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Oracle Database 12*c*: Oracle Automatic Storage Management Administration

Activity Guide
D81242GC10
Edition 1.0 | September 2014 | D85443

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This book was published using: Oracle Tutor

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Practices for Lesson 1: ASM Overview

Chapter 1

Practices for Lesson 1

Practices Overview

There are no practices for this lesson.

Practices for Lesson 2: Administering ASM Instances

Chapter 2

Practices for Lesson 2: Overview

Practices Overview

In these practices, you will adjust ASM initialization parameters, stop and start instances, and monitor the status of instances.

Practice 2-1: Administering ASM Instances

Overview

In this practice, you adjust initialization parameters in the SPFILE, and stop and start the ASM instances on local and remote nodes.

1. From a `vncuser` terminal on your desktop PC, change to the `root` account and restart the NAMED and NTPD services to ensure viability and availability of the services for the course practices.

```
[vncuser@classroom_pc - ~]$ su -
Password:
[root@classroom_pc ~]# service ntpd restart
Shutting down ntpd:                                        [FAILED]
ntpd: Synchronizing with time server:                      [  OK  ]
Starting ntpd:                                             [  OK  ]

[root@classroom_pc ~]# service named restart
Stopping named: .                                          [  OK  ]
Starting named:                                            [  OK  ]
[root@classroom_pc ~]# exit
Logout
[vncuser@classroom_pc - ~]$
```

2. Disk groups are reconfigured occasionally to move older data to slower disks. Even though these operations occur at scheduled maintenance times in off-peak hours, the rebalance operations do not complete before regular operations resume. There is some performance impact to the regular operations. The setting for the `ASM_POWER_LIMIT` initialization parameter determines the speed of the rebalance operation. Determine the current setting and increase the speed by 2.

   SSH to `host01` as the `grid` user, using the `-X` option. Set the environment to use the +ASM1 instance. Connect to the +ASM1 instance as SYS with the SYSASM privilege. What is the setting for `ASM_POWER_LIMIT`?

```
[vncuser@classroom_pc ~]$ ssh -X grid@host01
grid@host01's password: <oracle>
Last login: Tue Jul 30 20:19:28 2013 from 192.0.2.1
[grid@host01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[grid@host01 ~]$ sqlplus / as sysasm

SQL*Plus: Release 12.1.0.1.0 Production on Thu Aug 15 17:01:22
2013

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```

```
Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 -
64bit Production
With the Real Application Clusters and Automatic Storage
Management options

SQL> show parameter ASM_POWER_LIMIT

NAME                                 TYPE        VALUE
------------------------------------ ----------- ---------------
asm_power_limit                      integer     1
SQL>
```

3. This installation uses an SPFILE. Use the `ALTER SYSTEM` command to change the `ASM_POWER_LIMIT` for all nodes.

```
SQL> show parameter SPFILE

NAME                 TYPE        VALUE
-------------------- ----------- ---------------
spfile               string      +DATA/cluster01/ASMPARAMETERFI
                                 LE/registry.253.821741859

SQL> ALTER SYSTEM set ASM_POWER_LIMIT=3 SCOPE=BOTH SID='*';

System altered.

SQL> show parameter ASM_POWER_LIMIT


NAME                                 TYPE        VALUE
------------------------------------ ----------- ---------------
asm_power_limit                      integer     3
SQL>
```

4. You have decided that due to other maintenance operations you want the +ASM1 instance to handle the bulk of the rebalance operation, so you will set the `ASM POWER_LIMIT` to 1 on instance +ASM2 and +ASM3, and 5 on instance +ASM1. Exit SQL*Plus when finished.

```
SQL> ALTER SYSTEM set ASM_POWER_LIMIT=1 SCOPE=BOTH SID='+ASM2';

System altered.

SQL> ALTER SYSTEM set ASM_POWER_LIMIT=1 SCOPE=BOTH SID='+ASM3';

System altered.
```

```
SQL> ALTER SYSTEM set ASM_POWER_LIMIT=5 SCOPE=BOTH SID='+ASM1';

System altered.

SQL> column NAME format A16
SQL> column VALUE format A16
SQL> select inst_id, name, value from GV$PARAMETER
  2  where name like 'asm_power_limit';

   INST_ID NAME             VALUE
---------- ---------------- ----------------
         1 asm_power_limit  5
         2 asm_power_limit  1
         3 asm_power_limit  1

SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.1.0 - 64bit Production
With the Real Application Clusters and Automatic Storage
Management options
[grid@host01 ~]$
```

5. Use `srvctl` to view which database instances are running on each host.

```
[grid@host01 ~]$ srvctl status database -db orcl
Instance orcl_1 is running on node host02
Instance orcl_2 is running on node host03
Instance orcl_3 is running on node host01
[grid@host01 ~]$
```

6. Use `srvctl stop instance` command to stop the ASM instance on `host01`.

```
[grid@host01 ~]$ srvctl stop asm -n host01
PRCR-1014 : Failed to stop resource ora.asm
PRCR-1065 : Failed to stop resource ora.asm
CRS-2529: Unable to act on 'ora.asm' because that would require
stopping or relocating 'ora.DATA.dg', but the force option was
not specified
```

7. Re-run the `srvctl stop instance` command, using the `-f` option. Use the `crsctl stat res` command to check the state of the ASM and disk group resources on `host01`. Note the database instance up on `host01`.

```
[grid@host01 ~]$ srvctl stop asm -n host01 -f

[grid@host01 ~]$ crsctl stat res -t
--------------------------------------------------------------------
Name           Target  State        Server         State details
--------------------------------------------------------------------
```

```
Local Resources
--------------------------------------------------------------------------------
ora.ASMNET1LSNR_ASM.lsnr
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.DATA.dg
               OFFLINE OFFLINE      host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.FRA.dg
               OFFLINE OFFLINE      host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.LISTENER.lsnr
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.LISTENER_LEAF.lsnr
               OFFLINE OFFLINE      host04                   STABLE
               OFFLINE OFFLINE      host05                   STABLE
ora.net1.network
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.ons
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.proxy_advm
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
--------------------------------------------------------------------------------
Cluster Resources
--------------------------------------------------------------------------------
ora.LISTENER_SCAN1.lsnr
      1        ONLINE  ONLINE       host02                   STABLE
ora.LISTENER_SCAN2.lsnr
      1        ONLINE  ONLINE       host03                   STABLE
ora.LISTENER_SCAN3.lsnr
      1        ONLINE  ONLINE       host01                   STABLE
ora.asm
      1        OFFLINE OFFLINE                               STABLE
      2        ONLINE  ONLINE       host02                   STABLE
      3        ONLINE  ONLINE       host03                   STABLE
ora.cvu
      1        ONLINE  ONLINE       host01                   STABLE
ora.gns
      1        ONLINE  ONLINE       host01                   STABLE
ora.gns.vip
      1        ONLINE  ONLINE       host01                   STABLE
```

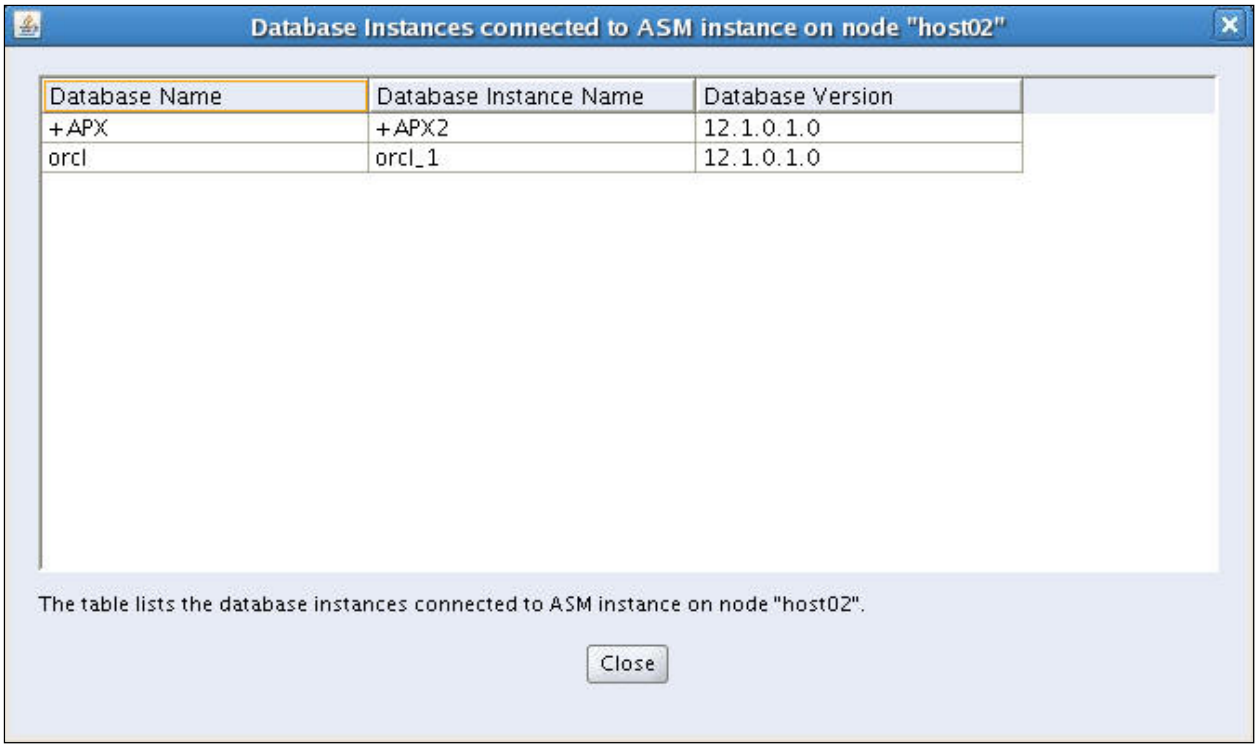
```
ora.host01.vip
      1        ONLINE  ONLINE       host01                   STABLE
ora.host02.vip
      1        ONLINE  ONLINE       host02                   STABLE
ora.host03.vip
      1        ONLINE  ONLINE       host03                   STABLE
ora.mgmtdb
      1        OFFLINE OFFLINE          Instance Shutdown,STABLE
ora.oc4j
      1        ONLINE  ONLINE       host01                   STABLE
ora.orcl.db
      1        ONLINE  ONLINE       host02            Open,STABLE
      2        ONLINE  ONLINE       host03            Open,STABLE
      3        ONLINE  ONLINE       host01            Open,STABLE
ora.scan1.vip
      1        ONLINE  ONLINE       host02                   STABLE
ora.scan2.vip
      1        ONLINE  ONLINE       host03                   STABLE
ora.scan3.vip
      1        ONLINE  ONLINE       host01                   STABLE
--------------------------------------------------------------------------------
[grid@host01 ~]$
```

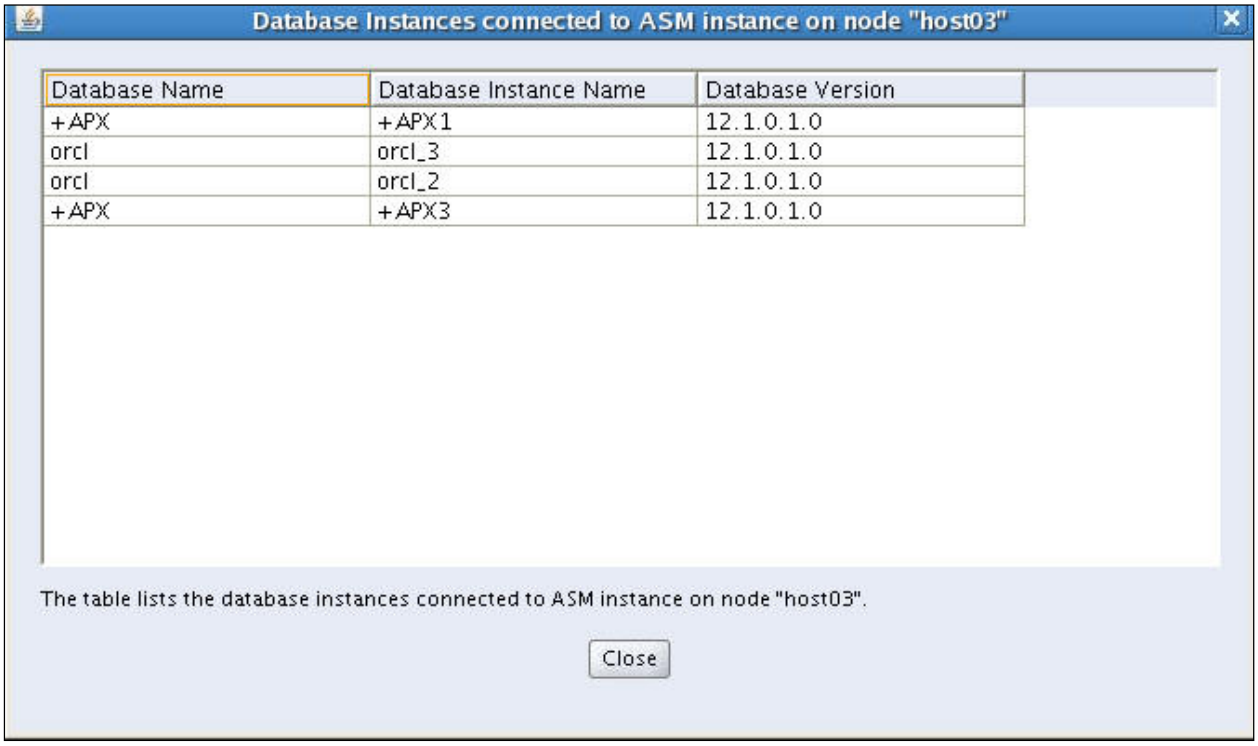
8. Restart the ASM instance on `host01`.

```
[grid@host01 ~]$ srvctl start asm -n host01
[grid@host01 ~]$
```

9 Execute `asmca` from the `grid` terminal window. Click the ASM Instances folder tab. The ASM instance should be up on `host01`. Right-click on +ASM1 and select View Connected Databases. Note that there are no connected database instances for +ASM1. Click close.

10. Next, right-click on +ASM2 and select View Connected Databases. Repeat this for +ASM3. You should see the orcl and ASM proxy instances relocated to these nodes.





11. Right-click `host02` and select Stop Instance. Make sure the Force Stop check box is selected in the Configure ASM: Stop Instance dialog box and click OK to continue. What happens? You should see a message similar to the following:
    Stopping ASM instance failed in node host02 with following message:

Following ASM clients are using ASM instance. orcl,orcl

Even though the Force option was specified, ASMCA will not stop an ASM instance with connected instances. When finished, exit from ASMCA.

12. Since Flex ASM will not relocate clients once an ASM instance is relocated, use SQL*Plus to relocate the database and ASM proxy instances back to `host01`. This statement closes the connection between the database instance and Flex ASM instance, triggering a reconnection to another Flex ASM instance. Refer to step 4 for original instance-to-host relationships.

    In this example, the database and ASM proxy connections were failed over to +ASM3 located on host03. SSH to that host and relocate the database instance connection (orcl_3) and ASM Proxy connection (+APX1). Exit SQL*Plus when finished.

    Note: When relocating an ASM client, the relocation command must be run on the node hosting the ASM instance to which the client is connected.

```
[grid@host01 ~]$ ssh host03

[grid@host03 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM3
The Oracle base has been set to /u01/app/grid

[grid@host03 ~]$ sqlplus / as sysasm

SQL*Plus: Release 12.1.0.1.0 Production on Mon Dec 30 16:04:30
2013

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Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 -
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Management options

SQL> alter system relocate client 'orcl_3:orcl';

System altered.

SQL> alter system relocate client '+APX1:+APX';

System altered.

SQL> exit
```

```
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.1.0 - 64bit Production
With the Real Application Clusters and Automatic Storage
Management options

[grid@host03 ~]$ exit
logout
Connection to host03 closed.
[grid@host01 ~]$
```

13. Use `srvctl` to view confirm the database instance was relocated back to `host01`.

```
[grid@host01 ~]$ srvctl status database -db orcl
Instance orcl_1 is running on node host02
Instance orcl_2 is running on node host03
Instance orcl_3 is running on node host01
[grid@host01 ~]$
```

14. Close all terminal windows opened for this practice.

Practices for Lesson 3: Flex ASM

Chapter 3

Practices for Lesson 3: Overview

Practices Overview

In this practice you will crash an ASM instance and examine how the client database transparently fails over to another Flex ASM instance.

Practice 3-1: Client Database Failover with Flex ASM

Overview

In this practice you will crash an ASM instance and examine how the client database transparently fails over to another Flex ASM instance.

1. Establish a terminal session connected to `host01` using the `grid` OS user. Configure the environment using the oraenv script. Enter +ASM1 when you are prompted for an ORACLE_SID value.

```
[vncuser@classroom_pc ~]$ ssh grid@host01
grid@host01's password: <oracle>
Last login: Fri Aug 16 15:31:06 2013 from 192.0.2.1
[grid@host01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[grid@host01 ~]$
```

2. Change to the directory that contains the scripts associated with this practice and examine the contents of `asm_clients.sql`. This query shows the clients connected to all of the Flex ASM instances in the cluster.

```
[grid@host01 ~]$ cd /stage/ASM/labs/less_03

[grid@host01 less_03]$ cat asm_clients.sql
col client_instance_name format a20

select distinct i.instance_name asm_instance_name,
c.instance_name client_instance_name, c.db_name, c.status
from gv$instance i, gv$asm_client c
where i.inst_id=c.inst_id;

exit

[grid@host01 less_03]$
```

3. Examine the clients connected to each of the Flex ASM instances. Take note of the connection mappings in your environment as they may differ. In particular, take note of the database instance connected to `+ASM3`.

```
[grid@host01 less_03]$ sqlplus / as sysasm @asm_clients

SQL*Plus: Release 12.1.0.1.0 Production on Mon Aug 19 19:56:39
2013

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```

```
Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 -
64bit Production
With the Real Application Clusters and Automatic Storage
Management options


ASM_INSTANCE_NAM CLIENT_INSTANCE_NAME DB_NAME  STATUS
---------------- -------------------- -------- ------------
+ASM1            +APX1                +APX     CONNECTED
+ASM1            orcl_3               orcl     CONNECTED
+ASM2            +APX2                +APX     CONNECTED
+ASM2            +ASM2                +ASM     CONNECTED
+ASM2            orcl_1               orcl     CONNECTED
+ASM3            +APX3                +APX     CONNECTED
+ASM3            +ASM3                +ASM     CONNECTED
+ASM3            orcl_2               orcl     CONNECTED

8 rows selected.

Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.1.0 - 64bit Production
With the Real Application Clusters and Automatic Storage
Management options
[grid@host01 less_03]$
```

4. Use the following command to take note of which server is running the database instance connected to `+ASM3`. In this case the database instance is `orcl_2` running on `host03`; however this may vary in your environment.

```
[grid@host01 less_03]$ srvctl status database -d orcl
Instance orcl_1 is running on node host02
Instance orcl_2 is running on node host03
Instance orcl_3 is running on node host01
[grid@host01 less_03]$
```

5. Establish another terminal session, using the `oracle` OS user, connecting to `host03`. Set the `oracle` environment, using the instance name identified in the previous steps.

```
[vncuser@classroom_pc ~]$ ssh oracle@host03
oracle@host01's password: <oracle>
Last login: Thu Aug 15 20:35:17 2013 from 192.0.2.1

[oracle@host03 ~]$ export ORACLE_SID=orcl_2
```

```
[oracle@host03 ~]$ export
ORACLE_HOME=/u01/app/oracle/product/12.1.0/dbhome_1
[oracle@host03 ~]$ export
PATH=$PATH:/u01/app/oracle/product/12.1.0/dbhome_1/bin
[oracle@host03 ~]$
```

6. Change to the directory that contains the scripts associated with this practice.

```
[oracle@host03 ~]$ cd /stage/ASM/labs/less_03
[oracle@host03 less_03]$
```

7. Connect to the RAC database instance as shown below. Confirm that you are connected to the database instance which is a client of `+ASM3`.

```
[oracle@host03 less_03]$ sqlplus system/oracle_4U

SQL*Plus: Release 12.1.0.1.0 Production on Tue Aug 20 13:41:02
2013

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Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 -
64bit Production
With the Partitioning, Real Application Clusters, Automatic
Storage Management, OLAP,
Advanced Analytics and Real Application Testing options

SQL> select instance_name from v$instance;

INSTANCE_NAME
----------------
orcl_2

SQL>
```

8. Start a workload using the `workload.sql` script located in `/home/oracle/labs/asm/less_03`. The script executes a series of transactions that flush the buffer cache, query data and update data.

```
SQL> @workload

System altered.



SYSTIMESTAMP
```

```
------------------------------------------------------------------
20-AUG-13 01.45.01.990433 PM +00:00


  COUNT(*) AVG(AMOUNT_SOLD)
---------- ----------------
    875231       109.178546 $
```

9. Back in your grid terminal session, abort the Flex ASM instance on host03 (+ASM3).

```
[grid@host01 less_03]$ srvctl stop asm -node host03 -stopoption
ABORT -force
[grid@host01 less_03]$
```

10. Confirm that no ASM instance is running on `host03`.

```
[grid@host01 less_03]$ crsctl status resource ora.asm -t
--------------------------------------------------------------------
Name           Target  State        Server
State details
--------------------------------------------------------------------
Cluster Resources
--------------------------------------------------------------------
ora.asm
      1        ONLINE  ONLINE       host01                   STABLE
      2        ONLINE  ONLINE       host02                   STABLE
      3        OFFLINE OFFLINE                               STABLE
--------------------------------------------------------------------
[grid@host01 less_03]$
```

11. Back in your oracle terminal session; confirm that the workload is still running. This demonstrates how Flex ASM improves availability by transparently failing over client database instances if a Flex ASM instance fails.

```
...
SYSTIMESTAMP
------------------------------------------------------------------
20-AUG-13 01.47.52.159764 PM +00:00


  COUNT(*) AVG(AMOUNT_SOLD)
---------- ----------------
    759469       109.492706
```

```
99999 rows updated.


Commit complete.


System altered.


SYSTIMESTAMP
---------------------------------------------------------------
20-AUG-13 01.49.17.850055 PM +00:00
...
```

12. Return to your grid terminal session and reexamine the Flex ASM client connections using the `asm_clients.sql` script. Notice that the `orcl` instance that was connected to `+ASM3` has been relocated. In the example below, the `orcl_2` instance that was previously connected to `+ASM3` on is now connected to `+ASM1` (on `host01`).

```
[grid@host01 less_03]$ sqlplus / as sysasm @asm_clients

SQL*Plus: Release 12.1.0.1.0 Production on Tue Aug 20 13:50:34
2013

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Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 -
64bit Production
With the Real Application Clusters and Automatic Storage
Management options


ASM_INSTANCE_NAM CLIENT_INSTANCE_NAME DB_NAME  STATUS
---------------- -------------------- -------- ------------
+ASM1            +APX1                +APX     CONNECTED
+ASM1            +APX3                +APX     CONNECTED
+ASM1            +ASM1                +ASM     CONNECTED
+ASM1            orcl_2               orcl     CONNECTED
+ASM1            orcl_3               orcl     CONNECTED
+ASM2            +APX2                +APX     CONNECTED
+ASM2            +ASM2                +ASM     CONNECTED
+ASM2            orcl_1               orcl     CONNECTED
```

```
8 rows selected.

Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.1.0 - 64bit Production
With the Real Application Clusters and Automatic Storage
Management options
[grid@host01 less_03]$
```

13. Return to your `oracle` terminal session. If the workload is still running, type `<Control>-C` to stop the workload. Exit the database session after stopping the workload.

```
SYSTIMESTAMP
---------------------------------------------------------------------
20-AUG-13 01.54.49.057202 PM +00:00


  COUNT(*) AVG(AMOUNT_SOLD)
---------- ----------------
     20437       378.622356

^C

ERROR at line 1:
ORA-01013: user requested cancel of current operation

SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.1.0 - 64bit Production
With the Partitioning, Real Application Clusters, Automatic
Storage Management, OLAP,
Advanced Analytics and Real Application Testing options
[oracle@host03 less_03]$
```

14. Return to your `grid` terminal session and restart the Flex ASM instance that you stopped earlier in this practice.

```
[grid@host01 less_03]$ srvctl start asm -node host03
[grid@host01 less_03]$
```

15. Confirm that Flex ASM is again running on `host03`.

```
[grid@host01 less_03]$ srvctl status asm
ASM is running on host01,host02,host03
[grid@host01 less_03]$
```

16. Reexamine the Flex ASM client connections. Notice that no `orcl` database instances are connected to the newly started Flex ASM instance `+ASM3`. This is because Flex ASM does not redistribute clients when an ASM instance is added.

```
[grid@host01 less_03]$ sqlplus / as sysasm @asm_clients

SQL*Plus: Release 12.1.0.1.0 Production on Tue Aug 20 14:20:03
2013

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Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 -
64bit Production
With the Real Application Clusters and Automatic Storage
Management options



ASM_INSTANCE_NAM CLIENT_INSTANCE_NAME DB_NAME  STATUS
---------------- -------------------- -------- ------------
+ASM1            +APX1                +APX     CONNECTED
+ASM1            +APX3                +APX     CONNECTED
+ASM1            +ASM1                +ASM     CONNECTED
+ASM1            orcl_2               orcl     CONNECTED
+ASM1            orcl_3               orcl     CONNECTED
+ASM2            +APX2                +APX     CONNECTED
+ASM2            +ASM2                +ASM     CONNECTED
+ASM2            orcl_1               orcl     CONNECTED

8 rows selected.

Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.1.0 - 64bit Production
With the Real Application Clusters and Automatic Storage
Management options
[grid@host01 less_03]$
```

17. Referring to the client connection output in step 16, we can see that there are two database client connections to +ASM1, `orcl_2` and `orcl_3`. From your `grid` terminal window on `host01`, connect to ASM as an ASM administrator using SQL*Plus. In this example, instances `orcl_2` and `orcl_3` are connected to `+ASM1` located on host01. From `host01`, select one of the `orcl` database instances and relocate it.

    Note: When relocating an ASM client, ***the relocation command must be run on the node hosting the ASM instance to which the client is connected***.

```
[grid@host01 less_03]$ sqlplus / as sysasm

SQL*Plus: Release 12.1.0.1.0 Production on Tue Aug 20 14:30:38
2013

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Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 -
64bit Production
With the Real Application Clusters and Automatic Storage
Management options

SQL> alter system relocate client 'orcl_2:orcl';

System altered.

SQL>
```

18. Referring to the client connection output in step 16, we can see that +ASM1 has two proxy clients connected, +APX1 and +APX3. Locate the node hosting the ASM instance to which the ADVM proxy instance +APX3 is connected. In this example, it is `host01`.Since we already have a SQL*Plus session open on that node, we'll use it to relocate the ADVM proxy instance `+APX3`.

```
SQL> alter system relocate client '+APX3:+APX';

System altered.

SQL>
```

19. Reexamine the Flex ASM client connections. Confirm that a proxy and database client connection exist for each ASM instance. We are not concerned with ASM to ASM client connection in this practice.

```
SQL> @asm_clients

ASM_INSTANCE_NAM CLIENT_INSTANCE_NAME DB_NAME  STATUS
---------------- -------------------- -------- ------------
+ASM1            +APX1                +APX     CONNECTED
+ASM1            +ASM1                +ASM     CONNECTED
+ASM1            orcl_3               orcl     CONNECTED
+ASM2            +APX2                +APX     CONNECTED
+ASM2            +ASM2                +ASM     CONNECTED
+ASM2            orcl_1               orcl     CONNECTED
```

```
+ASM3            +APX3                +APX     CONNECTED
+ASM3            orcl_2               orcl     CONNECTED

8 rows selected.

Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.1.0 - 64bit Production
With the Real Application Clusters and Automatic Storage
Management options
[grid@host01 less_03]$
```

Congratulations! You have exercised client database failover with Flex ASM.

20. Close all terminal windows opened for this practice.

Practices for Lesson 4: Administering ASM Diskgroups

Chapter 4

Practices for Lesson 4: Overview

Practices Overview

In these practices, you will add, configure, and remove disk groups, manage rebalance operations, and monitor disk and disk group I/O statistics.

Practice 4-1: Administering ASM Disk Groups

Overview

In this practice, you will change the configuration of a disk group, and control the resulting rebalance operations. You will determine the connected clients to the existing disk groups, and perform disk group checks.

Because the `asmadmin` group has only one member, `grid`, open a terminal window and become the grid OS user for this practice.

1. Open a terminal session from your desktop to `host01` as the `grid` user, use `oraenv` to set your environment. Use the `asmcmd lsdg` command to check the currently configured disk groups.

```
[vncuser@classroom_pc ~]$ ssh -X grid@host01
grid@host01's password:
Last login: Fri Aug 16 15:30:44 2013 from 192.0.2.1
[grid@host01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[grid@host01 ~]$ asmcmd lsdg
State    Type    Rebal  Sector  Block       AU  Total_MB
Free_MB  Req_mir_free_MB  Usable_file_MB  Offline_disks
Voting_files  Name
MOUNTED  NORMAL  N         512   4096  1048576     27270
13603             2745             5429              0
Y  DATA/
MOUNTED  EXTERN  N         512   4096  1048576      8117
7636                 0             7636              0
N  FRA/

[grid@host01 ~]$
```

2. Use the `asmcmd lsdsk` command to view the disks belonging to the DATA disk group.

```
[grid@host01 ~]$ asmcmd lsdsk -k -G DATA
Total_MB  Free_MB  OS_MB  Name       Failgroup  Failgroup_Type
Library  Label  UDID  Product  Redund   Path
    2745     1339   2745  DATA_0000  DATA_0000  REGULAR
System                          UNKNOWN  /dev/asmdisk1p1
    2745     1373   2745  DATA_0001  DATA_0001  REGULAR
System                          UNKNOWN  /dev/asmdisk1p10
    2745     1337   2745  DATA_0002  DATA_0002  REGULAR
System                          UNKNOWN  /dev/asmdisk1p11
    2565     1271   2565  DATA_0003  DATA_0003  REGULAR
System                          UNKNOWN  /dev/asmdisk1p12
    2745     1394   2745  DATA_0004  DATA_0004  REGULAR
System                          UNKNOWN  /dev/asmdisk1p2
```

```
    2745     1372   2745  DATA_0005  DATA_0005  REGULAR
System                          UNKNOWN  /dev/asmdisk1p3
    2745     1385   2745  DATA_0006  DATA_0006  REGULAR
System                          UNKNOWN  /dev/asmdisk1p4
    2745     1358   2745  DATA_0007  DATA_0007  REGULAR
System                          UNKNOWN  /dev/asmdisk1p5
    2745     1380   2745  DATA_0008  DATA_0008  REGULAR
System                          UNKNOWN  /dev/asmdisk1p6
    2745     1394   2745  DATA_0009  DATA_0009  REGULAR
System                          UNKNOWN  /dev/asmdisk1p7
[grid@host01 ~]$
```

3. Let's drop `DATA_0000`. Use the `chdg` command with inline XML. Use a power level of 5. Note that the command is typed without a return, all on one line.

```
chdg '<chdg name="DATA" power="5"><drop><fg name="DATA_0000">
   </fg><dsk name="DATA_0000"/></drop></chdg>'
```

```
[grid@host01 ~]$ asmcmd
ASMCMD> chdg '<chdg name="DATA" power="5"><drop><fg
name="DATA_0000"></fg><dsk name="DATA_0000"/></drop></chdg>'
Diskgroup altered.
ASMCMD> exit
[grid@host01 ~]$
```

4. Next, we will add another disk to the DATA disk group. Perform a disk check to verify the disk group metadata. Use the check disk group command `chkdg`.

```
[grid@host01 ~]$ asmcmd chkdg data
Diskgroup altered.
[grid@host01 ~]$
```

5. Add another disk (`/dev/asmdisk2p2`) to the DATA disk group and remove a disk (DATA_0004: `/dev/asmdisk1p2`), but the rebalance operation must wait until a quiet time and then proceed as quickly as possible. As the `grid` user, use SQL*Plus to connect to the ASM instance on `host01` and perform these operations.

```
[grid@host01 ~]$ sqlplus / as sysasm
SQL*Plus: Release 12.1.0.1.0 Production on Thu Aug 29 12:19:47
2013
...
SQL> ALTER DISKGROUP DATA ADD DISK '/dev/asmdisk2p2' REBALANCE
POWER 0;
Diskgroup altered.

SQL> ALTER DISKGROUP DATA DROP DISK DATA_0004 REBALANCE POWER 0;

Diskgroup altered.

SQL>
```

6. Next, start the rebalance operations on the DATA disk group. Specify a POWER of 6. Query the V$ASM_OPERATION view to monitor the rebalance.

```
SQL> alter diskgroup DATA rebalance power 6;

Diskgroup altered.

SQL> SELECT group_number, operation, state, power, est_minutes
FROM v$asm_operation;

GROUP_NUMBER OPERA STAT      POWER EST_MINUTES
------------ ----- ---- ---------- -----------
           1 REBAL DONE          6           0
           1 REBAL RUN           6           8
           1 REBAL WAIT          6           0

*******Wait a few moments********

SQL> SELECT group_number, operation, state, power, est_minutes
FROM v$asm_operation;

GROUP_NUMBER OPERA STAT      POWER EST_MINUTES
------------ ----- ---- ---------- -----------
           1 REBAL DONE          6           0
           1 REBAL RUN           6           5
           1 REBAL WAIT          6           0

SQL>
```

7. Change the rebalance POWER to 1024. Again, query the V$ASM_OPERATION view to monitor the rebalance.

```
SQL> alter diskgroup DATA rebalance power 1024;

Diskgroup altered.

SQL> SELECT group_number, operation, state, power, est_minutes
FROM v$asm_operation;

GROUP_NUMBER OPERA STAT      POWER EST_MINUTES
------------ ----- ---- ---------- -----------
           1 REBAL DONE       1024           0
           1 REBAL RUN        1024           4
           1 REBAL WAIT       1024           0
```

```
*******Wait a few moments********

SQL> SELECT group_number, operation, state, power, est_minutes
FROM v$asm_operation;

GROUP_NUMBER OPERA STAT      POWER EST_MINUTES
------------ ----- ---- ---------- -----------
           1 REBAL DONE       1024           0
           1 REBAL RUN        1024           2
           1 REBAL WAIT       1024           0

*******Wait a few moments********

SQL> SELECT group_number, operation, state, power, est_minutes
FROM v$asm_operation;

no rows selected

SQL> exit
[grid@host01 ~]$
```

8. Go to your grid terminal window and examine the disk I/O statistics using the `asmcmd lsdsk --statistics` command. Not surprisingly, the disks in the DATA disk group show the most activity.

```
[grid@host01 ~]$ asmcmd lsdsk --statistics
Reads  Write  Read_Errs  Write_Errs    Read_time    Write_Time
Bytes_Read  Bytes_Written  Voting_File  Path
 6840  22393          0           0   582.345733  56484.024116
530812928     1456355328            Y  /dev/asmdisk1p10
36235  11982          0           0   859.769323  39453.872909
869508608     1113336320            Y  /dev/asmdisk1p11
 5695   8806          0           0   459.753445  37964.154778
747701760     1387714048            Y  /dev/asmdisk1p12
 5828  11409          0           0   341.776886  43826.426401
445279232     1150704640            N  /dev/asmdisk1p3
 6859  17277          0           0   412.361881  40718.940752
434086400     1305931776            N  /dev/asmdisk1p4
 6445  13170          0           0   417.084221  56791.299622
427774976     1212386816            N  /dev/asmdisk1p5
 7084  11754          0           0   317.443469   33959.15562
342358016     1060115456            N  /dev/asmdisk1p6
33023  13362          0           0  1428.920143  33007.410328
837373952     1150667776            N  /dev/asmdisk1p7
  831  22295          0           0   297.991772  28561.556521
41459712      483681280             N  /dev/asmdisk1p8
```

```
   82   4068          0           0     6.581987    173.722826
963072      321740800            N  /dev/asmdisk1p9
   79   5449          0           0     6.109566    183.417132
25834496      311012864            N  /dev/asmdisk2p1
 2250   3349          0           0    38.469388    679.059259
39497728     1498926592            N  /dev/asmdisk2p2
[grid@host01 ~]$
```

9. Examine the disk statistics bytes and time for the DATA disk group with the `asmcmd iostat -t -G DATA` command.

```
[grid@host01 ~]$ asmcmd iostat -t -G DATA
Grp_Name Dsk_Name   Reads      Writes      Read_Time   Write_Time
DATA     DATA_0000  43880448   1501405184  43.386248   686.530418
DATA     DATA_0001  530878464  1458983936  582.389509  56486.91502
DATA     DATA_0002  877127168  1113573888  862.02442   39453.911472
DATA     DATA_0003  747922944  1387771392  461.871015  37964.15743
DATA     DATA_0005  446327808  1150819328  341.845769  43826.440187
DATA     DATA_0006  434094592  1308576768  412.470136  40721.835715
DATA     DATA_0007  427778048  1212591616  417.205455  56791.328394
DATA     DATA_0008  342472704  1060603392  318.194493  33964.683461
DATA     DATA_0009  845103104  1150815232  1438.402966 33007.42379
[grid@host01 ~]$
```

10. During this practice, we've dropped `/dev/asmdisk1p1` (DATA_0000, Step 3) and `/dev/asmdisk1p2` (DATA_0004, Step 5). We've also added `/dev/asmdisk2p2`. Execute `asmcmd lsdsk -G data -k` to confirm the dropped disks and identify the disk name assigned to `/dev/asmdisk2p2`.

```
[grid@host01 ~]$ asmcmd
ASMCMD> lsdsk -G data -k
Total_MB  Free_MB  OS_MB  Name       Failgroup  Failgroup_Type
Library  Label  UDID  Product  Redund   Path
    2745     1155   2745  DATA_0001  DATA_0001  REGULAR
System                        UNKNOWN  /dev/asmdisk1p10
    2745     1171   2745  DATA_0002  DATA_0002  REGULAR
System                        UNKNOWN  /dev/asmdisk1p11
    2565     1088   2565  DATA_0003  DATA_0003  REGULAR
System                        UNKNOWN  /dev/asmdisk1p12
    2745     1186   2745  DATA_0005  DATA_0005  REGULAR
System                        UNKNOWN  /dev/asmdisk1p3
    2745     1210   2745  DATA_0006  DATA_0006  REGULAR
System                        UNKNOWN  /dev/asmdisk1p4
    2745     1173   2745  DATA_0007  DATA_0007  REGULAR
System                        UNKNOWN  /dev/asmdisk1p5
    2745     1222   2745  DATA_0008  DATA_0008  REGULAR
System                        UNKNOWN  /dev/asmdisk1p6
```

```
    2745     1218   2745  DATA_0009  DATA_0009  REGULAR
System                          UNKNOWN  /dev/asmdisk1p7
    2627     1252   2627  DATA_0000  DATA_0000  REGULAR
System                          UNKNOWN  /dev/asmdisk2p2
[grid@host01 ~]$
```

11. Run the following SQL*Plus commands to return the DATA and DATA disk groups to the configuration at the beginning of the practice. (***Use the disk name associated with /dev/asmdisk2p2 in the DROP command***. In this example, that is DISK_0000.)

```
[grid@host01 ~]$ sqlplus / as sysasm
SQL> alter diskgroup data drop disk DATA_0000 rebalance power
1024;
Diskgroup altered.

SQL> ALTER DISKGROUP DATA ADD DISK '/dev/asmdisk1p1' REBALANCE
POWER 1024;
Diskgroup altered.

SQL> ALTER DISKGROUP DATA ADD DISK '/dev/asmdisk1p2' REBALANCE
POWER 1024;

Diskgroup altered.

SQL> exit
[grid@host01 ~]$
```

12. Close all terminal windows opened for this practice.

Practice 4-2: ASM Disk Group Space Management

Overview

In this practice you will investigate ASM disk group space management.

1. Open a terminal session from your desktop to `host01` as the `grid` user, use `oraenv` to set your environment. Use the `asmcmd lsdg` command to check the currently configured disk groups.

```
[vncuser@classroom_pc ~]$ ssh -X grid@host01
grid@host01's password:
Last login: Fri Aug 16 15:30:44 2013 from 192.0.2.1
[grid@host01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[grid@host01 ~]$ asmcmd
ASMCMD> lsdg
State    Type    Rebal  Sector  Block       AU  Total_MB
Free_MB  Req_mir_free_MB  Usable_file_MB  Offline_disks
Voting_files  Name
MOUNTED  NORMAL  N         512   4096  1048576     27270
13603             2745             5429              0
Y  DATA/
MOUNTED  EXTERN  N         512   4096  1048576      8117
7636                 0             7636              0
N  FRA/
ASMCMD> exit
[grid@host01 ~]$
```

2. Start ASMCA and create a disk group called TEST using EXTERNAL redundancy, using the three unused disks available (`asmdisk2p2`, `asmdisk2p3`, `asmdiskp4`). Exit ASMCA when finished.

```
[grid@host01 ~]$ asmca
```

3. Use the `asmcmd lsdg` command to view disk group space values for the TEST disk group. What is the total disk space in the disk group? How much is actually available?

```
[grid@host01 ~] $ asmcmd
ASMCMD> lsdg test
State   Type   Rebal Sector Block      AU Total_MB Free_MB
Req_mir_free_MB Usable_file_MB ...  Name
MOUNTED EXTERN N         512  4096 1048576     8283    8181
0           8181 ...  TEST/
ASMCMD> exit
[grid@host01 ~] $
```

The TOTAL_MB column shows that the size of the disk group is 8283 MB. Available space, shown under the Usable_file_MB column is actually 8181. In this example, 102 MB is consumed by ASM metadata for the disk group.

4. Stop the ora.TEST.dg resource and then drop the TEST disk group.

```
[grid@host01 ~]$ crsctl stop res ora.TEST.dg
CRS-2673: Attempting to stop 'ora.TEST.dg' on 'host02'
CRS-2673: Attempting to stop 'ora.TEST.dg' on 'host03'
CRS-2673: Attempting to stop 'ora.TEST.dg' on 'host01'
CRS-2677: Stop of 'ora.TEST.dg' on 'host02' succeeded
CRS-2677: Stop of 'ora.TEST.dg' on 'host03' succeeded
CRS-2677: Stop of 'ora.TEST.dg' on 'host01' succeeded

[grid@host01 ~]$ asmcmd
ASMCMD> dropdg -r -f TEST
ASMCMD> exit
[grid@host01 ~]$
```

5. Next, create a disk group called TEST2 using normal redundancy. Use the three disks available (asmdisk2p2, asmdisk2p3, asmdiskp4). Name the fail groups FGRP1, FGRP2, and FGRP3 respectively. Exit ASMCA when finished.

```
[grid@host01 ~]$ asmca
```

6. Use the asmcmd lsdg command to view space information for the TEST2 disk group. What do they mean in the context of a disk group with normal redundancy?

```
[grid@host01 ~]$ asmcmd
ASMCMD> lsdg test2
State    Type    Rebal  Sector  Block       AU  Total_MB
Free_MB  Req_mir_free_MB  Usable_file_MB  Offline_disks
Voting_files  Name
MOUNTED  NORMAL  N         512   4096  1048576      8283
7995             2761             2617              0
N  TEST2/
ASMCMD> exit
[grid@host01 ~]$
```

The TOTAL_MB column shows the sum of the total size of the member disks (8283 MB). Free_MB shows how much disk space is unused (7995 MB). Because of the disk group redundancy, this is ***not*** the usable space available. That number is shown under Useable_file_MB column (2617 MB). The value of Req_mir_free_MB (2761 MB) represents the amount of free space required for ASM to restore redundancy in the event of a failure.

7. In the previous step, we determined that `Req_mir_free_MB` is equal to 2761 MB. What is significant about that value? Execute the following SQL command: `select failgroup, total_mb, free_mb from v$asm_disk where failgroup like'FGRP%';`

```
[grid@host01 ~]$ sqlplus / as sysasm

SQL> select failgroup, total_mb, free_mb from v$asm_disk where
failgroup like'FGRP%';

FAILGROUP                       TOTAL_MB    FREE_MB
------------------------------ ---------- ----------
FGRP1                                2761       2665
FGRP3                                2761       2665
FGRP2                                2761       2665

SQL> exit

[grid@host01 ~]$
```

As you can see, the value of `Req_mir_free_MB` is 2761 MB, which is the size of a single fail group (and a single disk).

8. Open a terminal to `host01` as the `oracle` user. Set the `oracle` environment using `oraenv`.

```
[vncuser@classroom_pc ~]# ssh oracle@host01
oracle@host01's password:
[oracle@host01 ~]$ . oraenv
ORACLE_SID = [oracle] ? orcl
The Oracle base has been set to /u01/app/oracle
$
```

9. Start SQL*Plus and add a tablespace called TESTTB with a 1400 MB datafile in the TEST2 disk group.

```
$ sqlplus sys/oracle_4U@orcl as sysdba

SQL*Plus: Release 12.1.0.1.0 Production on Wed Nov 20 22:11:53
2013

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Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.1.0 -
64bit Production
```

```
With the Partitioning, Real Application Clusters, Automatic
Storage Management, OLAP,
Advanced Analytics and Real Application Testing options

SQL> create tablespace TESTTB datafile '+TEST2' size 1400m;

Tablespace created.

SQL>
```

10. Return to the grid terminal and use the `asmcmd lsdg` command to check space information for the TEST2 disk group. How much usable space is left?

```
[grid@host01 ~]$ asmcmd
ASMCMD> lsdg test2
State    Type    Rebal  Sector  Block       AU  Total_MB
Free_MB  Req_mir_free_MB  Usable_file_MB  Offline_disks
Voting_files  Name
MOUNTED  NORMAL  N         512   4096  1048576      8283
5163             2761            1201              0
N  TEST2/
ASMCMD> exit
[grid@host01 ~]$
```

The `Usable_file_MB` column shows that the available space has dropped to 1201 MB (2617 MB -1400 MB – 16 MB (for file overhead) = 1201 MB).

11. Return to the `oracle` terminal and add another 1400 MB datafile to the TESTTB tablespace. What do you think will happen?

```
SQL> alter tablespace TESTTB add datafile '+TEST2' size 1400m;

Tablespace altered.

SQL>
```

Even though `Usable_file_MB` was 1201 MB, you were able to create the datafile. ASM monitors `Usable_file_MB` only and does not stop users from exhausting the usable space.

12. Return to the `grid` terminal and use the `asmcmd lsdg` command to check space information for the TEST2 disk group once again. What does it show?

```
[grid@host01 ~]$ asmcmd
ASMCMD> lsdg test2
State    Type    Rebal  Sector  Block       AU  Total_MB
Free_MB  Req_mir_free_MB  Usable_file_MB  Offline_disks
Voting_files  Name
```

```
MOUNTED  NORMAL  N         512   4096  1048576      8283
2358             2761             -201               0
N  TEST2/
ASMCMD> exit
[grid@host01 ~]$
```

The `Usable_file_MB` column now shows a negative value, -201 MB. If a failure were to occur now, ASM would be unable to restore redundancy for the disk group. It is obviously important to monitor `Usable_file_MB` for NORMAL (or HIGH) redundancy disk groups.

13. When `Usable_file_MB` becomes negative, you should either free up adequate space or increase the size of the disk group. For this exercise, let's drop the TESTTB tablespace in the `oracle` terminal and then re-check using `asmcmd lsdg` from the `grid` terminal.

```
SQL> drop tablespace TESTTB;

Tablespace dropped.

SQL>

********SWITCH TERMINAL WINDOWS************

[grid@host01 ~]$ asmcmd lsdg test2
State    Type    Rebal  Sector  Block       AU  Total_MB
Free_MB  Req_mir_free_MB  Usable_file_MB  Offline_disks
Voting_files  Name
MOUNTED  NORMAL  N         512   4096  1048576      8283
7968             2761             2603               0
N  TEST2/
[grid@host01 ~]$
```

The `Usable_file_MB` column now shows that the available space has increased to 2603 MB.

Practice 4-3: Miscellaneous Administration Activities

Overview

In this practice you will perform various disk group administration and monitoring activities.

1. Open a terminal session from your desktop to `host01` as the `grid` user, use `oraenv` to set your environment. Make sure that the TEST2 disk group is mounted by all three ASM instances.

```
[vncuser@classroom_pc ~]$ ssh -X grid@host01
grid@host01's password:
Last login: Fri Aug 16 15:30:44 2013 from 192.0.2.1
[grid@host01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid

[grid@host01 ~]$ crsctl stat res ora.TEST2.dg
NAME=ora.TEST2.dg
TYPE=ora.diskgroup.type
TARGET=ONLINE          , ONLINE          , ONLINE
STATE=ONLINE on host01, ONLINE on host02, ONLINE on host03

[grid@host01 ~]$
```

2. Use `srvctl` to dismount the TEST2 disk group. Confirm the disk group is dismounted on all three nodes.

```
[grid@host01 ~]$ srvctl stop diskgroup -diskgroup TEST2
[grid@host01 ~]$

[grid@host01 ~]$ crsctl stat res ora.TEST2.dg -t
--------------------------------------------------------------------
Name           Target  State        Server
State details
--------------------------------------------------------------------
Local Resources
--------------------------------------------------------------------
ora.TEST2.dg
               OFFLINE OFFLINE      host01
STABLE
               OFFLINE OFFLINE      host02
STABLE
               OFFLINE OFFLINE      host03
STABLE
--------------------------------------------------------------------
[grid@host01 ~]$
```

3. Use `crsctl` to start the TEST2 disk group resource. Confirm the disk group resource is started on all three nodes.

```
[grid@host01 ~]$ crsctl start res ora.TEST2.dg
CRS-2672: Attempting to start 'ora.TEST2.dg' on 'host03'
CRS-2672: Attempting to start 'ora.TEST2.dg' on 'host01'
CRS-2672: Attempting to start 'ora.TEST2.dg' on 'host02'
CRS-2676: Start of 'ora.TEST2.dg' on 'host01' succeeded
CRS-2676: Start of 'ora.TEST2.dg' on 'host02' succeeded
CRS-2676: Start of 'ora.TEST2.dg' on 'host03' succeeded
[grid@host01 ~]$

[grid@host01 ~]$ crsctl stat res ora.TEST2.dg -t
--------------------------------------------------------------------------------
Name           Target  State        Server
State details
--------------------------------------------------------------------------------
Local Resources
--------------------------------------------------------------------------------
ora.TEST2.dg
               ONLINE  ONLINE       host01
STABLE
               ONLINE  ONLINE       host02
STABLE
               ONLINE  ONLINE       host03
STABLE
--------------------------------------------------------------------------------
[grid@host01 ~]$
```

4. Attempt to take the `FGRP1` failgroup offline. What do you observe?

```
[grid@host01 ~]$ asmcmd
ASMCMD> offline -G TEST2 -F FGRP1
ORA-15032: not all alterations performed
ORA-15283: ASM operation requires compatible.rdbms of 11.1.0.0.0
or higher (DBD ERROR: OCIStmtExecute)
ASMCMD> exit
[grid@host01 ~]$
```

It appears that `COMPATIBLE.RDBMS` value for the TEST2 disk group is lower than 11.1.0.0.0 !

5. Determine the current COMPATIBLE.RDBMS value for the TEST2 disk group. Change it to 12.1.0.0.0. Confirm the change.

```
[grid@host01 ~]$ asmcmd
ASMCMD> lsattr -G TEST2 -l compatible.rdbms
Name              Value
compatible.rdbms  10.1.0.0.0

ASMCMD> setattr -G TEST2 compatible.rdbms 12.1.0.0.0

ASMCMD> lsattr -G TEST2 -l compatible.rdbms
Name              Value
compatible.rdbms  12.1.0.0.0

ASMCMD> exit
[grid@host01 ~]$
```

6. Now, take the FGRP1 failgroup offline. Look at the operations in steps 4 and 5 that were logged in alert_+ASM1.log (look near the end of the file). What will happen to the FGRP1 failgroup if no other action is taken?

```
[grid@host01 ~]$ asmcmd
ASMCMD> offline -G TEST2 -F FGRP1
Diskgroup altered.

ASMCMD> exit

[grid@host01 grid]$ vi
/u01/app/grid/diag/asm/+asm/+ASM1/trace/alert_+ASM1.log
Mon Nov 25 22:02:24 2013
SQL> /* ASMCMD */ALTER DISKGROUP TEST2 OFFLINE DISKS IN
FAILGROUP FGRP1
Mon Nov 25 22:02:24 2013
ORA-15032: not all alterations performed
ORA-15283: ASM operation requires compatible.rdbms of 11.1.0.0.0
or higher

Mon Nov 25 22:02:24 2013
ERROR: /* ASMCMD */ALTER DISKGROUP TEST2 OFFLINE DISKS IN
FAILGROUP FGRP1
Tue Nov 26 00:41:25 2013
SQL> /* ASMCMD */ALTER DISKGROUP TEST2 SET ATTRIBUTE
'compatible.rdbms' = '12.1.0.0.0'
Tue Nov 26 00:41:29 2013
NOTE: Advancing RDBMS compatibility to 12.1.0.0.0 for grp 3
```

```
Tue Nov 26 00:41:29 2013
GMON querying group 3 at 292 for pid 37, osid 12134
Tue Nov 26 00:41:29 2013
SUCCESS: Advanced compatible.rdbms to 12.1.0.0.0 for grp 3
Tue Nov 26 00:41:29 2013
SUCCESS: /* ASMCMD */ALTER DISKGROUP TEST2 SET ATTRIBUTE
'compatible.rdbms' = '12.1.0.0.0'
Tue Nov 26 00:44:19 2013
SQL> /* ASMCMD */ALTER DISKGROUP TEST2 OFFLINE DISKS IN
FAILGROUP FGRP1
Tue Nov 26 00:44:19 2013
NOTE: DRTimer CD Create:  for disk group 3 disks:

NOTE: process _user12134_+asm1 (12134) initiating offline of
disk 0.3916273651 (TEST2_0000) with mask 0x7e in group 3 (TEST2)
without client assisting
NOTE: initiating PST update: grp 3 (TEST2), dsk = 0/0xe96d97f3,
mask = 0x6a, op = clear
Tue Nov 26 00:44:19 2013
GMON updating disk modes for group 3 at 296 for pid 37, osid
12134
WARNING: GMON has insufficient disks to maintain consensus.
minimum required is 3
NOTE: group TEST2: updated PST location: disk 0001 (PST copy 0)
NOTE: group TEST2: updated PST location: disk 0002 (PST copy 1)
Tue Nov 26 00:44:19 2013
NOTE: PST update grp = 3 completed successfully
NOTE: initiating PST update: grp 3 (TEST2), dsk = 0/0xe96d97f3,
mask = 0x7e, op = clear
Tue Nov 26 00:44:19 2013
GMON updating disk modes for group 3 at 297 for pid 37, osid
12134
NOTE: group TEST2: updated PST location: disk 0001 (PST copy 0)
NOTE: group TEST2: updated PST location: disk 0002 (PST copy 1)
Tue Nov 26 00:44:19 2013
NOTE: cache closing disk 0 of grp 3: TEST2_0000
Tue Nov 26 00:44:19 2013
NOTE: PST update grp = 3 completed successfully
NOTE: DRTimer CD Destroy: for diskgroup 3
Tue Nov 26 00:44:19 2013
SUCCESS: /* ASMCMD */ALTER DISKGROUP TEST2 OFFLINE DISKS IN
FAILGROUP FGRP1
Tue Nov 26 00:45:56 2013
```

```
WARNING: Started Drop Disk Timeout for Disk 0 (TEST2_0000) in
group 3 with a value 12960

[grid@host01 ~]
```

If failgroup FGRP1 is not brought back online in 12960 seconds (3.6 hours), Disk 0 (TEST2_0000), the sole disk belonging to the FGRP1 failgroup will be dropped. 3.6 hours is the default unless a different time is specified when the diskgroup is offlined.

7. Bring the FGRP1 failgroup online. Change the DISK_REPAIR_TIME to three minutes. Verify the change.

```
[grid@host01 ~]$ asmcmd
ASMCMD> online -G TEST2 -F FGRP1
Diskgroup altered.

ASMCMD> setattr -G TEST2 disk_repair_time 3m

ASMCMD> lsattr -G TEST2 -l disk_repair_time
Name              Value
disk_repair_time  3m

ASMCMD> exit

[grid@host01 grid]$
```

8. List the disks for disk group TEST2. Take the FGRP1 failgroup offline again. Look at the offline operation logged in alert_+ASM1.log (again, look near the end of the file). What is the Disk Drop Timeout value?

```
[grid@host01 ~]$ asmcmd
ASMCMD> lsdsk -G TEST2 -k
Total_MB  Free_MB  OS_MB  Name        Failgroup  Failgroup_Type
Library  Label  UDID  Product  Redund   Path
    2761     2623   2761  TEST2_0000  FGRP1      REGULAR
System                        UNKNOWN  /dev/asmdisk2p2
    2761     2623   2761  TEST2_0001  FGRP2      REGULAR
System                        UNKNOWN  /dev/asmdisk2p3
    2761     2623   2761  TEST2_0002  FGRP3      REGULAR
System                        UNKNOWN  /dev/asmdisk2p4

ASMCMD> offline -G TEST2 -F FGRP1
Diskgroup altered.

ASMCMD> exit
```

```
[grid@host01 ~]$ vi
/u01/app/grid/diag/asm/+asm/+ASM1/trace/alert_+ASM1.log


Tue Nov 26 14:31:03 2013
SQL> /* ASMCMD */ALTER DISKGROUP TEST2 SET ATTRIBUTE
'disk_repair_time' = '3m'
Tue Nov 26 14:31:03 2013
SUCCESS: /* ASMCMD */ALTER DISKGROUP TEST2 SET ATTRIBUTE
'disk_repair_time' = '3m'
Tue Nov 26 14:51:06 2013
SQL> /* ASMCMD */ALTER DISKGROUP TEST2 OFFLINE DISKS IN
FAILGROUP FGRP1
Tue Nov 26 14:51:06 2013
NOTE: DRTimer CD Create:  for disk group 3 disks:


NOTE: process _user28455_+asm1 (28455) initiating offline of
disk 0.3916273655 (TEST2_0000) with mask 0x7e in group 3 (TEST2)
without client assisting
NOTE: initiating PST update: grp 3 (TEST2), dsk = 0/0xe96d97f7,
mask = 0x6a, op = clear
Tue Nov 26 14:51:06 2013
GMON updating disk modes for group 3 at 337 for pid 37, osid
28455
WARNING: GMON has insufficient disks to maintain consensus.
minimum required is 3
NOTE: group TEST2: updated PST location: disk 0001 (PST copy 0)
NOTE: group TEST2: updated PST location: disk 0002 (PST copy 1)
Tue Nov 26 14:51:06 2013
NOTE: PST update grp = 3 completed successfully
NOTE: initiating PST update: grp 3 (TEST2), dsk = 0/0xe96d97f7,
mask = 0x7e, op = clear
Tue Nov 26 14:51:06 2013
GMON updating disk modes for group 3 at 338 for pid 37, osid
28455
NOTE: group TEST2: updated PST location: disk 0001 (PST copy 0)
NOTE: group TEST2: updated PST location: disk 0002 (PST copy 1)
Tue Nov 26 14:51:06 2013
NOTE: cache closing disk 0 of grp 3: TEST2_0000
Tue Nov 26 14:51:06 2013
NOTE: PST update grp = 3 completed successfully
NOTE: DRTimer CD Destroy: for diskgroup 3
Tue Nov 26 14:51:06 2013
SUCCESS: /* ASMCMD */ALTER DISKGROUP TEST2 OFFLINE DISKS IN
FAILGROUP FGRP1
Tue Nov 26 14:51:28 2013
```

```
WARNING: Started Drop Disk Timeout for Disk 0 (TEST2_0000) in
group 3 with a value 180
WARNING: Disk 0 (TEST2_0000) in group 3 will be dropped in:
(180) secs on ASM inst 1

[grid@host01 ~]$
```

The Disk Drop Timeout is 180 seconds (3 minutes).

9. Wait three minutes. List the disks belonging to the TEST2 disk group and verify that the failgroup FGRP1 disk, `TEST2_0000` has been dropped. Look at the disk drop operation logged in `alert_+ASM1.log`.

```
[grid@host01 ~]$ asmcmd
ASMCMD> lsdsk -G TEST2 -k
Total_MB  Free_MB  OS_MB  Name        Failgroup  Failgroup_Type
Library  Label  UDID  Product  Redund   Path
    2761     2617   2761  TEST2_0001  FGRP2      REGULAR
System                        UNKNOWN  /dev/asmdisk2p3
    2761     2617   2761  TEST2_0002  FGRP3      REGULAR
System                        UNKNOWN  /dev/asmdisk2p4

ASMCMD> exit

[grid@host01 ~]$ vi
/u01/app/grid/diag/asm/+asm/+ASM1/trace/alert_+ASM1.log
Tue Nov 26 14:51:28 2013
WARNING: Started Drop Disk Timeout for Disk 0 (TEST2_0000) in
group 3 with a value 180
WARNING: Disk 0 (TEST2_0000) in group 3 will be dropped in:
(180) secs on ASM inst 1
Tue Nov 26 14:54:32 2013
WARNING: Disk 0 (TEST2_0000) in group 3 will be dropped in: (0)
secs on ASM inst 1
WARNING: PST-initiated drop of 1 disk(s) in group 3(.483223299))
Tue Nov 26 14:54:32 2013
SQL> alter diskgroup TEST2 drop disk TEST2_0000 force /* ASM
SERVER */
NOTE: GroupBlock outside rolling migration privileged region
NOTE: requesting all-instance membership refresh for group=3
Tue Nov 26 14:54:32 2013
GMON updating for reconfiguration, group 3 at 340 for pid 40,
osid 28517
Tue Nov 26 14:54:32 2013
NOTE: cache closing disk 0 of grp 3: (not open) TEST2_0000
NOTE: group TEST2: updated PST location: disk 0001 (PST copy 0)
```

```
NOTE: group TEST2: updated PST location: disk 0002 (PST copy 1)
Tue Nov 26 14:54:32 2013
NOTE: group 3 PST updated.
Tue Nov 26 14:54:32 2013
NOTE: membership refresh pending for group 3/0x1ccd6703 (TEST2)
Tue Nov 26 14:54:32 2013
GMON querying group 3 at 341 for pid 22, osid 3459
Tue Nov 26 14:54:32 2013
NOTE: cache closing disk 0 of grp 3: (not open)
_DROPPED_0000_TEST2
Tue Nov 26 14:54:32 2013
SUCCESS: refreshed membership for 3/0x1ccd6703 (TEST2)
Tue Nov 26 14:54:32 2013
SUCCESS: alter diskgroup TEST2 drop disk TEST2_0000 force /* ASM
SERVER */
Tue Nov 26 14:54:32 2013
SUCCESS: PST-initiated drop disk in group 3(483223299))
Tue Nov 26 14:54:33 2013
NOTE: Attempting voting file refresh on diskgroup TEST2
Tue Nov 26 14:54:33 2013
NOTE: starting rebalance of group 3/0x1ccd6703 (TEST2) at power
1
Starting background process ARB0
Tue Nov 26 14:54:33 2013
ARB0 started with pid=41, OS id=28625
NOTE: assigning ARB0 to group 3/0x1ccd6703 (TEST2) with 1
parallel I/O
Tue Nov 26 14:54:33 2013
NOTE: 11/26/13 14:54:33 TEST2.F1X0 copy 3 relocating from 0:143
to 65534:4294967294 at FCN 0.19867
NOTE: F1B1 fcn on disk 2 synced at fcn 0.19867
NOTE: F1B1 fcn on disk 1 synced at fcn 0.19867
Tue Nov 26 14:54:41 2013
NOTE: stopping process ARB0
Tue Nov 26 14:54:41 2013
NOTE: GroupBlock outside rolling migration privileged region
NOTE: requesting all-instance membership refresh for group=3
Tue Nov 26 14:54:42 2013
SUCCESS: rebalance completed for group 3/0x1ccd6703 (TEST2)
Tue Nov 26 14:54:42 2013
GMON updating for reconfiguration, group 3 at 342 for pid 42,
osid 28636
Tue Nov 26 14:54:42 2013
```

```
NOTE: cache closing disk 0 of grp 3: (not open)
_DROPPED_0000_TEST2
NOTE: group TEST2: updated PST location: disk 0001 (PST copy 0)
NOTE: group TEST2: updated PST location: disk 0002 (PST copy 1)
Tue Nov 26 14:54:42 2013
NOTE: group 3 PST updated.
SUCCESS: grp 3 disk _DROPPED_0000_TEST2 going offline
Tue Nov 26 14:54:42 2013
GMON updating for reconfiguration, group 3 at 343 for pid 42,
osid 28636
Tue Nov 26 14:54:42 2013
NOTE: cache closing disk 0 of grp 3: (not open)
_DROPPED_0000_TEST2
NOTE: group TEST2: updated PST location: disk 0001 (PST copy 0)
NOTE: group TEST2: updated PST location: disk 0002 (PST copy 1)
Tue Nov 26 14:54:42 2013
NOTE: group 3 PST updated.
Tue Nov 26 14:54:42 2013
NOTE: membership refresh pending for group 3/0x1ccd6703 (TEST2)
Tue Nov 26 14:54:42 2013
GMON querying group 3 at 344 for pid 22, osid 3459
GMON querying group 3 at 345 for pid 22, osid 3459
Tue Nov 26 14:54:42 2013
NOTE: Disk _DROPPED_0000_TEST2 in mode 0x0 marked for de-
assignment
SUCCESS: refreshed membership for 3/0x1ccd6703 (TEST2)
NOTE: Attempting voting file refresh on diskgroup TEST2

[grid@host01 ~]$
```

10. Add disk `/dev/asmdisk2p2` back to the TEST2 disk group. Name the failgroup FGRP1.Verify that the disk has been successful added.

```
[grid@host01 ~]$ asmcmd

ASMCMD> chdg '<chdg name="test2"> <add><fg name="FGRP1"><dsk
string="/dev/asmdisk2p2" force="true"/></fg></add></chdg>'
Diskgroup altered.

ASMCMD> lsdsk -G TEST2 -k
Total_MB  Free_MB  OS_MB  Name        Failgroup  Failgroup_Type
Library  Label  UDID  Product  Redund   Path
    2761     2617   2761  TEST2_0000  FGRP1      REGULAR
System                        UNKNOWN  /dev/asmdisk2p2
```

```
    2761     2617   2761  TEST2_0001  FGRP2       REGULAR
System                          UNKNOWN  /dev/asmdisk2p3
    2761     2617   2761  TEST2_0002  FGRP3       REGULAR
System                          UNKNOWN  /dev/asmdisk2p4

ASMCMD> exit
[grid@host01 ~]$
```

11. Use `crsctl` to stop the TEST2 disk group resource. Drop the TEST2 disk group.

```
[grid@host01 ~]$ crsctl stop res ora.TEST2.dg
CRS-2673: Attempting to stop 'ora.TEST2.dg' on 'host02'
CRS-2673: Attempting to stop 'ora.TEST2.dg' on 'host03'
CRS-2673: Attempting to stop 'ora.TEST2.dg' on 'host01'
CRS-2677: Stop of 'ora.TEST2.dg' on 'host02' succeeded
CRS-2677: Stop of 'ora.TEST2.dg' on 'host01' succeeded
CRS-2677: Stop of 'ora.TEST2.dg' on 'host03' succeeded

[grid@host01 ~]$ asmcmd

ASMCMD> dropdg -r -f TEST2

ASMCMD> exit

[grid@host01 ~]$
```

12. Close all terminal windows opened for this practice.

Practices for Lesson 5: Administering ASM Files, Directories, and Templates

Chapter 5

Practices for Lesson 5: Overview

Practices Overview

In this practice, you will administer ASM files, directories, and templates.

Practice 5-1: Administering ASM Files, Directories, and Templates

Overview

In this practice, you use several tools to navigate the ASM file hierarchy, manage aliases, manage templates, and move files to different disk regions.

1. ASM is designed to hold database files in a hierarchical structure. Open a terminal session to `host01` as the `grid` user. After setting up the `grid` environment, navigate the orcl database files with ASMCMD.

```
[vncuser@classroom_pc ~]$ ssh grid@host01
grid@host01's password:
Last login: Mon Aug 26 15:56:29 2013 from 192.0.2.1
[grid@host01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid

[grid@host01 ~]$ asmcmd
ASMCMD> ls
DATA/
FRA/

ASMCMD> ls DATA
ASM/
ORCL/
cluster01/
orapwasm

ASMCMD> ls -l DATA/ORCL/*
Type           Redund  Striped  Time             Sys  Name

+DATA/ORCL/CONTROLFILE/:
CONTROLFILE    HIGH    FINE     AUG 23 05:00:00  Y
Current.262.824187693

+DATA/ORCL/DATAFILE/:
DATAFILE       MIRROR  COARSE   AUG 23 22:00:00  Y
EXAMPLE.266.824187847
DATAFILE       MIRROR  COARSE   AUG 26 17:00:00  Y
SYSAUX.258.824187411
DATAFILE       MIRROR  COARSE   AUG 23 22:00:00  Y
SYSTEM.259.824187525
DATAFILE       MIRROR  COARSE   AUG 23 05:00:00  Y
UNDOTBS1.261.824187643
DATAFILE       MIRROR  COARSE   AUG 23 22:00:00  Y
UNDOTBS2.267.824188979
```

```
DATAFILE        MIRROR  COARSE   AUG 25 06:00:00  Y
UNDOTBS3.268.824188993
DATAFILE        MIRROR  COARSE   AUG 23 05:00:00  Y
USERS.260.824187641

+DATA/ORCL/ONLINELOG/:
ONLINELOG       MIRROR  COARSE   AUG 23 05:00:00  Y
group_1.263.824187703
ONLINELOG       MIRROR  COARSE   AUG 23 05:00:00  Y
group_2.264.824187715
ONLINELOG       MIRROR  COARSE   AUG 23 05:00:00  Y
group_3.271.824189357
ONLINELOG       MIRROR  COARSE   AUG 23 05:00:00  Y
group_4.272.824189383
ONLINELOG       MIRROR  COARSE   AUG 23 05:00:00  Y
group_5.269.824189293
ONLINELOG       MIRROR  COARSE   AUG 23 05:00:00  Y
group_6.270.824189323

+DATA/ORCL/PARAMETERFILE/:
PARAMETERFILE   MIRROR  COARSE   AUG 25 22:00:00  Y
spfile.273.824189413

+DATA/ORCL/PASSWORD/:
PASSWORD        HIGH    COARSE   AUG 23 04:00:00  Y
pwdorcl.257.824187367

+DATA/ORCL/TEMPFILE/:
TEMPFILE        MIRROR  COARSE   AUG 25 06:00:00  Y
TEMP.265.824187763
PASSWORD        HIGH    COARSE   AUG 23 04:00:00  N    orapworcl
=> +DATA/ORCL/PASSWORD/pwdorcl.257.824187367
PARAMETERFILE   MIRROR  COARSE   AUG 25 22:00:00  N
spfileorcl.ora => +DATA/ORCL/PARAMETERFILE/spfile.273.824189413

ASMCMD>
```

2. The default structure may not be the most useful for some sites. Create a set of aliases for directories and files to match a file system. Let's create a directory called `oradata` under `+DATA/ORCL` . Use ASMCMD to do this.

```
ASMCMD> ls +DATA/ORCL
CONTROLFILE/
DATAFILE/
ONLINELOG/
PARAMETERFILE/
```

```
PASSWORD/
TEMPFILE/
orapworcl
spfileorcl.ora

ASMCMD> mkdir +DATA/ORCL/oradata

ASMCMD> ls +DATA/ORCL
CONTROLFILE/
DATAFILE/
ONLINELOG/
PARAMETERFILE/
PASSWORD/
TEMPFILE/
oradata/
orapworcl
spfileorcl.ora
ASMCMD>
```

3. Use ASMCMD to create an alias called `example_01.dbf` in the `oradata` folder for the EXAMPLE datafile in `+DATA/ORCL/DATAFILE`. List the alias when finished. View the file attributes.

```
ASMCMD> ls -l DATA/ORCL/DATAFILE
Type      Redund  Striped  Time             Sys  Name
DATAFILE  MIRROR  COARSE   AUG 29 09:00:00  Y
EXAMPLE.276.824711595
DATAFILE  MIRROR  COARSE   AUG 29 16:00:00  Y
SYSAUX.282.824711255
DATAFILE  MIRROR  COARSE   AUG 29 09:00:00  Y
SYSTEM.281.824711341
DATAFILE  MIRROR  COARSE   AUG 29 09:00:00  Y
UNDOTBS1.275.824711417
DATAFILE  MIRROR  COARSE   AUG 29 09:00:00  Y
UNDOTBS2.284.824712401
DATAFILE  MIRROR  COARSE   AUG 29 09:00:00  Y
UNDOTBS3.268.824712405
DATAFILE  MIRROR  COARSE   AUG 29 09:00:00  Y
USERS.280.824711417

ASMCMD> mkalias DATA/ORCL/DATAFILE/EXAMPLE.276.824711595
DATA/ORCL/oradata/example_01.dbf

ASMCMD> ls -l DATA/ORCL/oradata
Type      Redund  Striped  Time             Sys  Name
```

```
DATAFILE  MIRROR  COARSE   AUG 29 09:00:00  N    example_01.dbf
=> +DATA/ORCL/DATAFILE/EXAMPLE.276.824711595
ASMCMD>
```

4. Open a terminal session from your desktop to `host01` as the `oracle` user. Determine the instance name running on `host01` and set the environment. Create a new tablespace called XYZ. Use SQL*Plus to create the tablespace with a system generated datafile name. Determine the orcl instance running on `host01` and set the environment before starting.

```
[vncuser@classroom_pc ~]$ ssh oracle@host01
oracle@host01's password:
Last login: Thu Aug 29 06:14:28 2013 from 192.0.2.1

[oracle@host01 ~]$ $ pgrep -l ora_pmon
14578 ora_pmon_orcl_3

[oracle@host01 ~]$ export ORACLE_SID=orcl_3
[oracle@host01 ~]$ export
ORACLE_HOME=/u01/app/oracle/product/12.1.0/dbhome_1
[oracle@host01 ~]$ export PATH=$PATH:$ORACLE_HOME/bin

[oracle@host01 ~]$ sqlplus / as sysdba

SQL> CREATE TABLESPACE XYZ DATAFILE '+data' SIZE 200M;

Tablespace created.

SQL>
```

5. Return to the `grid` terminal and inspect the attributes of the XYZ tablespace datafile.

```
ASMCMD> ls -l --absolutepath data/orcl/datafile/XYZ*
Type      Redund  Striped  Time             Sys  Name
DATAFILE  MIRROR  COARSE   AUG 29 17:00:00  Y    none =>
XYZ.287.824751261
ASMCMD>
```

6. Create another data file for the XYZ tablespace. Name the new datafile `DATA/ORCL/ORADATA/XYZ_01.dbf`.

```
SQL> alter tablespace XYZ add datafile
'+data/orcl/oradata/XYZ_01.dbf' SIZE 200M;

Tablespace altered.
```

```
SQL>
```

7. Did both of the datafiles get system-assigned names? Exit ASMCMD when finished.

```
ASMCMD> ls -l --absolutepath data/orcl/oradata/XYZ*
Type      Redund  Striped  Time             Sys  Name
DATAFILE  MIRROR  COARSE   AUG 29 18:00:00  N    XYZ_01.dbf =>
+DATA/ORCL/DATAFILE/XYZ.288.824754301

ASMCMD> ls -l --absolutepath data/orcl/datafile/XYZ*
Type      Redund  Striped  Time             Sys  Name
DATAFILE  MIRROR  COARSE   AUG 29 17:00:00  Y    none =>
XYZ.287.824751261
DATAFILE  MIRROR  COARSE   AUG 29 18:00:00  Y
+DATA/ORCL/oradata/XYZ_01.dbf => XYZ.288.824754301

ASMCMD> exit
[grid@host01 ~]$
```

8. Next, go to your `grid` terminal and start a SQL session. The default value of `compatible.rdbms` is 10.1. It must be changed to 11.2 or better to complete the operation for the next step.

```
[grid@host01 ~]$ sqlplus / as sysasm
...
SQL> alter diskgroup data set attribute 'compatible.rdbms' =
'12.1';

Diskgroup altered.

SQL>
```

9. Now, move the files for the XYZ tablespace to the hot region of the DATA disk group. Use the SQL session in your `oracle` terminal. Use the absolute filenames listed in step 7.

```
SQL> alter diskgroup data modify file
'+data/orcl/datafile/XYZ.288.824754301'
attribute ( HOT MIRRORHOT );

Diskgroup altered.

SQL> alter diskgroup data modify file
'+data/orcl/datafile/XYZ.287.824751261'
attribute ( HOT MIRRORHOT );

Diskgroup altered.

SQL>
```

10. Run the `/stage/ASM/labs/less_05/region_query.sql` query from your `oracle` SQL session to view the attribute changes for the XYZ data files.

```
SQL> !cat /stage/ASM/labs/less_05/region_query.sql
column diskgroup format a9
column name format a40
SELECT dg.name AS diskgroup, f.file_number, f.primary_region,
f.mirror_region
FROM V$ASM_DISKGROUP dg, V$ASM_FILE f
WHERE dg.group_number = f.group_number and dg.name = 'DATA';

SQL> @/stage/ASM/labs/less_05/region_query.sql

DISKGROUP FILE_NUMBER PRIM MIRR
--------- ----------- ---- ----
DATA              253 COLD COLD
DATA              255 COLD COLD
DATA              256 COLD COLD
DATA              257 COLD COLD
DATA              258 COLD COLD
DATA              259 COLD COLD
DATA              260 COLD COLD
DATA              261 COLD COLD
DATA              262 COLD COLD
DATA              263 COLD COLD
DATA              264 COLD COLD

DISKGROUP FILE_NUMBER PRIM MIRR
--------- ----------- ---- ----
DATA              265 COLD COLD
DATA              266 COLD COLD
DATA              267 COLD COLD
DATA              268 COLD COLD
DATA              269 COLD COLD
DATA              270 COLD COLD
DATA              271 COLD COLD
DATA              272 COLD COLD
DATA              273 COLD COLD
DATA              274 COLD COLD
DATA              275 COLD COLD

DISKGROUP FILE_NUMBER PRIM MIRR
--------- ----------- ---- ----
```

```
DATA                276 COLD COLD
DATA                277 COLD COLD
DATA                278 COLD COLD
DATA                279 COLD COLD
DATA                280 COLD COLD
DATA                281 HOT  HOT
DATA                282 HOT  HOT

29 rows selected.

SQL>
```

11. Create a template that changes the default placement of files created in the DATA diskgroup to the hot region. Use the SQL session open in your `grid` terminal. Exit SQL when finished.

```
SQL> alter diskgroup data ADD TEMPLATE HOT_FILES
  2  ATTRIBUTE (HOT MIRRORHOT);

Diskgroup altered.

SQL> exit
[grid@host01 ~]$
```

12. Add another data file to the XYZ tablespace using the template. Was the file placed in the HOT region? Verify the new file is placed correctly.

```
SQL> alter tablespace XYZ add datafile '+data(HOT_FILES)' SIZE
200M;

Tablespace altered.

SQL> @/stage/ASM/labs/less_05/region_query.sql

DISKGROUP FILE_NUMBER PRIM MIRR
--------- ----------- ---- ----
DATA                253 COLD COLD
DATA                255 COLD COLD
DATA                256 COLD COLD
DATA                257 COLD COLD
DATA                258 COLD COLD
DATA                259 COLD COLD
DATA                260 COLD COLD
DATA                261 COLD COLD
DATA                262 COLD COLD
DATA                263 COLD COLD
```

```
DATA                264 COLD COLD

DISKGROUP FILE_NUMBER PRIM MIRR
--------- ----------- ---- ----
DATA                265 COLD COLD
DATA                266 COLD COLD
DATA                267 COLD COLD
DATA                268 COLD COLD
DATA                269 COLD COLD
DATA                270 COLD COLD
DATA                271 COLD COLD
DATA                272 COLD COLD
DATA                273 COLD COLD
DATA                274 COLD COLD
DATA                275 COLD COLD

DISKGROUP FILE_NUMBER PRIM MIRR
--------- ----------- ---- ----
DATA                276 COLD COLD
DATA                277 COLD COLD
DATA                278 COLD COLD
DATA                279 COLD COLD
DATA                280 COLD COLD
DATA                281 HOT  HOT
DATA                282 HOT  HOT
DATA                283 HOT  HOT

30 rows selected.
SQL>
```

13. Create a large table in the XYZ tablespace called CUST_COPY by executing the `cr_cust_copy.sql` script. This script makes a copy of the SH.CUSTOMERS table into the XYZ tablespace. Use the SQL session open in your `oracle` terminal.

```
SQL> !cat /stage/ASM/labs/less_05/cr_cust_copy.sql
/* create a copy of the SH.customers table in the XYZ tablespace */
/* force some I/O so hot and cold region stats can be viewed */

SET ECHO ON

CREATE TABLE Cust_copy TABLESPACE XYZ AS
SELECT * FROM SH.CUSTOMERS;

SQL> @/stage/ASM/labs/less_05/cr_cust_copy.sql
```

```
SQL>
SQL> CREATE TABLE Cust_copy TABLESPACE XYZ AS
  2  SELECT * FROM SH.CUSTOMERS;

Table created.
SQL>
```

14. Query the new table. Select all the rows to force some read activity with the command: `SELECT * FROM CUST_COPY`. Use the `SET PAGESIZE 300` command to speed up the display processing.

```
SQL> SET PAGESIZE 300
SQL> SELECT * FROM CUST_COPY;
... /* rows removed */
    100055 Andrew               Clark
F
              1978 Married              77 Cumberland Avenue
74673      Duncan                                 51402
SC                                                        52722
52790
260-755-4130             J: 190,000 - 249,999
11000
Clark@company.com              Customer total         52772
01-JAN-98           A



55500 rows selected.
SQL>
```

15. View the I/O statistics by region using ASMCMD from your `grid` terminal. Run the `io_stats.sql` script from your `oracle` terminal for a slightly different perspective.

```
[grid@host01 ~]$ asmcmd
ASMCMD> iostat --io --region -G DATA
Group_Name  Dsk_Name   Reads   Writes  Cold_Reads  Cold_Writes
Hot_Reads  Hot_Writes
DATA        DATA_0001  10946   40938   7829        26083
8          2
DATA        DATA_0002  139909  29537   137560      16709
7          31
DATA        DATA_0003  8936    20428   6897        13656
0          0
DATA        DATA_0004  2790    34353   2255        31473
8          5
DATA        DATA_0005  9321    23633   7391        14876
8          10
```

```
DATA         DATA_0006  64882   56026   63183        49687
17          15
DATA         DATA_0007  9576    23789   7833         15398
5           5
DATA         DATA_0008  10569   24576   9036         14661
21          25
DATA         DATA_0009  119301  30699   116486       16541
0           21
DATA         DATA_0010  3654    35445   3181         32190
8           6
ASMCMD>

*** Switch to oracle terminal****

SQL> !cat /stage/ASM/labs/less_05/io_stats.sql
column file_number heading 'FILE#' format 999
column diskgroup heading 'DSKGRP' format a6
column hot_reads heading 'H READS' format 9999999
column hot_writes heading 'H WRITES' format 9999999
column cold_reads heading 'C READS' format 9999999
column cold_writes heading 'C WRITES' format 9999999
column name format a40
SELECT dg.name AS diskgroup, f.file_number, f.primary_region,
f.mirror_region, f.hot_reads,f.hot_writes, f.cold_reads,
f.cold_writes
FROM V$ASM_DISKGROUP dg, V$ASM_FILE f
WHERE dg.group_number = f.group_number and dg.name = 'DATA';

SQL> @/stage/ASM/labs/less_05/io_stats.sql

DSKGRP FILE# PRIM MIRR H READS H WRITES C READS C WRITES
------ ----- ---- ---- ------- -------- ------- --------
DATA     253 COLD COLD       0        0       0        0
DATA     255 COLD COLD       0        0       0        0
DATA     256 COLD COLD       0        0       0        0
DATA     257 COLD COLD       0        0       0        0
DATA     258 COLD COLD       0        0       0        0
DATA     259 COLD COLD       0        0       0        0
DATA     260 COLD COLD       0        0       0        0
DATA     261 COLD COLD       0        0       0        0
DATA     262 COLD COLD       0        0       0        0
DATA     263 COLD COLD       0        0       0        0
DATA     264 COLD COLD       0        0       0        0

DSKGRP FILE# PRIM MIRR H READS H WRITES C READS C WRITES
```

```
------ ----- ---- ---- ------- -------- ------- --------
DATA     265 COLD COLD       0        0       0        0
DATA     266 COLD COLD       0        0       0        0
DATA     267 COLD COLD       0        0       0        0
DATA     268 COLD COLD       0        0       0        0
DATA     269 COLD COLD       0        0       0        0
DATA     270 COLD COLD       0        0       0        0
DATA     271 COLD COLD       0        0       0        0
DATA     272 COLD COLD       0        0       0        0
DATA     273 COLD COLD       0        0       0        0
DATA     274 COLD COLD       0        0       0        0
DATA     275 COLD COLD       0        0       0        0

DSKGRP FILE# PRIM MIRR H READS H WRITES C READS C WRITES
------ ----- ---- ---- ------- -------- ------- --------
DATA     276 COLD COLD       0        0       0        0
DATA     277 COLD COLD       0        0       0        0
DATA     278 COLD COLD       0        0       0        0
DATA     279 COLD COLD       0        0       0        0
DATA     280 COLD COLD       0        0       0        0
DATA     281 HOT  HOT       45       30       0        0
DATA     282 HOT  HOT       37       40       0        0
DATA     283 HOT  HOT       66       46       0        0

30 rows selected.

SQL>
```

16. From the `oracle` terminal, drop the tablespaces and templates created in this practice using the `drop_XYZ.sql` script. Exit all terminal windows opened for this practice when finished.

```
SQL> !cat /stage/ASM/labs/less_05/drop_XYZ.sql
cat: cat: No such file or directory
/* reset the changesmade in practice 5  */
/* drop tabespace XYZ includung contents and datafiles */
/* drop the HOT_FILES template */

SET ECHO ON

DROP TABLESPACE XYZ INCLUDING CONTENTS AND DATAFILES;

EXIT;
```

```
SQL> @/stage/ASM/labs/less_05/drop_XYZ.sql

SQL> DROP TABLESPACE XYZ INCLUDING CONTENTS AND DATAFILES;

Tablespace dropped.

SQL> alter diskgroup data drop template HOT_FILES;

Diskgroup altered.

SQL> exit
Disconnected from Oracle Database 12c Enterprise Edition Release
12.1.0.1.0 - 64bit Production
With the Partitioning, Real Application Clusters, Automatic
Storage Management, OLAP,
Advanced Analytics and Real Application Testing options
[oracle@host01 ~]$
```

17. Close all terminal windows opened for this practice.

Practices for Lesson 6: Administering Oracle CloudFS

Chapter 6

Practices for Lesson 6: Overview

Practices Overview

In this practice you will create, register, and mount an ACFS file system. In addition, you will manage ACFS snapshots.

Practice 6-1: Managing ACFS

Overview

In this practice, you will create, register, and mount an ACFS file system for general use. You will see the acfs modules that are loaded for ACFS. You willcreate, use, and manage ACFS snapshots.

1. Open a terminal window on your first node and become the `root` user. Set the environment for ASM. Use the `lsmod` command to list the currently loaded modules. Use the `grep` command to display only the modules that have the ora string in them. Note the first three modules in the list below. These modules are required to enable ADVM and ACFS. The oracleasm module is loaded to enable ASMlib management of the ASM disks. Check all three nodes.

```
[vncuser@classroom_pc ~] $ ssh root@host01
Password: <oracle>

[root@host01 ~]# . oraenv
ORACLE_SID = [root] ? +ASM1
The Oracle base has been set to /u01/app/grid
[root@host01 ~]#

/* on host01 */

[root@host01]# lsmod | grep ora
oracleacfs           3053229  0
oracleadvm            320180  2
oracleoks             417171  2 oracleacfs,oracleadvm
[root@host01 ~]#

  /* on host02 */
[root@host01]# ssh host02 lsmod | grep ora
oracleacfs           3053229  0
oracleadvm            320180  2
oracleoks             417171  2 oracleacfs,oracleadvm
[root@host01 ~]#

/* on host03 */

[root@host01 ~]# ssh host03 lsmod | grep ora
oracleacfs           3053229  0
oracleadvm            320180  2
oracleoks             417171  2 oracleacfs,oracleadvm
[root@host01 ~]#
```

2. Scenario: Your database application creates a number of image files stored as BFILES and external tables. These must be stored on a shared resource. An ACFS file system meets that requirement. First, create an ASM disk group strictly for ACFS volumes. Create an ASM volume and the ACFS file system. The ACFS volume should be 3 GB on the ACFS disk group. The mount point should be `/u01/app/oracle/asfcmounts/images`. These operations can be done with ASMCA, ASMCMD, or SQL*Plus. The ASMCMD solution is shown here.
   a. Open a terminal window on your first node as the grid user and set the environment and start ASMCA.

```
[vncuser@classroom_pc ~] $ ssh -X grid@host01
Password: <oracle>

[grid@host01]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[grid@host01]$ asmca
```

   b. From the grid terminal window, use ASMCA to create a disk group called ACFS.

```
[grid@host01]$ asmca
```

Step	Screen/Page Description	Choices or Values
a.	Disk Groups	Click Create.
b.	Create Disk Group	Enter ACFS in the Disk Group Name field. Ensure Normal for the redundancy level is selected as default. Select `/dev/asmdisk2p2 and /dev/asmdisk2p3`. Click Show Advanced Options and ensure ASM Compatibility is set to 12.1.0.0.0 and and set ADVM Compatibility to 12.1.0.0.0. Click OK.
c.	Disk Groups	Check that ACFS is mounted on all three nodes, then exit ASMCA.

   c. Next, create a volume called IMAGES. Click the Volumes folder tab, and then click Create. Enter IMAGES in the Volume Name field. Enter 2 G Bytes in the Size field. Click OK. When the operation has completed, click OK on the Volume: Creation dialog box.
   d. Next, you will create an ACFS file system using the newly created volume. Take notice of the Volume Device displayed on the Volumes folder tab of ASMCA. In this example, the device is `/dev/asm/images-387`. Your name will likely be slightly different.
   e. Click the ASM Cluster File Systems tab and then click Create. Enter `/u01/app/oracle/acfsmount/images` in the Mount Point field. Enter `oracle` in the username field and `dba` in the Group Name field. Make sure the correct device is displayed in the Select Volume name field. Click Ok.
   f. You will be prompted to run the `/u01/app/grid/cfgtoollogs/asmca/scripts/acfs_script.sh` script as the

`root` user. Go to the `root` terminal and take a moment to inspect the contents of the script. Execute it when ready.

```
[root@host01 ~]# cat
/u01/app/grid/cfgtoollogs/asmca/scripts/acfs_script.sh

#!/bin/sh

/u01/app/12.1.0/grid/bin/srvctl add filesystem -d /dev/asm/images-
387 -m /u01/app/oracle/acfsmount/images  -u oracle -fstype ACFS -
autostart ALWAYS
if [ $? = "0" -o $? = "2" ]; then
   /u01/app/12.1.0/grid/bin/srvctl start filesystem -d
/dev/asm/images-387
   if [ $? = "0" ]; then
      chown oracle:dba /u01/app/oracle/acfsmount/images
      chmod 775 /u01/app/oracle/acfsmount/images
      /u01/app/12.1.0/grid/bin/srvctl status filesystem -d
/dev/asm/images-387
      exit 0
   fi
   /u01/app/12.1.0/grid/bin/srvctl status filesystem -d
/dev/asm/images-387
fi

[root@host01 ~]#
/u01/app/grid/cfgtoollogs/asmca/scripts/acfs_script.sh

ACFS file system /u01/app/oracle/acfsmount/images is mounted on
nodes host01,host02,host03

[root@host01 ~]#
```

g. Click Close on the Run ACFS Script dialog box. Click Exit to quit ASMCA.

3. As the `grid` user, use the `crsctl` command to inspect the resource created for the new ACFS file system. Make sure it is mounted on all three nodes.

```
[grid@host01 ~]$ crsctl stat res -t
--------------------------------------------------------------------
Name           Target  State        Server                   State
details
--------------------------------------------------------------------
Local Resources
--------------------------------------------------------------------
ora.ACFS.IMAGES.advm
               ONLINE  ONLINE       host01                   Volume
device /dev/asm/images-387 is online,STABLE
               ONLINE  ONLINE       host02                   Volume
device /dev/asm/images-387 is online,STABLE
               ONLINE  ONLINE       host03                   Volume
device /dev/asm/images-387 is onlne,STABLE
```

```
ora.ACFS.dg
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.ASMNET1LSNR_ASM.lsnr
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.DATA.dg
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.FRA.dg
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.LISTENER.lsnr
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.LISTENER_LEAF.lsnr
               OFFLINE OFFLINE      host04                   STABLE
               OFFLINE OFFLINE      host05                   STABLE
ora.acfs.images.acfs
               ONLINE  ONLINE       host01                   mounted
                          on /u01/app/oracle/acfsmount/images,STABLE
               ONLINE  ONLINE       host02                   mounted
                          on /u01/app/oracle/acfsmount/images,STABLE
               ONLINE  ONLINE       host03                   mounted
                          on /u01/app/oracle/acfsmount/images,STABLE
ora.net1.network
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.ons
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.proxy_advm
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
--------------------------------------------------------------------------------
Cluster Resources
--------------------------------------------------------------------------------
ora.LISTENER_SCAN1.lsnr
      1        ONLINE  ONLINE       host02                   STABLE
ora.LISTENER_SCAN2.lsnr
      1        ONLINE  ONLINE       host03                   STABLE
ora.LISTENER_SCAN3.lsnr
      1        ONLINE  ONLINE       host01                   STABLE
ora.asm
```

```
      1        ONLINE  ONLINE       host01                   STABLE
      2        ONLINE  ONLINE       host02                   STABLE
      3        ONLINE  ONLINE       host03                   STABLE
ora.cvu
      1        ONLINE  ONLINE       host01                   STABLE
ora.gns
      1        ONLINE  ONLINE       host01                   STABLE
ora.gns.vip
      1        ONLINE  ONLINE       host01                   STABLE
ora.host01.vip
      1        ONLINE  ONLINE       host01                   STABLE
ora.host02.vip
      1        ONLINE  ONLINE       host02                   STABLE
ora.host03.vip
      1        ONLINE  ONLINE       host03                   STABLE
ora.oc4j
      1        OFFLINE OFFLINE                               STABLE
ora.orcl.db
      1        ONLINE  ONLINE       host03
Open,STABLE
      2        ONLINE  ONLINE       host02
Open,STABLE
      3        ONLINE  ONLINE       host01
Open,STABLE
ora.scan1.vip
      1        ONLINE  ONLINE       host02                   STABLE
ora.scan2.vip
      1        ONLINE  ONLINE       host03                   STABLE
ora.scan3.vip
      1        ONLINE  ONLINE       host01                   STABLE
--------------------------------------------------------------------------------
[grid@host01 ~]$
```

4. As the `root` user, view the registry status of the volume with the `acfsutil registry` command

```
[root@host01]# acfsutil registry -l
Device : /dev/asm/images-387 : Mount Point :
/u01/app/oracle/acfsmount/images : Options : none : Nodes : all :
Disk Group : ACFS : Volume : IMAGES
[root@host01]#
```

5. An ACFS file system can be resized, and it will automatically resize the volume, if there is sufficient space in the disk group. The images file system is near capacity. Increase the file system by 256 MB. As the `root` user, use the `acfsutil size +256M /u01/app/oracle/acfsmount/images` command.

```
[root@host01]# acfsutil size +256M /u01/app/oracle/acfsmount/images
acfsutil size: new file system size: 2415919104 (2304MB)
[root@host01 ~]#
```

6. As the `oracle` user, transfer a set of images to `/u01/app/oracle/acfsmount/images`. Unzip the images in `/stage/ASM/labs/less_06/images.zip` to the IMAGES file system.

```
[oracle@host01]$ cd /stage/ASM/labs/less_06
[oracle@host01 less_06]$ unzip images.zip -d
/u01/app/oracle/acfsmount/images
Archive:  images.zip
   creating: /u01/app/oracle/acfsmount/images/gridInstall/
  inflating: /u01/app/oracle/acfsmount/images/gridInstall/asm.gif
  inflating:
/u01/app/oracle/acfsmount/images/gridInstall/bullet2.gif

...

  inflating:
/u01/app/oracle/acfsmount/images/gridInstall/view_image.gif
 extracting:
/u01/app/oracle/acfsmount/images/gridInstall/white_spacer.gif
[oracle@host01 less_06]$
```

7. Verify that the files have been extracted.

```
[oracle@host01 less_06]$ ls -R  /u01/app/oracle/acfsmount/images
/u01/app/oracle/acfsmount/images:
gridInstall  lost+found

/u01/app/oracle/acfsmount/images/gridInstall:
asm.gif             t20108.gif        t30104.gif   t30119d.gif
bullet2.gif         t20109a.gif       t30105.gif   t30119.gif
bullet.gif          t20109b.gif       t30106.gif   t30120a.gif
divider.gif         t20110.gif        t30107.gif   t30120b.gif
gradient.gif        t20111a.gif       t30108a.gif  t30121d.gif
MoveAllButton.gif   t20111b.gif       t30108.gif   t30123a.gif
MoveButton.gif      t20111c.gif       t30109.gif   t30123b.gif
rpm-oracleasm.gif   t20111.gif        t30110.gif   t30123c.gif
show_me.gif         t20112.gif        t30111.gif   t30201.gif
t10101.gif          t20113.gif        t30112a.gif  t30202.gif
t10102.gif          t20113h.gif       t30112.gif   t30203.gif
t10103.gif          t20114c.gif       t30113a.gif  t30204a.gif
t10201.gif          t20114login.gif   t30113b.gif  t30204.gif
t10202.gif          t20114server.gif  t30114a.gif  t30205.gif
t10203.gif          t20117add.gif     t30114b.gif  t30206.gif
```

```
t10204.gif          t20117crtbs.gif   t30114.gif   t30207.gif
t10205.gif          t20117emctl.gif   t30115a.gif  t30208.gif
t20101.gif          t20117tbs.gif     t30115.gif   t40101.gif
t20102.gif          t20119asm.gif     t30116a.gif  t40102.gif
t20103.gif          t2017emctl.gif    t30116b.gif  t40104.gif
t20104.gif          t30101a.gif       t30116c.gif  t40105a.gif
t20105.gif          t30101b.gif       t30116d.gif  t40105b.gif
t20106.gif          t30101c.gif       t30118b.gif  Thumbs.db
t20107a.gif         t30102.gif        t30119b.gif  view_image.gif
t20107.gif          t30103.gif        t30119c.gif  white_spacer.gif
ls: /u01/app/oracle/acfsmount/images/lost+found: Permission denied
[oracle@host01]$
```

8. Create a snapshot of the IMAGES file system. Use the ACFSUTIL utility as the `root` user to execute the command:

```
/sbin/acfsutil snap create snap_001 \
   /u01/app/oracle/acfsmount/images
```

```
[root@host01]# /sbin/acfsutil snap create snap_001
/u01/app/oracle/acfsmount/images
acfsutil snap create: Snapshot operation is complete.

[root@host01]#
```

9. Find the `.SNAP` directory and explore the entries. How much space does the `gridInstall` directory tree use? How much space does the `.ACFS/snaps/snap_001/gridInstall` directory tree use?

```
[root@host01]# cd /u01/app/oracle/acfsmount/images
[root@host01 images]# ls -la
total 88
drwxrwx--- 5 oracle dba       4096 May  7 23:31 .
drwxrwxr-x 4 oracle oinstall  4096 May  7 11:53 ..
drwxr-xr-x 2 oracle oinstall 12288 May  7 16:30 gridInstall
drwx------ 2 root   root     65536 May  7 15:04 lost+found

[root@host01 images]# du -h gridInstall
2.0M    gridInstall

[root@host01]# ls .ACFS
repl  snaps

[root@host01 images]# ls .ACFS/snaps
snap_001
[root@host01 images]# ls .ACFS/snaps/snap_001
gridInstall  lost+found

[root@host01]# du -h .ACFS/snaps/snap_001/gridInstall
2.0M    .ACFS/snaps/snap_001/gridInstall
```

10. Delete the `asm.gif` file from the IMAGES file system.

```
[root@host01 images]# rm gridInstall/asm.gif
rm: remove regular file `gridInstall/asm.gif'? y
[root@host01 images]#
```

11. Create another snapshot of the IMAGES file system.

```
[root@host01 images]# /sbin/acfsutil snap create snap_002
/u01/app/oracle/acfsmount/images
acfsutil snap create: Snapshot operation is complete.
```

12. How much space is being used by the snapshots and the files that are stored in the IMAGES file system? Use the `acfsutil info` command to find this information.

```
[root@host01 images]# /sbin/acfsutil info fs
/u01/app/oracle/acfsmount/images
     ACFS Version: 12.1.0.1.0
    flags:        MountPoint,Available
    mount time:   Thu Aug 29 05:52:55 2013
    volumes:      1
    total size:   2550136832
    total free:   2358112256
    primary volume: /dev/asm/images-387
        label:
        flags:                 Primary,Available,ADVM
        on-disk version:       43.0
        allocation unit:       4096
        major, minor:          251, 198145
        size:                  2550136832
        free:                  2358112256
        ADVM diskgroup         ACFS
        ADVM resize increment: 33554432
        ADVM redundancy:       mirror
        ADVM stripe columns:   4
        ADVM stripe width:     131072
        compatible.advm:       12.1.0.0.0
    number of snapshots:  2
    snapshot space usage: 2260992
    replication status: DISABLED
[root@host01 images]#
```

13. Restore the `asm.gif` file to the file system from the snapshot.
    a. The snapshot is a sparse file representation of the file system, so you can browse the snapshot as if it were a full file system. All the OS file commands are functional. Find the `asm.gif` file in the snapshot. Perform this operation as the `root` user

```
[root@host01]$ cd /u01/app/oracle/acfsmount/images
[root@host01 images]# find .ACFS -name asm.gif
.ACFS/snaps/snap_001/gridInstall/asm.gif
...
```

b. Restore the `asm.gif` file by copying from the snapshot to the original location

```
[root@host01 images]$ cp ./.ACFS/snaps/snap_001/gridInstall/asm.gif
./gridInstall/asm.gif
```

14. Dismount the Images file system from all three nodes. This command must be executed by the `root` user. If the directory is busy, execute `lsof +d /u01/app/oracle/acfsmount/images` to find the user that is holding the directory open and stop that session.

```
[root@host01 images]# cd

[root@host01 ~]# crsctl stop resource ora.acfs.images.acfs
CRS-2673: Attempting to stop 'ora.acfs.images.acfs' on 'host01'
CRS-2673: Attempting to stop 'ora.acfs.images.acfs' on 'host03'
CRS-2673: Attempting to stop 'ora.acfs.images.acfs' on 'host02'
CRS-2677: Stop of 'ora.acfs.images.acfs' on 'host01' succeeded
CRS-2677: Stop of 'ora.acfs.images.acfs' on 'host02' succeeded
CRS-2677: Stop of 'ora.acfs.images.acfs' on 'host03' succeeded

root@host01 ~]#
```

15. Remove the IMAGES ACFS file system and volume using ASMCA started from the `grid` terminal window.

```
[grid@host01 ~]$ asmca
```

a. Click the ASM Cluster File Systems folder tab. Right click `/dev/asm/images-387` (your device name will be slightly different). Select Delete. Click Yes to confirm. In your `root` terminal window, run the script as prompted by the ASM Cluster File System: Delete dialog box. Close the dialog box when the script has been run.

```
[root@host01 ~]# /u01/app/12.1.0/grid/bin/srvctl remove filesystem -
d /dev/asm/images-387
[root@host01 ~]#
```

b. Click the Volumes tab. Right-click the Volume Device name and select Delete. Click the Disk Groups tab and right-click ACFS under the Disk Group Name column. Select Drop. Click Yes to confirm. Click Exit to end your ASMCA session.

16. As the `grid` user, execute `crsctl` to confirm the resources associated with the ACFS file system have been removed.

```
[grid@host01 ~]$ crsctl stat res -t|more
--------------------------------------------------------------------------
Name           Target  State        Server                   State
details
--------------------------------------------------------------------------
Local Resources
--------------------------------------------------------------------------
ora.ASMNET1LSNR_ASM.lsnr
```

```
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.DATA.dg
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.FRA.dg
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.LISTENER.lsnr
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.TEST.dg
               OFFLINE OFFLINE      host01                   STABLE
               OFFLINE OFFLINE      host02                   STABLE
               OFFLINE OFFLINE      host03                   STABLE
ora.TEST2.dg
               OFFLINE OFFLINE      host01                   STABLE
               OFFLINE OFFLINE      host02                   STABLE
               OFFLINE OFFLINE      host03                   STABLE
ora.net1.network
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.ons
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
ora.proxy_advm
               ONLINE  ONLINE       host01                   STABLE
               ONLINE  ONLINE       host02                   STABLE
               ONLINE  ONLINE       host03                   STABLE
--------------------------------------------------------------------------------
Cluster Resources
--------------------------------------------------------------------------------
ora.LISTENER_SCAN1.lsnr
      1        ONLINE  ONLINE       host02                   STABLE
ora.LISTENER_SCAN2.lsnr
      1        ONLINE  ONLINE       host03                   STABLE
ora.LISTENER_SCAN3.lsnr
      1        ONLINE  ONLINE       host01                   STABLE
ora.asm
      1        ONLINE  ONLINE       host01                   STABLE
      2        ONLINE  ONLINE       host02                   STABLE
      3        ONLINE  ONLINE       host03                   STABLE
ora.cvu
      1        ONLINE  ONLINE       host01                   STABLE
ora.gns
      1        ONLINE  ONLINE       host01                   STABLE
```

```
ora.gns.vip
      1        ONLINE  ONLINE       host01                   STABLE
ora.host01.vip
      1        ONLINE  ONLINE       host01                   STABLE
ora.host02.vip
      1        ONLINE  ONLINE       host02                   STABLE
ora.host03.vip
      1        ONLINE  ONLINE       host03                   STABLE
ora.oc4j
      1        ONLINE  ONLINE       host01                   STABLE
ora.orcl.db
      1        ONLINE  ONLINE       host02               Open,STABLE
      2        ONLINE  ONLINE       host03               Open,STABLE
      3        ONLINE  ONLINE       host01               Open,STABLE
ora.scan1.vip
      1        ONLINE  ONLINE       host02                   STABLE
ora.scan2.vip
      1        ONLINE  ONLINE       host03                   STABLE
ora.scan3.vip
      1        ONLINE  ONLINE       host01                   STABLE
--------------------------------------------------------------------------------
[grid@host01 ~]$
```

17. Close all terminal windows opened for this practice.

Practices for Lesson 7: Oracle CloudFS Advanced Topics

Chapter 7

Practices for Lesson 7: Overview

Practices Overview

In these practices, you will:

- Configure and use HANFS.
- Configure and use Cloud FS auditing.

Practice 7-1 Configuring and Using HANFS

Overview

In this practice you will configure and use High Availability NFS (HANFS). You will also shut down (crash) the node running the HANFS service and watch it migrate to a surviving node.

Tasks

1. Establish a terminal session connected to `host01` using the `root` OS user.

```
[vncuser@classroom_pc ~]$ ssh root@host01
root@host01's password: <oracle>
[root@host01 ~]$
```

2. Configure the environment using the `oraenv` script. Enter `+ASM1` when you are prompted for an ORACLE_SID value.

```
[root@host01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[root@host01 ~]$
```

3. HANFS requires a running NFS service on each node that can host the HANFS services. Use the following command to confirm that NFS is running on `host01`.

```
[root@host01 ~]# service nfs status
rpc.svcgssd is stopped
rpc.mountd (pid 1495) is running...
nfsd (pid 1558 1557 1556 1555 1554 1553 1552 1551) is running...
rpc.rquotad (pid 1491) is running...
[root@host01 ~]#
```

4. Confirm that NFS is also running on `host02` and `host03`.

```
[root@host01 ~]# ssh host02 service nfs status
rpc.svcgssd is stopped
rpc.mountd (pid 1473) is running...
nfsd (pid 1536 1535 1534 1533 1532 1531 1530 1529) is running...
rpc.rquotad (pid 1469) is running...
[root@host01 ~]# ssh host03 service nfs status
rpc.svcgssd is stopped
rpc.mountd (pid 1537) is running...
nfsd (pid 1600 1599 1598 1597 1596 1595 1594 1593) is running...
rpc.rquotad (pid 1533) is running...
[root@host01 ~]#
```

5. Soon you will create a new Cloud FS file system. In preparation for the new file system, create a mount point directory on `host01`.

```
[root@host01 ~]# mkdir -p /mnt/acfsmounts/acfs1
[root@host01 ~]#
```

6. Create the mount point directory on `host02`.

```
[root@host01 ~]# ssh host02 mkdir -p /mnt/acfsmounts/acfs1
[root@host01 ~]#
```

7. Become the `grid` OS user and set your environment.

```
[root@host01 ~]# su - grid
[grid@host01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[grid@host01 ~]$
```

8. Start the ASM Command Utility (ASMCMD).

```
[grid@host01 ~]$ asmcmd
ASMCMD>
```

9. Modify the `DATA` diskgroup to enable all the new ASM Dynamic Volume (ADVM) features included in release 12.1.

```
ASMCMD> setattr -G DATA compatible.advm 12.1.0.0.0
ASMCMD>
```

10. Create a new volume. Place the volume in the `DATA` disk group and set the volume size to 300 MB. Name the volume `VOL1`.

```
ASMCMD> volcreate -G DATA -s 300m VOL1
ASMCMD>
```

11. Examine the newly created volume and take note of the volume device associated with it. Note that your volume device will be different from that shown below (`/dev/asm/vol1-334`). Make note of the different volume device because you will require it numerous times in the following steps.

```
ASMCMD> volinfo -G DATA VOL1
Diskgroup Name: DATA

        Volume Name: VOL1
        Volume Device: /dev/asm/vol1-334
        State: ENABLED
```

```
          Size (MB): 320
          Resize Unit (MB): 32
          Redundancy: MIRROR
          Stripe Columns: 4
          Stripe Width (K): 128
          Usage:
          Mountpath:

ASMCMD>
```

12. Exit ASMCMD.

```
ASMCMD> exit
[grid@host01 ~]$
```

13. Exit your `grid` OS session.

```
[grid@host01 ~]$ exit
logout
[root@host01 ~]#
```

14. Make an `acfs` file system on the newly created volume. Use the volume device you identified in step 11.

```
[root@host01 ~]# mkfs -t acfs /dev/asm/vol1-334
mkfs.acfs: version                   = 12.1.0.1.0
mkfs.acfs: on-disk version           = 39.0
mkfs.acfs: volume                    = /dev/asm/vol1-334
mkfs.acfs: volume size               = 335544320
mkfs.acfs: Format complete.
[root@host01 ~]#
```

15. Create a new Cloud FS file system resource using the volume device you identified in step 11 along with the mount points you created at the beginning of the practice.

```
[root@host01 ~]# srvctl add filesystem -m /mnt/acfsmounts/acfs1
-d /dev/asm/vol1-334
[root@host01 ~]#
```

16. Start the new Cloud FS file system.

```
[root@host01 ~]# srvctl start filesystem -d /dev/asm/vol1-334
[root@host01 ~]#
```

17. Execute the `srvctl status filesystem` command. On which nodes is VOL1 mounted? Did you create a mount point on `host03`?

```
[root@host01 ~]# srvctl status filesystem
ACFS file system /mnt/acfsmounts/acfs1 is mounted on nodes
host01,host02, host03
[root@host01 ~]#
```

18. Create a small text file inside the new Cloud FS file system.

```
[root@host01 ~]# echo "Test File on ACFS" >
/mnt/acfsmounts/acfs1/testfile.txt
[root@host01 ~]#
```

19. Access the file from another node to demonstrate that the Cloud FS file system is working correctly.

```
[root@host01 ~]# ssh host02 cat
/mnt/acfsmounts/acfs1/testfile.txt
Test File on ACFS
[root@host01 ~]#
```

20. Modify the access privileges for your new file to enable access by any user.

```
[root@host01 ~]# chmod 777 /mnt/acfsmounts/acfs1/testfile.txt
[root@host01 ~]#
```

At this point you have created and tested a new Cloud FS file system. In the next part of this practice you will publish it using HANFS.

21. Your environment is preconfigured with a hostname and IP address that you will use to configure HANFS. Examine the IP address associated with the hostname `c01havip`.

```
[root@host01 ~]# nslookup c01havip
Server:         192.0.2.1
Address:        192.0.2.1#53

Name:   c01havip.example.com
Address: 192.0.2.159

[root@host01 ~]#
```

22. Create a new `havip` cluster resource using the hostname `c01havip`. Use `havip1` as the identifier for the new `havip` resource.

```
[root@host01 ~]# srvctl add havip -address c01havip -id havip1
[root@host01 ~]#
```

23. Create a new `exportfs` cluster resource. The `exportfs` resource publish the specified file system using HANFS. Following is a summary of the options used:
    - `-id havip1`: specifies the `havip` resource used to export the file system.
    - `-path /mnt/acfsmounts/acfs1`: specifies the file system being exported.
    - `-name export1`: specifies the name used to identify the `exportfs` resource.
    - `-options rw`: specifies the NFS options for the exported file system.
    - `-clients *.export.com`: specifies the clients permitted to access the exported file system.

```
[root@host01 ~]# srvctl add exportfs -id havip1 -path
/mnt/acfsmounts/acfs1 -name export1 -options rw -clients
*.example.com
[root@host01 ~]#
```

24. Start the newly created `exportfs` resource.

```
[root@host01 ~]# srvctl start exportfs -name export1
[root@host01 ~]#
```

25. Confirm that the `exportfs` resource is running. Note the server that the file system is exported on (`host02` in the example below).

```
[root@host01 ~]# srvctl status exportfs
export file system export1 is enabled
export file system export1 is exported on node host02
[root@host01 ~]#
```

26. Confirm that the `havip` resource is also running. The `havip` is started whenever an associated `exportfs` resource is started. Note that the `havip` resource is located on the same server as the `exportfs` resource.

```
[root@host01 ~]# srvctl status havip
HAVIP ora.havip1.havip is enabled
HAVIP ora.havip1.havip is running on nodes host02
[root@host01 ~]#
```

27. Establish another terminal session connected to `host04` as the `root` OS user. In the remainder of this practice you will use `host04` as an NFS client.

```
[vncuser@classroom_pc ~] $ ssh root@host04
root@host04's password: <oracle>
[root@host04 ~]#
```

28. Create an empty directory to use as an NFS mount point.

```
[root@host04 ~]# mkdir -p /mnt/hanfs1
[root@host04 ~]#
```

29. Mount the HANFS exported file system.

```
[root@host04 ~]# mount -o vers=3 c01havip:/mnt/acfsmounts/acfs1
/mnt/hanfs1
[root@host04 ~]#
```

HANFS supports NFS V2 and V3. If your NFS client is V4, include the `-o` option.

30. Execute the `df` command. Examine the output and confirm that the HANFS exported file system is mounted.

```
[root@host04 ~]# df
Filesystem           1K-blocks      Used Available Use% Mounted
on
/dev/xvda2            11677568   2879228   8205140  26% /
tmpfs                   797604         0    797604   0% /dev/shm
/dev/xvda1              247919     72098    163021  31% /boot
/dev/xvdb1            30961664    742840  28646064   3% /u01
/dev/xvdh1             2063504     84328   1874356   5% /share
c01havip:/mnt/acfsmounts/acfs1
                        327680    183296    144384  56%
/mnt/hanfs1
[root@host04 ~]#
```

31. Become the `grid` OS user.

```
[root@host04 ~]# su - grid
[grid@host04 ~]$
```

32. Using your HANFS mount, edit the text file you created earlier in this practice.

```
[grid@host04 ~]$ vi /mnt/hanfs1/testfile.txt
```

33. Add some text to the file and leave the file open. If you are unfamiliar with `vi`, type `o` to add a new line and then type some text.

```
Test File on ACFS
Here is some more text…
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
~
-- INSERT --                                    2,26          All
```

34. Back in your `root` terminal session on `host01`, stop Clusterware on the server running the HANFS services; that is, the server running the `exportfs` and `havip` resources, which you identified in steps 25 and 26.

```
[root@host01 ~]# crsctl stop cluster -n host02 -f
CRS-2673: Attempting to stop 'ora.crsd' on 'host02'
CRS-2790: Starting shutdown of Cluster Ready Services-managed
resources on 'host02'
CRS-2673: Attempting to stop 'ora.havip1.havip' on 'host02'
CRS-2673: Attempting to stop 'ora.SCRUBTEST.dg' on 'host02'
CRS-2673: Attempting to stop 'ora.LISTENER.lsnr' on 'host02'
CRS-2673: Attempting to stop 'ora.LISTENER_SCAN1.lsnr' on
'host02'
CRS-2673: Attempting to stop 'ora.orcl.db' on 'host02'
CRS-2677: Stop of 'ora.havip1.havip' on 'host02' succeeded
…
CRS-2673: Attempting to stop 'ora.net1.network' on 'host02'
```

```
CRS-2677: Stop of 'ora.net1.network' on 'host02' succeeded
CRS-2792: Shutdown of Cluster Ready Services-managed resources
on 'host02' has completed
CRS-2677: Stop of 'ora.crsd' on 'host02' succeeded
CRS-2673: Attempting to stop 'ora.ctssd' on 'host02'
CRS-2673: Attempting to stop 'ora.evmd' on 'host02'
CRS-2673: Attempting to stop 'ora.storage' on 'host02'
CRS-2677: Stop of 'ora.storage' on 'host02' succeeded
CRS-2673: Attempting to stop 'ora.asm' on 'host02'
CRS-2677: Stop of 'ora.ctssd' on 'host02' succeeded
CRS-2677: Stop of 'ora.asm' on 'host02' succeeded
CRS-2673: Attempting to stop 'ora.cluster_interconnect.haip' on
'host02'
CRS-2677: Stop of 'ora.cluster_interconnect.haip' on 'host02'
succeeded
CRS-2677: Stop of 'ora.evmd' on 'host02' succeeded
CRS-2673: Attempting to stop 'ora.cssd' on 'host02'
CRS-2677: Stop of 'ora.cssd' on 'host02' succeeded
[root@host01 ~]#
```

35. Confirm that the HANFS services have migrated to another server (`host03` in the example below).

```
[root@host01 ~]# srvctl status exportfs
export file system export1 is enabled
export file system export1 is exported on node host03
[root@host01 ~]# srvctl status havip
HAVIP ora.havip1.havip is enabled
HAVIP ora.havip1.havip is running on nodes host03
[root@host01 ~]#
```

36. Back in the NFS client session on `host04`, save the file and exit `vi` (type `<Esc> :wq <Enter>`). You may notice a slight pause while the NFS connection is re-established.

```
Test File on ACFS
Here is some more text…
~
~
~
~
~
~
~
~
~
```

```
~
~
~
~
~
~
~
~
~
~
~
:wq
```

37. Examine the file you just edited to confirm that your changes were saved. Now you have seen HANFS in action.

```
[grid@host04 ~]$ cat /mnt/hanfs1/testfile.txt
Test File on ACFS
Here is some more text…
[grid@host04 ~]$
```

38. Back in your `root` terminal session on `host01`, restart Clusterware on the server where you stopped it in step 34.

```
[root@host01 ~]# crsctl start cluster -n host02
CRS-2672: Attempting to start 'ora.cssdmonitor' on 'host02'
CRS-2672: Attempting to start 'ora.evmd' on 'host02'
CRS-2676: Start of 'ora.cssdmonitor' on 'host02' succeeded
CRS-2672: Attempting to start 'ora.cssd' on 'host02'
CRS-2672: Attempting to start 'ora.diskmon' on 'host02'
CRS-2676: Start of 'ora.diskmon' on 'host02' succeeded
CRS-2676: Start of 'ora.evmd' on 'host02' succeeded
CRS-2676: Start of 'ora.cssd' on 'host02' succeeded
CRS-2672: Attempting to start 'ora.ctssd' on 'host02'
CRS-2672: Attempting to start 'ora.cluster_interconnect.haip' on
'host02'
CRS-2676: Start of 'ora.ctssd' on 'host02' succeeded
CRS-2676: Start of 'ora.cluster_interconnect.haip' on 'host02'
succeeded
CRS-2672: Attempting to start 'ora.asm' on 'host02'
CRS-2676: Start of 'ora.asm' on 'host02' succeeded
CRS-2672: Attempting to start 'ora.storage' on 'host02'
CRS-2676: Start of 'ora.storage' on 'host02' succeeded
```

```
CRS-2672: Attempting to start 'ora.crsd' on 'host02'
CRS-2676: Start of 'ora.crsd' on 'host02' succeeded
[root@host01 ~]#
```

So far you have seen how HANFS services are automatically migrated when clusterware is stopped (or a server fails). However, HANFS services can also be manually relocated, which may be useful when you wish to prepare for a period of planned maintenance for example.

39. Manually relocate the `havip` resource. Specify the server where you just restarted clusterware as the relocation target (using the `-n` option). Note that the `exportfs` resource is automatically relocated when the `havip` is relocated. If you receive an error message indicating that the relocation target is not online, wait a few seconds and try again.

```
[root@host01 ~]# srvctl relocate havip -id havip1 -n host02 -f
HAVIP was relocated successfully
[root@host01 ~]#
```

40. Confirm that the HANFS services are relocated.

```
[root@host01 ~]# srvctl status exportfs
export file system export1 is enabled
export file system export1 is exported on node host02
[root@host01 ~]# srvctl status havip
HAVIP ora.havip1.havip is enabled
HAVIP ora.havip1.havip is running on nodes host02
[root@host01 ~]#
```

41. Exit the `grid` terminal session on `host04` and return to the `root` terminal session.

```
[grid@host04 ~]$ exit
logout
[root@host04 ~]#
```

42. Unmount the NFS mount on `host04`.

```
[root@host04 ~]# umount /mnt/hanfs1
[root@host04 ~]#
```

43. Back in your `root` terminal session on `host01`, stop the HANFS services.

```
[root@host01 ~]# srvctl stop exportfs -name export1 -f
[root@host01 ~]#
```

44. Stop the Cloud FS file system you have used throughout this practice.

```
[root@host01 ~]# srvctl stop filesystem -d /dev/asm/vol1-334
[root@host01 ~]#
```

Congratulations! You have successfully configured and used High Availability NFS (HANFS).

45. Close all terminal windows opened for this practice.

Practice 7-2: Configuring and Using Cloud FS Auditing

Overview

In this practice you will go through the process of configuring Cloud FS auditing. After configuration, you will interact with Cloud FS to generate audit records. Finally, you will also exercise the audit trail management procedure.

Tasks

1. Establish a terminal session connected to `host01` using the `root` OS user.

```
$ ssh root@host01
root@host01's password: <oracle>
[root@host01 ~]$
```

2. Configure the environment using the `oraenv` script. Enter `+ASM1` when you are prompted for an ORACLE_SID value.

```
[root@host01 ~]$ . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid
[root@host01 ~]$
```

3. Restart the file system you created in Practice 7-1 and confirm that the file system is mounted on `host01` and `host02`.

```
[root@host01 ~]# srvctl start filesystem -d /dev/asm/vol1-334
[root@host01 ~]# srvctl status filesystem -d /dev/asm/vol1-334
ACFS file system /mnt/acfsmounts/acfs1 is mounted on nodes
host01,host02, host03
[root@host01 ~]#
```

4. Create a new directory inside the Cloud FS file system. Later in this practice you will configure a security realm for the contents of this directory.

```
[root@host01 ~]# mkdir /mnt/acfsmounts/acfs1/Prac7-2
[root@host01 ~]#
```

5. Run the **`/stage/ASM/labs/less_07/dirperm.sh`** script to modify the permissions on the directory structure so that all users have full access.

```
[root@host01 ~]# /stage/ASM/labs/less_07/dirperm.sh
[root@host01 ~]#
```

6. To configure the Cloud FS security and auditing features you must designate specific OS users and groups, which are granted various administrative privileges. Examine the script at `/stage/ASM/less_07/users.sh`. The script contains commands that create three OS groups. In turn, a corresponding OS user account is also created and associated with each of the three OS groups. The purpose of these groups and user accounts will be described later in the practice when they are being used.

```
[root@host01 ~]# cat /stage/ASM/labs/less_07/users.sh
groupadd -g 9997 secadmin
useradd -g secadmin -m -u 9997 secadmin

groupadd -g 9999 auditmgr
groupadd -g 9998 auditor
useradd -g auditmgr -m -u 9999 auditmgr
useradd -g auditor -m -u 9998 auditor
[root@host01 ~]#
```

7. Execute `/stage/ASM/labs/less_07/users.sh` on `host01`.

```
[root@host01 ~]# /stage/ASM/labs/less_07/users.sh
[root@host01 ~]#
```

8. Examine the user accounts to confirm that they are created and that each account is associated with the corresponding OS group.

```
[root@host01 ~]# id secadmin
uid=9997(secadmin) gid=9997(secadmin) groups=9997(secadmin)

[root@host01 ~]# id auditmgr
uid=9999(auditmgr) gid=9999(auditmgr) groups=9999(auditmgr)

[root@host01 ~]# id auditor
uid=9998(auditor) gid=9998(auditor) groups=9998(auditor)

[root@host01 ~]#
```

9. The user and group definitions you just created are required on every cluster node where the Cloud FS file system is mounted. Execute `/stage/ASM/labs/less_07/users.sh` on `host02` and `host03`.

```
[root@host01 ~]# ssh host02 /stage/ASM/labs/less_07/users.sh
[root@host01 ~]# ssh host03 /stage/ASM/labs/less_07/users.sh
[root@host01 ~]#
```

10. Initialize Cloud FS security. Specify the `secadmin` user and `secadmin` group to receive the privileges required to administer Cloud FS security. Enter `oracle_4U` when you are prompted to enter a security administrator password. Note that this password is required every time a security administration operation is performed.

```
[root@host01 ~]# acfsutil sec init -u secadmin -g secadmin
Password for new ACFS Security administrator: <oracle_4U>
Re-enter password for new ACFS Security administrator:
<oracle_4U>
acfsutil sec init: Security wallet created.
[root@host01 ~]#
```

11. Assume the role of Cloud FS security administrator.

```
[root@host01 ~]# su secadmin
[secadmin@host01 root]$
```

12. Prepare the Cloud FS file system (mounted at `/mnt/acfsmounts/acfs1`) for Cloud FS security.

```
[secadmin@host01 root]$ acfsutil sec prepare -m
/mnt/acfsmounts/acfs1
ACFS Security administrator password: <oracle_4U>
System realm 'SYSTEM_SecurityMetadata' created.
System realm 'SYSTEM_Logs' created.
System realm 'SYSTEM_BackupOperators' created.
[secadmin@host01 root]$
```

13. Create a security realm. Specify `myrealm1` as the realm name. Include the following options:
    - `-m /mnt/acfsmounts/acfs1`: Specifies the file system.
    - `-e off`: Specifies that encryption is off for the realm.
    - `-o enable`: Enables security for the realm.

```
[secadmin@host01 root]$ acfsutil sec realm create myrealm1 -m
/mnt/acfsmounts/acfs1 -e off -o enable
ACFS Security administrator password: <oracle_4U>
[secadmin@host01 root]$
```

14. Add the `root` user and your practice directory (created in step 4) to the realm you just created.

```
[secadmin@host01 root]$ acfsutil sec realm add myrealm1 -m
/mnt/acfsmounts/acfs1 -u root -f -r /mnt/acfsmounts/acfs1/Prac7-2
ACFS Security administrator password: <oracle_4U>
[secadmin@host01 root]$
```

15. Query the newly created realm. Confirm that the realm is enabled and that it includes the `root` user.

```
[secadmin@host01 root]$ acfsutil sec info -m
/mnt/acfsmounts/acfs1 -n myrealm1
ACFS Security administrator password: <oracle_4U>
Realm status: ENABLED

Users present in realm 'myrealm1' are as follows :
        root

Groups present in realm 'myrealm1' are as follows :

Filters present in realm 'myrealm1' are as follows :

Encryption status : OFF

Realm description : ''
[secadmin@host01 root]$
```

16. Exit the `secadmin` terminal session.

```
[secadmin@host01 root]$ exit
exit
[root@host01 ~]#
```

At this point you have a Cloud FS file system configured with Cloud FS security. In the next part of this practice you will configure Cloud FS auditing. This involves 3 tasks:

- Initialize auditing across the system.
- Enable auditing for the file system.
- Enable auditing of command rules for files in a security realm.

17. As the system administrator, initialize Cloud FS auditing. This is a one-time configuration step where you specify the OS groups that are associated with the audit manager and auditor roles. By splitting various administrative tasks between these two roles, separation of duties is enforced so that no single administrator has all the privileges required to tamper with an audit trail.

```
[root@host01 ~]# acfsutil audit init -M auditmgr -A auditor
[root@host01 ~]#
```

18. Confirm the role assignments you made in the previous step. Note that once they are made, these assignments cannot be changed. That is why it is recommended that you create dedicated groups for the audit manager and auditor roles.

```
[root@host01 ~]# acfsutil audit info
Audit manager OS group : 'auditmgr'
Auditor OS group       : 'auditor'
[root@host01 ~]#
```

In the remainder of this practice, you will perform various tasks associated with the audit manager and auditor roles. To achieve this, you will be required to switch between the `auditmgr` and `auditor` user accounts.

19. Become the audit manager.

```
[root@host01 ~]# su auditmgr
[auditmgr@host01 root]$
```

20. Enable Cloud FS security auditing on the file system. After this command is executed, auditing commences on the file system.

```
[auditmgr@host01 root]$ acfsutil audit enable -m
/mnt/acfsmounts/acfs1 -s sec
[auditmgr@host01 root]$
```

21. Confirm that security auditing is enabled for the file system. Note that it is also possible to enable auditing for encryption; however you will not exercise this option in this practice.

```
[auditmgr@host01 root]$ acfsutil audit info -m
/mnt/acfsmounts/acfs1
Auditing information for mount point '/mnt/acfsmounts/acfs1':
Maximum Audit trail size  : 10 MB
Archive file      : 'NOT PRESENT'
Audit sources:
         Security   : 'ENABLED'
         Encryption : 'DISABLED'
[auditmgr@host01 root]$
```

22. Exit the audit manager terminal session.

```
[auditmgr@host01 root]$ exit
exit
[root@host01 ~]#
```

23. Become the security administrator.

```
[root@host01 ~]# su secadmin
[secadmin@host01 root]$
```

24. In addition to the core auditing capabilities that you enabled in step 20, you can enable auditing of command rules for files in a security realm. Execute the following command to enable auditing of command rules for the `myrealm1` realm that you created earlier in the practice. In this case you will audit realm authorizations (using the `-a` option) and realm violations (using the `-v` option).

```
[secadmin@host01 root]$ acfsutil sec realm audit enable myrealm1
-m /mnt/acfsmounts/acfs1 -a -v
ACFS Security administrator password: <oracle_4U>
[secadmin@host01 root]$
```

25. Exit the security administrator terminal session.

```
[secadmin@host01 root]$ exit
exit
[root@host01 ~]#
```

At this point you have gone through the process of configuring Cloud FS auditing. In a real production environment you may have multiple file systems and security realms, in which case you would need to repeat some of the tasks you have just performed.

Next, you will perform an action that will generate some audit records. Then, in the final part of this practice, you will perform the tasks required to manage the Cloud FS audit trail.

26. Change directory to the root of your Cloud FS file system.

```
[root@host01 ~]# cd /mnt/acfsmounts/acfs1
[root@host01 acfs1]#
```

27. As mentioned earlier, Cloud FS auditing implements a separation of duties policy so that specific privileges as granted to different administrative roles. As part of this arrangement, access to the files which make up the audit trail is controlled, and even the system administrator (`root`) cannot access them. Confirm this by attempting to access the directory that houses the audit files.

```
[root@host01 acfs1]# ls -l .Security/audit
ls: cannot open directory .Security/audit: Permission denied
[root@host01 acfs1]#
```

28. As the auditor, examine the audit directory. Note the size of the current audit log.

```
[root@host01 acfs1]# su auditor -c "ls -l .Security/audit"
total 4
----rw-r-- 1 root auditmgr 329 Aug 29 10:02 audit-host01-
849712409.log
[root@host01 acfs1]#
```

29. Use the following command to create a new file inside your practice directory. This action will generate a series of audit records that you will examine later.

```
[root@host01 acfs1]# cat testfile.txt > Prac7-2/audittest.txt
[root@host01 acfs1]#
```

30. As the auditor, re-examine the audit directory. Note that the action you performed in the previous step has caused the current audit log file to grow.

```
[root@host01 acfs1]# su auditor -c "ls -l .Security/audit"
total 4
----rw-r-- 1 root auditmgr 1268 Aug 29 10:06 audit-host01-
849712409.log
[root@host01 acfs1]#
```

Active audit files should not be interrogated because this could interrupt auditing or result in the loss of auditing data. To examine the records in an audit file, it must first be archived. This occurs automatically when the audit file size reaches 10 MB, or the audit manager can manually archive the audit trail at any time.

31. As the audit manager, archive the audit trail.

```
[root@host01 acfs1]# su auditmgr -c "acfsutil audit archive -m
/mnt/acfsmounts/acfs1"
acfsutil audit archive: ACFS-10356: waiting for the operation to
complete...
[root@host01 acfs1]#
```

32. Become the auditor.

```
[root@host01 acfs1]# su auditor
[auditor@host01 acfs1]$
```

33. Examine the audit directory. Notice that there are now three files. The file with the `.bak` extension is the archived audit log file, and the `.xml` file is a representation of the audit log that is ready to be consumed by Oracle Audit Vault if it is configured in the environment. The `.log` file is the next (current) audit log.

```
[auditor@host01 acfs1]$ ls -l .Security/audit
total 12
----rw-r-- 1 root     auditmgr  335 Aug 29 10:07 audit-host01-
849712409.log
----rw-r-- 1 root     auditmgr 1268 Aug 29 10:06 audit-host01-
849712409.log.bak
-rw-rw-r-- 1 auditmgr auditmgr 2925 Aug 29 10:07 audit-host01-
849712409.xml
[auditor@host01 acfs1]$
```

34. Examine the archived audit log file. Your filename will differ from the example shown below but it will end with the `.bak` extension. The first audit record (containing `Event:ACFS_AUDIT_ENABLE`) was generated when you enabled auditing for the file system in step 20. The remaining records were generated by the action you performed in step 29. Note that the auditor can use any available tools to examine the archived audit file. The auditor can also copy the contents of the archived audit file to another location if desired.

```
[auditor@host01 acfs1]$ more .Security/audit/audit-host01-
849712409.log.bak
Timestamp: 08/29/13 10:02:26:672 UTC
Event:ACFS_AUDIT_ENABLE
Source:ACFS Security
User:9999
Group:9999
Host:host01.example.com
Application:acfsutil.bin
Evaluation Result:ACFS_CMD_SUCCESS
Process:8489
FileSystem-ID:849712409
Message:acfsutil audit enable: ACFS-10991: Auditing is enabled
on mount point '/mnt/acfsmounts/acfs1'.

Timestamp: 08/29/13 10:06:09:181 UTC
Event:ACFS_AUDIT_CREATEFILE_OP
Source:ACFS Security
User:0
Group:0
Host:host01.example.com
Application:bash
Realm:myrealm1
File:Prac7-2
Evaluation Result:ACFS_AUDIT_REALM_AUTH
Process:8830
FileSystem-ID:849712409
Message:Realm authorization succeeded for file ops CREATEFILE

Timestamp: 08/29/13 10:06:09:181 UTC
Event:ACFS_AUDIT_OPENFILE_OP
Source:ACFS Security
User:0
Group:0
Host:host01.example.com
Application:bash
Realm:myrealm1
```

```
File:audittest.txt
Evaluation Result:ACFS_AUDIT_REALM_AUTH
Process:8830
FileSystem-ID:849712409
Message:Realm authorization succeeded for file ops OPENFILE

Timestamp: 08/29/13 10:06:09:264 UTC
Event:ACFS_AUDIT_WRITE_OP
Source:ACFS Security
User:0
Group:0
Host:host01.example.com
Application:cat
Realm:myrealm1
File:audittest.txt
Evaluation Result:ACFS_AUDIT_REALM_AUTH
Process:8830
FileSystem-ID:849712409
Message:Realm authorization succeeded for file ops WRITE

[auditor@host01 acfs1]$
```

35. Mark the archived audit file as read. This action signals that the archived file is no longer required and can be purged.

```
[auditor@host01 acfs1]$ acfsutil audit read -m
/mnt/acfsmounts/acfs1
[auditor@host01 acfs1]$
```

36. Exit the auditor terminal session.

```
[auditor@host01 acfs1]$ exit
exit
[root@host01 acfs1]#
```

37. As the audit manager, purge the audit trail. This action is required so that the next (current) audit log file can be archived.

```
[root@host01 acfs1]# su auditmgr -c "acfsutil audit purge -m
/mnt/acfsmounts/acfs1"
[root@host01 acfs1]#
```

38. As the auditor, examine the audit directory. Confirm that the archived log files (`.bak` and `.xml`) have been deleted.

```
[root@host01 acfs1]# su auditor -c "ls -l .Security/audit"
total 4
----rw-r-- 1 root auditmgr 1008 Aug 29 10:12 audit-host01-
849712409.log
[root@host01 acfs1]#
```

39. As the system administrator, change back to the home directory and stop the Cloud FS file system that you have been using throughout this practice.

```
[root@host01 acfs1]# cd
[root@host01 ~]# srvctl stop filesystem -d /dev/asm/vol1-334
[root@host01 ~]#
```

40. As the `root` user on `host01`, change directory to `/stage/ASM/labs/less_07` and run the `reset.sh` script to remove users and resources created in this practice. Change to the `grid` account and delete the VOL1 volume using ASMCMD.

```
[root@host01 ~]# cd /stage/ASM/labs/less_07
[root@host01 less_07]# ./reset.sh

[root@host01 less_07]# su - grid

[grid@host01 ~]# . oraenv
ORACLE_SID = [grid] ? +ASM1
The Oracle base has been set to /u01/app/grid

[grid@host01 ~]$ asmcmd

ASMCMD> voldelete -G DATA VOL1
ASMCMD> exit

[grid@host01 ~]$
```

41. Close all terminal windows opened for this practice.

    Congratulations! You have successfully gone through the process of configuring Cloud FS auditing. You have also interacted with Cloud FS to generate audit records, and finally you exercised the audit trail management procedure.