enable_app_protection (NULL)
BEGIN dvsys.dbms_macadm.enable_app_protection (NULL); END;

*
ERROR at line 1:
ORA-47503: Database Vault is not enabled in CDB$ROOT or
application root.
ORA-06512: at "DVSYS.DBMS_MACADM", line 2811
ORA-06512: at line 1

SQL>

```

- d. Enable Oracle Database Vault in the CDB root.

```

SQL> CONNECT c##sec_admin
Enter password: password
Connected.
SQL> EXEC dvsys.dbms_macadm.enable_dv

PL/SQL procedure successfully completed.

SQL> CONNECT / AS SYSDBA
Connected.
SQL> SELECT * FROM dba_dv_status;

NAME                                STATUS
-----
DV_APP_PROTECTION                   NOT CONFIGURED
DV_CONFIGURE_STATUS                 TRUE
DV_ENABLE_STATUS                    FALSE

SQL>

```

- e. Restart the database instance to enforce DV configuration and enablement.

```

SQL> SHUTDOWN IMMEDIATE
Database closed.

```

```

Database dismounted.
ORACLE instance shut down.
SQL> STARTUP
ORACLE instance started.

Total System Global Area 1426062768 bytes
Fixed Size                  9129392 bytes
Variable Size               486539264 bytes
Database Buffers            922746880 bytes
Redo Buffers                 7647232 bytes
Database mounted.
Database opened.
SQL> ALTER PLUGGABLE DATABASE pdb1 OPEN;

Pluggable database altered.

SQL> SELECT * FROM dba_dv_status;

NAME                                STATUS
-----
DV_APP_PROTECTION                   NOT CONFIGURED
DV_CONFIGURE_STATUS                 TRUE
DV_ENABLE_STATUS                    TRUE

SQL>

```

Q1/ Which user can enable the Database Vault operations control?

```

SQL> EXEC dvsys.dbms_macadm.enable_app_protection
BEGIN dvsys.dbms_macadm.enable_app_protection; END;

      *
ERROR at line 1: ORA-06550: line 1, column 13:
PLS-00904: insufficient privilege to access object
DVSYS.DBMS_MACADM
ORA-06550: line 1, column 7: PL/SQL: Statement ignored

SQL>

```

A1/ Only common accounts with DV_OWNER role can enable Database Vault operations control, even if the DV_OWNER role is granted locally.

```

SQL> CONNECT c##sec_admin
Enter password: password
Connected.
SQL> EXEC dvsys.dbms_macadm.enable_app_protection

PL/SQL procedure successfully completed.

SQL>

```

6. Display the status of Database Vault operations control in the CDB root and in PDB1.

```

SQL> CONNECT / AS SYSDBA
Connected.
SQL> SELECT * FROM dba_dv_status;

NAME                                STATUS
-----
DV_APP_PROTECTION                   ENABLED
DV_CONFIGURE_STATUS                 TRUE
DV_ENABLE_STATUS                     TRUE

SQL> CONNECT sys@PDB1 AS SYSDBA
Enter password: password
Connected.
SQL> SELECT * FROM dba_dv_status;

NAME                                STATUS
-----
DV_APP_PROTECTION                   ENABLED
DV_CONFIGURE_STATUS                 FALSE
DV_ENABLE_STATUS                     FALSE

SQL>

```

Q1/ Is the common user able to view the application data in PDB1?

```

SQL> CONNECT c##common_user@PDB1
Enter password: password
Connected.
SQL> SELECT COUNT(*) FROM hr.employees;
SELECT COUNT(*) FROM hr.employees
                        *
ERROR at line 1:

```

```
ORA-01031: insufficient privileges
```

```
SQL>
```

A1/ No. Database Vault operations control being enabled prevents any common user to view application data in PDBs.

Q2/ Does Database Vault operations control prevent common users from backing up the PDB in which they are granted the SYSDBA privilege locally?

```
SQL> CONNECT sys@PDB1 AS SYSDBA
Enter password: password
Connected.
SQL> GRANT sysdba TO c##common_user;

Grant succeeded.

SQL> EXIT
$
```

```
$ rman target c##common_user@PDB1

target database Password:
connected to target database: ORCL:PDB1 (DBID=505765219)

RMAN> BACKUP DATABASE;

Starting backup at 07-MAY-19
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 full datafile backup set
channel ORA_DISK_1: specifying datafile(s) in backup set
input datafile file number=00031
name=/u02/app/oracle/oradata/ORCL/pdb1/ORCL/884E0B72E5E159F9E053
E311ED0A1FC9/datafile/o1_mf_sysaux_gf3519s5_.dbf
input datafile file number=00030
name=/u02/app/oracle/oradata/ORCL/pdb1/ORCL/884E0B72E5E159F9E053
E311ED0A1FC9/datafile/o1_mf_system_gf3519ry_.dbf
```

```

input datafile file number=00032
name=/u02/app/oracle/oradata/ORCL/pdb1/ORCL/884E0B72E5E159F9E053
E311ED0A1FC9/datafile/o1_mf_undotbs1_gf3519s9_.dbf
channel ORA_DISK_1: starting piece 1 at 07-MAY-19
channel ORA_DISK_1: finished piece 1 at 07-MAY-19
piece
handle=/u03/app/oracle/fast_recovery_area/ORCL/884E0B72E5E159F9E
053E311ED0A1FC9/backupset/2019_05_07/o1_mf_nnndf_TAG20190507T143
541_gf35xy3p_.bkp tag=TAG20190507T143541 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:08
Finished backup at 07-MAY-19

RMAN> EXIT
$

```

A2/ If common users cannot view application data in PDBs, they can still complete administrative tasks for which they are granted privileges.

7. Disable the Database Vault operations control.

```

$ sqlplus c##sec_admin
Enter password: password

SQL> EXEC dvsys.dbms_macadm.disable_app_protection

PL/SQL procedure successfully completed.

SQL>

```

8. Display the status of Database Vault operations control in the CDB root and in PDB1.

```

SQL> CONNECT / AS SYSDBA
Connected.
SQL> SELECT * FROM dba_dv_status;

NAME                                STATUS
-----
DV_APP_PROTECTION                   DISABLED
DV_CONFIGURE_STATUS                 TRUE
DV_ENABLE_STATUS                    TRUE

SQL> CONNECT sys@PDB1 AS SYSDBA
Enter password: password
Connected.
SQL> SELECT * FROM dba_dv_status;

```

NAME	STATUS
DV_APP_PROTECTION	DISABLED
DV_CONFIGURE_STATUS	FALSE
DV_ENABLE_STATUS	FALSE

SQL>

Q1/ What do you observe about the status value?

A1/ The status shows *DISABLED* and not *NOT CONFIGURED*. This means that Database Vault operations control has been enabled previously.

Q2/ Is the common user able to view the application data in PDB1?

```
SQL> CONNECT c##common_user@PDB1
Enter password: password
Connected.
SQL> SELECT COUNT(*) FROM hr.employees;

COUNT (*)
-----
          107

SQL>
```

A2/ Yes.

Q3/ Can the Database Vault operations control be enabled in a PDB and disabled in another PDB?

1) Use the /home/oracle/labs/SEC/create_PDB2.sql to create another PDB in ORCL.

```
SQL> CONNECT / AS SYSDBA
Connected.
SQL> @/home/oracle/labs/SEC/create_PDB2.sql
...
SQL>
```

2) Enable the Database Vault operations control in PDB2.

```
SQL> CONNECT c##sec_admin@PDB2
Enter password: password
```



```

Connected.
SQL> EXEC dvsys.dbms_macadm.enable_app_protection
BEGIN dvsys.dbms_macadm.enable_app_protection; END;

*
ERROR at line 1:
ORA-65040: operation not allowed from within a pluggable
database
ORA-06512: at "DVSYS.DBMS_MACADM", line 2811
ORA-06512: at line 1

SQL>

```

A3/ No. Database Vault operations control be enabled in the CDB root only.

9. Reenable the Database Vault operations control.

```

SQL> CONNECT c##sec_admin
Enter password: password

SQL> EXEC dvsys.dbms_macadm.enable_app_protection

PL/SQL procedure successfully completed.

SQL>

```

10. The situation is that HR application data in PDB1 is very sensitive and should be protected against common users in the CDB. Nevertheless the C##REPORT common user should be able to access some of the HR application information in PDB1 to generate statistics for Human Resources.

- a. Create the common user C##REPORT granted the CREATE SESSION and SELECT ANY TABLE privileges.

```

SQL> CONNECT c##accts_admin
Enter password: password
Connected.
SQL> CREATE USER c##report IDENTIFIED BY password
        CONTAINER=ALL;

2
User created.

SQL> CONNECT / AS SYSDBA
Connected.
SQL> GRANT create session, select any table TO c##report

```

```

CONTAINER=ALL;

2
Grant succeeded.

SQL>

```

- b. Connect as the common user in PDB1 and check if the common user can access the application data in PDB1.

```

SQL> CONNECT c##report@PDB1
Enter password: password
Connected.
SQL> SELECT count(*) FROM hr.employees;
SELECT count(*) FROM hr.employees
                        *
ERROR at line 1:
ORA-01031: insufficient privileges

SQL>

```

Q1/ Is it the expected behavior?

A1/ Yes. Database Vault operations control is enabled.

Q2/ Is it possible to let C##REPORT access HR data in PDB1?

A2/ Yes. The common user can be added in the exception list of users and packages allowed to access local data in PDBs.

```

SQL> CONNECT c##sec_admin@PDB1
Enter password: password
Connected.
SQL> EXEC dvsys.dbms_macadm.add_app_exception( -
            owner => 'C##REPORT', -
            package_name => '')
BEGIN dvsys.dbms_macadm.add_app_exception(owner => 'C##REPORT',
package_name => ''); END;
*
ERROR at line 1:
ORA-65040: operation not allowed from within a pluggable
database
ORA-06512: at "DVSYS.DBMS_MACADM", line 1403
ORA-06512: at "DVSYS.DBMS_MACADM", line 1741
ORA-06512: at line 1

SQL>

```

Observe that any operation related to Database Vault operations control must be completed from the CDB root.

```
SQL> CONNECT c##sec_admin
Enter password: password
Connected.
SQL> EXEC dvsys.dbms_macadm.add_app_exception( -
            owner => 'C##REPORT', -
            package_name => '')
> >
PL/SQL procedure successfully completed.

SQL>
```

11. Display the exception list.

```
SQL> SELECT * FROM DVSYS.DBA_DV_APP_EXCEPTION;

OWNER          PACKAGE
-----
C##REPORT      %

SQL>
```

12. Connect as the common user in PDB1 and check if the common user can access the application data in PDB1.

```
SQL> CONNECT c##report@PDB1
Enter password: password
Connected.
SQL> SELECT count(*) FROM hr.employees;

COUNT (*)
-----
          107

SQL>
```

Q1/ Is it the expected behavior?

A1/ Yes. Database Vault operations control handles C##REPORT user as an exception who can access local data.

```
SQL> CONNECT c##common_user@PDB1
Enter password: password
Connected.
```

```
SQL> SELECT count(*) FROM hr.employees;
SELECT count(*) FROM hr.employees
                        *
ERROR at line 1:
ORA-01031: insufficient privileges

SQL> EXIT
$
```

13. Disable Database Vault operations control by executing the
/home/oracle/labs/SEC/disable_DVOps.sh.

```
$ /home/oracle/labs/SEC/disable_DVOps.sh
...
$
```

Practice 2-3: Constraining AUDIT POLICY and NOAUDIT POLICY SQL Commands with Oracle Database Vault Command Rules

Overview

In this practice you will forbid any user other than SYS and SYSTEM from using the AUDIT POLICY and NOAUDIT POLICY commands.

Tasks

1. Configure and enable Oracle Database Vault in the CDB root and in PDB1 by executing the `/home/oracle/labs/SEC/setup_DV_ORCL.sh` shell script.

```
$ /home/oracle/labs/SEC/setup_DV_ORCL.sh
...
$
```

2. Connect as SYSTEM to PDB1 and let SYSTEM create the required audit policies.

```
$ sqlplus system@PDB1
Enter password: password
SQL> CREATE AUDIT POLICY pol1 ACTIONS SELECT ON hr.employees;

Audit policy created.

SQL>
```

3. Enable the audit policy.

```
SQL> AUDIT POLICY pol1;

Audit succeeded.

SQL>
```

4. Connect in PDB1 as the security officer, C##SEC_ADMIN.

```
SQL> CONNECT c##sec_admin@PDB1
Enter password: password
Connected.
SQL>
```

5. Create a command rule that forbids users that are not SYS not SYSTEM from using the AUDIT POLICY and NOAUDIT POLICY commands in any circumstance and in PDB1 only.
 - a. First create the rule set to which you will associate the **Is Database Administrator** rule that checks whether the user executing a NOAUDIT POLICY command is granted the DBA role.

```
SQL> EXEC dvsys.DBMS_MACADM.CREATE_RULE_SET( -
          rule_set_name      => 'Check_user', -
```

```

        description      => 'Check user', -
        enabled           => DBMS_MACUTL.G_YES, -
        eval_options      => DBMS_MACUTL.G_RULESET_EVAL_ANY, -
        audit_options     => DBMS_MACUTL.G_RULESET_AUDIT_FAIL, -
        fail_options      => DBMS_MACUTL.G_RULESET_FAIL_SILENT, -
        fail_message      => '', -
        fail_code         => '', -
        handler_options   => DBMS_MACUTL.G_RULESET_HANDLER_OFF, -
        handler           => '', -
        is_static         => TRUE, -
        scope             => DBMS_MACUTL.G_SCOPE_LOCAL)
> > > > > > > > > > > > > >
PL/SQL procedure successfully completed.

SQL>

```

- b. Then associate the predefined `Is SYS or SYSTEM User` rule to the rule set.

```

SQL> EXEC dvsys.DBMS_MACADM.ADD_RULE_TO_RULE_SET( -
        rule_set_name => 'Check_user', -
        rule_name      => 'Is SYS or SYSTEM User')
> >
PL/SQL procedure successfully completed.

SQL>

```

- c. Then create the command rule.

```

SQL> EXEC dvsys.DBMS_MACADM.CREATE_COMMAND_RULE( -
        command          => 'AUDIT POLICY', -
        rule_set_name    => 'Check_user', -
        object_owner     => '%', -
        object_name      => 'POL1', -
        enabled          => DBMS_MACUTL.G_YES, -
        scope            => DBMS_MACUTL.G_SCOPE_LOCAL)
> > > > > >
PL/SQL procedure successfully completed.

SQL>

```

6. Reconnect as `SYSTEM` to `PDB1`, disable the audit policy and drop the policy.

```

SQL> CONNECT system@PDB1
Enter password: password
Connected.
SQL> NOAUDIT POLICY pol1;

```

```
Noaudit succeeded.
```

```
SQL> DROP AUDIT POLICY pol1;
```

```
Audit Policy dropped.
```

```
SQL>
```

Q1/ How is it possible that `SYSTEM` can disable the `POL1` audit policy and drop it although the policy is protected by a command rule?

A1/ The command rule is associated with the pre-defined rule “Is SYS or SYSTEM User”. The rule verifies that the user executing `AUDIT POLICY` or `NOAUDIT POLICY` command is either `SYS` or `SYSTEM`. If this is not the case, the command violates the command rule and is rejected.

7. Create a DBA junior and grant the user the DBA role in PDB1.

```
SQL> CONNECT c##accts_admin@PDB1
```

```
Enter password: password
```

```
Connected.
```

```
SQL> CREATE USER dba_junior IDENTIFIED BY password;
```

```
User created.
```

```
SQL> CONNECT sys@PDB1 AS SYSDBA
```

```
Enter password: password
```

```
Connected.
```

```
SQL> GRANT dba TO dba_junior;
```

```
Grant succeeded.
```

```
SQL>
```

8. Connect as the DBA junior and create an audit policy.

```
SQL> CONNECT dba_junior@PDB1
```

```
Enter password: password
```

```
Connected.
```

```
SQL> CREATE AUDIT POLICY pol1 ACTIONS SELECT ON hr.employees;
```

```
Audit policy created.
```

```
SQL>
```

9. Enable the audit policy.

```
SQL> AUDIT POLICY pol1;
AUDIT POLICY pol1
*
ERROR at line 1:
ORA-47400: Command Rule violation for AUDIT POLICY on POL1

SQL>

SQL>
```

Q1/ Who can now disable the audit policy if necessary?

```
SQL> CONNECT c##sec_admin@PDB1
Enter password: password
Connected.
SQL> NOAUDIT POLICY pol1;
NOAUDIT POLICY pol1
*
ERROR at line 1:
ORA-47400: Command Rule violation for AUDIT POLICY on POL1

SQL>
```

A1/ The command rule works for `AUDIT POLICY` and `NOAUDIT POLICY` commands even if the command defined is `AUDIT POLICY`. The Oracle Database Vault owner cannot disable the policy because `C##SEC_ADMIN` is neither `SYS` nor `SYSTEM`, the only user names checked by the “Is `SYS` or `SYSTEM` User” rule.

Q2/ Can `SYSTEM` disable the audit policy even if `SYSTEM` did not create it?

```
SQL> CONNECT system@PDB1
Enter password: password
Connected.
SQL> NOAUDIT POLICY pol1;

Noaudit succeeded.

SQL> DROP AUDIT POLICY pol1;
```



```
Audit Policy dropped.
```

```
SQL> EXIT
```

```
$
```

A2/ sys or SYSTEM can disable the audit policy even if they did not create it because an audit policy is a non-schema object, and therefore not owned by anyone.

10. Remove the Oracle Database Vault command rule and disable Oracle Database Vault in the CDB root and PDB1.

```
$ /home/oracle/labs/SEC/disable_DV_ORCL.sh
```

```
...
```

```
$
```

Practice 2-4: Auditing Direct User Activities

Overview

In this practice you will audit top-level user activities in the database without collecting indirect user activity.

Tasks

1. Execute the `/home/oracle/labs/SEC/create_proc.sh` shell script. The shell script creates a procedure that allows the `HR` user to raise employees' salary in `PDB1`.

```
$ /home/oracle/labs/SEC/create_proc.sh
...
$
```

2. In *Session1*, create and enable an audit policy that audits any salary increase.

```
$ sqlplus system@PDB1
Enter password: password

SQL> CREATE AUDIT POLICY pol_sal_increase
        ACTIONS UPDATE ON hr.employees;

2
Audit policy created.

SQL> AUDIT POLICY pol_sal_increase WHENEVER SUCCESSFUL;

Audit succeeded.

SQL>
```

3. In another session, *Session2*, connect as `HR` and increase the salary for employee ID 106 through the `RAISE_SALARY` procedure and then with the `UPDATE` command directly on the row.

```
$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ sqlplus hr@PDB1
Enter password: password

SQL> EXEC emp_admin.raise_salary(106,10)

PL/SQL procedure successfully completed.

SQL> UPDATE hr.employees SET salary=salary*0.1
        WHERE employee_id = 106;

2
1 row updated.
```

```
SQL> COMMIT;
Commit complete.
```

```
SQL> EXIT
$
```

Q1/ In Session1, are the update actions executed through the PL/SQL procedure and directly by the UPDATE command audited?

```
SQL> SELECT action_name, object_name, sql_text
       FROM unified_audit_trail
       WHERE unified_audit_policies = 'POL_SAL_INCREASE';
 2      3
ACTION_NAME  OBJECT_NAME
-----
SQL_TEXT
-----
UPDATE      EMPLOYEES
UPDATE EMPLOYEES SET SALARY = SALARY + :B2 WHERE EMPLOYEE_ID
= :B1

UPDATE      EMPLOYEES
UPDATE hr.employees SET salary=salary*0.1
        WHERE employee_id = 106

SQL>
```

A1/ Yes, they are.

4. Drop the policy.

```
SQL> NOAUDIT POLICY pol_sal_increase;

Noaudit succeeded.

SQL> DROP AUDIT POLICY pol_sal_increase;

Audit Policy dropped.

SQL>
```

5. In *Session1*, create and enable another audit policy that audits any salary increase executed directly with an `UPDATE` command.

```
SQL> CREATE AUDIT POLICY pol_sal_direct_increase
        ACTIONS UPDATE ON hr.employees ONLY TOPLEVEL;

2
Audit policy created.

SQL> AUDIT POLICY pol_sal_direct_increase WHENEVER SUCCESSFUL;

Audit succeeded.

SQL>
```

6. In *Session2*, repeat step 3 for employee ID 107.

```
$ sqlplus hr@PDB1
Enter password: password

SQL> EXEC emp_admin.raise_salary(107,30)

PL/SQL procedure successfully completed.

SQL> UPDATE hr.employees SET salary=salary*0.1
        WHERE employee_id = 107;

2
1 row updated.

SQL> COMMIT;

Commit complete.

SQL> EXIT

$
```

Q1/ In Session1, are the update actions executed through the PL/SQL procedure and directly by the `UPDATE` command audited?

```
SQL> SELECT action_name, object_name
        FROM unified_audit_trail
        WHERE unified_audit_policies = 'POL_SAL_DIRECT_INCREASE';

2      3
ACTION_NAME  OBJECT_NAME
-----

```

```
UPDATE      EMPLOYEES
```

```
SQL> EXIT
```

```
$
```

A1/ Only the direct UPDATE statement is audited as this is the purpose of the ONLY TOPLEVEL clause of the CREATE AUDIT POLICY command.

7. In *Session1*, drop the audit policies by executing the `/home/oracle/labs/SEC/drop_audit.sh` shell script.

```
$ /home/oracle/labs/SEC/drop_audit.sh
```

```
...
```

```
$
```

Practice 2-5: Handling Operations on Oracle-managed and User-managed Tablespaces Encrypted in TDE

Overview

In this practice you will manage operations on data of Oracle-managed and user-managed tablespaces unaffected by closing the TDE keystore.

You also use the Oracle By Example “Handling Operations on Oracle-Managed and User-Managed Tablespaces Encrypted” to see how to proceed. Launch a browser and click the bookmark from the Bookmarks toolbar of the browser. The URL is `file:///home/oracle/labs/OBEs/F11940_01/html/index.html`.

Tasks

1. Execute the `/home/oracle/labs/SEC/create_TBS.sh` shell script to create a user-managed tablespace in PDB1. The shell script first creates the CDB root keystore, opens the keystore and sets the master encryption key at the CDB root level and in PDB1.

```
$ /home/oracle/labs/SEC/create_TBS.sh
...
$
```

2. Check which tablespaces in the CDB root are encrypted.

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

SQL> SELECT tablespace_name, encrypted FROM dba_tablespaces;

TABLESPACE_NAME          ENC
-----
SYSTEM                   NO
SYSAUX                   NO
UNDOTBS1                  NO
TEMP                      NO
USERS                     NO

SQL>
```

3. Switch one of the Oracle-managed tablespaces and one of the user-managed tablespaces to encryption.

```
SQL> ALTER TABLESPACE system ENCRYPTION USING 'AES192' ENCRYPT;
ALTER TABLESPACE system ENCRYPTION USING 'AES192' ENCRYPT
*
ERROR at line 1:
```

```
ORA-28365: wallet is not open
```

```
SQL> ALTER TABLESPACE users ENCRYPTION USING 'AES192' ENCRYPT;  
ALTER TABLESPACE users ENCRYPTION USING 'AES192' ENCRYPT  
*  
ERROR at line 1:  
ORA-28365: wallet is not open  
  
SQL>
```

4. Open the CDB root keystore and set the key.

```
SQL> ADMINISTER KEY MANAGEMENT SET KEYSTORE OPEN  
IDENTIFIED BY password CONTAINER = ALL;  
  
2  
keystore altered.  
  
SQL>
```

```
SQL> ALTER TABLESPACE users ENCRYPTION USING 'AES192' ENCRYPT;  
  
Tablespace altered.  
  
SQL> ALTER TABLESPACE system ENCRYPTION USING 'AES192' ENCRYPT;  
  
Tablespace altered.  
  
SQL>
```

5. Verify that the tablespaces SYSTEM and USERS in the CDB root are encrypted.

```
SQL> SELECT tablespace_name, encrypted FROM dba_tablespaces;  
  
TABLESPACE_NAME          ENC  
-----  
SYSTEM                   YES  
SYSAUX                   NO  
UNDOTBS1                 NO  
TEMP                     NO  
USERS                    YES  
  
SQL>
```

6. Close the CDB root keystore.

```
SQL> ADMINISTER KEY MANAGEMENT SET KEYSTORE CLOSE
        IDENTIFIED BY password CONTAINER = ALL;

2
keystore altered.

SQL>
```

Q1/ Can you change the encryption algorithm for the tablespace SYSTEM?

```
SQL> ALTER TABLESPACE system ENCRYPTION USING 'AES128' ENCRYPT;
ALTER TABLESPACE system ENCRYPTION USING 'AES128' ENCRYPT
*
ERROR at line 1:
ORA-28365: wallet is not open

SQL>
```

A1/ No, it is not possible because the operation affects the encryption metadata of the Oracle-managed tablespace. The metadata updates are prevented with an ORA-28365 "wallet is not open" error, because the TDE master encryption key is not available when the TDE keystore is closed.

Q2/ Can you create tables, insert data in the tablespace SYSTEM?

```
SQL> CREATE TABLE system.test
        (c NUMBER, C2 CHAR(4)) TABLESPACE system;

2
Table created.

SQL> INSERT INTO system.test VALUES (1,'Test');

1 row created.

SQL> COMMIT;

Commit complete.

SQL>
```


A2/ Yes, it is possible because the operation affects only the data of the Oracle-managed tablespace and because the tablespace is an Oracle-managed tablespace.

Q3/ Can you change the encryption algorithm for the tablespace *USERS* and create tables, insert data in the tablespace *USERS*?

```
SQL> ALTER TABLESPACE users ENCRYPTION DECRYPT;
ALTER TABLESPACE users ENCRYPTION DECRYPT
*
ERROR at line 1:
ORA-28365: wallet is not open

SQL> CREATE TABLE system.test2
          (c NUMBER, C2 CHAR(4)) TABLESPACE users;
CREATE TABLE system.test2(c NUMBER, C2 CHAR(4)) TABLESPACE users
*
ERROR at line 1:
ORA-28365: wallet is not open

SQL>
```

A3/ No, it not possible in either case because operations on user-managed tablespaces still raise the ORA-28365 "wallet is not open" error when the CDB root keystore is closed.

Q4/ Is the behavior still the same in PDBs?

```
SQL> CONNECT sys@PDB1 AS SYSDBA
Enter password: password
Connected.
SQL> SELECT tablespace_name, encrypted FROM dba_tablespaces;
```

TABLESPACE_NAME	ENC
-----	----
SYSTEM	NO
SYSAUX	NO
UNDOTBS1	NO
TEMP	NO
USERS	NO

```
OMTS_TBS                YES

6 rows selected.

SQL>
```

- a. Reopen the CDB root keystore.

```
SQL> CONNECT / AS SYSDBA
Connected.
SQL> ADMINISTER KEY MANAGEMENT SET KEYSTORE OPEN
        IDENTIFIED BY password CONTAINER = ALL;

2
keystore altered.

SQL>
```

- b. Encrypt the SYSTEM tablespace.

```
SQL> CONNECT sys@PDB1 AS SYSDBA
Connected.
SQL> ALTER TABLESPACE system ENCRYPTION USING 'AES192' ENCRYPT;

Tablespace altered.

SQL> SELECT tablespace_name, encrypted FROM dba_tablespaces;

TABLESPACE_NAME          ENC
-----
SYSTEM                   YES
SYSAUX                   NO
UNDOTBS1                 NO
TEMP                     NO
USERS                    NO
OMTS_TBS                 YES

SQL>
```

- c. Close the CDB root keystore and therefore the PDBs keystores.

```
SQL> CONNECT / AS SYSDBA
Connected.
SQL> ADMINISTER KEY MANAGEMENT SET KEYSTORE CLOSE
        IDENTIFIED BY password CONTAINER = ALL;

2
keystore altered.

SQL>
```

- d. Complete metadata and data operations on the Oracle-managed tablespace `SYSTEM`.

```
SQL> CONNECT sys@PDB1 AS SYSDBA
Enter password: password
Connected.
SQL> ALTER TABLESPACE system ENCRYPTION USING 'AES128' ENCRYPT;
ALTER TABLESPACE system ENCRYPTION USING 'AES128' ENCRYPT
*
ERROR at line 1:
ORA-28365: wallet is not open

SQL> CREATE TABLE system.tab1 (c NUMBER) TABLESPACE system;

Table created.

SQL> INSERT INTO system.tab1 VALUES (1);

1 row created.

SQL> COMMIT;

Commit complete.

SQL>
```

- e. Complete metadata and data operations on the user-managed tablespace `OMTS_TBS`.

```
SQL> ALTER TABLESPACE omts_tbs ENCRYPTION USING 'AES128'
      ENCRYPT;
ALTER TABLESPACE omts_tbs ENCRYPTION USING 'AES128' ENCRYPT
*
ERROR at line 1:
ORA-28365: wallet is not open

SQL> CREATE TABLE system.tab2 (c NUMBER) TABLESPACE omts_tbs;
CREATE TABLE system.tab2 (c NUMBER) TABLESPACE omts_tbs
*
ERROR at line 1:
ORA-28365: wallet is not open

SQL> EXIT
$
```

A4/ Yes, the behavior still the same in PDBs.

7. Disable encryption in ORCL. Execute the

`/home/oracle/labs/SEC/remove_TDE_in_ORCL.sh` shell script.

```
$ /home/oracle/labs/SEC/remove_TDE_in_ORCL.sh
...
$
```

8. Recreate the database so as not to use TDE. Use the

`/home/oracle/labs/admin/recreate_ORCL.sh` shell script.

```
$ $HOME/labs/admin/recreate_ORCL.sh
...
$
```

Practices for Lesson 3: Using Availability Enhancements

Practices for Lesson 3: Overview

Overview

In these practices, you will use `RMAN` to connect to PDBs to use the recovery catalog to back up and restore PDBs. You will also observe the automatic deletion of flashback logs.

Practice 3-1: Using RMAN to Connect to a PDB and Use the Recovery Catalog

In this practice, you will use RMAN to connect to PDB1 and use the recovery catalog to back up PDB1.

Tasks

1. Execute the `/home/oracle/labs/admin/cleanup_PDBs.sh` shell script. The shell script drops all PDBs that may have been created by any of the practices in ORCL, and finally re-creates PDB1.

```
$ $HOME/labs/admin/cleanup_PDBs.sh
...
$
```

2. Execute the `/home/oracle/labs/HA/create_PDB2.sh` shell script. The shell script creates PDB2 in ORCL.

```
$ $HOME/labs/HA/create_PDB2.sh
...
$
```

3. Before starting the practice, execute the `$HOME/labs/HA/glogin.sh` shell script. It sets formatting for all columns selected in queries.

```
$ $HOME/labs/HA/glogin.sh
...
$
```

4. Execute the `/home/oracle/labs/HA/create_CDB19.sh` to re-create CDB19 and PDB19. CDB19 will be used as the recovery catalog CDB.

```
$ $HOME/labs/HA/create_CDB19.sh
...
$
```

5. To be able to connect to the recovery catalog and to PDB1 as the target database, create a virtual private RMAN catalog (VPC) in PDB19 for groups of databases and users of ORCL, PDB1 and PDB2.
 - a. Create the catalog owner in PDB19.

```
$ . oraenv
ORACLE_SID = [oracle] ? CDB19
The Oracle base has been set to /u01/app/oracle
$ sqlplus system@PDB19
Enter password : password

SQL> CREATE USER catowner IDENTIFIED BY password;
```

```

User created.

SQL> GRANT create session, recovery_catalog_owner,
      unlimited tablespace TO catowner;

2
Grant succeeded.

SQL> EXIT
$

```

- b. Create the RMAN base catalog in PDB19.

```

$ rman

RMAN> CONNECT CATALOG catowner@PDB19

recovery catalog database Password: password
connected to recovery catalog database

RMAN> CREATE CATALOG;

recovery catalog created

RMAN> EXIT
$

```

- c. Register ORCL in the catalog.

```

$ . oraenv
ORACLE_SID = [CDB19] ? ORCL
The Oracle base remains unchanged with value /u01/app/oracle
$ rman target / catalog catowner@PDB19

connected to target database: ORCL (DBID=1515130002)
recovery catalog database Password: password
connected to recovery catalog database

RMAN> REGISTER DATABASE;

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

RMAN> EXIT
$

```


- d. Execute the `$ORACLE_HOME/rdbms/admin/dbmsrmanvpc.sql` script after connecting to the catalog as `SYS` to grant VPD-required privileges to the base catalog owner.

```
$ sqlplus sys@PDB19 AS SYSDBA

Enter password: password

SQL> @$ORACLE_HOME/rdbms/admin/dbmsrmanvpc.sql -vpd catowner

Checking the operating user... Passed

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

=====
VPD SETUP STATUS:
VPD privileges granted successfully!
Connect to RMAN base catalog and perform UPGRADE CATALOG.

$
```

- e. Reconnect to RMAN base catalog and perform UPGRADE CATALOG.

```
$ rman

RMAN> CONNECT CATALOG catowner@PDB19

recovery catalog database Password: password
connected to recovery catalog database

RMAN> UPGRADE CATALOG;
recovery catalog owner is CATOWNER
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> EXIT

$
```

6. Create the VPC users, VPC_PDB1 and VPC_PDB2 in the catalog who will be given access for the metadata of PDB1 and PDB2, respectively.

```
$ sqlplus system@PDB19
Enter password : password

SQL> CREATE USER vpc_pdb1 IDENTIFIED BY password;

User created.

SQL> CREATE USER vpc_pdb2 IDENTIFIED BY password;

User created.

SQL> GRANT create session TO vpc_pdb1, vpc_pdb2;

Grant succeeded.

SQL> EXIT
$
```

7. As the base catalog owner, give the VPC users the access for the metadata of PDB1 and PDB2, respectively.

```
$ rman

RMAN> CONNECT CATALOG catowner@PDB19

recovery catalog database Password: password
connected to recovery catalog database

RMAN> GRANT CATALOG FOR PLUGGABLE DATABASE pdb1 TO vpc_pdb1;

Grant succeeded.

RMAN> GRANT CATALOG FOR PLUGGABLE DATABASE pdb2 TO vpc_pdb2;

Grant succeeded.

RMAN> EXIT
$
```

8. Connect to the PDB1 target PDB and to the recovery catalog as VPC_PDB1 user to back up and restore the PDB1 target PDB.

```
$ rman TARGET sys@PDB1 CATALOG vpc_pdb1@PDB19

target database Password: password
connected to target database: ORCL:PDB1 (DBID=4095280305)
recovery catalog database Password: password
connected to recovery catalog database

RMAN> BACKUP DATABASE;

Starting backup at 08-MAY-19
allocated channel: ORA_DISK_1
channel ORA_DISK_1: SID=276 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=00014
name=/u02/app/oracle/oradata/ORCL/pdb1/ORCL/884FEEEE353031076E053
E311ED0A028E/datafile/o1_mf_sysaux_gf3fhrkw_.dbf
input datafile file number=00013
name=/u02/app/oracle/oradata/ORCL/pdb1/ORCL/884FEEEE353031076E053
E311ED0A028E/datafile/o1_mf_system_gf3fhrkq_.dbf
input datafile file number=00015
name=/u02/app/oracle/oradata/ORCL/pdb1/ORCL/884FEEEE353031076E053
E311ED0A028E/datafile/o1_mf_undotbs1_gf3fhrky_.dbf
channel ORA_DISK_1: starting piece 1 at 08-MAY-19
channel ORA_DISK_1: finished piece 1 at 08-MAY-19
piece
handle=/u03/app/oracle/fast_recovery_area/ORCL/884FEEEE353031076E
053E311ED0A028E/backupset/2019_05_08/o1_mf_nnndf_TAG20190508T112
738_gf5h9byf_.bkp tag=TAG20190508T112738 comment=NONE
channel ORA_DISK_1: backup set complete, elapsed time: 00:00:07
Finished backup at 08-MAY-19

RMAN> EXIT

$
```

9. Retrieve the tag value from the backup completed above and display the backup set for PDB1 via the recovery catalog view.

```
$ sqlplus catowner@PDB19
Enter password: password
SQL> SELECT handle FROM rc_backup_piece
      WHERE tag = 'TAG20190508T112738';

2
HANDLE
```

```
-----  
/u03/app/oracle/fast_recovery_area/ORCL/884FEEE353031076E053E311  
ED0A028E/backupset/2019_05_08/o1_mf_nnndf_TAG20190508T112738_gf5  
h9byf_.bkp
```

```
SQL> EXIT  
$
```

Q1/ Can the VPC user VPC_PDB2 backup other PDBs than the PDB for which the VPC user VPC_PDB2 was granted access to?

```
$ rman TARGET sys@PDB1 CATALOG vpc_pdb2@PDB19
```

```
target database Password: password  
connected to target database: ORCL:PDB1 (DBID=4095280305)  
recovery catalog database Password: password  
connected to recovery catalog database
```

```
RMAN> BACKUP DATABASE;
```

```
Starting backup at 08-MAY-19
```

```
RMAN-00571: =====  
RMAN-00569: ===== ERROR MESSAGE STACK FOLLOWS =====  
RMAN-00571: =====  
RMAN-03002: failure of backup command at 05/08/2019 11:29:28  
RMAN-03014: implicit resync of recovery catalog failed  
RMAN-06004: Oracle error from recovery catalog database: RMAN-  
20001: target database not found in recovery catalog
```

```
RMAN> BACKUP PLUGGABLE DATABASE pdb1;
```

```
Starting backup at 08-MAY-19
```

```
RMAN-00571: =====  
RMAN-00569: ===== ERROR MESSAGE STACK FOLLOWS =====  
RMAN-00571: =====  
RMAN-03002: failure of backup command at 05/08/2019 11:30:26  
RMAN-03014: implicit resync of recovery catalog failed  
RMAN-06004: Oracle error from recovery catalog database: RMAN-  
20001: target database not found in recovery catalog
```

```
RMAN> EXIT  
$
```

A1/ The VPC user can perform operations only on the target PDB that he has been granted access to.

10. Connect as the catalog owner and revoke the CATALOG FOR PLUGGABLE DATABASE privilege on PDB1 and PDB2 from the VPC users.

```
$ rman CATALOG catowner@PDB19

recovery catalog database Password: password
connected to recovery catalog database

RMAN> REVOKE CATALOG FOR PLUGGABLE DATABASE pdb1 FROM vpc_pdb1;

Revoke succeeded.

RMAN> REVOKE CATALOG FOR PLUGGABLE DATABASE pdb2 FROM vpc_pdb2;

Revoke succeeded.

RMAN> EXIT
$
```

11. Verify that the VPC_PDB1 user cannot back up the PDB1 target PDB via the recovery catalog.

```
$ rman TARGET sys@PDB1 CATALOG vpc_pdb1@PDB19

target database Password: password
connected to target database: ORCL:PDB1 (DBID=4095280305)
recovery catalog database Password: password
connected to recovery catalog database

RMAN> BACKUP DATABASE;

Starting backup at 08-MAY-19
RMAN-00571: =====
RMAN-00569: ===== ERROR MESSAGE STACK FOLLOWS =====
RMAN-00571: =====
RMAN-03002: failure of backup command at 05/08/2019 11:31:23
RMAN-03014: implicit resync of recovery catalog failed
RMAN-06428: recovery catalog is not installed

RMAN> EXIT
$
```

12. Drop the recovery catalog in PDB19.

```
$ rman CATALOG catowner@PDB19
```

```
recovery catalog database Password: password  
connected to recovery catalog database
```

```
RMAN> DROP CATALOG;
```

```
recovery catalog owner is CATOWNER  
enter DROP CATALOG command again to confirm catalog removal
```

```
RMAN> DROP CATALOG;
```

```
recovery catalog dropped
```

```
RMAN> EXIT
```

```
$
```

Practice 3-2: Exploring Automatic Deletion of Flashback Logs

Overview

In this practice, you will observe the automatic deletion of flashback log files. The minimum flashback retention is one hour (60 minutes). Even if a user sets flashback retention to less than an hour, Oracle still considers flashback retention to be one hour. This is partly because Oracle logs flashback metadata in flashback logs approximately every thirty minutes.

Tasks

1. Verify that ORCL is in FLASHBACK mode and display the flashback retention period.

```
$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ sqlplus / AS SYSDBA

SQL> SELECT flashback_on FROM v$database;

FLASHBACK_ON
-----
YES

SQL>
```

If the database is not in FLASHBACK mode, use the following command to configure it in FLASHBACK mode.

```
SQL> ALTER DATABASE FLASHBACK ON;

Database altered.

SQL> SHOW PARAMETER DB_FLASHBACK_RETENTION_TARGET

NAME                                TYPE        VALUE
-----
db_flashback_retention_target       integer     70

SQL>
```

The flashback retention period is set to 70 minutes.

2. Increase the FRA size to ensure that there will be no space pressure that would automatically delete flashback logs.

```
SQL> ALTER SYSTEM SET db_recovery_file_dest_size=100G;

System altered.

SQL>
```

3. Check the flashback logs in the FRA.

```
SQL> HOST
$ cd /u03/app/oracle/fast_recovery_area/ORCL/flashback
$ ls -l
```

```
total 614424
-rw-r----- 1 oracle oinstall 209723392 May  9 05:28
ol_mf_gf601ksm_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:33
ol_mf_gf601mrc_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 05:28
ol_mf_gf7gnf6g_.flb
$
```

4. In another terminal window, execute the `/home/oracle/labs/HA/workload.sh` to generate flashback logs. The script takes a long time to complete. Continue to step 5 then step 6 to complete job after starting task 4.

```
$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ /home/oracle/labs/HA/workload.sh
...
SQL> UPDATE hr.tabflash SET c1=c1+12;

17895424 rows updated.

SQL> COMMIT;

Commit complete.

SQL> EXIT
...
$
```


5. Back in the initial terminal session, check again the flashback logs in the FRA. As we know that Oracle logs flashback metadata in flashback logs approximately every thirty minutes, it is not pertinent to check the list before. Nevertheless due to limit resource issue, go directly to task 6.

```
$ ls -l
total 3481748
-rw-r----- 1 oracle oinstall 209723392 May  9 07:46
ol_mf_gf601ksm_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:45
ol_mf_gf601mrc_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:46
ol_mf_gf7gnf6g_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:47
ol_mf_gf7pp3rb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:47
ol_mf_gf7ppxms_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7pqtcl_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7prq9x_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7psllo_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:49
ol_mf_gf7ptdsb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:49
ol_mf_gf7pv7of_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:50
ol_mf_gf7pwlph_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:51
ol_mf_gf7pww55_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:52
ol_mf_gf7pxstt_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:53
ol_mf_gf7q0ytp_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:53
ol_mf_gf7q1ypl_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:53
ol_mf_gf7q2wkj_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:53
ol_mf_gf7q3wm2_.flb
$ ls -ltr | wc -l
18
$ exit
SQL>
```

- Decrease the flashback retention period to 60 minutes. From the time you decrease the flashback retention period, you will observe that the list of flashback logs will remain stable and not increase any more.

```
SQL> ALTER SYSTEM SET
        DB_FLASHBACK_RETENTION_TARGET=60 SCOPE=BOTH;
2
System altered.

SQL>
```

- Check regularly the flashback logs in the FRA. Meanwhile, let the instructor teach the lesson about Performance enhancements.

```
SQL> EXIT
$ cd /u03/app/oracle/fast_recovery_area/ORCL/flashback
$ ls -ltr
total 3891364
-rw-r----- 1 oracle oinstall 209723392 May  9 07:45
ol_mf_gf60lmrc_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:46
ol_mf_gf7gnf6g_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:46
ol_mf_gf60lksm_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:47
ol_mf_gf7pp3rb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:47
ol_mf_gf7ppxms_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7pqtcl_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7prq9x_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7psllo_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:49
ol_mf_gf7ptdsb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:49
ol_mf_gf7pv7of_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:50
ol_mf_gf7pwlph_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:51
ol_mf_gf7pww55_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:52
ol_mf_gf7pxstt_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:53
ol_mf_gf7q0ytp_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:53
ol_mf_gf7q1ypl_.flb
```

```

-rw-r----- 1 oracle oinstall 209723392 May  9 07:54
ol_mf_gf7q2wkj_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:54
ol_mf_gf7q3wm2_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:54
ol_mf_gf7q5mnb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:54
ol_mf_gf7q4sgt_.flb
$ ls -ltr | wc -l
20
$

```

```

$ ls -ltr
total 6553888
-rw-r----- 1 oracle oinstall 209723392 May  9 07:45
ol_mf_gf60lmrc_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:46
ol_mf_gf7gnf6g_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:46
ol_mf_gf60lksm_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:47
ol_mf_gf7pp3rb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:47
ol_mf_gf7ppxms_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7pqtcl_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7prq9x_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7psllo_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:49
ol_mf_gf7ptdsb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:49
ol_mf_gf7pv7of_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:50
ol_mf_gf7pw1ph_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:51
ol_mf_gf7pww55_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:52
ol_mf_gf7pxstt_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:53
ol_mf_gf7q0ytp_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:53
ol_mf_gf7q1ypl_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:54
ol_mf_gf7q2wkj_.flb

```

```

-rw-r----- 1 oracle oinstall 209723392 May  9 07:54
ol_mf_gf7q3wm2_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:56
ol_mf_gf7q4sgt_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:56
ol_mf_gf7q5mnb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:57
ol_mf_gf7q8vnb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:01
ol_mf_gf7q9ohv_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:01
ol_mf_gf7qblcq_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:02
ol_mf_gf7qlwv2_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:02
ol_mf_gf7qmhcd_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:03
ol_mf_gf7qn992_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:04
ol_mf_gf7qnx9s_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:04
ol_mf_gf7qpd92_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:05
ol_mf_gf7qqv6b_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:06
ol_mf_gf7qs75b_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:07
ol_mf_gf7qtp80_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:07
ol_mf_gf7qxxgn_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:07
ol_mf_gf7qw2fl_.flb
$ ls -ltr | wc -l
35
$

```

```

$ ls -ltr
total 6789436
-rw-r----- 1 oracle oinstall 209723392 May  9 07:45
ol_mf_gf60lmrc_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:46
ol_mf_gf7gnf6g_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:46
ol_mf_gf60lksm_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:47
ol_mf_gf7pp3rb_.flb

```

```

-rw-r----- 1 oracle oinstall 209723392 May  9 07:47
ol_mf_gf7ppxms_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7pqtcl_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7prq9x_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:48
ol_mf_gf7psllo_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:49
ol_mf_gf7ptdsb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:49
ol_mf_gf7pv7of_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:50
ol_mf_gf7pwlph_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:51
ol_mf_gf7pww55_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:52
ol_mf_gf7pxstt_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:53
ol_mf_gf7q0ytp_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:53
ol_mf_gf7q1ypl_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:54
ol_mf_gf7q2wkj_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:54
ol_mf_gf7q3wm2_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:56
ol_mf_gf7q4sgt_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:56
ol_mf_gf7q5mnbb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 07:57
ol_mf_gf7q8vnb_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:01
ol_mf_gf7q9ohv_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:01
ol_mf_gf7qblcq_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:02
ol_mf_gf7qlwv2_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:02
ol_mf_gf7qmhcd_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:03
ol_mf_gf7qn992_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:04
ol_mf_gf7qnx9s_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:04
ol_mf_gf7qpd92_.flb

```

```

-rw-r----- 1 oracle oinstall 209723392 May  9 08:05
ol_mf_gf7qqv6b_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:06
ol_mf_gf7qs75b_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:07
ol_mf_gf7qtp80_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:07
ol_mf_gf7qw2fl_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:08
ol_mf_gf7qyggn_.flb
-rw-r----- 1 oracle oinstall 31473664 May  9 08:08
ol_mf_gf7qz0wl_.flb
-rw-r----- 1 oracle oinstall 209723392 May  9 08:13
ol_mf_gf7qyh9_.flb
$ ls -ltr | wc -l
35
$

```

Q1/ Are flashback logs deleted even if there is still enough space in FRA?

A1/ Yes. Flashback logs beyond retention period are proactively deleted without degrading the flashback performance and before there is space pressure. The number of flashback logs remains the same after decreasing the flashback retention.

8. In the other terminal window, if the `/home/oracle/labs/HA/workload.sh` did not complete, you can interrupt it by killing the shell script.

```

$ pgrep -lf workload
1366 workload.sh
$ kill -9 1366
$

```

Practices for Lesson 4: Using Performance Enhancements

Practices for Lesson 4: Overview

Overview

In these practices, you will use Memoptimized Rowstore - Fast Ingest, complete a PDB-level ADDM analysis, use Real-Time SQL Monitor as a SQL developer, populate in-memory objects and wait until they are populated, and finally configure and use PDB- level Database Replay.

Practice 4-1: Using Memoptimized Rowstore - Fast Ingest

Overview

In this practice, you will see how Memoptimized Rowstore - Fast Ingest deferred inserts are handled in the SGA and on disk through the Space Management Coordinator (SMCO) and Wxxx slave background processes, how deferred inserted rows are different from the conventional inserts.

Tasks

If you are working on an on-premise database, you will observe that the feature is not available on on-premise environment.

If you are working with a Cloud database, you would be able to proceed with the following steps.

1. Execute the `/home/oracle/labs/admin/cleanup_PDBs.sh` shell script. The shell script drops all PDBs that may have been created by any of the practices in `ORCL`, and finally re-creates `PDB1`. The session you are logged into is called *Session1*.

```
$ $HOME/labs/admin/cleanup_PDBs.sh
...
$
```

2. Before starting the practice, execute the `$HOME/labs/PERF/glogin.sh` shell script. It sets formatting for all columns selected in queries.

```
$ $HOME/labs/PERF/glogin.sh
...
$
```

3. Create the `HR.MEMOPTWRITES` table in `PDB1` to have rows inserted as deferred inserts. Ensure that the table data is written to the space allocated for fast ingest writes in the large pool in the shared pool area before being written to disk.
 - a. Create the table with the appropriate attribute.

```
$ sqlplus system@PDB1
Enter password : password

SQL> CREATE TABLE hr.memoptwrites
      (c1 NUMBER, c2 VARCHAR2(12)) MEMOPTIMIZE FOR WRITE;
  2  CREATE TABLE hr.memoptwrites
  *
ERROR at line 1:
ORA-62145: MEMOPTIMIZE FOR WRITE feature not allowed on segment
with deferred storage.

SQL>
```

Q1/ Which initialization parameter does the error refer to?

A1/ By default, an object created like a table does not have a segment created until a first row is inserted. MEMOPTIMIZE FOR WRITE tables require a segment created before the first row is inserted.

```
SQL> SHOW PARAMETER deferred_segment_creation

NAME                                TYPE        VALUE
-----                                -
deferred_segment_creation           Boolean      TRUE
SQL> ALTER SYSTEM SET deferred_segment_creation = FALSE
                                SCOPE=BOTH;

2
System altered.

SQL> CREATE TABLE hr.memoptwrites
        (c1 NUMBER, c2 VARCHAR2(12)) MEMOPTIMIZE FOR WRITE;

2
Table created.

SQL>
```

b. Verify that the attribute is set.

```
SQL> SELECT memoptimize_read Mem_read,
           memoptimize_write Mem_write
        FROM dba_tables
        WHERE table_name = 'MEMOPTWRITES';

2    3    4
MEM_READ MEM_WRIT
-----
DISABLED ENABLED

SQL>
```

Q2/ Is the space allocated for fast ingest writes in the large pool initialized?

```
SQL> SELECT * FROM V$MEMOPTIMIZE_WRITE_AREA;

TOTAL_SIZE USED_SPACE FREE_SPACE NUM_WRITES NUM_WRITERS CON_ID
-----
0          0          0          0          0          3

SQL>
```

A2/ No, it is not yet initialized. It waits for the first inserted row.

- c. Insert a row into the table so that the row goes to the space allocated for fast ingest writes in the large pool.

```
SQL> INSERT /*+ MEMOPTIMIZE_WRITE */ INTO hr.memoptwrites
        VALUES (1, 'Memoptwrites');

2
1 row created.
```

```
SQL> COMMIT;

Commit complete.

SQL>
```

Q3/ How many bytes are consumed in the space allocated for fast ingest writes in the large pool for the inserted row?

```
SQL> SELECT * FROM V$MEMOPTIMIZE_WRITE_AREA;

TOTAL_SIZE USED_SPACE FREE_SPACE NUM_WRITES NUM_WRITERS CON_ID
-----
371195904  1076816  370119088          0          1      3

SQL>
```

A3/ 371195904 bytes initialize the space allocated for fast ingest writes in the large pool. 1076816 bytes are consumed in the space allocated for fast ingest writes in the large pool for the inserted row by one writer.

Q4/ Why is only 1G allocated when 2G is the default value of allocation?

A4/ 2G is allocated from the large pool when there is enough space. If there is not enough space in the large pool, an ORA-4031 is internally discovered and automatically cleared. The allocation is retried with half the requested size. In our case, the allocation succeeds at 1G. If there was not enough space in the large pool, the allocation could have been tried with 512M and 256M after which the feature would be disabled until the instance was restarted.

After the space allocated for fast ingest writes in the large pool is initialized, the size remains static. It cannot grow or shrink.

- d. In another session, called *Session2*, insert and commit rows into the table by executing the `/home/oracle/labs/PERF/insert.sql` SQL script.

```
$ sqlplus system@PDB1
Enter password : password

SQL> @/home/oracle/labs/PERF/insert.sql
...
SQL>
```

Q5/ How many bytes are consumed in the space allocated for fast ingest writes in the large pool for the inserted rows? What do you observe (in Session1)?

```
SQL> SELECT * FROM V$MEMOPTIMIZE_WRITE_AREA;

TOTAL_SIZE USED_SPACE FREE_SPACE NUM_WRITES NUM_WRITERS CON_ID
-----
371195904   1076816  370119088          0          2      3

SQL>
```

A5/ 1076816 bytes are consumed for the inserted rows by two writers. The same amount of space is used despite the number of rows inserted.

- e. In each session, list the statistics about memoptimized writes.

1) In *Session2*:

```
SQL> SELECT display_name, value FROM v$mystat m, v$statname n
      WHERE m.statistic# = n.statistic#
      AND    display_name IN ( 'memopt w rows written',
                              'memopt w rows flushed');

2
DISPLAY_NAME                                VALUE
-----
memopt w rows written                        33
memopt w rows flushed                        0

SQL>
```

2) In *Session1*:

```
SQL> SELECT display_name, value FROM v$mystat m, v$statname n
      WHERE m.statistic# = n.statistic#
```

```

        AND      display_name IN ( 'memopt w rows written',
                                   'memopt w rows flushed');

2
DISPLAY_NAME                                VALUE
-----
memopt w rows written                        1
memopt w rows flushed                        0

SQL>

```

Q6/ How many writes were written via the space allocated for fast ingest writes in the large pool in Session1? And how many in Session2?

A1/ One row in Session1 and 33 in Session2.

Q7/ Is the space used in the space allocated for fast ingest writes in the large pool released after a certain time? You can check in either session.

```

SQL> SELECT * FROM V$MEMOPTIMIZE_WRITE_AREA;

TOTAL_SIZE USED_SPACE FREE_SPACE NUM_WRITES NUM_WRITERS CON_ID
-----
371195904      28320  371167584           0           2      3

SQL>

```

A7/ Yes. Re-execute the query after a few minutes. The background processes, w000 - w999 slaves, which have SMCO as the coordinator process, flush the data from the space allocated for fast ingest writes in the large pool to data files after 1MB worth of writes (per session per object) or after 60 seconds.

4. In Session2, read the content of the table.

```

SQL> SELECT distinct c1 FROM hr.memoptwrites;

C1
---
6
1
2
4
5
3

```

```
6 rows selected.
```

```
SQL>
```

5. In *Session1*, execute the `/home/oracle/labs/PERF/insert_before_flush.sql` SQL script to insert and commit more rows into the `HR.MEMOPTWRITES` table.

```
SQL> @/home/oracle/labs/PERF/insert_before_flush.sql
```

```
...
```

```
SQL>
```

Q8/ In Session2, does HR see all the rows inserted?

```
SQL> SELECT distinct c1 FROM hr.memoptwrites;
```

```
          C1
```

```
-----
```

```
          6
```

```
          1
```

```
          2
```

```
          4
```

```
          5
```

```
          3
```

```
6 rows selected.
```

```
SQL>
```

A8/ No. Any buffered data in the space allocated for fast ingest writes in the large pool cannot be read by any session, including the writer, until the background process sweep is complete, even if the data was committed.

- a. In *Session1*, either wait for the background process to flush the space allocated for fast ingest writes in the large pool data or manually flush the data from space allocated for fast ingest writes in the large pool to disk.

```
SQL> EXEC DBMS_MEMOPTIMIZE_ADMIN.WRITES_FLUSH
```

```
PL/SQL procedure successfully completed.
```

```
SQL>
```

Q9/ Can HR display the rows inserted now in Session2?

```
SQL> SELECT distinct c1 FROM hr.memoptwrites;

      C1
-----
        6
        1
        7
        2
        8
       11
        4
        5
       10
        3
        9

11 rows selected.

SQL>
```

A9/ Yes, because the Wxxx background process flushed the data from the space allocated for fast ingest writes in the large pool to disk.

6. In Session2, observe how constraints are evaluated on tables that have rows inserted as deferred inserts.
 - a. Create the HR.MEMOPTW table in PDB1 to have rows inserted as deferred inserts and a check constraint on C1. The values must be within the range of 1 to 10.
 - 1) Create the table.

```
SQL> CREATE TABLE hr.memoptw
      ( c1 NUMBER(3), c2 VARCHAR2(12),
        CONSTRAINT CC_CHECK CHECK (c1 BETWEEN 1 AND 10))
      MEMOPTIMIZE FOR WRITE;

      2      3      4
Table created.

SQL>
```

- 2) Insert rows into the table by executing the following command:

```
SQL> INSERT /*+ MEMOPTIMIZE_WRITE */ INTO hr.memoptw
      VALUES (0, 'Memoptw');
```

```

INSERT /*+ MEMOPTIMIZE_WRITE */ INTO hr.memoptw VALUES
(0, 'Memoptw')
*
ERROR at line 1:
ORA-02290: check constraint (HR.CC_CHECK) violated

SQL>

```

Q10/ Does the `INSERT` statement successfully complete?

A10/ No. The constraint is evaluated without looking at the existing data on disk and, therefore, is still honored in the foreground process.

- b. Create the `HR.MEMOPTW2` table in `PDB1` to have rows inserted as deferred inserts and a `UNIQUE` constraint on `C2`.

- 1) Create the table.

```

SQL> CREATE TABLE hr.memoptw2
      (c1 NUMBER(3), c2 VARCHAR2(12) CONSTRAINT un_c2 UNIQUE)
      MEMOPTIMIZE FOR WRITE;
2      3
Table created.

SQL>

```

- 2) Insert rows with the same value for `C2` into the table by executing the following command:

```

SQL> INSERT /*+ MEMOPTIMIZE_WRITE */ INTO hr.memoptw2
      VALUES (0, 'Memoptw');
2
1 row created.

SQL> INSERT /*+ MEMOPTIMIZE_WRITE */ INTO hr.memoptw2
      VALUES (1, 'Memoptw');
2
1 row created.

SQL>

```

Q11/ Do the `INSERT` statements successfully complete?

A11/ Yes. The `UNIQUE` constraint is evaluated when the insert is written to disk and, therefore, is deferred to the time of drainage to disk.

- 3) In *Session1*, flush the data from the space allocated for fast ingest writes in the large pool to disk.

```
SQL> EXEC DBMS_MEMOPTIMIZE_ADMIN.WRITES_FLUSH

PL/SQL procedure successfully completed.

SQL> EXIT
$
```

- 4) Commit the insert in *Session2*.

```
SQL> COMMIT;

Commit complete.

SQL>
```

Q12/ Is the data successfully written to disk?

```
SQL> SELECT * FROM hr.memoptw2;

      C1 C2
-----
      0 Memoptw

SQL> EXIT
$
```

A12/ No. The `UNIQUE` constraint is evaluated when the insert is written to disk. As such, the second row is not inserted when the data is written to disk from the space allocated for fast ingest writes in the large pool.

Practice 4-2: Completing an ADDM Analysis Inside a PDB

Overview

In this practice you will perform an ADDM analysis and recommendations for PDB1. It is better to execute PDB-specific ADDM analysis and recommendations than ADDM analysis on the CDB root.

Tasks

1. Before starting the practice, execute the `$HOME/labs/PERF/glogin.sh` shell script. It sets formatting for all columns selected in queries.

```
$ $HOME/labs/PERF/glogin.sh
...
$
```

2. Log in to PDB1. You are connected in *Session1*.

```
$ . oraenv
ORACLE_SID = [CDB19] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ sqlplus sys@PDB1 AS SYSDBA
Enter password : password

SQL>
```

3. In another terminal session called *Session2*, launch a workload on PDB1 by executing the `/home/oracle/labs/PERF/start_workload.sh` shell script. The workload continues until you remove the `/home/oracle/labs/PERF/runload` file.

```
$ . oraenv
ORACLE_SID = [ORCL] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ cd /home/oracle/labs/PERF
$ ./start_workload.sh 1 PDB1
...
SQL>
```

4. While the workload executes in PDB1 in *Session2*, after about 2 minutes, create a snapshot in *Session1*.

```
SQL> EXEC dbms_workload_repository.create_snapshot()

PL/SQL procedure successfully completed.

SQL>
```

5. Execute the ADDM task manually in *Session1*.

```
SQL> VAR tname VARCHAR2(60)
SQL> BEGIN
      :tname := 'PDB1_analysis_mode_task';
      DBMS_ADDM.ANALYZE_DB( :tname, 1, 2);
      END;
/
      2      3      4      5
PL/SQL procedure successfully completed.

SQL>
```

6. View the PDB report in *Session1*. You can then schedule the task repetitively.

```
SQL> SET PAGESIZE 50000
SQL> SELECT dbms_addm.get_report(:tname) FROM DUAL;

DBMS_ADDM.GET_REPORT(:TNAME)
-----
      ADDM Report for Task 'PDB1_analysis_mode_task'
      -----

Analysis Period
-----
AWR snapshot range from 1 to 2.
Time period starts at 15-MAY-19 08.56.46 AM
Time period ends at 15-MAY-19 08.58.55 AM

Analysis Target
-----
Database 'ORCL' with DB ID 4095280305.
Database version 19.0.0.0.0.
Analysis was requested for all instances, but ADDM analyzed
instance ORCL, numbered 1 and hosted at edvmrlp0.
See the "Additional Information" section for more information on
the requested instances.
ADDM detected that the system is a PDB.

Activity During the Analysis Period
-----
Total database time was 12 seconds.
The average number of active sessions was .1.
ADDM analyzed 1 of the requested 1 instances.
```

```

~~~~~
There are no findings to report.
~~~~~

      Additional Information
      -----

Miscellaneous Information
-----
There was no significant database activity to run the ADDM.

SQL>

```

Q1/ Are the recommendations related to the PDB level only?

A1/ Yes, they are. There are no recommendations at the CDB root level. The DB ID 4095280305 is the database ID of PDB1.

Q2/ Which is the type of CDB ADDM thinks it was for analysis?

A2/ The report displays: ADDM detected that the CDB type is PDB.

```

SQL> SELECT task_name, cdb_type_detected FROM dba_addm_tasks
      WHERE how_created = 'CMD';

 2
TASK_NAME                                CDB_TYPE_DETECTED
-----
PDB1_analysis_mode_task                  PDB

SQL>

```

7. In Session2, stop the workload by removing the /home/oracle/labs/PERF/runload file.

```

$ rm /home/oracle/labs/PERF/runload
$

```

8. In Session2, launch a workload on PDB1 again by executing the /home/oracle/labs/PERF/start_workload.sh shell script.

```

$ /home/oracle/labs/PERF/start_workload.sh 1 PDB1
...

```

9. In *Session1*, connect to the CDB root.

```
SQL> CONNECT / AS SYSDBA
Connected.
SQL>
```

10. While the workload executes in *PDB1* in *Session2*, after about 2 minutes, create a snapshot in *Session1*.

```
SQL> EXEC dbms_workload_repository.create_snapshot()

PL/SQL procedure successfully completed.

SQL>
```

11. Execute ADDM task manually in *Session1*. Retrieve recommendations for the CDB root only. First retrieve the snapshots values to analyze.

```
SQL> SELECT min(snap_id),max(snap_id) FROM awr_cdb_snapshot;

MIN(SNAP_ID) MAX(SNAP_ID)
-----
1          121

SQL> VAR tname VARCHAR2(60)
SQL> BEGIN
      :tname := 'CDB analysis_mode_task';
      DBMS_ADDM.ANALYZE_DB( :tname, 1, 2);
      END;
/
> > > >
PL/SQL procedure successfully completed.

SQL>
```

12. View the PDB report in *Session1*. You can then schedule the task repetitively.

```
SQL> SELECT DBMS_ADDM.GET_REPORT(:tname) FROM DUAL;

DBMS_ADDM.GET_REPORT(:TNAME)
-----
      ADDM Report for Task 'CDB analysis_mode_task'
      -----

Analysis Period
-----
AWR snapshot range from 1 to 2.
Time period starts at 15-MAY-19 07.00.57 AM
```

Time period ends at 15-MAY-19 08.00.10 AM

Analysis Target

Database 'ORCL' with DB ID 1517631634.

Database version 19.3.0.0.0.

Analysis was requested for all instances, but ADDM analyzed instance ORCL, numbered 1 and hosted at edvmrlp0.

See the "Additional Information" section for more information on the requested instances.

ADDM detected that the database type is MULTITENANT DB.

Activity During the Analysis Period

Total database time was 1 seconds.

The average number of active sessions was .0.

ADDM analyzed 1 of the requested 1 instances.

~~~~~

There are no findings to report.

~~~~~

Additional Information

Miscellaneous Information

There was no significant database activity to run the ADDM.

SQL>

Q1/ Are the recommendations related to the CDB level and PDB levels too?

A1/ There is no recommendation at a specific PDB level.

```
SQL> SELECT task_name, cdb_type_detected FROM dba_addm_tasks
       WHERE how_created = 'CMD';
```

2

TASK_NAME	CDB_TYPE_DETECTED
-----	-----
CDB analysis_mode_task	MULTITENANT DB

```
SQL> EXIT  
$
```

13. In *Session2*, stop the workload by removing the `/home/oracle/labs/PERF/runload` file.

```
$ rm /home/oracle/labs/PERF/runload  
$
```

Practice 4-3: Using Real-time SQL Monitoring as a SQL Developer

Overview

In this practice you will act in `PDB1` as a SQL developer without any super-user privileges nor roles. The SQL developer will use real-time SQL monitoring to analyze the performance of his/her SQL statements.

Tasks

1. Before starting the practice, execute the `/home/oracle/labs/PERF/glogin.sh` shell script in *Session1*. It sets formatting for all columns selected in queries.

```
$ /home/oracle/labs/PERF/glogin.sh
...
$
```

2. Execute the `/home/oracle/labs/PERF/RTMonitor.sql` SQL script in *Session1*. The script completes the following operations:
 - Creates the `MONI` user and `MONI_TEST` table and loads the table with thousands of rows.
 - Creates a developer user.
 - Grants the developer user the `CREATE SESSION` and `SELECT` ON the `MONI.MONI_TEST` table.

```
$ /home/oracle/labs/PERF/RTMonitor.sh
...
$
```

3. Check the privileges and roles granted to the `SQLDEV` user.

```
$ sqlplus sys@PDB1 AS SYSDBA
Enter password : password

SQL> SELECT * FROM dba_sys_privs WHERE grantee = 'SQLDEV';

GRANTEE PRIVILEGE          ADM COM INH
-----
SQLDEV  CREATE SESSION NO   NO   NO

SQL> SELECT owner, table_name, privilege
        FROM dba_tab_privs WHERE grantee = 'SQLDEV';
 2
OWNER    TABLE_NAME PRIVILEGE
-----
MONI     MONI_TEST   SELECT
```



```
SQL> SELECT * FROM dba_role_privs WHERE grantee = 'SQLDEV';

no rows selected

SQL>
```

Q1/ Is SQLDEV granted super-user privileges and roles such as those required in Oracle Database 18c to be able to use real-time SQL monitor?

A1/ No. He is not granted the SELECT CATALOG ROLE role.

4. In Session2, connect as the SQLDEV developer in PDB1 and execute a long-running query.

```
$ sqlplus sqldev@PDB1
Enter password: password

SQL> SELECT count(*) FROM moni.moni_test t1, moni.moni_test t2
      WHERE t1.c = t2.c AND t1.c = 1;

...
```

5. In Session1, connect as the SQLDEV developer to PDB1.

```
SQL> CONNECT sqldev@PDB1
Enter password: password
Connected.
SQL>
```

6. Get an overview of the long running queries.

```
SQL> SELECT sql_id, status, sql_text FROM v$sql_monitor;
SELECT sql_id, status, sql_text FROM v$sql_monitor
                                     *

ERROR at line 1:
ORA-00942: table or view does not exist

SQL>
```

Q1/ Traditionally, real-time SQL monitor is mainly used by DBAs because they are responsible for monitoring and tuning database performance. Real-time SQL monitor tracks and collects SQL and execution plan statistics in fixed views which are only accessible by users who have been granted the SELECT CATALOG ROLE role. A regular user, such as an application developer or a low-privileged user without the SELECT CATALOG ROLE role and SELECT privilege on the real-time SQL monitor fixed views, can write a SQL statement, execute it, see the SQL result set and its SQL plan using the explain plan command, but not its execution plan because it is stored in V\$SQL_PLAN.

Is the SQLDEV user granted the SELECT_CATALOG_ROLE role? Is the SQLDEV user granted the SELECT privilege on V\$SQL_PLAN? Can the SQLDEV user use real-time SQL monitor to view the execution plan for his SQL statement execution?

A1/ No. The SQLDEV user is not granted the SELECT_CATALOG_ROLE role nor the SELECT privilege on the V\$SQL_MONITOR view.

- a. Generate the SQL monitor report from the command line, run the REPORT_SQL_MONITOR function in the DBMS_SQLTUNE package.

```
SQL> VARIABLE my_rept CLOB
SQL> BEGIN
           :my_rept :=DBMS_SQLTUNE.REPORT_SQL_MONITOR();
END;
/ 2      3      4

PL/SQL procedure successfully completed.

SQL> SET LINESIZE 78
SQL> PRINT :my_rept

MY_REPT
-----
SQL Monitoring Report

SQL Text
-----
SELECT count(*) FROM moni.moni_test t1, moni.moni_test t2 WHERE
t1.c = t2.c AND t1.c = 1

Global Information
-----
Status                : EXECUTING
Instance ID           : 1
Session               : SQLDEV (30:25679)
SQL ID                : 9fqxj0xpnt222
SQL Execution ID      : 16777217
Execution Started     : 05/15/2019 09:32:21
First Refresh Time    : 05/15/2019 09:32:29
Last Refresh Time     : 05/15/2019 09:33:05
Duration              : 43s
Module/Action         : SQL*Plus/-
Service               : pdb1
Program               : sqlplus@edvmr1p0 (TNS V1-V3)
```

Global Stats

```
=====
| Elapsed |   Cpu   |   IO   | Other | Buffer | Read | Read |
| Time(s) | Time(s) | Waits(s) | Waits(s) | Gets  | Reqs  | Bytes |
=====
|    411  |    388  |    0.00 |    23  |    502 |    18 |    3MB |
=====
```

SQL Plan Monitoring Details (Plan Hash Value=183808681)

```
=====
| Id |      Operation      |      Name      | Rows | Cost | Time
| Start | Execs | Rows | Read | Read | Mem | Activity | Activity Detail
|
|      |      |      |      |      |      | (Estim) |      Active(s)
) | Active |      | (Actual) | Reqs | Bytes |      | (%) |      (# samples)
|
=====
|    0 | SELECT STATEMENT      |                |      |      |      |      |      |      35
4 |    +9 |    1 |    0 |      |      | . |      |
|
|    1 | SORT AGGREGATE        |                |      |      |      |      |      |      35
4 |    +9 |    1 |    0 |      |      | . |      |
|
| -> 2 | HASH JOIN              |                |      |      |      |      |      |      41
3 |    +2 |    1 |    4G |      |      | 15MB | 100.00 | Cpu (413)
|
|    3 | INDEX FAST FULL SCAN  | MONI_TEST_C_INDX | 198K | 114 |      |      |      |
1 |    +9 |    1 | 200K | 18 | 3MB | . |      |
|
| -> 4 | INDEX FAST FULL SCAN  | MONI_TEST_C_INDX | 198K | 114 |      |      |      |
4 |    +9 |    1 | 48640 |      |      | . |      |
|
=====
```

SQL> EXIT

\$

- b. In *Session2*, interrupt the long-running query.

CTRL C

```
SQL> SELECT count(*) FROM moni.moni_test t1, moni.moni_test t2
*
```

ERROR at line 1:

ORA-01013: user requested cancel of current operation

SQL> EXIT

\$

Practice 4-4: Waiting In-memory Objects to be Populated

Overview

In this practice you will populate in-memory tables into the in-memory column store (IMCS) and wait until they are completely populated before your application can access them. Your application will take better advantage of the complete population of the tables into the IMCS.

Tasks

1. Before starting the practice, execute the `/home/oracle/labs/PERF/glogin.sh` shell script in *Session1*. It sets formatting for all columns selected in queries.

```
$ /home/oracle/labs/PERF/glogin.sh
...
$
```

2. Configure the IMCS size to 800M, create and load in-memory tables `OE.PART`, `OE.SUPPLIER`, `OE.DATE_DIM`, `OE.CUSTOMER`, and `OE.LINEORDER`. Execute the `/home/oracle/labs/PERF/IM_tables.sh` shell script to complete these tasks.

```
$ /home/oracle/labs/PERF/IM_tables.sh
...
$
```

3. Verify that the in-memory column store size is set to 800M.

```
$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ sqlplus / AS SYSDBA

SQL> SHOW PARAMETER inmemory_size

NAME                                TYPE                                VALUE
-----
inmemory_size                       big integer 800M
SQL>
```

4. Check whether in-memory tables are populated into the IMCS.

```
SQL> SELECT segment_name, bytes, inmemory_size,
           bytes_not_populated, populate_status
        FROM v$im_segments;

2      3
no rows selected

SQL>
```

Q/ Why are the in-memory tables not populated into the IMCS?

A/ The in-memory tables are not populated into the IMCS because the on-demand population has not been requested.

5. In another session, Session2, log on as SYSTEM in PDB1. Execute the function to get information about the status of in-memory tables population at the percentage of 100.

```
$ sqlplus system@PDB1
Enter password: password

SQL> SELECT DBMS_INMEMORY_ADMIN.POPULATE_WAIT(PRIORITY=>'NONE' ,
        PERCENTAGE => 100, TIMEOUT => 180)
        FROM dual;

2
DBMS_INMEMORY_ADMIN.POPULATE_WAIT(PRIORITY=>'NONE' , PERCENTAGE =>
100,T
-----
1

SQL> EXIT
$
```

Q1/ Are all in-memory tables populated into the IMCS?

A1/ No, they are not. The population could not complete successfully. The code returned from the function is 1 which means that the in-memory objects are not fully populated into the IMCS because of the lack of space in the in-memory column store.

- a. Verify this assumption in Session1.

```
SQL> SELECT segment_name, bytes, inmemory_size,
        bytes_not_populated, populate_status
        FROM v$sqlim_segments;

2      3
SEGMENT_NAME          BYTES INMEMORY_SIZE BYTES_NOT_POPULATED
-----
POPULATE_STAT
-----
CUSTOMER              30932992          7602176              0
COMPLETED

LINEORDER             1592164352          575406080             236232704
OUT OF MEMORY
```

DATE_DIM	352256	1310720	0
COMPLETED			

```
SQL> EXIT
$
```

Q1/ Would you allow your application query the tables if you know that the tables queried are not fully populated into the IMCS?

A1/ No, not necessarily because the performance might not be as good.

Q2/ What can you do to prevent your application from accessing the tables in this case?

A2/ Writing a wrapper package that invokes the function at instance startup, the instance database being opened in restricted mode. The package first queries the in-memory tables, invokes the function and based on the returned code, either increases the `INMEMORY_SIZE` parameter value, restarts the database instance, and rechecks the returned code until the function returns the value 0. Then the package can open the database instance in normal mode.

6. Increase the IMCS space, in *Session1*.

```
SQL> ALTER SYSTEM SET inmemory_size=1G SCOPE=SPFILE;

System altered.

SQL> ALTER SYSTEM SET sga_target=1500M SCOPE=SPFILE;

System altered.

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

Total System Global Area 1417674048 bytes
Fixed Size                  9141568 bytes
Variable Size               377487360 bytes
Database Buffers            184549376 bytes
Redo Buffers                 7634944 bytes
```

```

In-Memory Area          838860800 bytes
Database mounted.
Database opened.
SQL> ALTER PLUGGABLE DATABASE pdb1 OPEN;

Pluggable database altered.

SQL>

```

7. In *Session2*, execute the function that waits until in-memory tables are populated into the IMCS to the specified percentage of 100.

```

$ sqlplus system@PDB1
Enter password: password

SQL> SELECT DBMS_INMEMORY_ADMIN.POPULATE_WAIT('NONE',100,180)
        FROM dual;

```

The query does not give any result until the population of the segments is 100% complete. Observe the population progress in *Session1*.

```

SQL> SELECT segment_name, bytes, inmemory_size,
           bytes_not_populated, populate_status
        FROM v$im_segments;

```

SEGMENT_NAME	BYTES	INMEMORY_SIZE	BYTES_NOT_POPULATED	POPULATE_STAT
CUSTOMER	30932992	7602176	0	COMPLETED
LINEORDER	1592172544	302710784	879632384	STARTED
DATE_DIM	352256	1310720	0	COMPLETED

```

SQL> SELECT segment_name, bytes, inmemory_size,
           bytes_not_populated, populate_status
        FROM v$im_segments;

```

```

      2      3
SEGMENT_NAME          BYTES INMEMORY_SIZE BYTES_NOT_POPULATED
-----
POPULATE_STAT
-----
CUSTOMER              30932992          7602176              0
COMPLETED

LINEORDER             1592172544        354484224             762650624
STARTED

DATE_DIM              352256           1310720              0
COMPLETED

SQL> SELECT segment_name, bytes, inmemory_size,
           bytes_not_populated, populate_status
        FROM   v$sql_segments;
      2      3
SEGMENT_NAME          BYTES INMEMORY_SIZE BYTES_NOT_POPULATED
-----
POPULATE_STAT
-----
CUSTOMER              30932992          7602176              0
COMPLETED

LINEORDER             1592172544        674562048              0
COMPLETED

SUPPLIER              2015232           1310720              0
COMPLETED

DATE_DIM              352256           1310720              0
COMPLETED

PART                  167591936          37355520              0
COMPLETED

SQL>

```


When the population completes, the query in *Session2* completes.

```
2
DBMS_INMEMORY_ADMIN.POPULATE_WAIT('NONE',100,180)
-----
0
SQL>
```

Q1/ Are all in-memory tables populated into the IMCS?

A1/ Yes, they are. The population could complete successfully. The code returned from the function is 0 which means that the in-memory objects are fully populated into the IMCS.

Q2/ Would you allow your application query the tables if you know that the tables queried are fully populated into the IMCS?

A2/ Yes. This is why the wrapper package invoking the function at instance startup would be beneficial.

8. In *Session2*, execute the function that waits until in-memory tables are populated into the IMCS to the specified percentage of 100 before the applications can access the tables.
 - a. First execute a SQL script in *Session2* that modifies the in-memory attribute of the OE tables.

```
SQL> @/home/oracle/labs/PERF/alter_OE.sql
...
SQL> EXIT
$
```

- b. In *Session1*, restart PDB1 so that the in-memory tables are no more populated into the IMCS.

```
SQL> ALTER PLUGGABLE DATABASE pdb1 close;

Pluggable database altered.

SQL> ALTER PLUGGABLE DATABASE pdb1 OPEN;

Pluggable database altered.

SQL>
```

- c. In *Session2*, connect and execute the function that waits until in-memory tables are populated into the IMCS to the specified percentage of 100.

```
$ sqlplus system@PDB1
Enter password: password
Connected.
SQL> SELECT DBMS_INMEMORY_ADMIN.POPULATE_WAIT(PRIORITY=>'NONE',
        PERCENTAGE=>100, TIMEOUT => 180)
        FROM dual;

2
DBMS_INMEMORY_ADMIN.POPULATE_WAIT(PRIORITY=>'NONE', PERCENTAGE=>100, T
-----
2

SQL>
```

Q1/ Are all in-memory tables populated into the IMCS? Check in *Session1*.

```
SQL> SELECT segment_name, bytes, inmemory_size,
        bytes_not_populated, populate_status
        FROM v$im_segments;

2      3
no rows selected

SQL>
```

A1/ No, they are not. The code returned from the function is 2 which means that there are no in-memory objects populated yet. This is the normal behavior as the in-memory tables have been set to no in-memory tables with the SQL script.

Q2/ If you don't know the different return code meaning, how can you retrieve a more meaningful message?

```
SQL> SET SERVEROUTPUT ON
SQL> DECLARE
    v_force boolean := TRUE;
    v_return integer;
BEGIN
    v_return := dbms_inmemory_admin.populate_wait(
        priority => 'NONE',
        percentage => 100,
```

```

        timeout => 180,
        force => v_force);
END;
/
  2      3      4      5      6      7      8
DBMS_INMEMORY.POPULATE_WAIT
timeout: 180
now: 15-MAY-19 09.48.13.196624000 AM +00:00
timeout time: 15-MAY-19 09.51.13.134256 AM
percentage: 100
priority: NONE
instances: 1
DBA_SEGMENTS:
NO INMEMORY OBJECTS TO POPULATE

PL/SQL procedure successfully completed.

SQL>

```

A2/ The message *NO INMEMORY OBJECTS TO POPULATE* is more meaningful.

- d. In *Session2*, update the priority `NONE` to `HIGH` for the two tables called in the `/home/oracle/labs/PERF/IM_query.sql` SQL script.

```

SQL> ALTER TABLE oe.lineorder INMEMORY PRIORITY high;

Table altered.

SQL> ALTER TABLE oe.date_dim INMEMORY PRIORITY high;

Table altered.

SQL> EXIT
$

```

- e. In *Session1*, restart `PDB1`.

```

SQL> ALTER PLUGGABLE DATABASE pdb1 close;

Pluggable database altered.

SQL> ALTER PLUGGABLE DATABASE pdb1 OPEN;

Pluggable database altered.

```

```
SQL> EXIT
$
```

- f. Use the function in *Session2* to verify that the in-memory tables with HIGH priority are fully populated.

```
$ sqlplus system@PDB1
Enter password: password
Connected.
SQL> SELECT DBMS_INMEMORY_ADMIN.POPULATE_WAIT(PRIORITY=>'HIGH',
        PERCENTAGE=>100, TIMEOUT => 60)
        FROM dual;
 2      3
DBMS_INMEMORY_ADMIN.POPULATE_WAIT(PRIORITY=>'HIGH', PERCENTAGE=>1
00,T
-----
0

SQL> SELECT segment_name, bytes, inmemory_size,
        bytes_not_populated, populate_status
        FROM v$im_segments;
 2      3
SEGMENT_NAME          BYTES INMEMORY_SIZE BYTES_NOT_POPULATED
-----
POPULATE_STAT
-----
LINEORDER          1592172544      675610624      0
COMPLETED

DATE_DIM            352256      1310720      0
COMPLETED

SQL> EXIT
$
```

9. In *Session1*, complete a last test by executing the `/home/oracle/labs/PERF/test.sh` shell script.

```
$ /home/oracle/labs/PERF/test.sh
...
$
```

10. In *Session1*, verify the return status of the function once the cleanup completed.

```
$ sqlplus / AS SYSDBA
Connected.
SQL> SELECT DBMS_INMEMORY_ADMIN.POPULATE_WAIT(PRIORITY=>'HIGH',
        PERCENTAGE=>100, TIMEOUT => 60)
        FROM dual;
   2      3
DBMS_INMEMORY_ADMIN.POPULATE_WAIT(PRIORITY=>'HIGH', PERCENTAGE=>1
00,T
-----
                                     3

SQL>
```

Q1/ How do you retrieve a more meaningful message?

A1/ Using the function in a PL/SQL block returns a more meaningful message. In the current situation, the function informs you that the INMEMORY_SIZE is set to 0 and cannot therefore populate in-memory tables.

```
SQL> SET SERVEROUTPUT ON
SQL> DECLARE
    v_force boolean := TRUE;
    v_return integer;
BEGIN
    v_return := dbms_inmemory_admin.populate_wait(
        priority => 'HIGH',
        percentage => 100,
        timeout => 60,
        force => v_force);
END;
/
   2      3      4      5      6      7      8      9     10     11
POPULATE ERROR, INMEMORY_SIZE=0

PL/SQL procedure successfully completed.

SQL> EXIT
$
```

11. Execute the `/home/oracle/labs/PERF/cleanup_IM_tables.sh` shell script to drop the in-memory tables in `PDB1` and disable the IMCS.

```
$ /home/oracle/labs/PERF/cleanup_IM_tables.sh
...
$
```

Practice 4-5: Configuring and Using Database Replay at PDB Level

Overview

In this practice you will capture a workload from PDB1 and replay the workload at the PDB level into PDB19. The Database Replay operations can be performed at the PDB level.

Tasks

1. Before starting the practice, execute the `/home/oracle/labs/PERF/DBReplay.sh` shell script in *Session1*. The script re-creates PDB1 and PDB19, removes any existing database replay files.

```
$ /home/oracle/labs/PERF/DBReplay.sh
...
$
```

In *Session1*, log in to PDB1 and capture the workload data by using Database Replay.

```
$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ sqlplus system@PDB1
Enter password: password

SQL>
```

- a. The Database Replay capture creates files in a directory. Create the logical directory for the capture files.

```
SQL> HOST mkdir -p /home/oracle/PDB1/replay

SQL> CREATE OR REPLACE DIRECTORY oltp
          AS '/home/oracle/PDB1/replay';

2
Directory created.

SQL>
```

- b. Start capturing data with the Database Replay procedure.

```
SQL> EXEC DBMS_WORKLOAD_CAPTURE.START_CAPTURE ( -
          name => 'OLTP_peak', -
          dir  => 'OLTP')

> >
PL/SQL> procedure successfully completed.

SQL>
```

- c. During the capture, in *Session2*, execute the workload on PDB1 by executing the `/home/oracle/labs/PERF/workload.sh` shell script.

```
$ /home/oracle/labs/PERF/workload.sh
...
$
```

- d. When you consider that the workload is sufficient for replay testing, stop the capture in *Session1*.

```
SQL> EXEC DBMS_WORKLOAD_CAPTURE.FINISH_CAPTURE ()

PL/SQL> procedure successfully completed.

SQL> EXIT
$
```

Process the capture files and replay the workload in *Session1* in PDB19.

2. As in the normal whole process of Database Replay, after capturing the workload into files, you process the capture files. You will replay the capture files in PDB19.

```
$ sqlplus system@PDB19
Enter password: password

SQL>
```

- a. Create the logical directory in PDB19 for processing and initializing the capture files stored in `/home/oracle/PDB1/replay` to be replayed.

```
SQL> CREATE OR REPLACE DIRECTORY oltp
          AS '/home/oracle/PDB1/replay';

2
Directory created.

SQL>
```

- b. Process the capture files

```
SQL> EXEC DBMS_WORKLOAD_REPLAY.PROCESS_CAPTURE ( -
          capture_dir => 'OLTP')

>
PL/SQL> procedure successfully completed.

SQL>
```

- c. Initialize the replay.

```
SQL> EXEC DBMS_WORKLOAD_REPLAY.INITIALIZE_REPLAY( -
          replay_name => 'R', replay_dir => 'OLTP')

>
PL/SQL> procedure successfully completed.
```


- d. Prepare the replay.

```
SQL> EXEC DBMS_WORKLOAD_REPLAY.PREPARE_REPLAY ()

PL/SQL> procedure successfully completed.

SQL>
```

- e. You are ready to start workload clients to replay the captured workload in PDB19 with `wrc` clients. In *Session2*, if the workload is still not finished, interrupt the `/home/oracle/labs/PERF/workload.sh` shell script, quit the SQL*Plus session and start the `wrc` process into PDB19.

```
$ wrc REPLAYDIR=/home/oracle/PDB1/replay USERID=system
SERVER=PDB19
...
Password: password
Wait for the replay to start (11:40:35)
```

The password required is the `SYSTEM` user password.

- f. The `wrc` client is waiting for Database Replay to start in the PDB. In *Session1*, execute the `START_REPLAY` procedure.

```
SQL> EXEC DBMS_WORKLOAD_REPLAY.START_REPLAY ()

PL/SQL> procedure successfully completed.

SQL>
```

- g. As soon as the Database Replay procedure is started in PDB19, the client starts replaying.

```
Replay client 1 started (11:42:05)
```

3. Meanwhile, in *Session1*, verify that the client is executing on PDB19.

```
SQL> CONNECT system@PDB19
Enter password: password
Connected.
SQL> SELECT username, con_id, module
       FROM v$session
       WHERE username <> 'SYS' AND con_id <> 0;

 2      3
USERNAME      CON_ID MODULE
-----
-----
```

```
SYSTEM          5 WRC$  
SYSTEM          5 SQL*Plus  
SYSTEM          5 WRC$  
  
SQL> EXIT  
$
```

4. When the `wrc` client finally completes, execute the `/home/oracle/labs/PERF/cleanup_DBReplay.sh` shell script to drop the Database Replay capture files.

```
Replay client 1 finished (11:50:11)  
$
```

```
$ /home/oracle/labs/PERF/cleanup_DBReplay.sh  
...  
$
```

**Practices for Lesson 5: Using
Big Data and Data
Warehousing Enhancements**

Practices for Lesson 5: Overview

Overview

In these practices, you will manipulate HyPTs.

Practice 5-1: Managing Hybrid Partitioned Tables

Overview

In this practice you create and maintain hybrid partitioned tables (HyPT).

Tasks

1. Before starting the practice, execute the `$HOME/labs/DW/glogin.sh` shell script. It sets formatting for all columns selected in queries.

```
$ $HOME/labs/DW/glogin.sh
...
$
```

2. Create an HyPT in `PDB1` with the following characteristics:
 - The table is partitioned by range on the `TIME_ID` column.
 - The default tablespace for internal partitions is `TS1`.
 - The default tablespace for external partitions is `CENT20`.
 - The fields in the records of the external files are separated by `'`.
 - The table is partitioned into 5 partitions:
 - 3 external partitions: `CENT18` is empty for the moment, `CENT19` has the `cent19.dat` file stored in another directory than the default, `CENT19`, `CENT20` has the `cent20.dat` file stored in the default directory.
 - 2 internal partitions: `Y2000` is stored in tablespace `TS2` and `PMAX` in the default tablespace.
- a. Create the tablespaces for the internal partitions.

```
$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base remains unchanged with value /u01/app/oracle
$ sqlplus system@PDB1
Enter password : password

SQL> CREATE TABLESPACE ts1
          DATAFILE '/u02/app/oracle/oradata/ORCL/pdb1/ts1.dbf'
          SIZE 100M;
2      3
Tablespace created.

SQL> CREATE TABLESPACE ts2
          DATAFILE '/u02/app/oracle/oradata/ORCL/pdb1/ts2.dbf'
          SIZE 100M;
2      3
```

Tablespace created.

SQL>

- b. Create the directories for the external partitions.

```
SQL> HOST mkdir -p /home/oracle/labs/DW/CENT18
SQL> HOST mkdir -p /home/oracle/labs/DW/CENT19
SQL> HOST mkdir -p /home/oracle/labs/DW/CENT20
SQL>
SQL> CREATE DIRECTORY cent18 AS '/home/oracle/labs/DW/CENT18';
```

Directory created.

```
SQL> CREATE DIRECTORY cent19 AS '/home/oracle/labs/DW/CENT19';
```

Directory created.

```
SQL> CREATE DIRECTORY cent20 AS '/home/oracle/labs/DW/CENT20';
```

Directory created.

SQL>

- c. Create the HYPT user.

```
SQL> CREATE USER hypt IDENTIFIED BY password
        DEFAULT TABLESPACE ts1;
```

2

User created.

```
SQL> GRANT read, write ON DIRECTORY cent18 TO hypt;
```

Grant succeeded.

```
SQL> GRANT read, write ON DIRECTORY cent19 TO hypt;
```

Grant succeeded.

```
SQL> GRANT read, write ON DIRECTORY cent20 TO hypt;
```

Grant succeeded.

```
SQL> GRANT create session, unlimited tablespace, create table
        TO hypt;
```

2

```
Grant succeeded.
```

```
SQL>
```

- d. Create the HyPT table.

```
SQL> CREATE TABLE hypt.hypt_tab
      (history_event NUMBER , time_id DATE)
      TABLESPACE ts1
      EXTERNAL PARTITION ATTRIBUTES
      (TYPE ORACLE_LOADER
       DEFAULT DIRECTORY cent20
       ACCESS PARAMETERS
        (FIELDS TERMINATED BY ','
         (history_event , time_id DATE 'dd-MON-yyyy')
        )
       REJECT LIMIT UNLIMITED
      )
PARTITION BY RANGE (time_id)
(PARTITION cent18 VALUES LESS THAN
 (TO_DATE('01-Jan-1800','dd-MON-yyyy')) EXTERNAL,
 PARTITION cent19 VALUES LESS THAN
 (TO_DATE('01-Jan-1900','dd-MON-yyyy')) EXTERNAL
      DEFAULT DIRECTORY cent19
      LOCATION ('cent19.dat'),
 PARTITION cent20 VALUES LESS THAN
 (TO_DATE('01-Jan-2000','dd-MON-yyyy')) EXTERNAL
      LOCATION('cent20.dat'),
 PARTITION y2000 VALUES LESS THAN
 (TO_DATE('01-Jan-2001','dd-MON-yyyy')) TABLESPACE ts2,
 PARTITION pmax VALUES LESS THAN (MAXVALUE));
 2   3   4   5   6   7   8   9   10  11  12  13  14  15
16  17  18  19  20  21  22  23  24  25
Table created.

SQL>
```

3. Insert rows into the table.

- a. Execute the `/home/oracle/labs/DW/insert.sql` SQL script to insert rows into the internal partitions of the `HYPT_TAB` table.

```
SQL> @/home/oracle/labs/DW/insert.sql
...
SQL>
```

- b. Insert a row for the date of 12 August 1997.

```
SQL> INSERT INTO hypt.hypt_tab
      VALUES (41, to_date('12.08.1997', 'dd.mm.yyyy'));
2  INSERT INTO hypt.hypt_tab
      *
ERROR at line 1:
ORA-14466: Data in a read-only partition or subpartition cannot
be modified.

SQL>
```

Q1/ Why does it fail?

A1/ The date can only be inserted into the external partition and therefore via the external file.

- c. Insert the row for the date of “12 August 1997” into the appropriate external file.

```
SQL> host echo "41,12-Aug-1997" >>
/home/oracle/labs/DW/CENT20/cent20.dat

SQL> SELECT history_event, TO_CHAR(time_id, 'dd-MON-yyyy')
      FROM   hypt.hypt_tab PARTITION (cent20);
2
HISTORY_EVENT TO_CHAR(TIME_ID, 'DD-
-----
1 01-JAN-1976
2 01-JAN-1915
3 01-JAN-1928
4 01-JAN-1937
5 01-JAN-1949
6 01-FEB-1959
7 01-FEB-1996
8 01-FEB-1997
9 01-FEB-1998
10 01-FEB-1998
41 12-AUG-1997

11 rows selected.

SQL>
```

Q1/ What happens if you append a row into the wrong external file?


```

SQL> host echo "42,12-Aug-1997" >>
/home/oracle/labs/DW/CENT19/cent19.dat

SQL> SELECT history_event, TO_CHAR(time_id, 'dd-MON-yyyy')
      FROM hypt.hypt_tab PARTITION (cent19);
 2
HISTORY_EVENT TO_CHAR(TIME_ID, 'DD-
-----
          11 01-JAN-1876
          12 01-JAN-1815
          13 01-JAN-1828
          14 01-JAN-1837
          15 01-JAN-1849
          16 01-FEB-1859
          17 01-FEB-1896
          18 01-FEB-1897
          19 01-FEB-1898
          20 01-FEB-1898
          42 12-AUG-1997

11 rows selected.

SQL>

```

A1/ There is no control on the `TIME_ID` of the records inserted as rows into the external partitions, as it is the case for rows inserted into internal partitions.

- d. Remove the line inserted into `/home/oracle/labs/DW/CENT19/cent19.dat`.

```

SQL> host
$ vi /home/oracle/labs/DW/CENT19/cent19.dat
...
42,12-Aug-1997
$ exit

SQL>

```

4. Query the rows in the external and internal partitions.

```

SQL> SELECT history_event, TO_CHAR(time_id, 'dd-MON-yyyy')
      FROM hypt.hypt_tab PARTITION (cent18);
 2
no rows selected

```

```
SQL> SELECT history_event, TO_CHAR(time_id, 'dd-MON-yyyy')
        FROM hypt.hypt_tab PARTITION (cent19);
```

```
2
```

```
HISTORY_EVENT TO_CHAR(TIME_ID, 'DD-
```

```
-----
```

```
11 01-JAN-1876
```

```
12 01-JAN-1815
```

```
13 01-JAN-1828
```

```
14 01-JAN-1837
```

```
15 01-JAN-1849
```

```
16 01-FEB-1859
```

```
17 01-FEB-1896
```

```
18 01-FEB-1897
```

```
19 01-FEB-1898
```

```
20 01-FEB-1898
```

```
10 rows selected.
```

```
SQL> SELECT history_event, TO_CHAR(time_id, 'dd-MON-yyyy')
        FROM hypt.hypt_tab PARTITION (y2000);
```

```
2
```

```
HISTORY_EVENT TO_CHAR(TIME_ID, 'DD-
```

```
-----
```

```
21 31-DEC-2000
```

```
22 31-OCT-2000
```

```
23 01-FEB-2000
```

```
24 27-MAR-2000
```

```
25 31-MAR-2000
```

```
26 15-APR-2000
```

```
27 02-SEP-2000
```

```
28 12-AUG-2000
```

```
8 rows selected.
```

```
SQL> SELECT history_event, TO_CHAR(time_id, 'dd-MON-yyyy')
        FROM hypt.hypt_tab PARTITION (pmax);
```

```
2
```

```
HISTORY_EVENT TO_CHAR(TIME_ID, 'DD-
```

```
-----
```

```
29 12-AUG-2018
```

```
30 15-SEP-2017
```

```
SQL>
```

Q1/ How would you distinguish the partitioned tables from the hybrid partitioned tables?

A1/ Verify the existence of the hybrid partitioned table in the following view and then the list of the partitions from DBA_TAB_PARTITIONS.

```
SQL> SELECT * FROM dba_external_tables WHERE owner = 'HYPT';
```

```
OWNER    TABLE_NAME TYP
```

```
-----
```

```
TYPE_NAME
```

```
-----
```

```
DEF
```

```
---
```

```
DEFAULT_DIRECTORY_NAME
```

```
-----
```

```
REJECT_LIMIT
```

```
ACCESS_
```

```
-----
```

```
ACCESS_PARAMETERS
```

```
-----
```

```
PROPERTY    INMEMORY INMEMORY_COMPRESS
```

```
-----
```

```
HYPT        HYPT_TAB    SYS
```

```
ORACLE_LOADER
```

```
SYS
```

```
CENT20
```

```
UNLIMITED
```

```
CLOB
```

```
FIELDS TERMINATED BY ','
```

```
(history_event , time_id DATE 'dd-MON-yyyy')
```

```
ALL
```

```
DISABLED
```

```
SQL>
```

```
SQL> SELECT partition_name, high_value FROM dba_tab_partitions
WHERE table_name = 'HYPT_TAB';
```

```
2
```

```
PARTITION_NAME HIGH_VALUE
```

```
-----
```

```
CENT18          TO_DATE(' 1800-01-01
```

```
00:00:00', 'SYYYY-M
```

```
M-DD HH24:MI:SS', 'N
```

```
LS_CALENDAR=GREGORIA
```

```

CENT19          TO_DATE(' 1900-01-01
                  00:00:00', 'SYYYY-M
                  M-DD HH24:MI:SS', 'N
                  LS_CALENDAR=GREGORIA

CENT20          TO_DATE(' 2000-01-01
                  00:00:00', 'SYYYY-M
                  M-DD HH24:MI:SS', 'N
                  LS_CALENDAR=GREGORIA

PMAX            MAXVALUE
Y2000           TO_DATE(' 2001-01-01
                  00:00:00', 'SYYYY-M
                  M-DD HH24:MI:SS', 'N
                  LS_CALENDAR=GREGORIA

SQL>

```

5. Create another partitioned table with only internal partitions. Execute the `/home/oracle/labs/DW/internal_part.sql` SQL script.

```

SQL> @/home/oracle/labs/DW/internal_part.sql
SQL> CREATE TABLE hypt.part_tab
2         (history_event NUMBER , time_id DATE)
3         TABLESPACE ts1
4         PARTITION BY RANGE (time_id)
5         (PARTITION cent18 VALUES LESS THAN (TO_DATE('01-Jan-
1800','dd-MON-yyyy')) ,
6         PARTITION cent19 VALUES LESS THAN (TO_DATE('01-Jan-
1900','dd-MON-yyyy')) ,
7         PARTITION cent20 VALUES LESS THAN (TO_DATE('01-Jan-
2000','dd-MON-yyyy')) ,
8         PARTITION y2000 VALUES LESS THAN (TO_DATE('01-Jan-
2001','dd-MON-yyyy')) TABLESPACE ts2,
9         PARTITION pmax VALUES LESS THAN (MAXVALUE));

Table created.

SQL>

```

- a. Insert rows into the table. Execute the `/home/oracle/labs/DW/insert2.sql` SQL script to insert rows into the internal partitions of the `PART_TAB` table.

```
SQL> @/home/oracle/labs/DW/insert2.sql
...
SQL>
```

- b. Display the rows in the table.

```
SQL> SELECT history_event, TO_CHAR(time_id, 'dd-MON-yyyy')
      FROM hypt.part_tab PARTITION (y2000);

2
HISTORY_EVENT TO_CHAR(TIME_ID, 'DD-
-----
                21 31-DEC-2000
                22 31-OCT-2000
                23 01-FEB-2000
                24 27-MAR-2000
                25 31-MAR-2000
                26 15-APR-2000
                27 02-SEP-2000
                28 12-AUG-2000

8 rows selected.

SQL> SELECT history_event, TO_CHAR(time_id, 'dd-MON-yyyy')
      FROM hypt.part_tab PARTITION (pmax);

2
HISTORY_EVENT TO_CHAR(TIME_ID, 'DD-
-----
                29 12-AUG-2018
                30 15-SEP-2017

SQL>
```

6. Add an external partition to the internal partitioned table `HYPT.PART_TAB` for the 17th century. The external file `cent17.dat` storing historic events of the 17th century is stored in the directory `/home/oracle/labs/DW/CENT17`.
- a. Create the logical directory.

```
SQL> CREATE DIRECTORY cent17 AS '/home/oracle/labs/DW/CENT17';

Directory created.

SQL>
```

- b. Grant the read and write privileges on the directory to HYPT.

```
SQL> GRANT read, write ON DIRECTORY cent17 TO hypt;

Grant succeeded.

SQL>
```

- c. Add the external partition to the HYPT.PART_TAB.

- 1) First define the external parameters for all external partitions that might be added to the HYPT.PART_TAB table.

```
SQL> ALTER TABLE hypt.part_tab
      ADD EXTERNAL PARTITION ATTRIBUTES
      (TYPE ORACLE_LOADER
       DEFAULT DIRECTORY cent17
       ACCESS PARAMETERS
        (FIELDS TERMINATED BY ','
         (history_event , time_id DATE 'dd-MON-yyyy'))
       REJECT LIMIT UNLIMITED
      );

 2   3   4   5   6   7   8   9
Table altered.

SQL>
```

- 2) Verify the existence of the hybrid partitioned table in the following view.

```
SQL> SELECT * FROM dba_external_tables WHERE owner = 'HYPT';

OWNER    TABLE_NAME TYP
-----
TYPE_NAME
-----
DEF
---
DEFAULT_DIRECTORY_NAME
-----
REJECT_LIMIT                                ACCESS_
-----
ACCESS_PARAMETERS
-----
PROPERTY    INMEMORY INMEMORY_COMPRESS
-----
HYPT        HYPT_TAB    SYS
ORACLE_LOADER
SYS
CENT20
```

```

UNLIMITED                                CLOB
FIELDS TERMINATED BY ','
        (history_event , time_id DATE 'dd-MON-yyyy')
ALL      DISABLED

HYPT      PART_TAB      SYS
ORACLE_LOADER
SYS
CENT17
UNLIMITED                                CLOB
FIELDS TERMINATED BY ','
        (history_event , time_id DATE 'dd-MON-yyyy')
ALL      DISABLED

SQL>

```

3) Then add the external partition for all historic records of the 17th century.

```

SQL> ALTER TABLE hypt.part_tab
      ADD PARTITION cent17 VALUES LESS THAN
        (TO_DATE('01-Jan-1700','dd-MON-yyyy'))
          EXTERNAL LOCATION('cent17.dat');
2      3      4      ADD PARTITION cent17 VALUES LESS THAN
                    *
ERROR at line 2:
ORA-14074: partition bound must collate higher than that of the
last partition

SQL>

```

Q1/ What can you do to add the partition below the first one?

A2/ Split the first partition to a partition limit that will be the high limit of the partition added.

```

SQL> ALTER TABLE hypt.part_tab
      SPLIT PARTITION cent18
      AT (TO_DATE('01-Jan-1700','dd-MON-yyyy'))
      INTO (PARTITION cent17 EXTERNAL LOCATION('cent17.dat'),
            PARTITION cent18);
2      3      4      5
Table altered.

SQL>

```

4) List the partitions of the table.

```
SQL> SELECT partition_name, high_value FROM dba_tab_partitions
       WHERE table_name='PART_TAB';
```

```
2
```

```

PARTITION_NAME HIGH_VALUE
-----
CENT17          TO_DATE(' 1700-01-01
                  00:00:00', 'SYYYY-M
                  M-DD HH24:MI:SS', 'N
                  LS_CALENDAR=GREGORIA

CENT18          TO_DATE(' 1800-01-01
                  00:00:00', 'SYYYY-M
                  M-DD HH24:MI:SS', 'N
                  LS_CALENDAR=GREGORIA

CENT19          TO_DATE(' 1900-01-01
                  00:00:00', 'SYYYY-M
                  M-DD HH24:MI:SS', 'N
                  LS_CALENDAR=GREGORIA

CENT20          TO_DATE(' 2000-01-01
                  00:00:00', 'SYYYY-M
                  M-DD HH24:MI:SS', 'N
                  LS_CALENDAR=GREGORIA

PMAX            MAXVALUE
Y2000           TO_DATE(' 2001-01-01
                  00:00:00', 'SYYYY-M
                  M-DD HH24:MI:SS', 'N
                  LS_CALENDAR=GREGORIA

```

```
6 rows selected.
```

```
SQL>
```

```
SQL> SELECT history_event, TO_CHAR(time_id, 'dd-MON-yyyy')
       FROM hypt.part_tab PARTITION (cent17);
```

```
2
```

```

HISTORY_EVENT TO_CHAR(TIME_ID, 'DD-
-----
101 01-JAN-1676

```



```

102 01-JAN-1615
103 01-JAN-1628
104 01-JAN-1637
105 01-JAN-1649
106 01-FEB-1659
107 01-FEB-1696
108 01-FEB-1697
109 01-FEB-1698
200 01-FEB-1698

```

10 rows selected.

SQL>

7. The partition storing 17th century historic events is no longer required. Remove the external parameters for the hybrid partitioned that was added to the `HYPT.PART_TAB` table.

```

SQL> ALTER TABLE hypt.part_tab
      DROP EXTERNAL PARTITION ATTRIBUTES();
ALTER TABLE hypt.part_tab DROP EXTERNAL PARTITION ATTRIBUTES()
*
ERROR at line 1:
ORA-14354: operation not supported for a hybrid-partitioned
table

SQL>

```

Q1/ What does the error message mean?

A1/ As long as there is one external partition left, the attributes for the external partitions cannot be removed from the hybrid partitioned table.

- a. First drop the external partition from the `HYPT.PART_TAB` table.

```

SQL> ALTER TABLE hypt.part_tab DROP PARTITION cent17;

Table altered.

SQL>

```

- b. Then remove the external parameters for the hybrid partitioned table.

```

SQL> ALTER TABLE hypt.part_tab
      DROP EXTERNAL PARTITION ATTRIBUTES();

2
Table altered.

SQL>

```

8. Drop the HyPTs.

```
SQL> DROP TABLE hypt.hypt_tab PURGE;
```

```
Table dropped.
```

```
SQL> DROP TABLE hypt.part_tab PURGE;
```

```
Table dropped.
```

```
SQL> EXIT
```

```
$
```

Practice 5-2: Creating and Populating In-memory Hybrid Partitioned Tables

Overview

In this practice you create and load partitions of an in-memory hybrid partitioned table.

Tasks

1. If you completed the steps 1 and 2.a to 2.c of 5-1, then go on with the following steps, else complete the steps 1 and 2.a to 2.c of 5-1 first.
2. Set the in-memory column store size to 800M.

```
$ sqlplus / AS SYSDBA

SQL> ALTER SYSTEM SET inmemory_SIZE = 800M SCOPE=SPFILE;

System altered.

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

Total System Global Area 1417670704 bytes
Fixed Size                  9142320 bytes
Variable Size               377487360 bytes
Database Buffers            184549376 bytes
Redo Buffers                 7630848 bytes
Database mounted.
Database opened.
SQL> ALTER PLUGGABLE DATABASE ALL OPEN;

Pluggable database altered.

SQL>
```

3. Create the in-memory hybrid partitioned table `HYPT.HYPT_INMEM_TAB` in `PDB1` with the `COMPRESSION FOR QUERY HIGH` attribute.

```
SQL> CONNECT system@PDB1
Enter password: password
Connected.
```

```

SQL> CREATE TABLE hypt.hypt_inmem_tab
      (history_event NUMBER , time_id DATE)
      TABLESPACE ts1
      EXTERNAL PARTITION ATTRIBUTES
      (TYPE ORACLE_LOADER
      DEFAULT DIRECTORY cent20
      ACCESS PARAMETERS
      (FIELDS TERMINATED BY ','
      (history_event , time_id DATE 'dd-MON-yyyy')
      )
      REJECT LIMIT UNLIMITED
      )
PARTITION BY RANGE (time_id)
(PARTITION cent18 VALUES LESS THAN
  (TO_DATE('01-Jan-1800','dd-MON-yyyy')) EXTERNAL,
PARTITION cent19 VALUES LESS THAN
  (TO_DATE('01-Jan-1900','dd-MON-yyyy')) EXTERNAL
      DEFAULT DIRECTORY cent19
      LOCATION ('cent19.dat'),
PARTITION cent20 VALUES LESS THAN
  (TO_DATE('01-Jan-2000','dd-MON-yyyy')) EXTERNAL
      LOCATION('cent20.dat'),
PARTITION y2000 VALUES LESS THAN
  (TO_DATE('01-Jan-2001','dd-MON-yyyy')) TABLESPACE ts2,
PARTITION pmax VALUES LESS THAN (MAXVALUE))
INMEMORY MEMCOMPRESS FOR QUERY HIGH;
  2   3   4   5   6   7   8   9   10  11  12  13  14  15
16  17  18  19  20  21  22  23  24  25  26
Table created.

SQL>

```

Q1/ Which partitions are defined as in-memory segments?

```

SQL> SELECT partition_name, inmemory, inmemory_compression
      FROM dba_tab_partitions
      WHERE table_name = 'HYPT_INMEM_TAB';
  2   3
PARTITION_NAME INMEMORY INMEMORY_COMPRESS
-----
CENT18          DISABLED
CENT19          DISABLED

```

```

CENT20          DISABLED
PMAx            ENABLED   FOR QUERY HIGH
Y2000           ENABLED   FOR QUERY HIGH

SQL>

```

A1/ Only the internal partitions are defined as in-memory segments.

4. Insert rows into the different partitions of the table by executing the `/home/oracle/labs/DW/insert_select.sql` SQL script and query the table to populate the data into the in-memory column store.

```

SQL> @/home/oracle/labs/DW/insert_select.sql
...
SQL>

```

Q1/ Which partitions are populated into the in-memory column store?

```

SQL> SELECT segment_name, partition_name, tablespace_name,
           Populate_status
       FROM v$im_segments;

```

2	3		
SEGMENT_NAME	PARTITION_NAME	TABLESPACE_NAME	POPULATE_STAT
HYPT_INMEM_TAB	PMAx	TS1	COMPLETED
HYPT_INMEM_TAB	Y2000	TS2	COMPLETED

```

SQL>

```

A1/ Only the partitions defined as in-memory segments are populated into the in-memory column store.

Q2/ Does the execution plan show the different types of access to partitions?

```

SQL> EXPLAIN PLAN FOR SELECT * FROM hypt.hypt_inmem_tab;

Explained.

SQL> SELECT * FROM TABLE(DBMS_XPLAN.DISPLAY);

PLAN_TABLE_OUTPUT

```

```

-----
| Id | Operation | Name |
| Rows | Bytes | Cost (%CPU)| Time | Pstart| Pstop |
-----
| 0 | SELECT STATEMENT |
368K| 7917K| 778 (11)| 00:00:01 | |
| 1 | PARTITION RANGE ALL |
368K| 7917K| 778 (11)| 00:00:01 | 1 | 5 |
| 2 | TABLE ACCESS HYBRID PART INMEMORY FULL| HYPT_INMEM_TAB
368K| 7917K| 778 (11)| 00:00:01 | 1 | 5 |
| 3 | TABLE ACCESS INMEMORY FULL | HYPT_INMEM_TAB
| | | | | 1 | 5 |
-----

```

10 rows selected.

```

SQL> EXPLAIN PLAN FOR
      SELECT * FROM hypt.hypt_inmem_tab PARTITION (PMAX);
2
Explained.

```

```

SQL> SELECT * FROM TABLE(DBMS_XPLAN.DISPLAY);

```

PLAN_TABLE_OUTPUT

```

-----
| Id | Operation | Name | Rows |
| Bytes | Cost (%CPU)| Time | Pstart| Pstop |
-----
| 0 | SELECT STATEMENT | | 82171 |
1765 K| 25 (56)| 00:00:01 | |
| 1 | PARTITION RANGE SINGLE | | 82171 |
1765K| 25 (56)| 00:00:01 | 5 | 5 |
| 2 | TABLE ACCESS INMEMORY FULL| HYPT_INMEM_TAB | 82171 |
1765K| 25 (56)| 00:00:01 | 5 | 5 |
-----

```

9 rows selected.

```

SQL> EXPLAIN PLAN FOR
      SELECT * FROM hypt.hypt_inmem_tab PARTITION (CENT19);
2
Explained.

```

```

SQL> SELECT * FROM TABLE(DBMS_XPLAN.DISPLAY);

```

PLAN_TABLE_OUTPUT

```
-----  
| Id | Operation | Name | Rows |  
Bytes | Cost (%CPU)| Time | Pstart| Pstop |  
-----  
| 0 | SELECT STATEMENT | | 8169 |  
175K| 31 (7)| 00:00:01 | | |  
| 1 | PARTITION RANGE SINGLE | | 8169 |  
175K| 31 (7)| 00:00:01 | 2 | 2 |  
| 2 | EXTERNAL TABLE ACCESS FULL | HYPT_INMEM_TAB | 8169 |  
175K| 31 (7)| 00:00:01 | 2 | 2 |  
-----
```

9 rows selected.

SQL> DROP TABLE hypt.hypt_inmem_tab PURGE;

Table dropped.

SQL> EXIT

\$

A2/ According to the partition accessed, the operation shows either EXTERNAL TABLE ACCESS FULL (not INMEMORY) or TABLE ACCESS INMEMORY FULL.

Practice 5-3: Creating and Populating In-memory External Tables

Overview

In this practice you create and load an in-memory external table.

Tasks

If you are working on an on-premise database, you will observe that the feature is not available on on-premise environment.

If you are working with a Cloud database, you would be able to proceed with the following steps.

1. If you completed steps 2.b and 2.c of 5-1, and step 1.a of 5-2, go on with the following steps. If not, complete steps 2.a to 2.c of 5-1 first, and then step 1.a of 5-2.
2. Create the in-memory external table `HYPT.INMEM_EXT_TAB` in `PDB1` with the following attributes:
 - The default directory for external files is `CENT20`.
 - The fields in the records of the external files are separated by `','`.
 - The in-memory compression is `FOR CAPACITY HIGH`.

```
$ sqlplus system@PDB1
Enter password: password

SQL> CREATE TABLE hypt.inmem_ext_tab
      (history_event NUMBER, time_id DATE)
      ORGANIZATION EXTERNAL
      (TYPE ORACLE_LOADER
       DEFAULT DIRECTORY cent20
       ACCESS PARAMETERS (FIELDS TERMINATED BY ','))
      LOCATION ('cent20.dat'))
      INMEMORY MEMCOMPRESS FOR CAPACITY HIGH;
  2      3      4      5      6      7      8
Table created.

SQL>
```

3. Query the table.

```
SQL> ALTER SESSION SET query_rewrite_integrity=stale_tolerated;

Session altered.

SQL> SELECT * FROM hypt.inmem_ext_tab;

HISTORY_EVENT TIME_ID
-----
```



```

1 01-JAN-76
2 01-JAN-15
3 01-JAN-28
4 01-JAN-37
5 01-JAN-49
6 01-FEB-59
7 01-FEB-96
8 01-FEB-97
9 01-FEB-98
10 01-FEB-98
41 12-AUG-97

```

11 rows selected.

SQL>

Q1/ Is the data populated into the in-memory column store?

```

SQL> SELECT segment_name, tablespace_name, populate_status
       FROM v$im_segments;

```

```

2      3
SEGMENT_NAME      TABLESPACE_NAME      POPULATE_STAT
-----
INMEM_EXT_TAB     SYSTEM                      COMPLETED

```

SQL>

A1/ Querying the in-memory external table initiates the population into the in-memory column store in the same way that it does for an internal table. Executing the DBMS_INMEMORY.POPULATE procedure is useless.

4. Display the in-memory attributes of the external table.

```

SQL> SELECT * FROM dba_external_tables
       WHERE owner='HYPT';

```

```

2
OWNER      TABLE_NAME      TYP
-----
TYPE_NAME
-----
DEF
---
```

```

DEFAULT_DIRECTORY_NAME
-----
REJECT_LIMIT                                ACCESS_
-----
ACCESS_PARAMETERS
-----
PROPERTY    INMEMORY INMEMORY_COMPRESS
-----
HYPT      INMEM_EXT_TAB    SYS
ORACLE_LOADER
SYS
CENT20
0                                CLOB
FIELDS TERMINATED BY ','
ALL      ENABLED    FOR CAPACITY HIGH

SQL>

```

5. Query the in-memory external with a degree of parallelism of 2.

```

SQL> EXPLAIN PLAN FOR
      SELECT /*+ PARALLEL(2) */ * FROM hypt.inmem_ext_tab;

2
Explained.

SQL> SELECT * FROM TABLE(DBMS_XPLAN.DISPLAY);

PLAN_TABLE_OUTPUT
-----
| Id | Operation                                | Name |
Rows | Bytes | Cost (%CPU)| Time     | TQ  | IN-OUT | PQ |
Distrib |
-----
| 0 | SELECT STATEMENT                        |      |
102K| 2193K| 197 (5)| 00:00:01 |      |      |   |
| 1 | PX COORDINATOR                          |      |
| 2 | PX SEND QC (RANDOM)                      | :TQ10000 |
102K| 2193K| 197 (5)| 00:00:01 | Q1,00 | P->S | QC (RAND) |
| 3 | PX BLOCK ITERATOR                      |      |
102K| 2193K| 197 (5)| 00:00:01 | Q1,00 | PCWC |
| 4 | EXTERNAL TABLE ACCESS INMEMORY FULL | INMEM_EXT_TAB |
102K| 2193K| 197 (5)| 00:00:01 | Q1,00 | PCWP |
-----

Note
-----

```

```
- Degree of Parallelism is 2 because of hint  
  
15 rows selected.  
  
SQL>
```

6. Drop the HYPT schema.

```
SQL> DROP USER hypt CASCADE;  
  
User dropped.  
  
SQL> EXIT  
$
```


Practices for Lesson 6: Using Diagnosability Enhancements

Practices for Lesson 6: Overview

Overview

In these practices, you will use the Automatic SQL Diagnosis and Repair function to diagnose, get and implement recommendations for a SQL statement that executes with a poor performance and for another SQL statement that fails with an `ORA-00600` error. You will also collect data with Service Request Data Collection (SRDC) for specific events like `ORA-00600` error and hanging situation.

Practice 6-1: Fixing SQL Statements by Using Automatic SQL Diagnosis and Repair

Overview

In this practice, you diagnose, get and implement recommendations for a SQL statement that performs with a poor performance and for another SQL statement that fails with an `ORA-00600` error.

Tasks

1. Execute the `/home/oracle/labs/admin/cleanup_PDBs.sh` shell script. The shell script drops all PDBs that may have been created by any of the practices in `ORCL`, and finally recreates `PDB1`. You are in *Session1*.

```
$ $HOME/labs/admin/cleanup_PDBs.sh
...
$
```

2. Before starting the practice, execute the `$HOME/labs/DIAG/glogin.sh` shell script. It sets formatting for all columns selected in queries.

```
$ $HOME/labs/DIAG/glogin.sh
...
$
```

3. Execute the `/home/oracle/labs/DIAG/table.sh` shell script. The shell script creates and loads the `DIAG.TAB1` table, and creates an index on the table, in `PDB1`.

```
$ $HOME/labs/DIAG/table.sh
...
$
```

4. Log in to `PDB1` as `DIAG` and execute the query. The SQL statement executes with a poor performance.

```
$ sqlplus diag@PDB1
Enter password: password

SQL> SELECT /*+ FULL(a) FULL (b) */
          sum(a.num) ,sum(b.num) ,count (*)
        FROM tab1 a,tab1 b
        WHERE a.id = b.id
        AND a.id = 100;
 2   3   4   5
SUM(A.NUM) SUM(B.NUM) COUNT (*)
-----
          100          100          1

SQL>
```

5. Call the function to diagnose and automatically implement the recommendations to improve the performance of the SQL statement.

```
SQL> DESC dbms_sqldiag
...
FUNCTION SQL_DIAGNOSE_AND_REPAIR RETURNS NUMBER
Argument Name          Type          In/Out
Default?
-----
SQL_ID                  VARCHAR2      IN
PLAN_HASH_VALUE         NUMBER        IN      DEFAULT
SCOPE                   VARCHAR2      IN      DEFAULT
TIME_LIMIT              NUMBER        IN      DEFAULT
PROBLEM_TYPE           NUMBER       IN      DEFAULT
AUTO_APPLY_PATCH        VARCHAR2      IN      DEFAULT

SQL>
```

Q1/ How do you set the problem type for the SQL statement diagnostic, as the `PROBLEM_TYPE` is a `NUMBER` attribute?

A1/ Read the `$ORACLE_HOME/rdbms/admin/dbmsdiag.sql` script:

```
- PERFORMANCE - User suspects this is a performance problem
- WRONG_RESULTS - User suspects the query is giving inconsistent results
- COMPILATION_ERROR - User sees a crash in compilation
- EXECUTION_ERROR - User sees a crash in execution
- ALT_PLAN_GEN - Just explore all alternative plans
- --

- PROBLEM_TYPE_PERFORMANCE          CONSTANT    NUMBER := 1;
- PROBLEM_TYPE_WRONG_RESULTS         CONSTANT    NUMBER := 2;
- PROBLEM_TYPE_COMPILATION_ERROR     CONSTANT    NUMBER := 3;
- PROBLEM_TYPE_EXECUTION_ERROR       CONSTANT    NUMBER := 4;
- PROBLEM_TYPE_ALT_PLAN_GEN          CONSTANT    NUMBER := 5;
```

The `PROBLEM_TYPE` value is 1 for performance type problems.

```
SQL> SET SERVEROUTPUT ON
SQL> VAR incident_id NUMBER
SQL> DECLARE
    recom_count number(10);
BEGIN
    :incident_id := dbms_sqldiag.sql_diagnose_and_repair(
```



```

        sql_text => 'SELECT /*+ FULL(a) FULL (b) */
sum(a.num),sum(b.num),count(*) FROM tab1 a,tab1 b WHERE a.id = b.id
and a.id = 100',
        problem_type => DBMS_SQLDIAG.PROBLEM_TYPE_PERFORMANCE,
        time_limit => 1000,
        scope=>DBMS_SQLDIAG.SCOPE_COMPREHENSIVE,
        auto_apply_patch => 'YES');
        select count(*) into recom_count from
dba_advisor_recommendations where task_name = to_char(:incident_id);
        dbms_output.put_line ( recom_count || ' recommendations
generated for incident '||:incident_id);
end;
/
1 recommendations generated for incident 50408
 2      3      4      5      6      7      8      9     10     11     12     13
PL/SQL procedure successfully completed.

SQL>

```

6. Find the recommendations generated from the diagnosis.

```

SQL> SELECT finding_id, type FROM dba_advisor_recommendations
      WHERE task_name = to_char(:incident_id);

 2
FINDING_ID TYPE
-----
          1 SQL PROFILE

SQL>

```

7. Report the detail of the recommendations.

```

SQL> VAR b_report CLOB
SQL>
SQL> DECLARE
    v_tname  VARCHAR2(32767);
BEGIN
    v_tname  := '50408';
    :b_report := dbms_sqldiag.report_diagnosis_task(v_tname);
END;
/
 2      3      4      5      6      7
PL/SQL procedure successfully completed.

SQL>
SQL> DECLARE
    v_len    NUMBER(10);
    v_offset NUMBER(10) :=1;
    v_amount NUMBER(10) :=10000;

```

```

BEGIN
  v_len := DBMS_LOB.getlength(:b_report);
  WHILE (v_offset < v_len)
  LOOP
    DBMS_OUTPUT.PUT_LINE(DBMS_LOB.SUBSTR(:b_report,v_amount,v_offset
    ));
    v_offset := v_offset + v_amount;
  END LOOP;
END;
/
  2      3      4      5      6      7      8      9     10     11     12     13
GENERAL INFORMATION
SECTION
-----
Tuning Task Name      : 50408
Tuning Task Owner     : DIAG
Workload Type         : Single SQL Statement
Scope                 : COMPREHENSIVE
Time Limit(seconds): 1000
Completion Status     : COMPLETED
Started at            : 05/15/2019 10:23:55
Completed at          : 05/15/2019 10:23:56
-----
Schema Name          : DIAG
Container Name: PDB1
SQL ID               : 30u8jcw90fw9
SQL Text             : SELECT /*+ FULL(a) FULL (b) */
sum(a.num),sum(b.num),count(*) FROM tab1 a,tab1 b WHERE a.id =
b.id AND a.id = 100
-----
FINDINGS SECTION (1 finding)
-----
1- SQL Profile Finding (see explain plans section
below)
-----
A potentially better execution plan was found for this
statement.

Recommendation (estimated benefit: 99.83%)
-----
- A manually-created SQL profile is present on the system.
  Name: SYS_SQLPROF_0166b07518cc0001
  Status: ENABLED

```

```

Validation results
-----

The SQL profile was tested by executing both its plan and the
original plan and measuring their respective execution
statistics. A plan may have been only partially executed if the
other could be run to completion in less time.

Original Plan                With SQL Profile            % Improved
-----
Completion Status:           COMPLETE                COMPLETE
Elapsed Time (s):            .007051                .00008
98.86 %
CPU Time (s):                .006919                .00008
98.84 %
User I/O Time (s):           0                        0

Buffer Gets:                 3710                    6
99.83 %
Physical Read Requests:      0                        0

Physical Write Requests:     0                        0
Physical
Read Bytes:                   0                        0
Physical Write
Bytes:                         0                        0
Rows Processed:
1                             1
Fetches:                      1
1
Executions:                   1                        1

Notes
-----

1. Statistics for the original plan were averaged over 10
executions.
2. Statistics for the SQL profile plan were averaged over 10
executions.

-----

PL/SQL procedure successfully completed.

SQL>

```

8. Check the SQL profile automatically created by the diagnosis and repair function.

```
SQL> SELECT sql_text, status FROM dba_sql_profiles;

SQL_TEXT                                                    STATUS
-----
select /*+ FULL(a) FULL (b) */ sum(a.num),sum(b.num), ENABLED
count(*) from tab1 a, tab1 b where a.id = b.id
and a.id = 100

SQL>
```

9. Verify that the poor performing SQL statement is now using the SQL profile.

```
SQL> EXPLAIN PLAN FOR
      SELECT /*+ FULL(a) FULL (b) */
             sum(a.num),sum(b.num),count(*)
      FROM tab1 a,tab1 b
      WHERE a.id = b.id AND a.id = 100;

 2   3   4   5
Explained.

SQL> SELECT * FROM TABLE(DBMS_XPLAN.DISPLAY);

PLAN_TABLE_OUTPUT
-----
Plan hash value: 3082937155
-----
| Id  | Operation                                | Name    | Rows
|----|-----|-----|-----|
| 0   | SELECT STATEMENT                        |         |    1
| 20  |      4  (0)| 00:00:01 |
| 1   | SORT AGGREGATE                          |         |    1
| 20  |      |         |
| 2   | MERGE JOIN CARTESIAN                    |         |    1
| 20  |      4  (0)| 00:00:01 |
| 3   | TABLE ACCESS BY INDEX ROWID BATCHED    | TAB1     |    1
| 10  |      2  (0)| 00:00:01 |
|* 4   | INDEX RANGE SCAN                        | TAB1_I   |    1
|    |      1  (0)| 00:00:01 |
| 5   | BUFFER SORT                             |         |    1
| 10  |      2  (0)| 00:00:01 |
| 6   | TABLE ACCESS BY INDEX ROWID BATCHED    | TAB1     |    1
| 10  |      2  (0)| 00:00:01 |
```

```

|* 7 |          INDEX RANGE SCAN                      | TAB1_I |      1
|    |          1      (0) | 00:00:01 |
-----
Predicate Information (identified by operation id):
-----

  4 - access("A"."ID">=100)
  7 - access("B"."ID">=100)

Hint Report (identified by operation id / Query Block Name /
Object Alias):

Total hints for statement: 2 (U - Unused (2))
-----

  3 -  SEL$1 / A@SEL$1
        U -  FULL(a) / rejected by IGNORE_OPTIM_EMBEDDED_HINTS

  6 -  SEL$1 / B@SEL$1
        U -  FULL (b) / rejected by IGNORE_OPTIM_EMBEDDED_HINTS

Note
-----
- SQL profile "SYS_SQLPROF_0166b07518cc0001" used for this
statement

34 rows selected.

SQL>

```

10. Call the function on the poor performing SQL statement.

Q1/ What happens if you ask the diagnosis function to explore all alternative plans for the SQL query?

```

SQL> DECLARE
BEGIN
    :incident_id := dbms_sqldiag.sql_diagnose_and_repair(
        sql_text => ' SELECT /*+ FULL(a) FULL (b) */
sum(a.num),sum(b.num),count(*) FROM tab1 a,tab1 b WHERE a.id =
b.id AND a.id = 100',
        problem_type => DBMS_SQLDIAG.PROBLEM_TYPE_ALT_PLAN_GEN,
        auto_apply_patch => 'YES');
END;
/

```

```

2      3      4      5      6      7      8
DECLARE
*
ERROR at line 1:
ORA-20001: '5' - invalid problem type
ORA-06512: at "SYS.DBMS_SQLDIAG_INTERNAL", line 587
ORA-06512: at "SYS.DBMS_SQLDIAG", line 391
ORA-06512: at "SYS.DBMS_SQLDIAG", line 2454
ORA-06512: at line 3

SQL>

```

A1/ The problem type `PROBLEM_TYPE_ALT_PLAN_GEN` refers to the constant 5 (refer task 5). As there are no other plans in `DBA_SQL_PLAN_BASELINES` for the same query, the function cannot satisfy the condition to find alternate plans.

11. You will now test a failing SQL statement for which SQL Diagnose and Repair provides and implements a patch. Execute the `/home/oracle/labs/DIAG/crash_delete.sql` SQL script. The SQL statement fails with an `ORA-00600` error. Click enter after each pause.

```

SQL> CONNECT system@PDB1
Enter password: password
Connected.
SQL> @/home/oracle/labs/DIAG/crash_delete.sql
SQL> set echo on
SQL>
SQL> -- This example generates a workaround for a crash. This
bug has already
SQL> -- been fixed but we toggle the bug fix using an underscore
parameter
SQL> -- which uses the (internal) feature called bug fix
control.
SQL> -- This script will pause periodically to allow you to read
the comments
SQL> -- and see the output of the previous command on the
screen. Just press
SQL> -- return to make the demo resume.
SQL>
SQL> pause

SQL>
SQL> -- To begin the demo we will create the user diag and grant
SQL> -- advisor privileges to him.
SQL>

```

```
SQL> pause

SQL>
SQL> grant connect, resource, dba, query rewrite, unlimited
tablespace to diag identified by password;

Grant succeeded.

SQL>
SQL> alter user diag account unlock;

User altered.

SQL>
SQL> -- Next we need to create and populate the table used by
the demo.
SQL> -- We will also create an index on the table;
SQL>
SQL> pause

SQL> connect diag/password@PDB1;
Connected.
SQL>
SQL> drop table simple_table;
drop table simple_table
      *
ERROR at line 1:
ORA-00942: table or view does not exist

SQL>
SQL> create table simple_table(a varchar(40), b number, c
varchar(240), d varchar(240));

Table created.

SQL>
SQL> create index tc on simple_table(b, d, a);

Index created.

SQL>
SQL> insert into simple_table values('a', 1, 'b', 'c');
```

```

1 row created.

SQL> insert into simple_table values('a', 1, 'x', 'c');

1 row created.

SQL> insert into simple_table values('e', 2, 'f', 'g');

1 row created.

SQL>
SQL> -- In order to crash the system we need to switch off the
code line that
SQL> -- normal protects against this type of crash. We can
switch off the code
SQL> -- using the (internal) feature called bug fix control.
SQL>
SQL> pause

SQL>
SQL> -- switch the code
SQL> alter system set "_fix_control"="5868490:OFF";

System altered.

SQL> -- alter session set optimizer_dynamic_sampling = 0;
SQL>
SQL> -- Now that the code line has been switched off lets get
the execution
SQL> -- plan for a simple delete statement.
SQL>
SQL> pause

SQL>
SQL> --- explain the plan
SQL> explain plan for delete
  2      /*+
  3          USE_HASH_AGGREGATION(@"SEL$80F8B8C6")
  4          USE_HASH(@"SEL$80F8B8C6" "T1"@"DEL$1")
  5          LEADING(@"SEL$80F8B8C6" "T2"@"SEL$1" "T1"@"DEL$1")
  6          FULL(@"SEL$80F8B8C6" "T1"@"DEL$1")
  7          FULL(@"SEL$80F8B8C6" "T2"@"SEL$1")

```



```

8      OUTLINE(@"DEL$1")
9      OUTLINE(@"SEL$1")
10     OUTLINE(@"SEL$AD0B6B07")
11     OUTLINE(@"SEL$7D4DB4AA")
12     UNNEST(@"SEL$1")
13     OUTLINE(@"SEL$75B5BFA2")
14     MERGE(@"SEL$7D4DB4AA")
15     OUTLINE_LEAF(@"SEL$80F8B8C6")
16     ALL_ROWS
17     OPT_PARAM('_optimizer_cost_model' 'fixed')
18     DB_VERSION('11.1.0.7')
19     OPTIMIZER_FEATURES_ENABLE('11.1.0.7')
20     NO_INDEX(@"SEL$1" "T2"@"SEL$1")
21     */
22  from simple_table t1 where t1.a = 'a' and rowid <> (select
max(rowid) from simple_table t2 where t1.a= t2.a and t1.b = t2.b
and t1.d=t2.d);

```

Explained.

SQL>

SQL> --- display the plan

```
SQL> select plan_table_output from
table(dbms_xplan.display('plan_table',null));
```

PLAN_TABLE_OUTPUT

Plan hash value: 1481897562

	Id	Operation	Name	Rows	Bytes
	Cost				
	(%CPU)	Time			
6	0	DELETE STATEMENT		1	338
	(34)	00:00:01			
	1	DELETE	SIMPLE_TABLE		
*	2	FILTER			
6	3	HASH GROUP BY		1	338
	(34)	00:00:01			

```

|* 4 |      HASH JOIN      |      |      1 |    338 |
5
(20) | 00:00:01 |
|* 5 |      TABLE ACCESS FULL| SIMPLE_TABLE |      2 |    338 |
2
(0) | 00:00:01 |
|* 6 |      TABLE ACCESS FULL| SIMPLE_TABLE |      2 |    338 |
2
(0) | 00:00:01 |

```

Predicate Information (identified by operation id):

```

2 - filter(ROWID<>MAX(ROWID))
4 - access("T1"."A"="T2"."A" AND "T1"."B"="T2"."B" AND
"T1"."D"="
T2"."D")

5 - filter("T2"."A"='a')
6 - filter("T1"."A"='a')

```

Note

- dynamic statistics used: dynamic sampling (level=2)

25 rows selected.

SQL>

SQL> -- The plan shows that we we will do a full table scan our.

SQL> -- If we execute this simple system it will crash the system.

SQL>

SQL> Pause

SQL> --- This statement caused the system to crash.

```

SQL> delete /*+ USE_HASH_AGGREGATION(@"SEL$80F8B8C6")
USE_HASH(@"SEL$80F8B8C6" "T1"@"DEL$1") LEADING(@"SEL$80F8B8C6"
"T2"@"SEL$1" "T1"@"DEL$1") FULL(@"SEL$80F8B8C6" "T1"@"DEL$1")
FULL(@"SEL$80F8B8C6" "T2"@"SEL$1") OUTLINE(@"DEL$1")
OUTLINE(@"SEL$1") OUTLINE(@"SEL$AD0B6B07")
OUTLINE(@"SEL$7D4DB4AA") UNNEST(@"SEL$1")
OUTLINE(@"SEL$75B5BFA2") MERGE(@"SEL$7D4DB4AA")
OUTLINE_LEAF(@"SEL$80F8B8C6") ALL_ROWS
OPT_PARAM('_optimizer_cost_model' 'fixed')

```

```

DB_VERSION('11.1.0.7') OPTIMIZER_FEATURES_ENABLE('11.1.0.7')
NO_INDEX(@"SEL$1" "T2"@"SEL$1") */ from simple_table t1 where
t1.a = 'a' and rowid <> (select max(rowid) from simple_table t2
where t1.a= t2.a and t1.b = t2.b and t1.d=t2.d);
delete /*+ USE_HASH_AGGREGATION(@"SEL$80F8B8C6")
USE_HASH(@"SEL$80F8B8C6" "T1"@"DEL$1") LEADING(@"SEL$80F8B8C6"
"T2"@"SEL$1" "T1"@"DEL$1") FULL(@"SEL$80F8B8C6" "T1"@"DEL$1")
FULL(@"SEL$80F8B8C6" "T2"@"SEL$1") OUTLINE(@"DEL$1")
OUTLINE(@"SEL$1") OUTLINE(@"SEL$AD0B6B07")
OUTLINE(@"SEL$7D4DB4AA") UNNEST(@"SEL$1")
OUTLINE(@"SEL$75B5BFA2") MERGE(@"SEL$7D4DB4AA")
OUTLINE_LEAF(@"SEL$80F8B8C6") ALL_ROWS
OPT_PARAM('optimizer_cost_model' 'fixed')
DB_VERSION('11.1.0.7') OPTIMIZER_FEATURES_ENABLE('11.1.0.7')
NO_INDEX(@"SEL$1" "T2"@"SEL$1") */ from simple_table t1 where
t1.a = 'a' and rowid <> (select max(rowid) from simple_table t2
where t1.a= t2.a and t1.b = t2.b and t1.d=t2.d)

*
ERROR at line 1:
ORA-00600: internal error code, arguments: [13011], [73039],
[4230321], [0], [4230321], [17], [], [], [], [], [], []

SQL>

```

12. Call the function to diagnose and automatically implement the patch for the failing SQL statement.

- a. Find the SQL_ID for the failing statement.

```

SQL> SELECT sql_id FROM v$sql
       WHERE sql_text LIKE 'delete%USE_HASH%';

 2
SQL_ID
-----
53390wmjjqgra

1 row selected.

SQL>

```

- b. Call the function with the SQL_ID as input and the appropriate problem type. (Refer task 5).

```

SQL> SET SERVEROUTPUT ON
SQL> VAR incident_id NUMBER
SQL> DECLARE
    recom_count number(10);
BEGIN

```

```

:incident_id := dbms_sqldiag.sql_diagnose_and_repair(
    sql_id => '53390wmjjqgra',
    problem_type => 4,
    auto_apply_patch => 'YES');

SELECT count(*) into recom_count
FROM dba_advisor_recommendations
WHERE task_name = to_char(:incident_id);

dbms_output.put_line ( recom_count || ' recommendations
generated for incident '||:incident_id);
END;
/
1 recommendations generated for incident 96043
 2      3      4      5      6      7      8      9     10     11     12     13
PL/SQL procedure successfully completed.

SQL>

```

13. Find the recommendations generated from the diagnosis.

```

SQL> SELECT finding_id, type FROM dba_advisor_recommendations
      WHERE task_name = to_char(:incident_id);

 2
FINDING_ID TYPE
-----
          1 SQL PATCH

1 row selected.

SQL>

```

14. Find the SQL patch.

```

SQL> SELECT name, task_exec_name, status FROM dba_sql_patches
      WHERE name = to_char(:incident_id)
      AND sql_text LIKE 'delete%';

 2      3
NAME                                TASK_EXEC_NAME STATUS
-----
96043                                EXEC_1          ENABLED

1 row selected.

SQL>

```

Q1/ Is the SQL patch implemented?

SQL> EXPLAIN PLAN FOR delete

/*+

```

USE_HASH_AGGREGATION(@"SEL$80F8B8C6")
USE_HASH(@"SEL$80F8B8C6" "T1"@"DEL$1")
LEADING(@"SEL$80F8B8C6" "T2"@"SEL$1" "T1"@"DEL$1")
FULL(@"SEL$80F8B8C6" "T1"@"DEL$1")
FULL(@"SEL$80F8B8C6" "T2"@"SEL$1")
OUTLINE(@"DEL$1")
OUTLINE(@"SEL$1")
OUTLINE(@"SEL$AD0B6B07")
OUTLINE(@"SEL$7D4DB4AA")
UNNEST(@"SEL$1")
OUTLINE(@"SEL$75B5BFA2")
MERGE(@"SEL$7D4DB4AA")
OUTLINE_LEAF(@"SEL$80F8B8C6")
ALL_ROWS
OPT_PARAM('_optimizer_cost_model' 'fixed')
DB_VERSION('11.1.0.7')
OPTIMIZER_FEATURES_ENABLE('11.1.0.7')
NO_INDEX(@"SEL$1" "T2"@"SEL$1")

```

*/

```

from simple_table t1 where t1.a = 'a' and rowid <> (select
max(rowid) from simple_table t2 where t1.a= t2.a and t1.b = t2.b
and t1.d=t2.d);

```

```

  2    3    4    5    6    7    8    9    10    11    12    13    14
15    16    17    18    19    20    21    22

```

Explained.

SQL> SELECT plan_table_output

FROM TABLE(dbms_xplan.display('plan_table',null));

PLAN_TABLE_OUTPUT

Plan hash value: 3259336479

Id	Operation	Name	Rows	Bytes
Cost (%CPU)	Time			
0	DELETE STATEMENT		1	169
3 (0)	00:00:01			
1	DELETE	SIMPLE_TABLE		
* 2	FILTER			

```
|* 3 | INDEX FULL SCAN | TC | 2 | 338 |
1 (0) | 00:00:01 |
| 4 | SORT AGGREGATE | | 1 | 169 |
|* 5 | TABLE ACCESS FULL| SIMPLE_TABLE | 1 | 169 |
2 (0) | 00:00:01 |
```

```
-----
Predicate Information (identified by operation id):
-----
```

```
2 - filter(ROWID<> (SELECT /*+ UNNEST UNNEST NO_INDEX ("T2")
NO_INDEX ("T2") */ MAX(ROWID) FROM "SIMPLE_TABLE" "T2" WHERE "T
2"."A"=:B1 AND "T2"."B"=:B2 AND "T2"."D"=:B3))
```

```
3 - access("T1"."A"='a')
```

```
filter("T1"."A"='a')
```

```
5 - filter("T2"."A"=:B1 AND "T2"."B"=:B2 AND "T2"."D"=:B3)
```

```
Hint Report (identified by operation id / Query Block Name /
Object Alias):
```

```
Total hints for statement: 7 (U - Unused (2), N - Unresolved
(5))
```

```
-----
0 - SEL$7D4DB4AA
```

```
N - MERGE(@"SEL$7D4DB4AA")
```

```
0 - SEL$80F8B8C6
```

```
N - FULL(@"SEL$80F8B8C6" "T1"@ "DEL$1")
```

```
N - FULL(@"SEL$80F8B8C6" "T2"@ "SEL$1")
```

```
N - LEADING(@"SEL$80F8B8C6" "T2"@ "SEL$1" "T1"@ "DEL$1")
```

```
N - USE_HASH(@"SEL$80F8B8C6" "T1"@ "DEL$1")
```

```
4 - SEL$1
```

```
U - UNNEST(@"SEL$1") / hint overridden by
NO_QUERY_TRANSFORMATION
```

```
5 - SEL$1 / T2@SEL$1
```

```
U - NO_INDEX(@"SEL$1" "T2"@ "SEL$1")
```

```
Note
```

```
-----
```

```
- dynamic statistics used: dynamic sampling (level=2)
```

```
- SQL patch "96043" used for this statement
```

```
46 rows selected.
```

```
SQL>
```

A1/ The SQL patch is automatically implemented.

15. Re-execute the failing SQL statement with the implemented patch.

```
SQL> delete /*+ USE_HASH_AGGREGATION(@"SEL$80F8B8C6")
USE_HASH(@"SEL$80F8B8C6" "T1"@"DEL$1") LEADING(@"SEL$80F8B8C6"
"T2"@"SEL$1" "T1"@"DEL$1") FULL(@"SEL$80F8B8C6" "T1"@"DEL$1")
FULL(@"SEL$80F8B8C6" "T2"@"SEL$1") OUTLINE(@"DEL$1")
OUTLINE(@"SEL$1") OUTLINE(@"SEL$AD0B6B07")
OUTLINE(@"SEL$7D4DB4AA") UNNEST(@"SEL$1")
OUTLINE(@"SEL$75B5BFA2") MERGE(@"SEL$7D4DB4AA")
OUTLINE_LEAF(@"SEL$80F8B8C6") ALL_ROWS
OPT_PARAM('_optimizer_cost_model' 'fixed')
DB_VERSION('11.1.0.7') OPTIMIZER_FEATURES_ENABLE('11.1.0.7')
NO_INDEX(@"SEL$1" "T2"@"SEL$1") */ from simple_table t1 where
t1.a = 'a' and rowid <> (select max(rowid) from simple_table t2
where t1.a= t2.a and t1.b = t2.b and t1.d=t2.d);

1 row deleted.

SQL> ROLLBACK;

Rollback complete.

SQL> EXIT
$
```

Observe that the statement does not fail anymore.

16. Set the fix for the error back ON and clean up the DIAG schema.

```
$ /home/oracle/labs/DIAG/cleanup_crash.sh
...
$
```

Practice 6-2: Creating SRDCs for Specific Events

Overview

In this practice, you will collect diagnostic files for an ORA-00600 error and also for a hanging instance startup, and upload files directly to your service request.

Tasks

1. Log in as root to the server and install Trace File Analyzer in \$ORACLE_BASE/tfa.

```
# cd /u01/app/oracle
# unzip /home/oracle/labs/DIAG/TFA-LINUX_v19.2.1.zip
Archive:  /home/oracle/labs/DIAG/TFA-LINUX_v18.3.3.zip
  inflating: README.txt
  inflating: installTFA-LINUX
#
```

```
# ./installTFA-LINUX
TFA Installation Log will be written to File :
/tmp/tfa_install_6105_2018_10_15-11_55_44.log

Starting TFA installation

TFA Version: 192100 Build Date: 201810050542

Enter a location for installing TFA (/tfa will be appended if
not supplied) [/u01/app/oracle/tfa]:

Running Auto Setup for TFA as user oracle...

Would you like to do a [L]ocal only or [C]lusterwide
installation ? [L|l|C|c] [C] : L
Installing TFA now...

Discovering Nodes and Oracle resources

Starting Discovery...

No Grid Infrastructure Discovered on this system . . . . .

hostname
```


Searching for running databases...

1. ORCL

Searching out ORACLE_HOME for selected databases...

Getting Oracle Inventory...

ORACLE INVENTORY: /u01/app/oraInventory

Discovery Complete...

TFA Will be Installed on *hostname*...

TFA will scan the following Directories

+++++

<i>hostname</i>		
+-----+		
Trace Directory Resource		Resource
+-----+		
/u01/app/oraInventory/ContentsXML		INSTALL
/u01/app/oraInventory/logs		INSTALL
/u01/app/oracle/cfgtoollogs		CFGTOOLS
/u01/app/oracle/diag/rdbms/orcl/ORCL/cdump		RDBMS
/u01/app/oracle/diag/rdbms/orcl/ORCL/trace		RDBMS
/u01/app/oracle/diag/tnslsnr		TNS
/u01/app/oracle/diag/tnslsnr/your/listener/cdump		TNS
/u01/app/oracle/diag/tnslsnr/your_hostname/listener/trace		TNS
/u01/app/oracle/product/19.3.0/dbhome_1/cfgtoollogs		CFGTOOLS
/u01/app/oracle/product/19.3.0/dbhome_1/install		INSTALL
/u01/app/oracle/product/19.3.0/dbhome_1/rdbms/log		RDBMS
'-----		

Installing TFA on *hostname*:

HOST: *hostname* TFA_HOME: /u01/app/oracle/tfa/*hostname*/tfa_home

```

| Host      | Status of TFA | PID   | Port  | Version  | Build
ID          |
+-----+-----+-----+-----+-----+-----+
| hostname | RUNNING      | 7955  | 42182 | 19.2.1.0.0 |
18330020181005054218 |
'-----+-----+-----+-----+-----+-----+

Running Inventory in All Nodes...

Enabling Access for Non-root Users on hostname...
ERROR:
/u01/app/oracle/tfa/hostname/tfa_home/internal/cached_kv.out
does not exists

Adding default users to TFA Access list...

Summary of TFA Installation:
.------.
|                               |
|                               | hostname |
+-----+-----+-----+-----+-----+-----+
| Parameter          | Value |
+-----+-----+-----+-----+-----+-----+
| Install location   | /u01/app/oracle/tfa/hostname/tfa_home |
| Repository location | /u01/app/oracle/tfa/repository |
| Repository usage    | 0 MB out of 10240 MB |
'-----+-----+-----+-----+-----+-----+'

TFA is successfully installed...

Usage : /u01/app/oracle/tfa/bin/tfactl <command> [options]

commands:collect|collection|analyze|ips|run|start|stop|enable|di
sable|status|print|access|purge|directory|host|receiver|set|tool
status|uninstall|nosetfa|syncnodes|setupmos|upload|availability|
rest|events|search|changes|isa
For detailed help on each command use:
    /u01/app/oracle/tfa/bin/tfactl <command> -help

#

```

If TFA is already installed, you will get the following output.

```

# ./installTFA-LINUX
TFA Installation Log will be written to File :
/tmp/tfa_install_7099_2019_05_15-15_11_41.log

Starting TFA installation

TFA Version: 192100 Build Date: 201904251105

TFA HOME : /u01/app/oracle/tfa/hostname/tfa_home

Installed Build Version: 183300 Build Date: 201810050542

TFA is already installed. Upgrading TFA

TFA Upgrade Log : /u01/app/oracle/tfa/hostname/tfapatch.log

TFA-00002 Oracle Trace File Analyzer (TFA) is not running
TFA-00002 Oracle Trace File Analyzer (TFA) is not running
Unable to determine the status of TFA in other nodes.
TFA will be upgraded on Node hostname:

Do you want to continue with TFA Upgrade ? [Y|N] [Y]: Y

Upgrading TFA on hostname :

Stopping TFA Support Tools...

Shutting down TFA for Patching...

Shutting down TFA
Removed symlink /etc/systemd/system/multi-
user.target.wants/oracle-tfa.service.
Removed symlink
/etc/systemd/system/graphical.target.wants/oracle-tfa.service.
. . . . .
. . .
Successfully shutdown TFA..

No Berkeley DB upgrade required

Copying TFA Certificates...

```

```

Starting TFA in hostname...

Starting TFA..
Created symlink from /etc/systemd/system/multi-
user.target.wants/oracle-tfa.service to
/etc/systemd/system/oracle-tfa.service.
Created symlink from
/etc/systemd/system/graphical.target.wants/oracle-tfa.service to
/etc/systemd/system/oracle-tfa.service.
Waiting up to 100 seconds for TFA to be started..
. . . . .
Successfully started TFA Process..
. . . . .
TFA Started and listening for commands

Enabling Access for Non-root Users on hostname...

.------.
| Host      | TFA Version |TFA Build ID      | Upgrade Status |
+-----+-----+-----+-----+
| hostname | 19.2.1.0.0 |19210020190425110550| UPGRADED       |
'-----+'-----+'-----+'-----'

#

```

2. Switch as `oracle` and check that the TFA Collector is running.

```

# exit
$ /u01/app/oracle/tfa/bin/tfactl -help
Usage : /u01/app/oracle/tfa/bin/tfactl <command> [options]

commands:diagcollect|collection|analyze|ips|run|start|stop|print
|directory|toolstatus|setupmos|upload|events|search|changes|blac
kout
For detailed help on each command use:
    /u01/app/oracle/tfa/bin/tfactl <command> -help
$

```

```

$ cd /u01/app/oracle/tfa/bin
$ ./tfactl status

.------.
| Host      | Status of TFA | PID    | Port  | Version      | Build
ID          | Inventory Status |

```

```

+-----+-----+-----+-----+-----+-----+
| hostname | RUNNING      | 28467 | 55757 | 19.2.1.0.0 |
19210020190425110550 | COMPLETE      |
'-----+-----+-----+-----+-----+-----+
$

```

3. Start a Service Request Data Collection (SRDC) for all ORA-00600 errors that happened in ORCL.

Q1/ How do you get the list of possible types of SRDC?

```

$ ./tfactl collect -srdc -help

Service Request Data Collection (SRDC).

Usage : /u01/app/oracle/tfa/bin/tfactl collect -srdc
<srdc_profile> [-tag <tagname>] [-z <filename>] [-last <n><h|d>|
-from <time> -to <time> | -for <time>] -database <database>
    -tag <tagname> The files will be collected into tagname
directory inside repository
    -z <zipname> The collection zip file will be given this
name within the TFA collection repository
    -last <n><h|d> Files from last 'n' [d]ays or 'n' [h]ours
    -since Same as -last. Kept for backward compatibility.
    -from "Mon/dd/yyyy hh:mm:ss" From <time>
or "yyyy-mm-dd hh:mm:ss"
or "yyyy-mm-ddThh:mm:ss"
or "yyyy-mm-dd"
    -to "Mon/dd/yyyy hh:mm:ss" To <time>
or "yyyy-mm-dd hh:mm:ss"
or "yyyy-mm-ddThh:mm:ss"
or "yyyy-mm-dd"
    -for "Mon/dd/yyyy" For <date>.
or "yyyy-mm-dd"

<srdc_profile> can be any of the following,
Listener Services SRDC - Data Collection for TNS-12516 /
TNS-12518 / TNS-12519 / TNS-12520.
    Naming_Services SRDC - Data Collection for ORA-12154 /
ORA-12514 / ORA-12528.
ORA-00020 SRDC for database ORA-00020 Maximum
number of processes exceeded
ORA-00060 SRDC for ORA-00060. Internal error
code.

```

ORA-00600	SRDC for ORA-00600. Internal error code.
ORA-00700	SRDC for ORA-00700. Soft internal error.
ORA-01031	SRDC - How to Collect Standard Information for ORA - 1031 /ORA -1017 during SYSDBA connections
ORA-01555	SRDC for database ORA-01555 Snapshot too Old problems
ORA-01578	SRDC - Required diagnostic Data Collection for NOLOGGING ORA-1578/ORA-26040 DBV-00201.
ORA-01628	SRDC for database ORA-01628 Snapshot too Old problems
ORA-04030	SRDC for ORA-04030. OS process private memory was exhausted.
ORA-04031	SRDC for ORA-04031. More shared memory is needed in the shared/streams pool.
ORA-07445	SRDC for ORA-07445. Exception encountered, core dump.
ORA-08102	SRDC - Required diagnostic Data Collection for ORA-08102.
ORA-08103	SRDC - Required diagnostic Data Collection for ORA-08103.
ORA-22924	SRDC - ORA-22924 or ORA-1555 on LOB data: Checklist of Evidence to Supply (Doc ID 1682707.1)
ORA-27300	SRDC for ORA-27300. OS system dependent operation:open failed with status: (status).
ORA-27301	SRDC for ORA-27301. OS failure message: (message).
ORA-27302	SRDC for ORA-27302. failure occurred at: (module).
ORA-29548	SRDC - Providing Supporting Information for Oracle JVM Issues (Doc ID 2175568.1)
ORA-30036	SRDC for database ORA-30036 Unable to extend Undo Tablespace pproblems
TNS-12154	SRDC - Data Collection for TNS-12154.
TNS-12514	SRDC - Data Collection for TNS-12514.
TNS-12516	SRDC - Data Collection for TNS-12516.
TNS-12518	SRDC - Data Collection for TNS-12518.
TNS-12519	SRDC - Data Collection for TNS-12519.
TNS-12520	SRDC - Data Collection for TNS-12520.
TNS-12528	SRDC - Data Collection for TNS-12528.
dbasm	SRDC AUTOMATION: ENHANCE ASM/DBFS/DNFS/ACFS COLLECTIONS
dbaudit	SRDC - How to Collect Standard Information for Database Auditing
dbawrspace	SRDC for database AWR space problems

dbblockcorruption	SRDC - Required diagnostic Data Collection for Alert Log Message "Corrupt block relative dba".
dbdataguard	SRDC to capture diagnostic data for Data Guard issues
dbdatapatch	SRDC - Data Collection for Datapatch issues.
dbexp	SRDC - How to Collect Information for Troubleshooting Export (EXP) Related Problems
dbexpdp	SRDC - diagnostic Collection for DataPump Export Generic Issues
dbexpdpapi	SRDC - diagnostic Collection for DataPump Export API Issues
dbexpdpperf	SRDC - diagnostic Collection for DataPump Export Performance Issues
dbexpdptts	SRDC - Data to supply for Transportable Tablespace Datapump and original EXPORT, IMPORT
dbfs	SRDC for dbfs.
dbggclassicmode	SRDC for DOC ID 1913426.1, 1913376.1 and 1912964.1
dbggintegratedmode	SRDC for GoldenGate extract/replicat abends problems.
dbimp	SRDC - diagnostic Collection for Traditional Import Issues
dbimpdp	SRDC - diagnostic Collection for DataPump Import (IMPDP) Generic Issues
dbimpdpperf	SRDC - diagnostic Collection for DataPump Import (IMPDP) Performance Issues
dbinstall	SRDC for Oracle RDBMS install problems.
dbinvalidcomp	SRDC - Invalid Components and Objects : Checklist of Evidence to Supply
dbinvalidobj	SRDC - Objects Getting Invalidated: Checklist of Evidence to Supply
dbpartition	SRDC - Data to Supply for Create/Maintain Partitioned/Subpartitioned Table/Index Issues
dbpartitionperf	SRDC - Data to Supply for Slow Create/Alter/Drop Commands Against Partitioned Table/Index
dbpatchconflict	SRDC for Oracle RDBMS patch conflict problems.
dbpatchinstall	SRDC for Single Instance Database Shutdown problems
dbperf	SRDC for database performance problems.
dbpreupgrade	SRDC for database preupgrade problems.
dbrac	SRDC AUTOMATION: ENHANCE ASM/DBFS/DNFS/ACFS COLLECTIONS
dbracinst	SRDC AUTOMATION: ENHANCE ASM/DBFS/DNFS/ACFS COLLECTIONS

dbrman	SRDC - Required diagnostic data collection for RMAN related issues, such as backup, maintenance, restore and recover, RMAN-08137 or RMAN-08120
dbrman600	SRDC - Required diagnostic data collection for RMAN-00600 error (Doc ID 2045195.1).
dbrmanperf	SRDC - Required diagnostic data collection for RMAN Performance(1671509.1).
dbscn	SRDC for database SCN problems.
dbshutdown	SRDC for Single Instance Database Shutdown problems
dbspatialexportimport	SRDC - Data Collection for Oracle Spatial Export/Import Issues.
dbspatialinstall	SRDC - Data Collection for Oracle Spatial Installation Issues.
dbsqlperf	SRDC - How to Collect Standard Information for a SQL Performance Problem Using TFA Collector.
dbstartup	SRDC for Single Instance Database Startup problems
dbtde	SRDC - How to Collect Standard Information for Transparent Data Encryption (TDE) (Doc ID 1905607.1)
dbtextinstall	SRDC - Data Collection for Oracle Text Installation Issues - 12c.
dbtextupgrade	SRDC - Data Collection for Oracle Text Upgrade Issues - 12c.
dbundocorruption	SRDC - Required diagnostic Data Collection for UNDO Corruption.
dbunixresources	SRDC to capture diagnostic data for DB issues related to O/S resources
dbupgrade	SRDC for database upgrade problems.
dbxdb	SRDC for database XDB Installation and Invalid Object problems
dnfs	SRDC for DNFS.
emagentperf	EM SRDC - Collect diagnostic Data for EM Agent Performance Issues.
emcliadd	EM SRDC - Errors during the adding of a database/listener/ASM target via EMCLI.
emclusdisc	EM SRDC - Cluster target, cluster (RAC) database or ASM target is not discovered.
emdbsys	EM SRDC - Database system target is not discovered/detected/removed/renamed correctly.
emdebugoff	SRDC for unsetting EM Debug.
emdebugon	SRDC for setting EM Debug.
emgendisc	EM SRDC - General error is received when discovering or removing a database/listener/ASM target.
emmetricalert	SRDC for EM Metric Events not Raised and General Metric Alert Related Issues.

emomscrash	SRDC - Collect diagnostic Data for all Enterprise Manager OMS Crash / Restart Performance Issues.
emomsheap	SRDC - Collecting diagnostic Data for Enterprise Manager OMS Heap Usage Alert Performance Issues.
emomshungcpu	SRDC - Collecting diagnostic Data for Enterprise Manager OMS hung or High CPU Usage Performance Issues.
emprocdisc	EM SRDC - Database/listener/ASM target is not discovered/detected by the discovery process.
emrestartoms	EM SRDC - Re-start OMS.
emtbsmetric	SRDC for EM Tablespace Space Used Metric Issues.
esexalogic	SRDC - Exalogic Full Exaloggs Data Collection Information.
exsmartscan	SRDC - Exadata: Smart Scan Not Working Issues.
ggintegratedmodenodb	SRDC for GoldenGate extract/replicat abends problems.
gridinfra	SRDC AUTOMATION: ENHANCE ASM/DBFS/DNFS/ACFS COLLECTIONS
gridinfrainst	SRDC AUTOMATION: ENHANCE ASM/DBFS/DNFS/ACFS COLLECTIONS
internalerror	SRDC for all other types of internal database errors.
zlgeneric	SRDC - Zero Data Loss Recovery Appliance (ZDLRA) Data Collection.
\$	

A1/ The -help option is always helpful to get the possible values of options.

- a. Collect diagnostic data for your service request SR12345 (this is a fake SR) for the ORA-00600 errors that happened in practice 6-1.

```
$ ./tfactl collect -srdc ORA-00600 -sr SR12345
MOS setup is not done. It is needed to upload collection to SR
Run: tfactl setupmos
$
```

It is possible that the command does not request the MOS setup. In this case, jump to step b.

```
$ ./tfactl setupmos

Access Denied: Only TFA Admin can run this command
$
```

The wallet file is secured to be read write by the `root` user only. This is the reason why you have to log on as `root`.

```

$ su -
Password: password
Last login: Tue Oct 16 07:38:22 UTC 2018 on pts/0
# cd /u01/app/oracle/tfa/bin
# ./tfactl setupmos
Enter User Id: Test
Enter Password: password
Wallet does not exist ... creating
Wallet created successfully
USER details added/updated in the wallet
PASSWORD details added/updated in the wallet
SUCCESS - CERTIMPORT - Successfully imported certificate
#

```

It is possible that the command raises errors. Nevertheless, continue with b.

- b. Switch back to `oracle` and collect the diagnostic data related to the 2nd occurrence of the ORA-00600 errors in ORCL for the SR12345.

```

# exit
$ ./tfactl collect -srdc ORA-00600 -sr SR12345
Enter the time of the ORA-00600 [YYYY-MM-DD
HH24:MI:SS,<RETURN>=ALL] :
Enter the Database Name [<RETURN>=ALL] : ORCL

1. May/15/2019 10:30:49: [orcl] ORA-00600: internal error code,
arguments: [13011], [73039], [4230321], [0], [4230321], [17],
[], [], [], [], [], []

Please choose the event : 1-1 [1] 1
Selected value is : 1 ( May/15/2019 10:30:49 )
Scripts to be run by this srdc: ipspack rdahcvel1210 rdahcvel1120
rdahcvel1110
Components included in this srdc: OS DATABASE NOCHMOS
Collecting data for local node(s)
Scanning files from May/15/2019 08:30:49 to May/15/2019 12:30:49

Collection Id : 20190515154751hostname

Detailed Logging at :
/u01/app/oracle/tfa/repository/srdc_ora600_collection_Wed_May_15
_15_47_52_UTC_2019_node_local/diagcollect_20190515154751_
hostname.log
2019/05/15 15:47:55 UTC : NOTE : Any file or directory name
containing the string .com will be renamed to replace .com with
dotcom

```

```

2019/05/15 15:47:55 UTC : Collection Name :
tfa_srdc_ora600_Wed_May_15_15_47_52_UTC_2019.zip
2019/05/15 15:47:55 UTC : Getting list of files satisfying time
range [05/15/2019 08:30:49 UTC, 05/15/2019 12:30:49 UTC]
2019/05/15 15:47:55 UTC : Collecting additional diagnostic
information...
2019/05/15 15:48:10 UTC : Collecting ADR incident files...
2019/05/15 15:48:18 UTC : Completed collection of additional
diagnostic information...
2019/05/15 15:48:20 UTC : Completed Local Collection
2019/05/15 15:48:20 UTC : Uploading collection to SR - SR12345
2019/05/15 15:48:21 UTC : Failed to upload collection to SR
.------.
|           Collection Summary           |
+-----+-----+-----+-----+
| Host      | Status    | Size    | Time    |
+-----+-----+-----+-----+
| hostname | Completed | 2.9MB   | 25s     |
+-----+-----+-----+-----+

Logs are being collected to:
/u01/app/oracle/tfa/repository/srdc_ora600_collection_Wed_May_15
_16_08_23_UTC_2019_node_local
/u01/app/oracle/tfa/repository/srdc_ora600_collection_Wed_May_15
_16_08_23_UTC_2019_node_local/hostname.tfa_srdc_ora600_Wed_May_1
5_16_08_23_UTC_2019.zip
$

```

Do not pay attention to the “Failed to upload collection to SR”. The SR is a fake one.

Q1/ Which options would you use to upload the initialization parameter file to SR in MOS?

```

$ ./tfactl upload -sr SR12345 -user TEST
$ORACLE_HOME/dbs/initORCL.ora
SR12345 is not a valid SR number.
$

```

A1/ The upload allows you to upload other files to your SR in MOS. The command above fails because the SR used is a fake one.

4. Start a Service Request Data Collection (SRDC) for the hanging situation after startup that happens in ORCL.
 - a. Execute the `/home/oracle/labs/DIAG/startup_issue.sh` shell script. Once the shell script is launched, a hanging situation appears after database instance startup.

```
$ /home/oracle/labs/DIAG/startup_issue.sh
SQL> shutdown immediate
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL> exit
Disconnected from Oracle Database 19c Enterprise Edition Release
19.0.0.0.0 - Production Version 19.3.0.0.0

SQL*Plus: Release 19.0.0.0.0 - Production on Tue Oct 16 15:48:17
2018 Version 19.3.0.0.0

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Connected to an idle instance.

SQL> STARTUP
ORACLE instance started.

Total System Global Area 2382363480 bytes
Fixed Size 9132888 bytes
Variable Size 503316480 bytes
Database Buffers 1023410176 bytes
Redo Buffers 7643136 bytes
In-Memory Area 838860800 bytes
Database mounted.
Database opened.
SQL> set echo off
```

- b. Open another terminal window and log in as `oracle`. You are in *Session2*. Launch TFA to collect diagnostic data for the startup issue.

```
$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ cd $ORACLE_BASE/tfa/bin
$ ./tfactl collect -srdc dbstartup
Enter the Database Name [Required for this SRDC] : ORCL
```

```

Instance startup was completed in the very last startup
[ 1 ]Wed May 15 09:35:32 2019
[ 2 ]Wed May 15 09:41:59 2019
[ 3 ]Wed May 15 09:50:56 2019
[ 4 ]Wed May 15 09:52:51 2019
[ 5 ]Wed May 15 10:17:20 2019
[ 6 ]Wed May 15 10:21:43 2019
[ 7 ]Wed May 15 15:50:54 2019
[ 8 ]Wed May 15 15:54:07 2019
[ 9 ]Wed May 15 15:56:32 2019
[ 10 ]Wed May 15 16:09:41 2019
Please choose the problematic startup [1..10] [10] : 10
Can you simulate the issue now so that TFA can automatically
collect the diagnostic data ? [Y|y|N|n] [Y] : Y
Please execute the following commands:
strace -ftT -o
/u01/app/oracle/tfa/repository/suptools/srdc/user_oracle/1539700
389_srdc_dbstartup/start_trace.out sqlplus /nolog
SQL>conn / as sysdba;
SQL>startup
Wait 5-10 minutes then kill process and do shutdown immediate if
necessary
Press <Enter> when complete

```

Note: Instead of using `STARTUP` command in the list of suggested commands, use the `startup.sql` SQL script that creates the issue.

- c. In another terminal window, called *Session3*, execute the commands suggested by TFA.

```

$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ cd $ORACLE_BASE/tfa/bin
$ strace -ftT -o
/u01/app/oracle/tfa/repository/suptools/srdc/user_oracle/1539700
389_srdc_dbstartup/start_trace.out sqlplus /nolog

SQL*Plus: Release 19.0.0.0.0 - Production on Tue Oct 16 14:34:39
2018 Version 19.3.0.0.0

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SQL> conn / as sysdba;
Connected to an idle instance.

```

```

SQL> startup
ORA-01081: cannot start already-running ORACLE - shut it down
first
SQL> shutdown immediate
Database closed.
Database dismounted.
ORACLE instance shut down.
SQL> @/home/oracle/labs/DIAG/startup.sql
SQL> STARTUP
ORACLE instance started.

Total System Global Area 2382363480 bytes
Fixed Size                  9132888 bytes
Variable Size              503316480 bytes
Database Buffers          1023410176 bytes
Redo Buffers                7643136 bytes
In-Memory Area             838860800 bytes
Database mounted.
Database opened.
SQL> set echo off

```

- d. In *Session2*, press **Enter**.

```

Please execute the following script in a sqlplus session.
startup nomount
alter session set events '10046 trace name context forever,
level 12';
alter database mount;
alter database open;
Wait for 10 minutes.
Press <Enter> when complete

```

- e. In another session, called *Session4*, execute the commands suggested by TFA.

```

$ . oraenv
ORACLE_SID = [oracle] ? ORCL
The Oracle base has been set to /u01/app/oracle
$ cd $ORACLE_BASE/tfa/bin
$ strace -ftT -o
/u01/app/oracle/tfa/repository/suptools/srdc/user_oracle/1539700
389_srdc_dbstartup/start_trace.out sqlplus /nolog

SQL*Plus: Release 19.0.0.0.0 - Production on Tue Oct 16 14:34:39
2018 Version 19.3.0.0.0

```

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SQL> **conn / as sysdba;**

Connected to an idle instance.

SQL> **startup nomount**

ORA-01081: cannot start already-running ORACLE - shut it down first

SQL> **shutdown immediate**

Database closed.

Database dismounted.

ORACLE instance shut down.

SQL> **startup nomount**

ORACLE instance started.

Total System Global Area 2382363480 bytes

Fixed Size 9132888 bytes

Variable Size 503316480 bytes

Database Buffers 1023410176 bytes

Redo Buffers 7643136 bytes

In-Memory Area 838860800 bytes

SQL> **alter session set events '10046 trace name context forever, level 12';**

Session altered.

SQL> **@/home/oracle/labs/DIAG/startup_mount.sql**

SQL> **ALTER DATABASE MOUNT;**

Database altered.

SQL> **ALTER DATABASE OPEN;**

Database altered.

- f. In Session2, press **Enter**.

Running hanganalyze....

Hang analysis in

/u01/app/oracle/diag/rdbms/orcl/ORCL/trace/ORCL_ora_16413.trc

Running transaction recovery SQL script.....

Scripts to be run by this srvc: rdahcve1120 rdahcve1210

rdahcve1110 cp_parameter

Components included in this srvc: DATABASE OS

Collecting data for local node(s)

Collection Id : 20190515162855hostname

Detailed Logging at :

/u01/app/oracle/tfa/repository/srdc_dbstartup_collection_Wed_May_15_16_28_56_UTC_2019_node_local/diagcollect_20190515162855_hostname.log

2019/05/15 16:29:00 UTC : NOTE : Any file or directory name containing the string .com will be renamed to replace .com with dotcom

2019/05/15 16:29:00 UTC : Collection Name :
tfa_srdc_dbstartup_Wed_May_15_16_28_56_UTC_2019.zip

2019/05/15 16:29:00 UTC : Scanning of files for Collection in progress...

2019/05/15 16:29:00 UTC : Collecting additional diagnostic information...

2019/05/15 16:29:05 UTC : Getting list of files satisfying time range [05/15/2019 04:29:00 UTC, 05/15/2019 16:29:05 UTC]

2019/05/15 16:29:11 UTC : Completed collection of additional diagnostic information...

2019/05/15 16:29:20 UTC : Collecting ADR incident files...

2019/05/15 16:29:23 UTC : Completed Local Collection

```
.-----.
```

Collection Summary			
Host	Status	Size	Time
hostname	Completed	19MB	23s

```
'-----'
```

Logs are being collected to:

/u01/app/oracle/tfa/repository/srdc_dbstartup_collection_Wed_May_15_16_28_56_UTC_2019_node_local

/u01/app/oracle/tfa/repository/srdc_dbstartup_collection_Wed_May_15_16_28_56_UTC_2019_node_local/hostname.tfa_srdc_dbstartup_Wed_May_15_16_28_56_UTC_2019.zip

\$

Q1/ Does the trace file generated hold information about the cause of the hang?

A1/ The trace and diagnostic files help the Oracle Support analysts find the root cause of the issue.


```
=====
Chains most likely to have caused the hang:
```

```
[a] Chain 1 Signature: 'CPU or Wait CPU'<='library cache load lock'
```

```
Chain 1 Signature Hash: 0x456ca47b
```

```
[b] Chain 2 Signature: 'resmgr:cpu quantum'
```

```
Chain 2 Signature Hash: 0x8114dfec
```

```
[c] Chain 3 Signature: 'CPU or Wait CPU'
```

```
Chain 3 Signature Hash: 0xabe82914
=====
```

You can send and upload the zip file automatically to your SR by using the same `-sr` option used in the previous task 3 step b. The Oracle Support analysts use the trace and diagnostic files to find the root cause of the hang and provide a solution.

5. Kill and quit all the sessions.

```
$ pgrep -lf sqlplus
```

```
13807 sqlplus
```

```
14853 strace
```

```
14855 sqlplus
```

```
15759 strace
```

```
15761 sqlplus
```

```
$ kill -9 13807
```

```
$ kill -9 14853
```

```
$ kill -9 14855
```

```
$ kill -9 15759
```

```
$ kill -9 15761
```

```
$
```


Practices for Lesson 7: Using Sharding Enhancements

Practices for Lesson 7

There are no practices for this lesson.